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.

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Editorial

Being proud and confident in the work we do

Ngā mihi nui kia koutou katoa.

I've been reflecting on 20 years of service at the Ministry for Primary Industries, owing to an imminent career move offshore. I've been thinking about the changes in the Ministry over this time: the changes in farming, veterinary science and animal-based industries; and in New Zealand society at large. We live in fascinating and challenging times, whether you're viewing from a cultural, geopolitical, environmental, technological or economic perspective – hopefully all of these. Are we evolving in the right ways to survive, thrive and lead in this changing world?

Before my job interview in 1994, I read a year's worth of *Surveillance* magazine issues cover to cover. I'm sure it was instrumental in setting me up to perform satisfactorily. Now it feels very appropriate that, 20 years older and wiser, I can share a few parting thoughts in this same magazine.

The agricultural production, processing and export industries retain a critically important place in the New Zealand economy, creating productivity, employment and export earnings. Our sectors compete for customers domestically and internationally. There are plenty of stories to back up the view that while efficient pasture-based commodity production systems remain a key platform, we are spring-boarding to value-added products marketed directly to consumers through modern channels.

The world wants what we can deliver – safe, healthy, natural foods produced through ethical and sustainable systems. This has always been our natural advantage, but we cannot take it for granted. We need to continue to define and strive for best practice. We need the primary industries to be technology-driven and innovative, in touch with and responding to consumer demands, incorporating precision agricultural techniques, while retaining our connection with natural environments that people intuitively know grow good food.

We must confront head-on the tension between production and conservation, so that we demonstrate we are farming within environmental limits and passing on a healthy and productive ecosystem to future generations. I'm proud that veterinarians have been instrumental in creating cross-disciplinary dialogue and system-thinking through the One Health movement, which sees human health, animal health and welfare, and ecosystem health as inextricably linked. It's hard breaking down barriers between the agricultural and environmental sectors to foster shared understanding, empathy and sustainable practices. I have huge respect for those people engaging in this work in New Zealand in a manner that builds bridges, though I accept adversarial challenge also plays its part. We have to resolve this collectively to meet consumer expectations, to retain social license, and to honour our ancestors and descendants. It's the most important issue the primary sectors face here in New Zealand that is under our direct control. Kia kaha, mahi tahi.

I think a lot about the partnership between regulator and industry, both in the specific regulatory systems that I'm involved in (biosecurity, food safety, animal welfare, trade) and within the more generic context of driving productivity and innovation. Industry places a high value on the international reputation of our regulatory base. The regulator is increasingly understanding the need to apply customer-centric systems thinking to achieve best-practice regulatory stewardship. That is a fantastic platform of mutual understanding and respect for co-operation.

As we take our goods and services to the world, we need to work as NZ Inc., connecting, collaborating, leveraging expertise and maximising value from networks. I see great examples of this in our international approach. The genetics trade (including the much-maligned exports of breeding livestock) is often the cornerstone for a wide portfolio of agricultural goods and services. The starting interest in genetics unlocks the door internationally. Recently our exports of Thoroughbred horses to China created opportunity for exchange of equine health and husbandry expertise and services, establishing lasting relationships between professionals in both countries. Our free trade agreement with China has seen not only huge growth in export trade, but also co-operation in dairy production, food safety, biosecurity and animal welfare, building valuable relationships between counterparts in government and private sectors. Government agencies are working hard to show a unified position. Movements like Te Hono Primary Industries Bootcamps are creating opportunities to think innovatively about collaboration. We are actively re-discovering the importance of focused effort and public-private collaborative investment to drive innovation through research and development, as in the Primary Growth Partnerships.

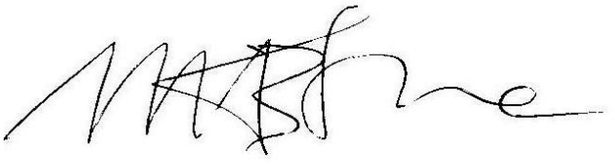
Globalisation is severely criticised these days, but it seems obvious to me that the world's challenges must be met through actively building international coalitions that adhere to common frameworks that provide for a growing population while increasing our future productive capacity. International co-operation has never been more important, and New Zealand understands this. Despite being a small international player we have built a reputation as an innovative thinker, honest broker and skilful negotiator in many international settings. It's a privilege to repeatedly witness examples of our leadership there.

Finally, I can't help thinking of all the people that work in the primary industries, and I experience the feelings of pride and

nostalgia that come with a fond farewell. I also think of the farmers in my family, those I worked with as a veterinarian, and that I've met in my career at MPI. My veterinary colleagues, including my father, who serve them and their animals. The representatives of the sectors that I've worked closely with. Colleagues in regulatory partners like AsureQuality, OSPRI, SPCA and the Veterinary Council. And of course, my many friends and colleagues within MPI. I am deeply grateful for the development opportunities I have been given. I recognise that we must continue to inspire and attract talented and committed people to our common passion of growing and protecting New Zealand. I rather romantically hope some young person might read this issue of *Surveillance* and be inspired in some way.

In September I move to the OIE (World Organisation for Animal Health), as Deputy Director General International Standards and Science. The opportunity to take a leadership role in an organisation such as OIE, so closely aligned with my own values and purpose, comes rarely and could not be passed up. I will remain a loyal Kiwi, and direct everything I've learned from you all towards their international work programmes in animal health, welfare standards and science. If I can help advance that agenda and add something to New Zealand's already strong reputation, I will be very proud and confident that this serves NZ Inc. also.

No reira, tēnā koutou, tēnā koutou, tēnā tātou katoa.



Matthew Stone
Director, Animal and Animal Product Standards
Ministry for Primary Industries

International animal trade

Risk analysis

The Animals and Aquatic Risk Analysis Team produces science-based risk analyses for border and post-border activities. The primary focus of the team is the analysis of biological risks posed by imported goods. The team also reviews assessments done by other teams and external consultants.

The standard process in drafting risk analyses includes internal and external expert peer review, with the draft risk analysis including options for managing any hazards assessed to be a risk. Draft risk analyses are released for public consultation alongside Import Health Standards (IHSs), which are subsequently developed from their content.

Risk analysis work completed during 2015 included the following.

Pasteurised eggs

An assessment was requested to identify additional biosecurity risks that may be associated with pasteurised egg products imported under the current IHSs (*Pasalbic.aus* and *Poueggic.aus*), which have less stringent processing conditions than the commodity definition used in the 2008 import risk analysis for egg powders. Although the less stringent conditions specified in *Poualbic.aus* for pasteurised egg white from Australia may not be sufficient to inactivate *Escherichia coli* or infectious bronchitis virus, further assessment did not determine either of these to be risks.

Bovine and porcine sausage casings

This import risk analysis examined the biosecurity risks associated with the international trade in natural sausage casings of bovine and porcine origin. Natural sausage casings are made from the intestines of cattle and pigs that have passed ante- and post-mortem inspection. The intestines are subject to a number of processing steps that remove gut contents and different tissue layers, and the casings are subsequently stored at room temperature for a minimum of 30 days in dry salt or saturated brine. Disease-causing organisms associated with bovine and porcine intestines were identified from previously peer-reviewed MPI risk analyses. Of these organisms, only one was assessed to be a risk: classical swine fever virus (in hog casings).

Bovine viral diarrhoea virus in bovine germplasm

Bovine viral diarrhoea virus (BVDV) exists as two species, BVDV-1 and BVDV-2. Infection with BVDV-1 is common in New Zealand cattle. BVDV-2 is not recognised in New Zealand although overseas it has been associated with severe disease. BVDV-2 has previously been assessed to be a risk associated with the importation of bovine semen and embryos into New Zealand. This qualitative risk assessment provided an updated literature review of the risks of BVDV transmission through the importation of bovine germplasm, and described import risk management options.

Foot and mouth disease virus in Asian elephants

Because foot and mouth disease virus (FMDV) is endemic in Sri Lanka, MPI's current IHS for Asian elephants (*Elephas maximas*) from Sri Lanka requires them to be held for at least 90 days in an FMDV-free country before export to New Zealand. Because this requirement has been difficult to meet, a re-assessment of the FMDV risks associated with these imports, and the measures that could be considered to effectively manage these risks, was requested. Elephants are "spillover" hosts for FMDV, so they are only rarely infected and only through contact with infected ruminants. There are no reports suggesting that elephants have spread FMDV, either to other elephants or to other animal species. However, as Asian elephants are recognised to be susceptible to infection with this virus, FMDV was assessed to be a risk in this case.

Milk and milk products derived from pasteurised milk for human consumption

This qualitative biosecurity risk analysis examined the biosecurity risks associated with importing pasteurised milk and milk products for human consumption that are derived from cattle, sheep, goats and water buffaloes. No organisms or disease agents were assessed to be risks in the commodities under consideration, provided that proper care and precautions are taken and manufacturing standards are adhered to.

Fish bait hazards

Imported fish bait used in New Zealand commercial and recreational fisheries is currently of marine origin. It may consist of either wild or farmed finfish that have been frozen whole and uneviscerated, and is traded as a bulk commodity. A new document provided a list of hazards likely to be associated with imported bait, a list of the main finfish species imported for bait, and a list of species known to be susceptible to the identified hazards. Each species was identified as either of "high" or "low" regulatory concern, based on a recognised association with an OIE-listed disease, a New Zealand-notifiable aquatic disease, or any other pathogenic agent, that is likely to remain viable in extended frozen storage. The report did not assess the biosecurity risks associated with imported bait, but it should be noted that New Zealand has remained free from the hazards identified in this document despite importing large volumes of a number of fish species for bait.

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, and 2 841 of them were issued during 2015 (**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.

Table 1: Number of import permits issued by Animal Imports Team, 2015

Category	Product type	Number
Animal product	Animal feed	16
	Animal product	130
	Bee	35
	Dairy/meat samples	4
	Dairy	1
	Egg	8
	Equine	1
	Fibre	15
	Fish	1
	Hides/skins	5
	Meat	8
	Porcine	27
	Poultry	1
	Wool	2
	Total	**254**
Biologicals	General	397
	Restricted	213
	Organisms	2
	Total	**612**
Embryos	Bovine	16
	Laboratory animals	7
	Ovine	2
	Total	**25**
Live animals	Bovine	1
	Butterfly	6
	Camelid	11
	Caprine	1
	Dog/cat	53
	Dog/cat – quarantine	1 436
	Equine	32
	Fish	13
	Hatching eggs	12
	Insect	2
	Invertebrate	56
	Laboratory animals	42
	Marine invertebrates	9
	Ovine	4
	Rabbit	11
	Small animals	2
	Zoological	19
	Total	**1 710**
Semen	Bovine	89
	Canine	2
	Caprine	1
	Equine	4
	Ovine	10
	Porcine	2
	Laboratory animals	3
	Total	**111**
Transit	All	129
	Total permits issued	**2 841**

Numbers of live animal imports in 2015 are listed in **Table 2**. These are estimates based on importers' stated intentions and may differ from the numbers actually imported.

Table 2: Live animal and germplasm imports by species in 2014

Species	2015
Alpaca	95
Marine invertebrates/fish	185
Caprine	1
Cat	1 821
Zoo	49
Dog	3 899
Donkey	4
Horse	1 393
Guinea pig	97
Invertebrate	528
Laboratory animal	105
Ovine	5
Rabbit	12
Total	**8 194**

The following is a summary of new or amended import health standards issued during 2015.

Guinea pigs from Australia

A new IHS for guinea pigs from Australia was issued on 17 March 2015.

Horses

The IHS for horses was amended on 6 November 2015 to update requirements.

Zoo marsupials and monotremes

The IHS for zoo marsupials and monotremes from Australia (kangaroos, wallabies, koalas, wombats, echidnas, feather-tailed gliders and potoroos) was issued in December 2015. The standard is based on scientific risk analysis. Development of this standard was requested by the zoo industry and has been identified as a priority for the ongoing success of their businesses.

Dog semen

The IHS for semen from dogs was amended on 22 October 2015.

The following two previous IHSs were combined with minor amendments:

- IHS for semen from dogs (*Canis familiaris*) from Australia – 19 September 2008; and
- IHS for frozen semen from dogs (*Canis familiaris*) from specified countries – 26 May 2008.

Horse semen and embryos

A new IHS for horse semen and embryos from specific countries (Australia, Canada, European Union, Norway, Switzerland, USA) was issued on 17 December 2015. The standard has added requirements for equine embryos (none existed previously); and for equine semen there are no longer requirements for dourine or glanders from the specified countries. Equine viral arteritis measures are now aligned with the OIE's Terrestrial Animal Health Code where possible. The 28-day isolation period for semen donors prior to entering the collection centre has been removed.

Sheep and goat semen and embryos

The IHS for sheep and goat semen and embryos was issued on 22 June 2015.

Hides and skins

A minor amendment to the IHS for hides and skins was issued on 7 August 2015 to update the IHS in relation to the Requirements and Guidance template, and to clarify Transitional Facility requirements.

Pasteurised egg and products containing pasteurised egg from Australia

The IHS was amended on 12 June 2015 to clarify and update requirements.

Poultry hatching eggs and specific-pathogen-free chicken eggs

The IHS for poultry hatching eggs and specific-pathogen-free chicken eggs was amended on 24 July 2015 to remove the requirement for *Ornithobacterium rhinotracheale* as this organism was determined to be present in New Zealand.

Turkey meat

The IHS for turkey meat was updated on 22 June 2015 and amended to align with changes to the OIE Code.

Specified foods for human consumption containing animal products

The IHS was amended on 30 June 2015 to clarify and update requirements.

Exports of live animals and germplasm

Export figures for live animals and germplasm for the year 2015 are presented in **Tables 3 and 4**.

Table 3 compares live animal and germplasm exports from 2005 to 2015 and **Table 4** shows the global distribution by region of the numbers of exports for 2015.

Since 2007 there has been a year-on-year increase in exports of day-old chicks, and poultry hatching eggs have a shown an increase of about a million on 2014 (**Table 3**). The increased trade in day-old chicks and poultry hatching eggs is believed to be driven by disease outbreaks in the poultry industries of the US and Europe. The number of day-old broiler chicks for breeding exported to Asia is growing rapidly and it is expected that China will eventually become our fourth largest export market for these. There is an ongoing export trade to the Pacific Islands in day-old chicks from both broiler and layer bloodlines (**Table 4**).

This year has seen a significant increase in the export of live sheep (**Table 3**), with almost 44 000 more animals than in the previous year. This can be attributed to a particularly large shipment to Mexico.

Shipments of racehorses have slightly increased, with additional movements of horses to China, Malaysia, Japan and the US, alongside our established markets in Australia and Hong Kong (**Table 4**).

Exports of live cattle have decreased to their long-term average numbers between 2007 and 2013, though it should be noted this is a significant drop from the peak in 2014 (**Table 3**).

There was a decrease in germplasm exports in 2015 (**Table 3**). Bovine semen exports showed a marked decline, down from nearly 1.6 million to 1.25 million, whereas exports of cervine semen almost doubled from the previous year. The number of ovine embryos exported halved compared to the two previous years.

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

Number of export certificates issued

During 2015 there were 35 Overseas Market Access Requirements (OMARs) or export certificates issued and notified as notices under the Animals Products Act 1999. Of these, six represented new requirements while the rest were amendments to existing requirements, due to changes.

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Table 3: Comparison of live animal and germplasm exports from 2005 to 2015

	2015	2014	2013	2012	2011	2010	2009	2008	2007
Bees (packages (kg), queen and bumble)	40 675	44 116	36 737	8 776	37 180	37 523	34 621	27 435	20 387
Bovine embryos	437	536	850	1 801	950	943	1 077	915	574
Bovine semen	1 251 776	1 596 560	1 573 105	1 160 455	1 085 082	1 073 877	1 237 044	785 939	716 865
Canine semen	47	420	9	41	12	166	56	48	3
Cats & dogs	4 045	4 278	5 980	6 151	5 873	4 247	3 999	5 051	4 797
Cervine semen	1 557	816	325	220	275	2 590	3 001	1 833	390
Equine semen	4 119	3 032	3 265	3 324	2 362	2 670	5 195	4 214	3 903
Ferrets	0	0	0	374	760	825	1 397	1 801	2 660
Live alpacas & llamas	228	200	156	456	404	198	375	353	123
Live cattle	21 186	85 732	36 573	39 636	30 499	16 150	12 847	17 075	25 909
Live deer	28	0	0	65	31	15	46	115	159
Live goats	0	35	0	0	979	58	190	6	349
Live horses	2 713	2 622	2 853	2 886	3 308	2 292	2 469	2 512	2 562
Live sheep	45 166	1 082	380	421	177	307	124	118	34 894
Ovine embryos	825	1 836	1 737	0	320	114	230	1 652	3 751
Ovine semen	5 049	5 518	1 877	7 271	11 819	4 954	10 374	19 921	12 365
Poultry (day-old chicks)	2 221 689	1 700 483	1 270 703	1 136 530	1 342 542	1 324 543	1 098 192	854 678	867 573
Poultry (hatching eggs)	4 076 927	3 036 075	2 536 565	2 365 466	3 173 403	5 185 128	3 860 755	5 275 056	7 471 678

Table 4: Volume of live animal and germplasm exports to various regions in 2015

	Africa	Asia	Australia	Canada	Central and South America	Europe	Middle East	Pacific Islands	United States	Total
Bee packages		41		34 211						34 252
Bees, queen & bumble		30		6 393						6 423
Bovine embryos			113		206	95			23	437
Bovine semen	225 813	15 497	202 320	2 510	479 704	268 403		1 500	56 029	1 251 776
Canine semen	12	2	25			8				47
Caprine embryos					23					23
Caprine semen	300									300
Cats & dogs	35	294	2 525	89	14	633	22	89	344	4 045
Cervine embryos				139					64	203
Cervine semen			95	135		522			805	1 557
Equine semen			4 119							4 119
Live alpacas & llamas		10	12			206				228
Live cattle		17 962			3 224					21 186
Live deer		28								28
Live goats			23							23
Live horses		752	1 791			68	12	25	65	2 713
Live sheep			7		45 123	36				45 166
Other		3	25						20	48
Other birds		424	4		36					464
Ovine embryos			582		243					825
Ovine semen			3 962			100			987	5 049
Poultry (day-old chicks		1 368 949						852 740		2 221 689
Poultry (hatching eggs)		732 672					175 860	3 168 395		4 076 927
Zoo animals		5	27		4				4	40

Animal Health Laboratory

As New Zealand's national veterinary laboratory, the Ministry for Primary Industries Animal Health Laboratory (AHL) plays a vital role in protecting New Zealand from animal diseases that could have a serious effect on our animal industries, the health of New Zealanders and our environment.

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. As part of the facilities at Wallaceville we maintain enhanced physical containment level three laboratories with specialised equipment and procedures that allow 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 about a range of exotic and emerging pathogens such as foot-and-mouth disease, avian influenza, theileriosis and bonamiaosis.

During 2015 the developing National Biocontainment Laboratory provided great interest to stakeholders, with increasing numbers of government, overseas officials and industry visitors to the Wallaceville site. Highlights of 2015 included publication of the first scientific report on grey mullet (*Mugil cephalus*) infection by the myxozoan parasite *Myxobolus episquamalis* in New Zealand. The lead author, staff member Henry Lane, is being supported by AHL to undertake PhD studies through Otago University on the ecology of *Bonamia* spp. parasites of the Bluff oyster, *Ostrea chilensis*. High levels of oyster deaths caused by *B. exitiosa* have twice caused the closure of the Foveaux Strait oyster fishery. In January 2015 *B. ostrea* was first identified in oysters from the Marlborough Sounds by PCR tests conducted as part of Henry's PhD studies. This resulted in an early alert for a biosecurity response to be mounted in time to contain the parasite within the infected area. Henry will be spending 12 months supported by a Fulbright scholarship at the Institute of Marine Science, Virginia, USA, to further his studies on *Bonamia*.

National Biocontainment Laboratory

The National Biocontainment Laboratory Project (NBLP) was initiated in 2012 after MPI identified a need to replace the existing high-level biocontainment facilities. These are used by the AHL to undertake day-to-day veterinary diagnostic and surveillance work, and to respond to exotic disease outbreaks. Progress on the NBLP continued in 2015. Tender submissions for the main construction work were assessed and the contract was awarded to Fletcher Construction.

The design was further refined throughout the year as the project undertook value engineering exercises to validate the new facility's design and ensure the building and its features will be sufficient to meet MPI's future needs.

Site preparations, including relocating existing services, upgrading present infrastructure and demolishing two laboratory buildings, were largely completed before the official sod-turning ceremony in October, which officially marked the beginning of construction. Much of the site excavation was completed in December and contractors were able to begin work on the foundations before Christmas.

Supporting surveillance programmes

The AHL carries out surveillance diagnostic work for a number of important pathogens including avian influenza, transmissible spongiform encephalopathy and arboviruses. All of these programmes require collecting or being sent large numbers of samples for diagnostic testing. For example, for the avian influenza programme AHL staff collect oral and cloacal samples from about a thousand wild waterfowl in areas where they often mix with migratory birds, then identify and characterise any influenza viruses found. (For further details see the annual reports for these individual programmes.)

Facilitating trade

One of the core functions of the AHL is to perform diagnostic testing that supports trade in NZ primary industries. The AHL also supports trade through performing diagnostic tests as part of exotic animal disease investigations, responses, and for surveillance programmes. Importantly, our testing serves as a resource for passive surveillance, providing our trading partners continual assurance of our freedom from specific unwanted or notifiable animal diseases.

As the AHL is the national veterinary reference laboratory, much of the testing it performs is not available elsewhere in NZ, often because it requires specialist expertise and facilities. We perform a broad range of such tests in both physical containment level 2 and enhanced physical containment level 3+ laboratory facilities, to maintain the appropriate levels of biosecurity containment. In addition, we have close working relationships with a wide range of OIE and international reference laboratories that assist us with testing when required.

The almost 30 000 diagnostic tests performed at the AHL in 2015 either directly or indirectly facilitated primary trade (**Table 1**). There were more than 6 000 cost-recovered tests undertaken to support trade, including but not limited to the aquaculture, dairy, beef, lamb and bloodstock industries. Tests were also undertaken to support the import or export of companion animals. The AHL also helped zoos and wildlife parks by testing unusual or novelty animal species to enable import or export of these animals.

More than 9 000 tests were undertaken by the AHL as part of exotic disease investigations to rule out the presence of exotic or notifiable animal diseases. This work was also critical in ensuring that trade in animals and animal products could be maintained with international trading partners.

Throughput

The AHL works in four science disciplines: virology, immunology, bacteriology and aquatic diseases. Teams include expert Principal Advisers, Senior Scientists, Scientists and Senior Technicians capable of carrying out the complex, diverse analyses and investigations that are presented to us on a daily basis.

The AHL offers more than 450 diagnostic test methods across the science disciplines, many of which are uniquely offered within NZ and include high-throughput testing capability for high-priority animal diseases. These tests range from classic, well-established techniques such as virus isolation, ELISA and microscopy, through to molecular analysis and state-of-the-art technologies such as real-time PCR, Next Generation sequencing and bioinformatic analysis. Some testing cannot be offered within NZ, and in those cases AHL manages the subcontracting of the work overseas to suitably accredited reference laboratories.

The AHL performed more than 30 000 tests in the 2015 calendar year, encompassing a large range of the test methods we offer (**Table 1**).

As a national reference facility the AHL also constantly works to develop and enhance diagnostic capability through implementing new or improved test methods to ensure we lead the way in veterinary laboratory diagnostics in NZ (see "Exotic disease preparedness", below).

Supporting incursion investigations

The AHL uses traditional laboratory tests through to state-of-the-art technologies to diagnose and identify exotic pathogens. It is essential that these organisms are ruled out under safe conditions of high laboratory containment before any other diagnostic work is performed in lower-containment laboratories.

Listed below are some examples of the 2015 incursion investigations carried out by the Bacteriology and Aquatic Animal Diseases, Immunology and Virology teams at Wallaceville, using conventional and molecular analytical techniques to exclude and identify pathogens.

Table 1: Summary of test numbers and description of work conducted by AHL, 2015

Purpose of testing	Number of tests / accessions	Description of work
Exotic disease investigations	9 086 / 295	(1) Testing to rule out the presence of exotic pathogens. (2) Identification of reptiles and amphibians that cross our borders.
Cost-recovery diagnostics	2 203 / 103	Encompasses cost-recovered diagnostic testing and project work, much of which utilises capability not available elsewhere.
Surveillance projects (Crown-funded)	9 998 / 90	Testing to support surveillance programmes including TSE, arbovirus and avian influenza.
Import/export/trade (cost recovery)	6 096 / 688	(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)	380 / 93	Specific testing for AB purposes to rule out presence of various pathogens, including some exotic diseases.
Quality assurance	2 085 / 242	The AHL participates in 64 programmes of inter-laboratory proficiency testing through eight 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.

Avian

Many submissions from chickens and ducks were tested for avian influenza virus, Newcastle disease and chlamydia. There were also several suspect infectious bursal disease investigations involving weak positive serum tests from industry surveillance that were followed up by AHL using PCR, and all found to be negative. Such non-specific antibody results have recurred for several years, and a small project to investigate the cause has been initiated at AHL.

Aquatic

The number of aquatic disease investigations requiring laboratory testing is increasing, with many submissions from commercial and natural disease events, several leading to responses. Submissions of oysters, scallops, paua, pipi and tuatua have been tested for ostreid herpesvirus-1, *Rickettsia*-like organisms, *Bonamia ostreae* and *Perkinsus olseni*. Rock lobsters with tailfin rot have been tested for Flavobacteriaceae and *Aquamarina hominis*, with negative findings, and are being followed-up with Next Generation sequencing to determine whether a novel pathogen is causing the pathology. Farmed fish testing has been both routine (to ensure freedom from disease in breeding fish stock) and for export testing, such as testing groper/hapuka for nodavirus and salmon for whirling disease. Other submissions have resulted in significant biosecurity responses by MPI, as in the case of salmon found to be infected with *Rickettsia*-like organisms (RLOs) and *Tenacibaculum maratimum*. Further characterisation of the RLOs using whole-genome sequencing is being undertaken.

Bee pathogens

Investigations were carried out with PCR testing for Israeli acute paralysis virus, Kashmir bee virus, European foulbrood, sac brood virus, deformed wing virus,

Lotomaria passim, black queen cell virus and *Nosema ceranae*. A die-off of bumble bees was also tested for *N. ceranae*. At a port, a sea container from the US was found to be carrying a swarm of "hitchhiking" bees that were tested for a range of exotic organisms as a prospective assessment of risks, and then destroyed.

Bovine

On-going surveillance testing for *Theileria orientalis* Ikeda strain has resulted in numerous scientific publications and increased our knowledge of its epidemiology in NZ cattle. Bovine submissions were tested for a wide range of pathogens, including bovine viral diarrhoea virus I and II, border disease, bovine herpesvirus-1 (also known as infectious bovine rhinotracheitis), bovine papillomavirus, bovine adenovirus and the bacterial pathogens *Yersinia, Campylobacter, Salmonella, Brucella, Clostridium botulinum* and *Chlamydia*. Several tests to exclude anthrax were also carried out on suspect cases.

Canine

A wide variety of investigative testing was carried out in dogs, including for *Brucella*, leptospirosis, canine distemper virus, canine influenza, *Babesia gibsoni*, canine heartworm (microfilaria) and *Ehrlichia canis*.

Caprine

Goat submissions were tested for piroplasm, caprine arthritis encephalitis, *Maedi-visna* and herpesvirus, with type 2 caprine herpesvirus identified in one case.

Equine

Numerous horse submissions through the year were variously tested for *Taylorella equigenitalis, Babesia caballi*, equine influenza virus, equine infectious anaemia virus, horsepox, equine herpesvirus-1 and -4, and equine viral arteritis.

Suspicion of equine influenza cast on horses originating from NZ and exported to Malaysia was categorically refuted by AHL laboratory records and robust evidence from accredited test data.

Feline

Two cat pathology submissions were received for fungal culture and tested for sporotrichosis (*Cryptococcus neoformans* suspected) and *Alternaria* spp.

Ovine

Submissions were tested for ovine pestivirus, hairy shaker disease, parapox (confirmed as orf) and border disease. In a case of ovine abortions with fetal deformities present, we tested for bluetongue virus, akabane and Schmallenberg virus – all negative.

Porcine

Pigs were tested for influenza virus and porcine circovirus.

Wildlife and captive animals

To better understand several conditions presenting in wildlife and assess the relative risk to primary industries, we have assisted the Department of Conservation and other organisations with their investigations.

Investigation of morbidity and mortality in Otago Peninsula yellow-eyed penguins identified *Corynebacterium oesophogitis* as the pathogenic organism. Penguins in another investigation were tested for haemoplasmosis. The kaki/black stilt is a critically endangered native species and the breeding programme has experienced significant losses of chicks caused by encephalitis with neurological clinical signs. Extensive flavivirus testing was negative and is being followed up with virus isolation and Next Generation sequencing. Kea were tested for *Candida albicans*, and the causes of "scabby bum syndrome" in kakapo are also being investigated. Chameleons, iguanas, native geckos, Eastern water dragons and tuatara have been variously tested for fungi, with *Paranannizziopsis australiensis* and *P. californiensis* being identified on several occasions. Zoo animals and other unusual submissions this year have included emu for AI exclusion; lemur for *Francisella tularensis*, herpesvirus and adenovirus exclusion following sudden death; and guinea pigs, hares and rabbits for a range of bacterial, fungal and viral tests.

Exotic disease preparedness

The AHL continues to improve its preparedness for exotic disease response by investing in staff training and new technology. This has included the purchase of new equipment to enhance our molecular diagnostic capability, updating and replacing real-time PCR machines, and establishing Next Generation sequencing capability. During 2015 a number of new or improved tests were implemented to enhance our diagnostic capability for exotic animal disease. These included real-time PCRs for salmonid alphavirus, *Ornithobacterium rhinotracheale* and exotic avian *Mycoplasma* species, equine viral arteritis, bovine viral diarrhoea, arboviruses and foot-and-mouth disease (FMD – though no live FMD virus is held at the AHL).

The AHL continues to develop a laboratory plan for a potential FMD incursion in NZ. This has included a training course at the World Reference Laboratory for FMD, in Pirbright, UK, attended by an AHL scientist in both of the last two years. This has been invaluable in providing first-hand knowledge of the methods and logistics for a major response, and has been incorporated into the AHL plan.

National and international connections

As the national reference laboratory, the AHL maintains an extensive network of national and international contacts for subcontracted tests, for access to reference material and for technical advice. Visiting technical delegations from trading partners visit the AHL when assuring themselves of NZ's testing capabilities. In addition, 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 level 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; and
- Sub-committee of Aquatic Animal Health Standards, an Australian and NZ committee that provides technical advice on aquatic animal health issues in support of policy planning – Brian Jones and Cara Brosnahan.

Staffing and structure

See **Table 2.**

Staff publications in scientific and technical journals

Brosnahan C, Pande A, Jones B (2015). Snapper mortalities: finding a cause. *Surveillance* 42(4), 24–26.

Buckle K, Ha HJ (2015). Investigation of an unusual veterinary syndrome leading to confirmation of sporadic bovine encephalomyelitis (SBE) in New Zealand. *Surveillance* 42(2), 9.

Hall RJ, Draper JL, Nielsen FG, Dutilh BE (2015). Beyond research: a primer for considerations on using viral metagenomics in the field and clinic. *Frontiers in Microbiology* 6:224.

Hiriote W, Gias EL, Welsh SH, Toms GL (2015). An investigation of the genetic basis of increased susceptibility to neutralization by anti-fusion glycoprotein antibody arising on passage of human respiratory syncytial virus in cell culture. *Journal of Medical Virology* 87:130–131.

Lane HS, Booth K, Pande A, Jones JB (2015). First report of the myxozoan parasite *Myxobolus episquamalis* infecting grey mullet (*Mugil cephalus*) from New Zealand. *New Zealand Journal of Marine and Freshwater Research* 49(2), 173–177.

Lester PJ, Bosch PJ, Gruber MAM, Kapp EA, Peng L, Brenton-Rule EC, Buchanan J, Stanislawek WL, Archer M, Corley JC, Masciocchi M, Oystaeyen AV, Wenseleers T (2015). No Evidence of Enemy Release in Pathogen and Microbial Communities of Common Wasps (*Vespula vulgaris*) in Their Native and Introduced Range. PLOS ONE 10(3): e0121358.

McFadden AMJ, Heath ACG, Fairley R, Trolove P, Pulford DJ (2015). Theileria (Ikeda) associated bovine anaemia in a West Coast dairy farm. *Vetscript* 28, 28–30.

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Ohneiser, SA, Hills SF, Cave NJ, Passmore D, Dunowska M (2015). Canine parvoviruses in New Zealand from a monophyletic group distinct from the viruses circulating in other parts of the world. *Veterinary Microbiology* 178(3–4), 190–200.

O'Keefe J (2015). Editorial: Building our biosecurity capability. *Surveillance* 41(3), 3.

Perera, PK, Gasser RB, Pulford DJ, Stevenson DA, Firestone SM, McFadden AMJ, Jabbar A (2015). Comparison of the performance of three PCR assays for the detection and differentiation of *Theileria orientalis* genotypes. *Parasites and Vectors* 8, 524.

Stanislawek WL, Rawdon TG, Tana T (2015). Avian influenza surveillance programme. *Surveillance* 42 (3), 20–21.

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Table 2: Staffing and structure

Director, Investigation and Diagnostic Centres and Response	Veronica Herrera (Wellington)
Director, National Biocontainment Laboratory Project	Joseph O'Keefe
Animal Health Laboratory Manager	Wendy McDonald
Bacteriology and Aquatic Animal Diseases	
Manager and Principal Advisor	Brian Jones
Scientists	Hye Jeong Ha, Fang Fang, Cara Brosnahan, Sharon Humphrey, (Senior Scientist vacancy)
Technical staff	Yen Yen Yuen, Taryrn Haydon (0.8 FTE), Henry Lane (0.4 FTE), Mary Ann Tuboltsev (Secondment 0.75 FTE)
Fisheries Forensic Analyst	Graeme Bremner (0.6 FTE)
Immunology	
Manager	Richard Spence
Scientists	Rick Clough, Barbara Binney, Rudolfo Bueno, Richard Swainsbury
Technical staff	Michaela Hannah (0.6 FTE), Emma Bramley, Tais Garcia
Technical Resource Coordinator	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
Technical assistants	Barbara Black, Mary Mewett
Containment Laboratory	
Supervisor	Bryan Schroeder
Quality Assurance	
Advisor	Irina Bolotovski

Animal Health Surveillance

The following tables present animal health data collected by MPI from various sources during 2015.

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

Table 2 lists the number of *Salmonella* serotypes by animal species diagnosed by veterinary pathology laboratories.

Table 3 presents a summary of results from the salmon surveillance programme run annually in approved establishments for the export of salmon for human consumption to Australia. No significant infectious disease was detected during this programme. Eighteen salmon farms were tested and none recorded significant mortalities.

Table 4A presents a cumulative list of investigations conducted by Incursion Investigators from MPI's Surveillance and Incursion Investigation (Animals and Marine) Team, more than once during the period 2010–2015 that have resulted in exclusion of OIE-notifiable diseases or other selected significant exotic diseases.

Table 4B presents a list of significant investigations conducted during 2015 by MPI's Surveillance and 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 pathology laboratories during 2015

Cattle	
Total sick animal cases	**16 898**
Abnormalities of reproductive system	**256**
Neospora caninum	13
C. fetus ssp. venerealis	0
Pestivirus infection	6
Abortion	**677**
Neospora caninum	146
Mycotic abortion	3
Pestivirus infection	8
Leptospira spp.	2
Congenital defects	**7**
Ill thrift/diarrhoea	**8 310**
Pestivirus infection	243
Gastrointestinal parasitism	18
Johne's disease - suspicious and confirmed	1 506
Trace element deficiency	287
Yersinia spp.	375
Rotavirus	480
Nervous signs	**498**
Listeria monocytogenes	6
Hepatic encephalopathy	0
Metabolic disease	36
Malignant catarrhal fever	6
Polioencephalomalacia	7
Histophilus somnus	0
Sudden death	**1 023**
Clostridium spp.	4
Respiratory disease	**610**
Sheep	
Total sick animal cases	**1 231**
Abnormalities of reproductive system	**175**
Brucella ovis	9
Abortion	**204**
Campylobacter fetus spp. *fetus*	21
Other Campylobacter spp.	9
Toxoplasma gondii	37
Salmonella Brandenburg	35
Congenital defects	**2**
Ill thrift/diarrhoea	**374**
Johne's disease	14
Trace element deficiency	17
Gastrointestinal parasitism	9
Nervous signs	**65**
Listeria monocytogenes	12
Polioencephalomalacia	**1**
Clostridium spp.	1
Respiratory disease	**42**
Sudden death	**279**
Gastrointestinal parasitism	6
Farmed deer	
Total sick animal cases	**155**
Abortion	**0**
S. zooepidemicus	0
Congenital defects	**0**
Ill thrift/diarrhoea	**79**
Johne's disease	8
Trace element deficiency	12
Yersinia spp.	9
Nervous signs	**11**
Malignant catarrhal fever	0
Sudden death	**45**
Gastrointestinal parasitism	0
Malignant catarrhal fever	0
Horses	
Total sick animal cases	**6 438**
Abortion	**48**
S. zooepidemicus	2
Circulatory disease	**288**
Ill thrift/diarrhoea	**1 211**
Gastrointestinal parasitism	4
Nervous signs	**242**
Respiratory disease	**696**
Streptococcal infection	60
Sudden death	**26**
Pigs	
Total sick animal cases	**72**
Abortion	**3**
Ill thrift/diarrhoea	**27**
Nervous signs	**4**
Sudden death	**15**
Goats	
Total sick animal cases	**405**
Abortion	**10**
Ill thrift/diarrhoea	**184**
Gastrointestinal parasitism	2
Respiratory disease	**22**
Nervous signs	**20**
Listeria monocytogenes	1
Caprine arthritis encephalitis	0
Sudden death	**42**
Clostridium perfringens D (enterotoxaemia)	1
Gastrointestinal parasitism	0
Lamoids	
Total sick animal cases	**285**
Abortion	**3**
Ill thrift/diarrhoea	**132**
Gastrointestinal parasitism	6
Nervous signs	**11**
Respiratory disease	**10**
Sudden death	**24**
Avian species	
Total number of submissions	**503**

Table 2: *Salmonella* serotypes isolated from animals during 2015

Serotype	Bovine	Camelid	Canine	Equine	Feline	Ovine	Reptile
Salmonella Abortusequi	-	-	-	-	-	-	-
Salmonella Abortusovis	-	-	-	-	-	-	-
Salmonella Adelaide	-	-	-	-	-	-	-
Salmonella Agona	5	-	-	-	-	-	-
Salmonella Albany	-	-	-	-	-	-	-
Salmonella Amager	-	-	-	-	-	-	-
Salmonella Amsterdam	-	-	-	-	-	-	-
Salmonella Anatum	2	-	-	-	-	-	-
Salmonella Arizonae	-	-	-	-	-	-	-
Salmonella Banana	-	-	-	-	-	-	-
Salmonella Bareilly	-	-	-	-	-	-	-
Salmonella Bere	-	-	-	-	-	-	-
Salmonella Bovismorbificans	56	-	1	-	-	-	-
Salmonella Brancaster	-	-	-	-	-	-	-
Salmonella Brandenburg	36	-	2	-	-	38	-
Salmonella Bredeney	-	-	-	-	-	-	-
Salmonella California	-	-	-	-	-	-	-
Salmonella Choleraesuis	-	-	-	-	-	-	-
Salmonella Cubana	-	-	-	-	-	-	-
Salmonella Derby	-	-	-	-	-	-	-
Salmonella Dublin	-	-	-	-	-	-	-
Salmonella Eastbourne	-	-	-	-	-	-	-
Salmonella Emek	3	-	-	-	-	-	-
Salmonella Enterica	-	-	-	-	-	-	-
Salmonella Enteritidis	4	-	1	-	-	1	1
Salmonella Fresno	-	-	-	-	-	-	-
Salmonella Give	-	-	-	-	-	-	-
Salmonella Hadar	-	-	1	-	-	-	-
Salmonella Havana	-	-	-	-	-	-	-
Salmonella Heidelberg	-	-	-	-	-	-	-
Salmonella Hindmarsh	2	-	-	-	-	39	-
Salmonella Houtenae	-	-	-	-	-	-	-
Salmonella Hvittingfoss	-	-	-	-	-	-	-
Salmonella Infantis	1	-	-	-	-	1	-
Salmonella Johannesburg	-	-	-	-	-	-	-
Salmonella Kedougou	-	-	-	-	-	-	-
Salmonella Kentucky	-	-	-	-	-	-	-
Salmonella Kiambu	-	-	-	-	-	-	-
Salmonella Kottbus	-	-	-	-	-	-	-
Salmonella Lexington	-	-	-	-	-	-	-
Salmonella Litchfield	-	-	-	-	-	-	-
Salmonella Liverpool	1	-	-	-	-	-	-
Salmonella Livingstone	-	-	-	-	-	-	-
Salmonella London	-	-	-	-	-	-	-
Salmonella Luckenwalde	-	-	-	-	-	-	-
Salmonella Mana	-	-	-	-	-	-	-
Salmonella Mbandaka	2	-	-	-	-	-	-
Salmonella Meleagridis	-	-	-	-	-	-	-

Salmonella Minnesota	-	-	-	-	-	-	-
Salmonella Mississippi	-	-	-	-	-	-	-
Salmonella Molade	-	-	-	-	-	-	-
Salmonella Montevideo	-	-	-	-	-	-	-
Salmonella Muenster	-	-	-	-	-	-	-
Salmonella Nchanga	-	-	-	-	-	-	-
Salmonella Newington	-	-	-	-	-	-	-
Salmonella Newport	-	-	-	-	-	-	-
Salmonella Onderstepoort	-	-	-	-	-	-	1
Salmonella Oranienburg	-	-	-	-	-	-	-
Salmonella Orion	-	-	-	-	-	-	-
Salmonella Paratyphi	-	-	-	-	-	-	-
Salmonella Poona	-	-	-	-	-	-	-
Salmonella Potsdam	-	-	-	-	-	-	-
Salmonella Pullorum	-	-	-	-	-	-	-
Salmonella Reading	-	-	-	-	-	-	-
Salmonella Rideauf	-	-	-	-	-	-	-
Salmonella Rissen	-	-	-	-	-	-	-
Salmonella Rough	-	-	-	-	-	-	-
Salmonella Ruiru	1	-	-	-	-	-	-
Salmonella Saintpaul	2	-	-	-	-	-	4
Salmonella Salford	-	-	-	-	-	-	-
Salmonella Schwarzengrund	-	-	-	-	-	-	-
Salmonella Senftenberg	7	-	-	-	-	-	-
Salmonella Singapore	-	-	-	-	-	-	-
Salmonella Tennessee	-	-	-	-	-	-	-
Salmonella Thompson	-	-	-	-	-	-	-
Salmonella Typhi	-	-	-	-	-	-	-
Salmonella Typhimurium	127	-	5	12	6	3	-
Salmonella Typhisuis	-	-	-	-	-	-	-
Salmonella Uganda	-	-	-	-	-	-	-
Salmonella Victoria	-	-	-	-	-	-	-
Salmonella Virchow	-	-	-	-	-	-	-
Salmonella Wangata	-	-	-	-	-	-	-
Salmonella Warragul	-	-	-	-	-	-	-
Salmonella Weltevreden	-	-	-	-	-	-	-
Salmonella Westhampton	-	-	-	-	-	-	-
Salmonella Worthington	-	-	-	-	-	-	-
Salmonella Yoruba	-	-	-	-	-	-	-
Salmonella Zanzibar	-	-	-	-	-	-	-
Unspecified	9	1	2	2	2	-	1
Total	**258**	**1**	**12**	**14**	**8**	**82**	**7**

Table 3: Salmonid surveillance for fish exported to Australia for human consumption during 2015

Pathogen tested for	No of farms	No of samples	No of positives
Viral cultures	18	1 920	0
Myxobolus cerebralis	10	600	0
Yersinia ruckeri	18	1 920	0
Aeromonas salmonicida	18	1 920	0
Renibacterium salmoninarum	8	480	0

Table 4a: Cumulative list of significant (*A) negative investigations of suspected exotic diseases, 2009–2014

Disease agents investigated and confirmed as negative	2010	2011	2012	2013	2014	2015	Total
Aeromonas salmonicida (fish) *B			3		2		5
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	12
Anthrax	4	1	1	3	4	2	15
Avian influenza: highly pathogenic notifiable avian influenza & Newcastle disease *B	10	7	8	4	3	5	37
Avian influenza: low-pathogenicity notifiable avian influenza *B			6	2	2	1	11
Avian polyomavirus *C			1	2			3
Babesia canis, B. gibsoni, B. felis	5		5	2	1	1	14
Bluetongue		4	6		2	4	16
Brucella abortus	2	2	3	2	2	1	12
Brucella canis	4	6	8	6	5	9	38
Brucella melitensis			2		1	1	4
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	13
Burkholderia mallei (glanders) and *B. pseudomallei* (melioidosis)	1				1	2	4
Canine distemper virus	1		1	1	2	3	8
Canine influenza	1	1				2	4
Canine transmissible venereal tumour		2					2
Classical swine fever	1	1					2
Chlamydophila abortus (enzootic abortion)		1	1		1		3
Colony collapse disorder (bees)	4	2					6
Contagious agalactia		2					2
Contagious bovine pleuropneumonia	1		2	1			4
Ehrlichia canis	7	3	1	1	1		13
Equine piroplasmosis	8	5	2	3	2	3	23
Equine herpesvirus type 1 (abortion strains, neuropathogenic strains)	2		3	1	6	1	13
Equine infectious anaemia/Equine viral arteritis	14	7	14	17	4	7	63
Equine influenza		2	1	2	3	2	10
European foulbrood (bees) *B	4	4	4	3	7	8	30
Exotic ticks		6		3	3	15	27
Fish/shellfish mortality (wild or managed, marine) – exclusion of exotic and novel infectious disease agents	6	4	6	5	4	11	36
Haemorrhagic septicaemia (*Pasteurella multocida* – toxogenic strains)	4	9	7	3		1	24
Heartworm (*Dirofilaria immitis*)		3	2			3	8
Hydatids (*Echinococcus* spp.)	3	1	1			1	6
Infectious bovine rhinotracheitis (exotic strains)		1	4	1		2	8
Infectious bursal disease	4	3	2	5	1	3	18
Israeli acute paralysis virus (bees) *B	2	2	3	1	3	7	18
Leishmaniasis	1	1	2				4
Leptospira (exotic strains)	1	1	2	1	3	1	9
Mycoplasma bovis	3	4	3	1	4		15
Mycoplasma mycoides mycoides (large colony)		1	2				3
Myxomatosis		1	1	2		1	5
Nosema ceranae (bees)	*C	1	1	1	2	2	7
Ornithobacterium rhinotracheale	2		2	1	1	*C	6
Perkinsus marinus and *P. olseni* (molluscs)		2	1	2	2		7
Porcine reproductive and respiratory syndrome	2	1			1	2	6
Poxviruses (ruminants and camelids)			4	1	1	2	8
Psittacine herpesvirus (incl. Pacheco's disease)				2			2
Pulmonary adenomatosis virus			2				2
Q fever *(Coxiella burnetti)*			3	1	2		6
Rabies	1		1	1			3
Rinderpest		1	2				3
Ross River virus		1	1				2
Salmonella (exotic strains)	2	2	4	4	2	1	15
Small hive beetle (*Aethina tumida*) (bees) *B	2	5	1		2	1	11
Slow paralysis virus, Acute bee paralysis virus (bees) *B	2				1		3
Tracheal mite (*Acarapis woodi*) (bees) *B	2	3	2	1	3	9	20
Transmissible spongiform encephalopathy agents (scrapie; BSE; chronic wasting disease; FSE) *B			3	4	3	5	15
Trichinella spiralis	1			1			2
Tropilaelaps clareae and *T. koenigerum* (bees) *B	2	3	3	1		4	13
Tularaemia (*Francisella tularensis*)			1			2	3
Viral haemorrhagic septicaemia (fish)			1		1		2
Viral vesicular disease	6	12	7	5	4	9	43
West Nile virus	1	2	1		4	1	9
Total	**118**	**129**	**159**	**111**	**108**	**142**	**767**

Table 4B: List of significant positive investigations of suspected exotic diseases, 2015

Disease agents/vectors investigated and confirmed as positive, and host species	Number of positive investigations in 2015
Babesia canis (dog) *D	1
Bonamia ostreae (dredge oyster, *Ostrea chilensis*)	1
Brown dog tick (*Rhipicephalus sanguineus*) *E	2
Cyclospora spp. (deer)	1
Erhlichia canis (dog) *D	1
Exotic ticks *F	7
Helicobacter bilis, H. trogontum (sheep) *G1	11 *H
Leishmania spp. (dog) *D	1
Lotmaria passim (bees) *G	5
Ornithobacterium rhinotracheale (birds) *G	1
Paranannizziopsis australasiensis (captive tuatara Sphenodon punctatus and Eastern water dragon *Intellagama lesueurii lesueurii*) *G[2]	2
Perkinsus olseni (scallops *Pecten novaezelandiae*) *G	2
Plasmodium elongatum (little blue penguin *Eudyptula minor*) *G	1
Prototheca zopfii (dog) *G	1
Rickettsia-like organisms (shellfish) *G	2
Tenacibaculum maritimum (Chinook salmon *Oncorhynchus tshawytscha*) *G	1

[1]Gill *et al.* (2016)
[2]Humphrey *et al.* (2016); Masters *et al.* (2016)

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 testing in the MPI active surveillance programmes for these disease agents. See Roper (2014), Stanislawek *et al.* (2015) and Vink (2015).

*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 Confirmed disease agents in Table 4B 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 NZ.

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

*G These positive reports constitute baseline surveillance detection or host extension of endemic organisms.

*H These positive reports represent a baseline surveillance detection over 2010–2013 of an endemic organism. Characterisation of the organism, as part of a research programme, was completed in 2015 (Gill *et al.*, 2016).

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Avian influenza surveillance programme

Figure 1: MPI AHL technicians collecting samples from ducks at the mouth of the Kaituna River (left) and at Lake Te Roto Kare

New Zealand's avian influenza surveillance programme is multi-faceted, incorporating active surveillance of resident wild birds, and enhanced passive surveillance. NZ has never had a case of high-pathogenicity avian influenza virus infection 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 in targeted migratory and resident birds.

The first six 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 2010, surveillance focused on resident birds, mainly waterfowl (**Figure 1**).

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 2015, cloacal and oropharyngeal swabs were collected from 1 065 healthy resident mallard ducks (**Table 1**). 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 (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

Table 1: Active surveillance for avian influenza viruses in wild birds, 2015

Location	Number of mallard ducks sampled	Number of samples tested (cloacal & oropharyngeal)	No. of RT/PCR positives		Confirmed H7 isolates
			H5	H7	
Turua, Piako River, Hauraki Plains, Waikato	320	640	0	0	0
Kaituna River mouth, Bay of Plenty	320	640	0	0	0
Gisborne and Wairoa, Hawke's Bay	320	640	0	0	0
Hamilton, Waikato	43	86	0	0	0
Invercargill, Southland	62	124	0	9	5
Total	**1 065**	**2 130**	**0**	**9***	**5***

*The amino acid pattern of the HA cleavage site was consistent with low-pathogenic H7 viruses in all of the examined samples.

regions. Positive or suspect samples were then tested using real-time H5 and H7 RT/PCR TaqMan (Slomka *et al.*, 2007; Sidoti *et al.*, 2010) and conventional H5, H7 RT-PCRs. The H7-positive samples were tested with conventional RT/PCRs to obtain genomic information. All H7-positive samples were subjected to virus isolation (Stanislawek *et al.*, 2002) and partial genomic sequencing. No influenza subtype H5 was found in the samples collected in 2015.

Influenza A RNA was detected in 33.5 percent of the 1 065 ducks sampled (cloacal, oropharyngeal or both collected samples), lower than in the previous year (43.5 percent). Influenza subtype H7 RNA was confirmed in nine samples from two locations in Southland, and five H7 viruses were isolated.

All H7-RNA-positive samples were examined and some were selected for sequencing. The amino acid pattern of the HA cleavage site of all examined samples was consistent with low-pathogenic H7 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. A number of influenza viruses (subtypes H1, H3, H4, and H6) were isolated in Turua, Kaituna and Gisborne.

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 report is either stood down or investigated further 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 IDC at Wallaceville, is applied to submissions. This includes necropsy and sample collection for histology, bacteriology and virology. The presence of avian influenza is assessed 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 2015, 14 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.

Table 2: Avian mortality reports and investigations, 2015

Month	Reports	Investigations
January	3	1
February	5	1
March	4	2
April	5	1
May	5	2
June	2	1
July	4	1
August	1	0
September	3	1
October	2	0
November	8	3
December	3	1

However, in one case investigated in 2015, an organism not previously reported in New Zealand was confirmed. In this case, a poultry veterinarian phoned the duty Incursion Investigator to discuss cases of upper respiratory disease seen in backyard fancy-breed chickens in Canterbury. The notifier had information from a poultry conference in Australia where the poor sensitivity of standard laboratory approaches (culture and conventional PCR) for detecting *Ornithobacterium rhinotracheale* had been discussed, and details of a real-time PCR assay had been made available (Blackall, 2015; Groves, 2015). In conjunction with the reporting veterinarian, frozen stored tracheal swabs from an earlier affected flock and fresh upper respiratory tract swabs from a more recently affected flock were submitted to theAHL. Molecular testing at the IDC (Wallaceville) excluded the involvement of avian influenza and avian paramyxoviruses, and identified a mixture of endemic bacterial respiratory pathogens including *O. rhinotracheale* in six of the nine samples, and found *Avibacterium paragallinarum* in all samples. *O. rhinotracheale* was detected using a newly implemented real-time PCR protocol (Adelwhab *et al.*, 2013) after conventional PCR failed to detect the pathogen. The outbreak was characterised by upper respiratory disease, including sinusitis and localised exudative lesions ("canker") affecting areas of the mouth, tongue or pharynx, without death. Flocks responded well to routine antibiotic therapy. *O. rhinotracheale* had not previously been detected in New Zealand, and is an Unwanted Organism under the Biosecurity Act 1993. As part of delimiting surveillance, respiratory swab extracts held at the AHL from previous poultry disease investigations were tested. Oropharyngeal swabs (n = 59) collected from three commercial poultry farms

(broiler, free-range layer, barn layer) experiencing upper respiratory tract disease associated with *A. paragallinarum* were tested for *O. rhinotracheale* using the new real-time PCR. Twelve samples tested positive in the RT-PCR, while the conventional PCR was positive for only one sample.

The investigation concluded that *O. rhinotracheale* has a widespread distribution in both the commercial and backyard poultry sectors. The clinical respiratory disease seen in these cases was thought to be the result of the mixed involvement of a number of respiratory pathogens, including *O. rhinotracheale*. This corresponded with the literature, where *O. rhinotracheale* is the most commonly identified co-infectant associated with other respiratory agents (Chin *et al.*, 2008).

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Wildlife disease surveillance

Surveillance of wildlife continues to be 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) 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 monitoring to detect changes in disease occurrence that may indicate an emerging disease requiring further investigation. As well as using MPI's own data, this work also draws on key disease occurrence information created by other organisations undertaking surveillance in, or working with wildlife, in particular the Department of Conservation (DOC). Routine disease diagnoses in wildlife by veterinary diagnostic laboratories are also monitored. MPI receives anonymous summaries of results from testing samples from feral animals, captive or wild native animals meeting a sick animal case criterion that are submitted to diagnostic laboratories by veterinary practitioners, DOC field workers, research workers or others. Reports of particular interest are summarised in the *Quarterly review of diagnostic cases* article in each edition of *Surveillance*. In addition, causes of mortalities of threatened or critically endangered native species are monitored. 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), animals found dead in the field or in captive facilities are sent to the laboratory for post-mortem examination by veterinary wildlife pathologists. Since 2012, MPI has provided ancillary laboratory testing to help determine the cause of death in these cases.

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

Wildlife cases processed by veterinary laboratories

Records of wildlife mortality are held in the Huia database, which is jointly owned by DOC and Massey University and maintained by Wildbase Pathology at IVABS. Most cases involve mortalities in indigenous birds, particularly threatened species submitted by DOC for diagnosis by Wildbase Pathology. The database also holds some case records from surveillance activities, private veterinary laboratories and researchers. **Figure 1** shows avian cases compared to cases involving other types of wildlife over the period 2011–2015. The number of avian cases submitted in 2015 increased slightly compared to 2014 but remained fewer than in 2011 when more than 300 oiled seabirds were examined after the container ship *Rena* was wrecked in the Bay of Plenty.

In 2015, birds comprised 89 percent of submissions, with lizards and tuatara (*Sphenodon punctatus*) 3.6 percent, cetaceans (whales and Hector's dolphins, *Cephalorhynchus hectori*) 2 percent, pinnipeds (mainly NZ sea lions, *Phocarctos hookeri*) 2 percent, bats 1 percent, and native fish 1 percent. Other wild mammals and amphibians totalled less than 1 percent. Mortalities of both juvenile and adult yellow-eyed penguins or hōiho (*Megadyptes antipodes*) continued to be of concern in the coastal Otago region, and mortalities of kiwi, NZ falcons and blue ducks caused by mustelid predation occurred in several areas during re-introduction programmes. There was a moderate decrease in the number of lizard and cetacean necropsies performed and an increase in the number of bat and native fish necropsies.

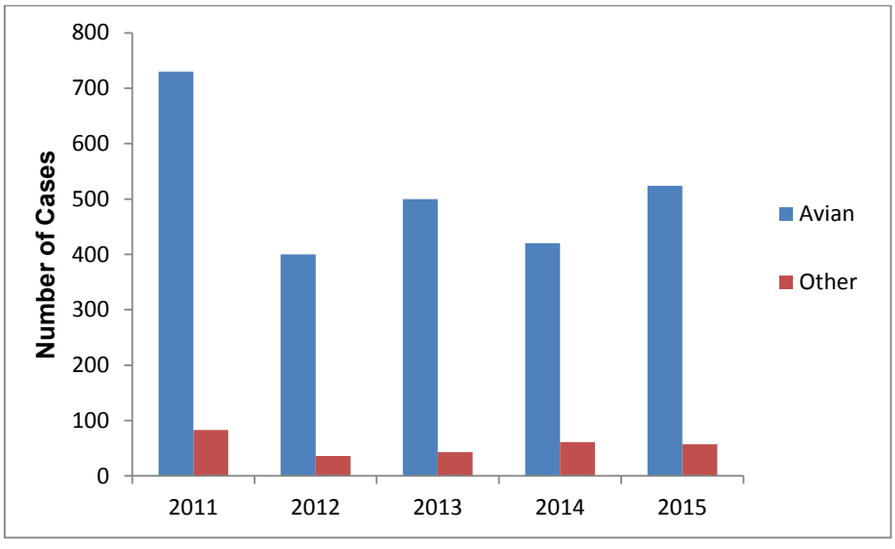

Figure 1: Numbers of wildlife cases in birds and other taxonomic groups recorded in the Huia database, 2011–2015

Disease surveillance in highly threatened species such kakapo (*Strigops habroptilus*), black stilt (*Himantopus novaezelandiae*), hihi/stitchbird (*Notiomystis cincta*) and the endangered species and subspecies of kiwi (*Apteryx* spp.) 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 2015 is shown in **Figure 2**. The highest numbers of cases submitted were from the Wellington and Otago regions, followed by Waikato and Manawatu/Whanganui. The Wellington cases included submissions from Wellington Zoo, Zealandia (Karori), Mana Island and Kapiti Island. The Otago submissions included those from the highly endangered population of yellow-eyed penguins of coastal Otago. Manawatu/Whanganui cases included those from the National Wildlife Centre at Mt Bruce/Pukaha and from Tongariro National Park. Waikato cases included those from Otorohanga, Mangatautari and Rotorua. 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 on offshore islands such as Tiritiri Matangi, Motutapu and Ponui. This year there was an increase in cases submitted from locally administered wildlife sanctuaries such as Bushy Park, Mangatautari, Cape Kidnappers and Zealandia.

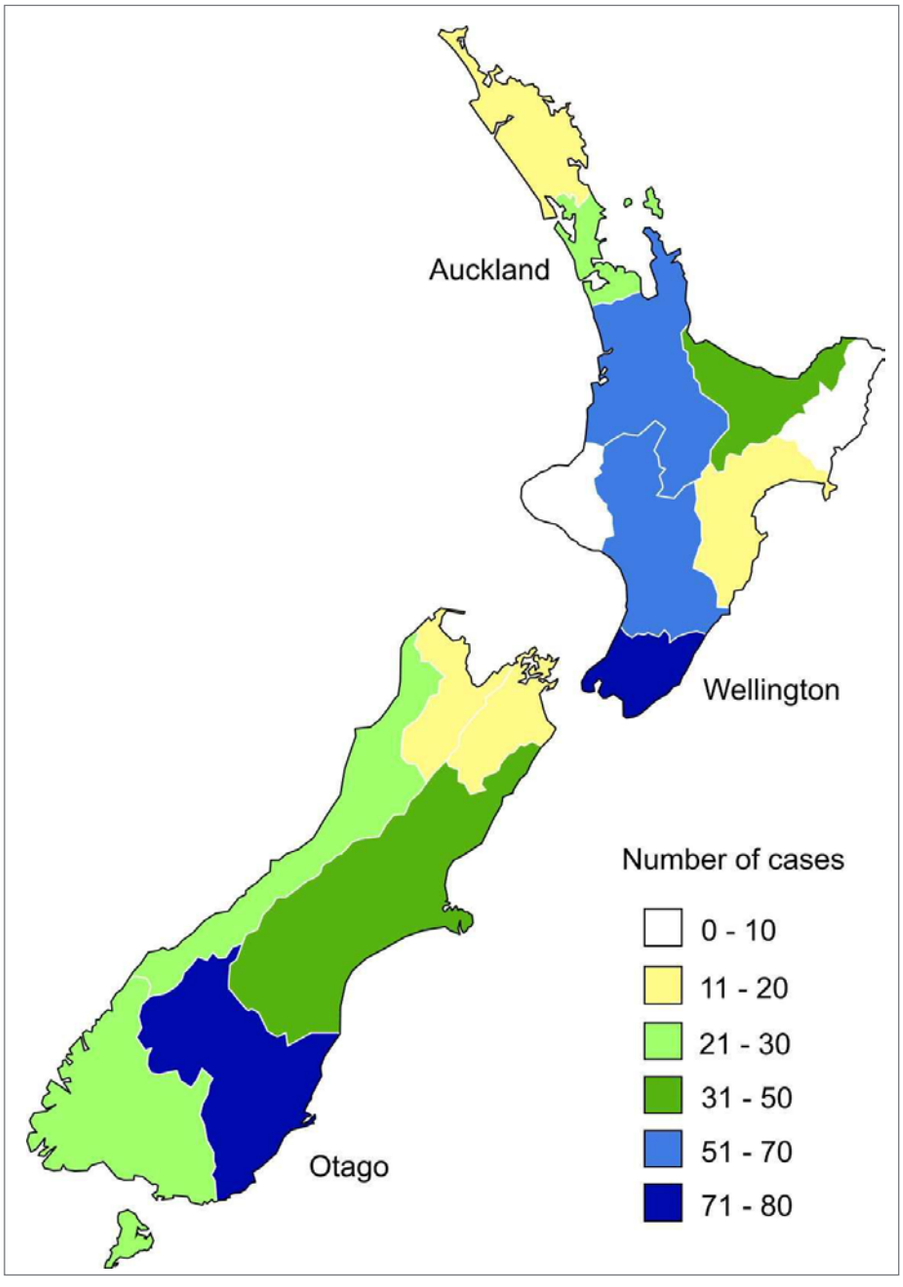

Figure 2: Number of bird cases recorded in the Huia database for 2015 by region

Wildlife cases of special interest in 2015

Avian malaria in South Island penguins

Plasmodium infection has long been suspected in penguins from the Otago and Southland regions (Laird, 1950; Graczyk *et al.*,1995; Alley 2001), but until recently few clinical cases had been observed. Sturrock and Tompkins (2007) found no evidence of infection in blood samples from 143 yellow-eyed penguins, using a specific PCR test for malarial parasites. However, these penguins were from an area of the Otago Peninsula where seroprevalence of malarial antibodies is known to be high, raising doubts as to the accuracy of the earlier reports. It was concluded, however, that the discrepancies could be explained either by inaccuracy of the serological test used, or by infection occurring in juveniles and subsequently being cleared in the surviving adults. Sturrock & Tompkins (2008) found a low prevalence of *Plasmodium* in non-native passerines on the Otago Peninsula, which Holder *et al.* (1999) suggested was due to the low density of mosquito vectors present.

In February 2015, *Plasmodium elongatum* was identified as the cause of death in a juvenile Fiordland crested penguin found on a beach near Hokitika (Hunter, 2015). Two months later, two yellow-eyed penguins (a juvenile

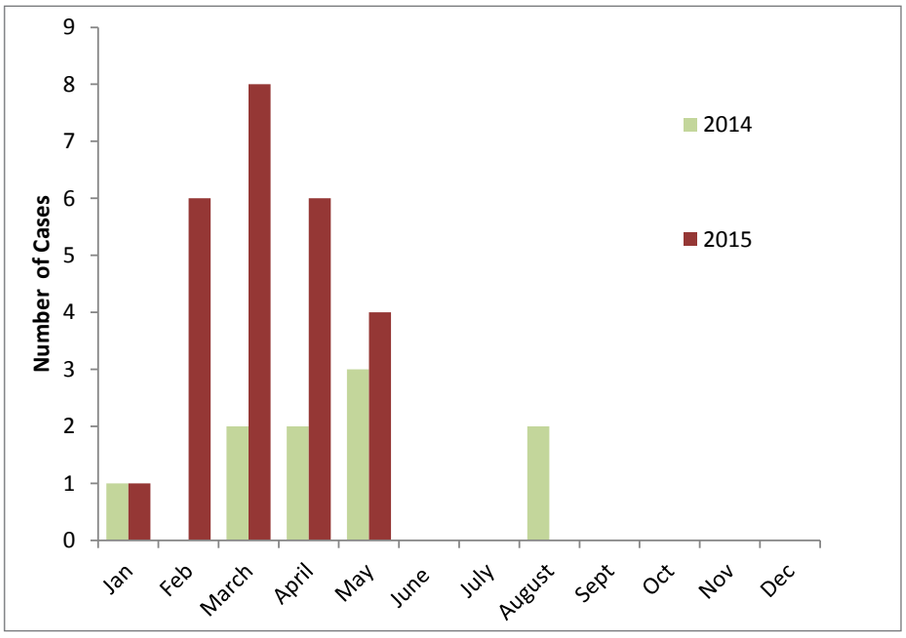

Figure 3: Numbers of leg and flipper injuries in penguins necropsied at Wildbase Pathology by month, 2015

from Otago Peninsula and an adult from Moeraki, North Otago) were submitted to Wildbase for post-mortem examination. The juvenile bird was in poor body condition and had thoracic and abdominal air sacculitis consistent with aspergillosis. There were at least six well-circumscribed dull yellow raised plaques up to 20 mm in diameter in the left thoracic air sac, and several smaller plaques around the right adrenal gland and cranial pole of the right kidney. The liver was diffusely and markedly enlarged, with rounded edges and a meaty consistency, and the spleen was also enlarged and meaty. The second bird showed no evidence of airsacculitis but the liver was markedly enlarged and the spleen was three times the normal size and contained areas of dark discoloration. Although both these birds were submitted frozen, histopathology showed marked pulmonary interstitial hypercellularity, mainly from infiltrating mononuclear cells. Protozoal organisms were present within endothelial cells and macrophages of the lung, heart and spleen of the second (Moeraki) bird, and *Plasmodium elongatum* was identified in the lungs of both penguins by PCR.

Also during February, a third yellow-eyed penguin and an erect-crested penguin (*Eudyptes scalateri*) were admitted to Wildbase Hospital, where they were treated for severely infected wounds over 1–2 months. Both birds died on the same day and at necropsy had similar pathological changes. The pericardial sacs of both birds contained a large amount of clear, straw-coloured fluid, and there was mild ascites. The lungs were oedematous and mottled deep red to purple in colour. There were numerous haemorrhages over the epicardium and a small number on the endocardium. Both the livers and spleens were also enlarged and meaty. Histopathology revealed similar changes to those seen in the earlier cases, with *Plasmodium*-like organisms in endothelial cells of the lung, heart and spleen. PCR analysis of tissues from both birds identified these organisms as *Plasmodium elongatum*.

These cases have confirmed that avian malaria can be a cause of mortality in individual penguins in the South Island. Some of the affected birds were in rehabilitation at the time of death, so perhaps infection from local sources occurred in captivity. Avian malaria has been known to cause infections and mortalities in captive birds in several other countries (Bennett *et al*., 1993; Cranfield *et al*., 1994; Graczyk *et al*., 1994). One reason for the high incidence of infections in birds taken into captivity is that they may be exposed to birds carrying other strains of *Plasmodium* to which they are not adapted (Schoener *et al*., 2014). This, combined with the stress of captivity and concurrent diseases such as aspergillosis, may result in an acute parasitaemia with endothelial cell damage and haemorrhage, as seen in the current cases. It must be emphasised, however, that despite these recent cases there is still no evidence that the disease is responsible for the mass penguin mortalities that have occasionally been seen.

Limb injuries in yellow-eyed penguins

In March 2015, the Yellow-eyed Penguin Trust reported that nearly 50 penguins had been brought to rehabilitation centres suffering from what were thought (Anonymous, 2015) to be bites by barracouta (*Thyrsites atun*). An increase in numbers of yellow-eyed penguins with limb injuries was first noted at Wildbase in the autumn of 2014 and since then more than 25 fatally injured birds have been examined (**Figure 3**).

The lesions observed consisted of sharp-edged lacerations extending through the skin and subcutis of one or both lower limbs and/or occasionally flippers, often involving underlying tendons and synovia. By the time the birds were submitted to the clinic or for post-mortem examination, the wounds had usually progressed to a chronic septic tenosynovitis, arthritis and osteoarthritis. The lacerations tended to be located over the cranial, medial and lateral aspects of the hock and digits, with the plantar surfaces largely unaffected. Often three or four lacerations ran in parallel 20–30 mm apart, and were up to 40 mm long and 5+ mm wide, depending on the degree of healing and/or secondary infection. In most cases the lacerations were longitudinal; less commonly they

ran in a diagonal or transverse direction. Because the injuries were often severe enough to incapacitate the affected birds and prevent them from foraging, many showed emaciation resulting in their death or necessitating euthanasia.

Although local ecologists and staff of the Department of Conservation believe these wounds are most likely produced by barracouta attacks, there is as yet no direct evidence. But the nature of the wounds, the known ability of barracouta to inflict wounds, and their abundance in Otago waters has made this fish a prime suspect. Barracouta have sharp teeth, which have cut the hands of many anglers (Walrond, 2013) and the injuries sustained by the affected penguins are not consistent with those produced by other known predators of penguins in Otago (Hocken, 2000).

Barracouta are pelagic fish that are plentiful on the continental shelf around New Zealand, especially during the summer months, and their diet normally consists of a variety of small fish, including young barracouta (Burgess, 2014), krill, sprat (also favoured by yellow-eyed penguins) and pilchards (O'Driscoll, 1998). Anglers have observed that barracouta will attack any sort of food that is moving, often jumping clear of the water in pursuit of a single baitfish (Burgess, 2014). They are schooling fish that seem to move in and out of various localities, probably depending on the availability of food. They are often abundant off the coasts of Kaikoura, Otago and Southland and may form an important part of the diet of New Zealand fur seals, *Arctocephalus forsteri*, during winter and spring (Fea *et al*., 1999).

The reason for the likely recent increase in attacks by barracouta is uncertain, but the possibility of a prey switch to penguins owing to a decline in the numbers of the more readily available coastal fish species that comprise their diet should be considered. However, it remains difficult to explain why other species of penguins, and other seabirds, have apparently not been affected by similar attacks.

Salmonellosis in red-crowned parakeets

Bacterial hepatitis in psittacine birds in NZ is most commonly caused by *Yersinia* sp. (Cork *et al*., 1999), although a few cases of salmonellosis have previously been reported in kaka (*Nestor meridionalis septentrionalis*) over the last 15 years (Hunter and Alley, unpublished data; Alley & Gartrell, 2002). The first cases (2000–2002) were due to infections with *Salmonella* Typhimurium phage type 160, but the *S.* Typhimurium phage type 56 variant has predominated more recently. The most common cause of acute hepatitis and splenitis in red-crowned parakeets or kararikі (*Cyanoramphus novaezelandiae novaezelandiae*) is yersiniosis, which at necropsy presents with characteristic multifocal pinpoint lesions of inflammatory necrosis throughout the liver and spleen. Salmonellosis lesions in birds are usually less spectacular and consist of hepatic and splenic enlargement and occasionally necrotising ingluvitis (Alley *et al*., 2000).

Two cases of salmonellosis have occurred recently in red-crowned parakeets kept in a large aviary. Both birds died suddenly during the summer months, eight weeks apart. They weighed 54 g (Case 1) and 56 g (Case 2) and were in moderate to good body condition. The livers in both cases were moderately enlarged and rounded with numerous dull yellow foci up to 2 mm in diameter scattered over the capsular surface and throughout the parenchyma (**Figure 4**). In both cases the spleen was moderately to markedly enlarged with a meaty texture and in Case 2 there was a single 2-mm-diameter raised yellow focus on the surface. In both cases the proventriculi and gizzards were full of seed and grit, while the proximal small intestine contained a moderate amount of mucoid-to-watery, pale yellow contents.

Microscopically the livers exhibited multifocal areas of inflammatory necrosis, each with occasional necrotic multinucleated giant cells and a surrounding heterophil infiltration. Scattered throughout these foci were large numbers of Gram-negative coccobacilli. There was marked congestion in the lungs, and small numbers of capillaries were distended with colonies of Gram-negative coccobacilli. Similar bacteria were also visible within myocardial, splenic and renal blood vessels.

Because of the gross appearance of the hepatic and splenic lesions and the relatively common occurrence of yersiniosis in red-crowned parakeets, yersiniosis was given as a provisional diagnosis in Case 1. However, the histopathology of the lesions was not typical of *Yersinia* sp., which usually produces distinctive necrotic foci containing colonies of smaller organisms with a fluffy appearance. Bacterial culture isolated S. Typhimurium from both birds and this was confirmed by the ESR enteric reference laboratory as phage type 45 variant. This *Salmonella* strain currently appears to be the most common variant in circulation among birds in New Zealand.

Wildlife cases notified via the exotic disease hotline

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

Newcastle disease (avian paramyxovirus-1) and high-pathogenic avian influenza (AI), two major exotic diseases of birds, were ruled out in all cases of avian illness or mortality. In an isolated case, a zoo emu developed a bloody oral discharge and gurgling at the base of the throat, sparking concerns of possible AI. No other birds appeared to be affected and the emu was the only one of its kind at the zoo, although there was a large population of feral chickens nearby. Avian influenza was ruled out by PCR testing at the MPI Animal Health Laboratory (AHL). Infectious laryngotracheitis (ILT) virus, an endemic virus, was confirmed by PCR. This is a herpesviral disease of birds, and can be associated with bloody laryngotracheal discharge, as in this case. The emu recovered from the disease. Attenuated

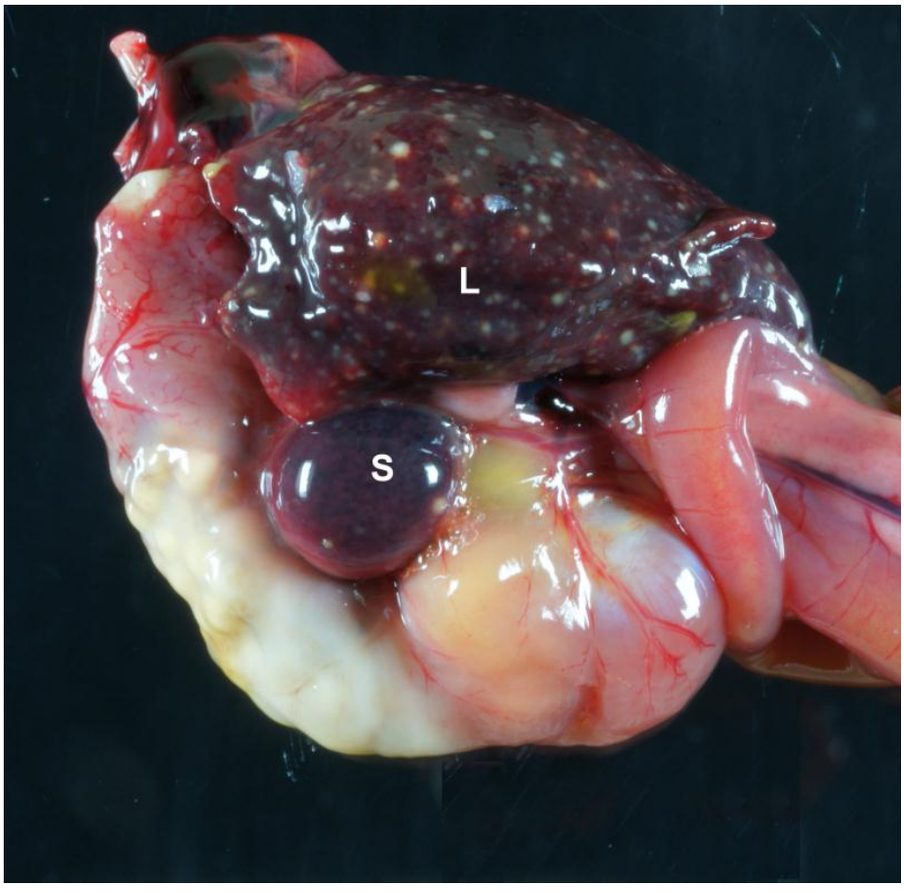

Figure 4: Liver (L), spleen (S) and upper gastrointestinal tract from Case 2 showing multifocal liver lesions and an enlarged spleen. Photo: Stuart Hunter

live ILT virus vaccines are available, and the potential impact and ways to control the disease were under consideration, as well as population control of feral chickens.

In a case of mortality among wild mallard ducks in Auckland, post-mortem examination was used in conjunction with the epidemiology of the disease to rule out exotic disease, and to determine that death was most likely caused by botulism. Occasional reports of dead sparrows were notified throughout the year, but in all cases these were isolated events considered most consistent with intoxication by alphachlorolose, a commercially-available poison for wild birds.

Fungal dermatitis in tuatara and other reptilian species was investigated as part of work to determine the distribution and pathology of the emerging fungal pathogen *Paranannizziopsis australasiensis* (PA, formerly known as the *Chrysosporium* analogue of *Nanniziopsis vriesii*, or CANV). This pathogen has been confirmed in two NZ captive tuatara populations, but has not been found in other captive or wild populations. It is closely related to other fungal pathogens such as *Ophidiomyces ophiodiicola*, which worldwide have caused severe disease in many wild reptile species, although the disease in tuatara appears to be self-limiting in most cases.

As part of this year's investigations, PA was confirmed in an Eastern water dragon (*Intellagama lesueurii*, formerly *Physignathus lesueurii*) from one of the previously-known infected facilities. This animal had developed raised, slightly yellow/brown lumps on its ventrum and tail, consistent with some of the more severe lesions seen on tuatara. Other reptiles with skin lesions tested negative, including a dead tuatara with granulomatous lesions from a facility considered to be free of PA; three NZ green geckos (*Naultinus elegans*), an endangered Otago skink (*Oligosoma otagense*), and a native gold-striped gecko (*Hoplodactylus chrysosireticus*). Detection of PA fungi can be difficult, as fungal elements are embedded in the scales and can be difficult to sample, and because fungal cultures are very slow-growing, meaning tests take weeks or months to complete. Further research into PA is needed, and that research has now been converted into an AHL-funded project in conjunction with Master's degree research taking place at Wildbase (IVABS, Massey University).

Unusual fungal infection in a zoo kea (*Nestor notabilis*) with recurrent fungal granulomas was investigated after a regional veterinary laboratory reported difficulties in confirming a definitive fungal identification. The fungal agent *Candida albicans* was confirmed by the AHL, using biochemical and germ-tube testing. The kea was put on long-term anti-fungal therapy.

Long-term illness and death in a kereru (native wood pigeon, *Hemiphaga novaeseelandiae*) from a wildlife sanctuary was investigated. Fungal infection was found and confirmed to be *Aspergillus* spp.

A haemoparasite found in the blood of an injured wild fledgling little blue penguin (*Eudyptula minor*) from Auckland was confirmed to be *Plasmodium elongatum*, an agent identified previously in this species. The bird did not show signs of disease associated with *P. elongatum*, although the agent has been associated with disease in several penguin species (see earlier).

Several disease cases in rabbits and hares were investigated, including rule-out of rabbit syphilis (*Treponema paraluiscuniculi*, also known as *T. cuniculi*) in a pet rabbit with severe perineal ulcerative dermatitis. Rabbit syphilis is a non-zoonotic sexually-transmitted spirochaetal infection of rabbits. It is thought likely to be present in New Zealand (Midwinter & Fairley,

1999) but has never been confirmed by laboratory testing. Several exotic diseases of hares (myxomatosis, European brown hare syndrome and tularemia) were ruled out as a cause of death in four young hares (*Lepus europaeus*) reported by a landowner in the Wellington region. Post-mortem examination of the most recently dead hare indicated it probably died from a syndrome known as colibacillosis, in which the microflora balance in the intestine is upset, allowing the proliferation of *E. coli*.

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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, 2015). Surveillance for CWD is not mandated by the World Organisation for Animal Health (OIE), and is partly funded by industry; it is carried out to assure New Zealand's trade partners of freedom from this disease.

Both 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; a rapid TSE test is done at MPI's Investigation and Diagnostic Centres (IDCs) when histopathology cannot rule out a TSE diagnosis. The IDEXX TSE enzyme immunoassay (EIA) (IDEXX Laboratories Inc., Westbrook, Maine, USA) is used for all rapid testing. **Table 1** shows the numbers of samples tested in 2015.

New Zealand performs type B surveillance for BSE as specified by Chapter 11.4 of the OIE Terrestrial Animal Health Code (OIE, 2015a). 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 2015 generated 37 284 BSE points and all tests were negative.

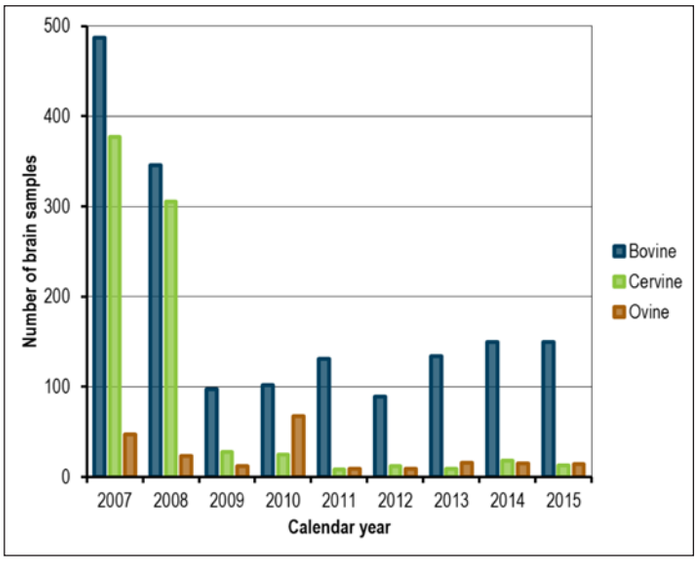

Figure 1: Numbers of brain samples tested for BSE, scrapie and CWD under the incentivised passive surveillance scheme from 2007 to 2015

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 2015, 320 sheep and 324 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, MPI announced the finding of the first confirmed case of atypical scrapie/Nor98 in a New Zealand-born sheep (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, 2015b), 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, whereas the atypical scrapie/Nor98 prion is not detected in lymphoid

Table 1: Numbers of samples tested for TSEs in 2015, by passive and active surveillance

Species	Tissue	Test type	Source of test issue		Surveillance stream
			Routine Surveillance	Imported animal	
Cattle	Brain	Histopathology	150*	-	Passive
		IDEXX TSE EIA	12	3	Passive (rule-out)
Deer	Brain	Histopathology	13	-	Passive
		IDEXX TSE EIA	2	0	Passive (rule-out)
	MRLN†	IDEXX TSE EIA	324	-	Active
Sheep	Brain	Histopathology	14	-	Passive
		IDEXX TSE EIA	1	4	Passive (rule-out)
	MRLN	IDEXX TSE EIA	320	-	Active

* This level of testing earned 37 284 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

tissue (Meloni *et al.*, 2012); therefore, testing of lymphoid tissue using an ELISA test is an attractive proposition. Research at the IDC to evaluate whether lymphoid tissue testing could be used with confidence showed that testing medial retropharyngeal lymph nodes (MRLNs) from sheep and goats with the IDEXX TSE test had high diagnostic sensitivity and specificity (Kittelberger *et al.*, 2014). Consequently, MRLN samples of sheep and deer taken under the active surveillance programme were analysed using this test. The TSE surveillance programme will continue to be refined in accordance with new knowledge, tests, standards and market access needs.

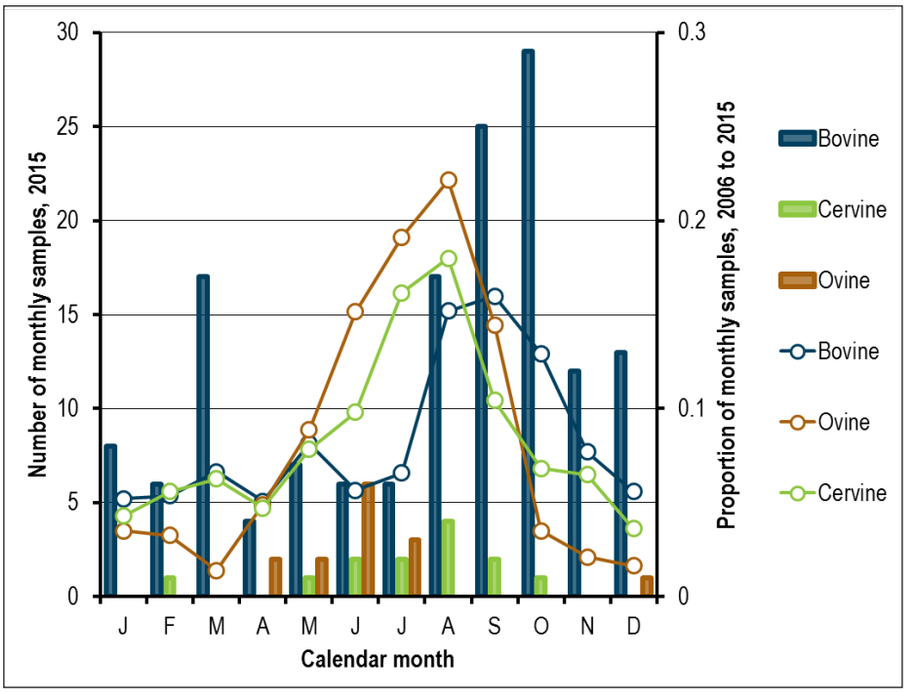

Figure 2: Numbers of brain samples tested for BSE, scrapie and CWD under the incentivised passive surveillance scheme during 2015 (left axis, bars), and trend by calendar month of samples submitted from 2006 to 2015 (right axis, lines)

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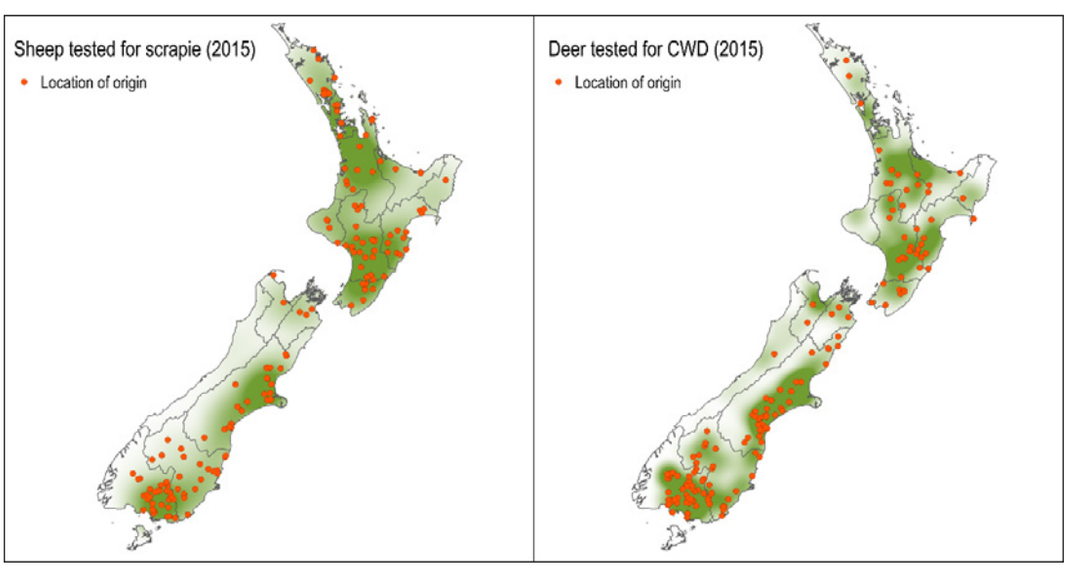

Figure 3: Locations of farms submitting sheep samples for classical scrapie (left; n = 160) and deer samples for CWD (right; n = 162) during 2015. Two animals were sampled per location. The underlying heatmap represents the density of farms with sheep and deer respectively (source: FarmsOnLine)

Arbovirus surveillance programme

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 this genus is not present. The vector species *C. brevitarsus* and *C. wadai* would be particularly problematic here, owing to their tolerance of colder environments (Ryan *et al.*, 1991). However, the likelihood is low that the route of introduction 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).

The surveillance strategy has three components:

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

Early warning system

MPI 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 Investigation and Diagnostic Centres and Response (IDC&R) Directorate, Wallaceville.

Herd testing

During 2016 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 (**Figure 2**). 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.

Figure 1: Blood-feeding *Culicoides* midges (from Wilson, Darpel & Mellor, 2008)

Figure 2: Locations of light trapping in New Zealand

Test results

The aim of herd testing is to detect serological evidence of exposure to bluetongue, epizootic haemorrhagic disease and Akabane viruses. All blood samples sent to the Animal Health Laboratory, Wallaceville, tested negative for antibodies to bluetongue virus and epizootic haemorrhagic disease virus by the agar-gel immunodiffusion test. These samples also tested negative to Akabane virus antibodies by enzyme-linked immunosorbent assay.

Insect samples were processed by the Plant Health and Environment Laboratories of IDC&R in Auckland and Christchurch. In total 442 153 insects were screened (**Figure 2**) but no *Culicoides* spp. were found. There were 4 752 native midges (Ceratopogonidae) trapped, which suggests that the traps ought to catch *Culicoides* spp. if these are present in New Zealand. This year the traps caught significantly more native Ceratopogonidae than in any previous season, which may reflect the warmer-than-average autumn temperatures.

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Honey bee exotic pest and disease surveillance report

This report summarises surveillance activities for the year 1 July 2015 to 30 June 2016.

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, 365 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 on 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. While the number inspected met the target, it was much lower than in previous years owing to a decrease in the number of beekeeping operations supplying bees for live export. A partial explanation for this may be the record honey prices received this year, which made some 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 screen these calls and determine whether sampling is justified.

Table 1: Number of apiaries surveyed and samples taken in 2015–2016

Samples tested	Routine samples (apiaries)	Suspect samples	Results	MPI specification for routine samples
Internal parasites	365	13	All negative	350
External parasites	365	3	All negative	350
European foulbrood	365	2	All negative	350 inspections, with any suspect larvae sampled for laboratory diagnosis
Small hive beetle	365	1	All negative	350 inspections, with any suspect beetle or larvae sampled for laboratory diagnosis
Exotic bee species	365	1	All negative	350 inspections, with any suspect bees sampled for laboratory diagnosis

Sixteen calls were received that resulted in further investigation and, in some cases, sampling. These included calls in relation to suspect European foulbrood, unexplained bee deaths, unusual insects found in hives, suspect small hive beetle, suspect bee poisoning and bees with dysentery, suspect Asian bees and illegal importation of Russian beeswax. In a number of other cases, on interviewing the caller 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**).

Results

All hives inspected, sampled and tested for the listed exotic pests and bee diseases were negative.

Reports

Each year, AsureQuality Ltd, on behalf of MPI, reports on exotic surveillance activities in *Surveillance* and *The New Zealand Beekeeper* magazine. These reports are used to meet international reporting requirements with regard to New Zealand's bee health status, and for keeping New Zealand beekeepers informed about surveillance activities.

Apiary database

AsureQuality Ltd maintains an apiary database that contains information on beekeeping enterprises in New Zealand. As of 8 June 2016 there were 6 735 beekeepers managing 684 046 hives on 42 175 apiaries. New beekeepers are still entering the industry at record levels, with 1 488 new registrations in the 12 months to 8 June, resulting in a net increase of 1 184 beekeepers. About a third of beekeepers have less than two seasons of experience. 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

As in previous years, five articles were written for publication in *The New Zealand Beekeeper* magazine, on surveillance issues relating to exotic bee pests and diseases and their relevance to the NZ beekeeping industry. These articles covered Asian honey bee (*Apis cerana*), biosecurity risk pathways and general bee health. An overview article is published at the beginning of the field season, outlining the plan for the current season and drawing particular attention to changes from previous years. At the end of the field season a summary article is written to report on the results of surveillance activities.

During the 12-month period, AsureQuality Apiculture Technical Advisers (ATAs) were invited to a number of hobby clubs, beekeeping meetings and commercial beekeeper field days. ATAs take these opportunities to provide information on exotic pests and diseases of honey bees. Additionally, our trading partners are increasingly requiring greater assurance of the disease-free status of exported live bees. To help provide this assurance, ATAs train Inspecting Beekeepers (who clear apiaries for export) in the identification of apiculture pests and diseases.

Technical development

To maintain technical development of the surveillance programme, relevant national and international literature on surveillance techniques and exotic bee diseases and pests was reviewed. Additionally, the annual half-day technical meeting was held for apiculture officers as part of their training.

AsureQuality Ltd maintains a group of apicultural technical experts who are competent in bee disease recognition and control.

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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 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's role is to manage and deliver the TBfree NZ TB control and the National Animal Identification and Tracing (NAIT) programmes.

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

- to eradicate TB from wildlife over at least 2.5 million hectares of vector risk areas (VRA), 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 is 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 provide independence from OSPRI, 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 developed an amended TB NPMP proposal. Following consultation with farmers on the amended TB NPMP, it was submitted to the Minister of Agriculture for consideration. The Minister subsequently approved the amended proposal and the government's share of funding the plan was approved in the 2016 Parliamentary Budget. The other NPMP stakeholders (dairy, beef and deer farming interests) have also agreed to the plan and their funding share. The amended NPMP for bovine tuberculosis came into being on 1 July 2016.

The aims of the 2016 amended NPMP are:

1. To eradicate bovine TB from New Zealand:

- 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 will be detailed, along with any transitional arrangements, in a revised 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 will see a reduction from the $80m budgeted for TB control in 2015–2016, to an average of $60m/year for 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 wide-ranging organisation 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 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 for the 2014–2015 financial year it was 0.14 percent. The period prevalence for the 2015-2016 financial year has subsequently fallen to 0.09 percent. Provided that New Zealand holds its infected herd period prevalence at 0.2 percent or less for another year, it will meet the World Organisation for Animal Health (OIE) classification as a country that is officially free from bovine tuberculosis. New Zealand will then need to maintain it at 0.2 percent or less to retain this status.

Tuberculosis in cattle

At 30 June 2016, 39 cattle herds (0.06 percent point prevalence) were classified as infected with TB. During the preceding 12 months, of the 51

infected herds that were in a position to have their infected status revoked, 23 (45 percent) tested clear. Of the 67 446 clear-status herds, 23 (0.03 percent) were identified as infected during 2015–2016. The 12-month infected-herd period prevalence to 30 June 2016 was 0.09 percent.

During the 12 months to 30 June 2016, 3.72 million cattle (2.75 million dairy cattle and 0.97 million beef cattle) were tested with the intradermal caudal fold tuberculin (CFT) test (Prionics Lelystad tuberculin, 3 000 IU/dose). From these, 73 skin-test-positive animals were identified and slaughtered.

An additional 5 938 cattle that were considered to have been non-specific responders to the CFT test were given an ancillary serial test (standard or special antigen, gamma-interferon [Bovigam™]). There were 91 reactors (1.5 percent) to these ancillary serial tests and they were all slaughtered. Ancillary parallel testing (gamma-interferon) was undertaken on 9 905 caudal-fold-test-negative cattle from infected herds. There were 14 reactors to the parallel tests and all were slaughtered.

In total, 178 reactor cattle (five per 100 000 tested) were slaughtered, of which 43 (24 percent) either had visible lesions of tuberculosis, or *M. bovis* was cultured from samples taken from them.

A further 36 tuberculous cattle (1.4 per 100 000 slaughtered) were detected during routine meat inspection of the 2.6 million cattle sent for slaughter during the previous 12 months.

The 12-month period prevalence of tuberculosis in cattle (43 tuberculous reactors and 36 infected cattle found during routine slaughter) for the 2015–2016 financial year was 0.8 per 100 000 cattle (base cattle population = 10 million).

Prevalence of tuberculosis

The point prevalence of infected cattle and deer herds at 30 June 2016 was 0.06 percent (down from 0.14 percent last year) and the 12-month period prevalence for 2015–2016 was 0.09 percent.

Tuberculosis in wildlife

Tuberculous possums and occasionally other wildlife (pigs, deer, cats, ferrets, stoats, hedgehogs and hares) have been identified historically in 32 separate areas of New Zealand in association with persistent infection in cattle and deer herds. Areas containing wildlife maintenance hosts of TB are classified as Vector Risk Areas (VRAs). Possums (*Trichosurus vulpecula*) are considered to be the main tuberculosis maintenance host and the main wildlife vector for 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, tuberculosis 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 2015–2016 financial year, possums were controlled on 2.57 million ha of land (2.21 million ha ground control and 0.36 million ha aerial control), with a cumulative area under vector control of about 6.7 million ha (25 percent of New Zealand's land area).

At June 2016, VRAs covered about 31 percent of New Zealand's land area. During the 2015–2016 financial year, wild animal surveys were undertaken in VRAs to provide objective data to:

- support areas that are in the process of proving that the possum population is 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 the species and number of wild animals that were surveyed (or provided from Landcare Research projects) and the number that were found with TB in 2015–2016.

VFAs account for 69 percent of the total land area and in 2015–2016 contained 20 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 risk posed to VFAs are from TB-infected wild animals migrating from adjacent Vector Risk Areas (VRAs), or due to hunters unwittingly liberating TB-infected wild animals, or through the dumping of TB-infected wild animal carcasses (or infectious parts thereof) in VFAs, which then infect local scavenger species, especially feral pigs and ferrets. Surveys are also undertaken when infected herds are found in VFAs and wild animals are the suspected source of infection, or if there is concern that wild animals may have become infected from contact with infected cattle or deer. In 2015–2016, a total of 1 751 possums, 229 wild pigs, five ferrets, two cats and a stoat were surveyed from 13 sites. In the North Island, sites included Northland, Waiuku, Hauturu, Wairoa Buffer and Waitotara. In the South Island, sites included Golden Bay, the northern part of the Main Divide, Timaru Creek and Mt Cargill, near Dunedin. TB was identified in six possums and a ferret taken from Mt Cargill, and as a result the Central and Coastal Otago VRA has been extended to include the area around Mt Cargill.

Table 1: Numbers of wild animals sampled and number with TB in 2015–2016

	Possums	Wild pigs	Wild deer	Ferrets	Others
Number sampled	6 735	1 589	52	4 211	24 stoats 16 feral cats 1 weasel
Number and (percentage with TB)	22 (0.33)	18 (1.13)	4 (7.7)	23 (0.55)	0

Success of the third NPMP

The objectives of the third NPMP were set to be achieved during 2011–2026, but as of June 2016 greater progress has been made than expected. The infected herd period prevalence has been maintained at less than 0.4 percent and TB has been eradicated from 1.55 million of the proposed 2.5 million ha of VRA. Research is still under way to determine whether TB has been eradicated from

the extensive forests of the Rangitoto and Hauhungaroa Ranges (~120 000 ha) and Hokonui Hills (~11 500 ha) but results so far look promising. The objective of preventing spread of TB-infected wild animals into VFAs has largely been achieved, even though during the third NPMP TB was identified in possum populations from two previously clear areas of the Rolleston Range and at Mt Cargill.

Research summary 2015–2016

In 2015–2016, 21 of 25 funded projects were continuations of multi-year projects. The high proportion of multi-year projects reflects the need for research to rigorously investigate ecological and epidemiological processes that, by their very nature, take several years to fully understand. An example of this is how possums might shift their home ranges and re-aggregate 12–24 months after control, and interpreting how such changes might influence TB persistence and the modelling used to prove freedom from TB.

This year also saw approval of the fourth bovine TB NPMP, which sets out to achieve freedom from TB in livestock by 2026, in possums by 2040, and to eradicate TB altogether by 2055. Such ambitious objectives were only considered and agreed to by stakeholders because research has shown that this can be achieved and confirmed over large areas, and not only in accessible farmland but also in less-accessible forestlands.

In order for OSPRI to fulfil the new NPMP objectives as cost-effectively as possible, ongoing projects and new projects funded in 2016–2017 must provide the relevant outputs. Consequently, this year's request for new proposals focused on topics that OSPRI staff identified as high priority. Although most research is contracted as individual projects, each project often contributes to answering bigger questions, either from working in parallel with concurrently funded projects or by building on knowledge from previous research. The following projects will help OSPRI to conduct better vector-control operations and be more confident about making decisions to stop control and declare areas TB-free.

Post-control possum aggregation in forests and farmlands

To stop TB persisting in a possum population it is necessary to reduce the density of possums until the uninfected-possum-to-infected-possum contact rate is low enough to prevent TB from spreading. If, however, after control, surviving and immigrant possums seek each other out and re-aggregate to form local clusters that are dense enough for TB to persist, then we need to be aware of this. Such knowledge will ensure necessary follow-up control is applied, and confirm whether the computer models used to predict TB persistence are realistic. This project investigated possum distribution and movements after control in a large area of forest and farmland in the central North Island. Possum distribution was mapped using chew cards immediately before and up to three years after control. About 20 possums in each site were also collared with GPS units to monitor changes in their home ranges. One year after control, possums were clustered at both sites, with 80 percent of the forest possums occupying only 29 percent of the area. The shift of home ranges after control, the tendency of post-control possums to cluster, and the association of possums with members of the opposite sex, all suggest the likely driver of this aggregation was the search for mates. These possums also increased their home ranges, with the mean area of 2–5 ha in uncontrolled populations being increased to 90 ha for forest possums and 56 ha for farmland possums. Now that we know possums do re-aggregate after control, this information is being integrated into our population models. What is unknown at this stage is whether such re-aggregation enables TB to persist in these low-density populations.

Low-cost aerial application of 1080 baits

Aerial application of 1080 baits continues to be an important tool for cost-effective possum control over large areas of forest where ground-based control is difficult or expensive. With limited budgets, cost is a major constraint on the area over which control can be applied and there is an ongoing need to reduce aerial control costs/ This research project built on a series of previous projects that examined bait sowing rates, flight-path spacing, and compared broadcast, strip and cluster sowing. Previous research showed that sowing baits in strips 40–60 metres wide, with unbaited gaps in between, produced a similar kill rate to that obtained when baits were evenly spread to give total coverage. The wider the flight-path spacing, the less flying time is required and therefore the lower the cost. However, as the spacing increases, so does the width of unbaited areas, and it is important to know how wide these unbaited areas can be without compromising the effectiveness of control. Additionally, although helicopters with underslung buckets are the preferred method of distributing baits, a change from broadcast sowing to strip sowing provides the opportunity to using fixed-wing aircraft, which are equally effective, faster and cheaper, especially over very large areas of forest. This project determined the cost-effectiveness of fixed-wing aircraft and the effect of widening the flight-path spacing. In the experimental area, which was unforested scrubland with low-to-medium possum densities, pre-fed strip-sowing of bait at 0.4 kg/ha (with 125 m flight-path spacing) and 0.29 kg/ha (with 175 m flight-path spacing) killed 100 percent of radio-collared possums that had been released to monitor the kill rate. So in this habitat type, a combination of low bait sowing rates and wide flight-path spacing still yielded very high kill rates. The fixed-wing aircraft sowing speed (hectares per hour flown) was 2.0–2.2 times higher than for the helicopter,

largely because the aeroplane flew twice as fast. Thanks to this project, fixed-wing aircraft can now be considered as an alternative to helicopters, especially in areas of more than 20 000 hectares and where suitable airstrips are available. However, before fixed-wing aircraft can be used this way, operators will need to modify them to apply baits at the required low sowing rates.

Detection of TB in possums by possums

When a Vector Control Zone has had several years of possum control and it is believed that the area might have become TB-free, it becomes necessary to decide whether or not to stop applying control. Getting this decision right is critical, because it has significant implications for cost and for successful TB eradication. To help OSPRI staff make these decisions a proof-of-freedom tool has been developed, which combines a prior probability that an area is TB-free with information from possum and sentinel surveys. The required prior probability is generated using the Spatial Possum-TB Model (SPM), with data on the area's possum control history. A key parameter in the SPM is the TB transmission rate (the probability that an uninfected possum will get infected by an infected possum). Because it is difficult to measure the transmission rate in the field, the probability value currently used in the model is generated theoretically to produce a pre-determined TB prevalence. This project was the first attempt to directly measure the transmission probability. It was conducted in the Orongorongo Valley, near Wellington, where TB has been found in possums since the 1990s. This is one of the few areas where TB-infected possums have not been controlled, making it ideal for this project. First the researchers artificially infected a sample of possums with a strain of TB that was different from the local strain, so newly infected animals could be identified. In the main trial, one experimental grid had 80 possums, each of whose home range overlapped with that of at least one experimentally infected possum, while the other grid had 142. The distinctive TB strain was found in three of the possums with overlapping home ranges, yielding transmission rate estimates ranging from 0.0 to 0.013. Although the trial was a success, the results showed a wide variation in transmission rates, so before the empirical estimates can be used in the SPM, further field trials and analyses are needed to determine the cause of the variation observed.

Do native birds benefit from aerial 1080 operations?

Cost-effective reduction of possum numbers over large areas of forest relies on the aerial application of 1080 baits. There is ongoing public concern as to whether these operations benefit New Zealand's native birds, so OSPRI co-funded an extensive Department of Conservation monitoring programme that assessed the impact of repeated aerial 1080 use on native birds in extensive areas of forest in the Tararua Ranges, South Westland and the Marlborough Sounds. Birds have now been counted using digital audio recorders or 5-minute bird counts at five sites where there have been 12 aerial 1080 operations since 2010. Preliminary analysis of these counts indicates a positive response to 1080 for most forest birds, and no obvious long-term negative effects. The nesting success and survival of morepork, kaka, robin, rifleman, rock wren and weka were also monitored. Morepork robin, rifleman and rock wren nesting success increasing dramatically after the 1080 operations. No mortality was detected among robins, morepork, kaka and rifleman. Some rock wren died immediately after one 1080 operation but overall there was a net benefit for all these species. Weka were not killed by 1080 in any of the operations, nor was their nesting success affected, and their survival the following year was much higher in the 1080-treated area than at a nearby untreated area. Kaka nesting success has not been analysed yet because the birds studied nested late this year. Overall, these results support previous studies that show native birds benefit from possum, rat and stoat control.

Whole-genome-sequencing for improved identification of the source of TB

When herds become infected with TB, OSPRI's Area Disease Managers (ADMs) examine evidence of livestock movement, herd infection history, distance of herds from known wildlife infection, and the *M. bovis* strain type. This helps them determine whether the infection is wildlife-related, in-herd, or from livestock movement. A key part of this decision process is knowing the strain type of the infection, and this has historically been done using restriction enzyme analysis (REA). Although REA strain-typing has been very helpful in identifying potential sources of infection, it is technically very difficult to perform. For this reason, variable number tandem repeats (VNTR) strain typing was introduced in 2012. This is simpler but less discriminatory than REA. However, the advent of whole-genome sequencing (WGS) of *M. bovis* provides a means of getting the highest level of discrimination, as well as measuring the rate at which TB bacteria mutate. A project built around WGS for *M. bovis* isolates has provided a database of about 400 types from throughout New Zealand and has helped ADMs determine the possible sources of TB in newly infected herds. WGS will also help clarify the source and appropriate management options for areas such as Mt Cargill, where *M. bovis* was recently found in possums and a ferret in a VFA.

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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 160oC 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 $14 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 $14 for each apiary registered on 31 March, the date the levy is assessed.

Hive inspection and audit programme to 31 May 2016

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 2015 and 31 May 2016, 1 704 cases of AFB were found by beekeepers (0.25 percent of hives) and/or AsureQuality staff in 1 017 apiaries (2.41 percent). Corresponding AFB infection rates for 2014–2015 were 1 210 hives (0.21 percent) and 666 apiaries (1.93 percent).

As of 31 May 2016 there were 3 404 beekeepers with DECAs and a Certificate of Inspection Exemption (51 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 355 new DECAs were approved.

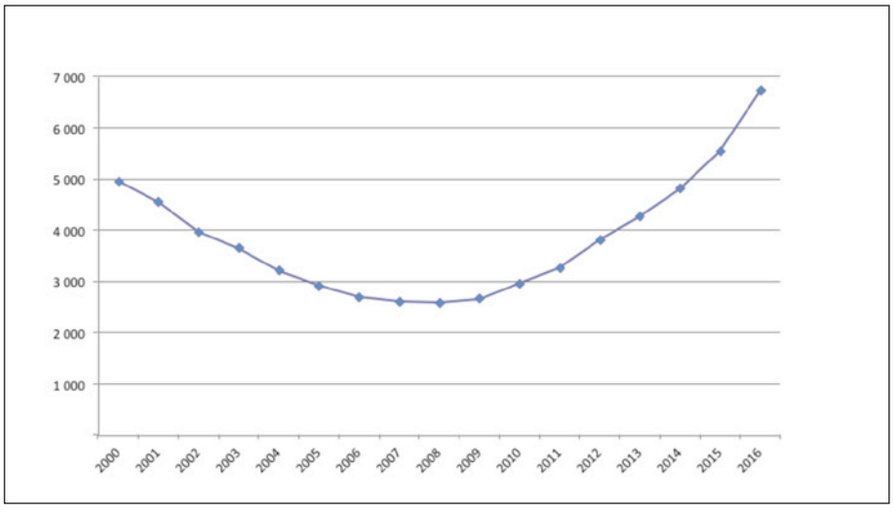

Figure 1: Numbers of beekeepers, 2000–2016

Apiary register and statistics

There were 3 331 beekeepers who owned 52 349 hives on 6 016 apiaries that required a Certificate of Inspection as of 8 June 2016. This means they have to engage the services of an approved beekeeper to inspect and report on the AFB status of their hives. The number of beekeepers in this category is up 40 percent from last year – much higher than the 21 percent increase in beekeeper numbers. The significant increase in new beekeeper registrations has resulted in the numbers of beekeepers holding a DECA falling from around 60 percent to 51 percent in recent years (**Figure 1**).

There were 6 735 beekeepers owning 684 046 hives on 42 175 apiaries as of 31 May 2016, compared to 5 551 beekeepers, 34 476 apiaries and 575 872 hives at the same time last year. Over the last few years the industry has continued to grow, with a net increase in beekeeper numbers of 21 percent in the last year, and this has long surpassed the pre-varroa figure of 4 956 beekeepers. This increase represents increased numbers of both commercial and hobbyist beekeepers, but has resulted in the average number of hives per apiary remaining unchanged. Hive numbers increased by 19 percent over last year.

The main increases were again in the North Island, where 77 percent of

Continued on page 38

Annual reports from industry surveillance and disease control programmes

Brucella ovis accreditation scheme 2015

Numbers of animals tested in 2015 were slightly down compared to 2014 (**Table 1**). The overall infection rate (reactors / samples tested) was 2.3 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 2015.

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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Table 1: *Brucella ovis* testing and eradication, 2015

Area	Flocks with reactors *	Flocks with eradication in progress or completed
Far North & Auckland	8	2
Waikato, Waitomo & BOP	3	1
Taranaki & Wanganui	9	2
East Coast	5	2
Hawke's Bay	5	1
Manawatu & Rangitikei	3	0
Wairarapa & Wellington	1	1
Marlborough & Canterbury	2	1
Otago & Southland	9	5

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

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 2015, the two private poultry laboratories screened a total of 11 054 blood samples collected under the whole-flock testing programme. Samples were screened using the IDEXX FlockChek ELISA.

There were 101 reactors from 43 flocks and

- 24 reactors from 17 flocks re-tested negative;
- 23 reactors from 18 flocks were not re-tested (as they had already been sent for processing);
- samples from 20 reactors in three flocks were sent for VNT at Wallaceville and tested negative; and
- 34 reactors from five re-bled flocks were sent for VNT at Wallaceville and tested negative.

These investigations, which included blood sampling, serology, collection of bursa for histology and PCR testing all led to the conclusion that IBD was 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

the new beekeepers were registered. 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. This is the highest net increase in beekeeper numbers since 2008 when the downward trend began to reverse.

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Poultry health surveillance

The tables presented here summarise results of health testing in the poultry industry during 2015. **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 – 2015

Disease	Number tested	Number positive	Vaccination status*
Newcastle disease	2 081	0	
Egg drop syndrome	1 173	47	(V)
Chicken anaemia	1 022	1 374	V
Avian encephalomyelitis	2 145	1 341	V
Infectious bronchitis	3 613	3 209	V
Reovirus	620	530	
Infectious laryngotracheitis	647	422	(V)
Mycoplasma gallicepticum	11 529	15	
Mycoplasma synoviae	9 100	52	
Mycoplasma meleagridis	0	0	
Salmonella Pullorum	4 584	2†	
Infectious bursal disease	11 054	101§	
Avian influenza	2 680	0	

*V = All vaccinated; (V) = Some vaccinated
§See IBD report, page 38, for explanation
† Resolved as negative

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

Salmonella isolates	Finished and feed sources	Broiler samples *
Agona	0	10
Anatum	1	0
Riru	2	0
Havana	0	0
Infantis	6	10
Mbandaka	0	1
Senftenberg	1	1
Tennessee	0	0
Typhimurium	12	4
Bovisorbificans	0	85
Livingstone	0	4
Group B	0	2
Group C	0	8
Group E	0	1
Salmonella spp.	0	8
Fresno	3	0
Typhimurium PT 1	1	0
Typhimurium PT56	3	4
Typhimurium PT 193	1	0
Total positive / total tested	**30 / 3 578**	**135 / 3 831**

* Samples include environmental swabs and whole carcass rinse birds

Quarterly review of diagnostic cases

New Zealand Veterinary Pathology

Bovine

A group of yearling beef cattle in the Waipa district had evidence of severe diarrhoea, depression and weight loss. GGT levels in four were markedly elevated (968–2 528 IU/L; reference range 0–36). Serum zinc levels were 12–21 µmol/L, with most below 20. It is recommended that supplementation should cause serum zinc levels to rise to 20–35 µmol/L in order to mitigate the effects of sporodesmin exposure, so supplementation may have been insufficient in this case. Three of the four animals also had *Theileria* spp. organisms visible on blood smear. **Sporodesmin toxicity** was diagnosed. The role of ***Theileria*** in this syndrome was not determined, as further haematology was not performed.

Three yearling cattle in the Matamata-Piako district were not doing well, but had no major clinical signs. Two of them had ***Theileria*** spp. organisms visible on blood smear. Biochemistry testing on two animals revealed markedly elevated GGT levels (1 929 and 3 294 IU/L; reference range 0–36), consistent with **sporodesmin toxicity**.

A small group of yearling cattle in the Matamata-Piako district had clinical evidence of anaemia. Blood smears revealed the presence of numerous ***Theileria*** spp. organisms, coupled with severe anaemia (haematocrits 0.08–0.09 in three animals; reference range 0.24–0.40). **Clinical theileriosis** was diagnosed.

A group of yearling cattle in the Matamata-Piako district had diarrhoea and wasting. Culture for ***Yersinia*** was positive on one animal and another had moderate anaemia (haematocrit 0.20; normal range 0.24–0.40) with ***Theileria*** spp. organisms visible on blood smear. GGT levels in two of three animals tested were moderately elevated (244 and 339 IU/L; reference range 0–36). **Yersiniosis complicated by *Theileria* and sporodesmin toxicity** was diagnosed.

A group of autumn-born calves less than three weeks old in Palmerston North exhibited scours. Samples from four animals all tested positive to a rotavirus antigen ELISA. Testing for coronavirus and cryptosporidia, and cultures for *Salmonella,* were all negative. **Rotaviral enteritis** was diagnosed.

A group of 25 six-month-old calves from Marlborough had a history of sudden weight loss, scouring and cough. A faecal egg count revealed a high count of 1 250 eggs per gram. Further testing for coccidia and culture for *Salmonella* revealed no evidence of any other agents. **Enteric parasitism** was diagnosed**.**

Twelve dairy calves in the Waipa district had scours and three of them died. Faeces from two animals both tested positive for **rotavirus** and low numbers of **cryptosporidia** were also present. Culture of faeces revealed the presence of ***Salmonella* Zanzibar**. **Rotaviral diarrhoea complicated by salmonellosis** was diagnosed.

A group of dairy cows in the Waitaki district showed evidence of photosensitivity after being fed swedes (*Brassica napus*). Three of the animals tested had elevated GGT levels (195–547 IU/L; reference range 0– 6), and GDH (219–>600 IU/L; reference range 8–41). **Glucosinolate toxicity** was diagnosed.

Four out of a group of 91 beef steers in Central Hawke's Bay had severe depression and dehydration. One had neurological signs and died during examination. The animals had a history of access to acorns 14 days prior. Biochemistry on one of the affected animals revealed a severe **azotaemia** (urea 96.3 mmol/L; reference range 2.7–12.3) and creatinine of 2 870 µmol/L (reference range 55–130), consistent with **acute renal failure caused by acorn intoxication.**

A group of dairy cows in the Hauraki district had decreased production and weight loss, and one animal had **haematuria**. The herd was being supplemented with zinc to prevent facial eczema, but testing showed that serum zinc levels ranged up to 320 µmol/L, much higher than the ideal levels (20–35 µmol/L) to prevent facial eczema. **Zinc toxicity** was diagnosed.

A recently calved cow on a dairy property in the Waipa district had marked bloody diarrhoea with dehydration and a drop in production. Culture of the faeces revealed ***Salmonella* Typhimurium.**

Forty out of a group of 7 000 weaner deer in the Taupo district died acutely, with evidence of enteritis. Histopathology revealed a multifocal suppurative enteritis with intralesional bacterial colonies. Faecal culture from three samples confirmed the presence of ***Yersinia pseudotuberculosis*** and resulted in a diagnosis of **yersiniosis.**

Five cows from a dairy property in the Matamata-Piako district aborted late in gestation. Samples from one calf were submitted for histology and culture. Histology revealed the presence of fibrin thrombi in the cerebral blood vessels, consistent with infection. Fungal culture of stomach contents was positive for ***Mortierella wolfii***. **Mycotic abortion caused by *Mortierella*** was diagnosed.

A yearling dairy heifer in the South Waikato district had acute diarrhoea. BVD antigen ELISA testing was negative, and cultures for *Salmonella* and *Yersinia* were also negative. Histology revealed marked congestion of the mucosa of the ileum and jejunum, with prominent intranuclear inclusions present in the vascular endothelium of the intestine, kidney, abomasum and rumen, consistent with **bovine adenovirus infection**.

A dairy property in the Whakatane district experienced abortions among mature dairy cows. A fetus and placenta were submitted for necropsy and histologic examination. Grossly, the placenta had thickened cup-shaped cotyledons and moderate thickening of the intercotyledonary placenta. Histology revealed a marked necrosuppurative placentitis with numerous intralesional fungal hyphae. **Mycotic abortion** was diagnosed.

A group of calves in the Western Bay of Plenty district had severe scour and were rapidly losing condition. Many were febrile, with temperatures of 39–39.7°C. Five faecal samples were submitted for culture, and ***Yersinia pseudotuberculosis*** was isolated from three. **Yersinosis** was diagnosed.

Two 2-year-old heifers transported to the Franklin district from the South Island were scouring and appeared pale. One animal died. Biochemistry testing revealed marked azotemia (creatinine 2 347 µmol/L; reference range 55–130) and elevated urea (72.4 mmol/L; reference range 2.7–12.3). There was marked anaemia, with a haematocrit of 0.13 (reference range 0.24–0.40). **Acute renal failure** secondary to haemolysis and haemoglobinuric nephrosis was suspected. The serum zinc level in one of the animals was 160.0 µmol/L (reference range 11–20), so the cause of the haemolysis was identified as **zinc toxicity**. The heifers had recently been administered zinc capsules to control facial eczema.

Ovine

Six ewes from a mob in Gisborne died after mustering for shearing. Necropsy showed evidence of an inflamed gut and liquid abomasal contents. Histology samples were too autolysed for accurate interpretation, but ***Salmonella*** **Typhimurium** was isolated from intestinal contents and **salmonellosis** was diagnosed.

Three six-month-old ewe lambs from a property in the Tararua district died suddenly. They had high fevers (41.5°C) and a watery, green scour. The intestinal tract appeared inflamed on gross necropsy. ***Salmonella*** **Hindmarsh** was isolated from gut contents and **salmonellosis** was diagnosed.

A mob of sheep in the Tasman district had increased mortalities, with very pale dead ewes and lambs, and pale mucous membranes in the living animals. Faecal egg counts revealed up to 11 000 strongyle eggs per gram of faeces. Larval culture showed that 75 percent of these strongyles were ***Haemonchus*** sp., and **haemonchosis** was diagnosed.

Equine

A foal less than four weeks of age was found dead in Invercargill, after being observed to be well 24 hours previously. Postmortem revealed fluid colonic contents. and faecal culture was positive for ***Salmonella*** **Typhimurium**. Acute **salmonellosis** was diagnosed.

A yearling Thoroughbred in Papakura had a five-day history of inappetance and lethargy. Blood work by the submitting veterinarian revealed severe **hypoalbuminemia** and a mild **azotemia**. Ultrasound examination revealed a thickened gut wall. PCR testing was negative for *Lawsonia*. The hypoalbuminemia persisted and the animal developed worsening oedema and diarrhoea, and was eventually euthanased. Histologic examination of the colon revealed a marked suppurative mucosal colitis with numerous intralesional larval cyathostomes visible. **Larval cyathostomiaisis** was diagnosed.

Porcine

A smallholder in the Franklin district bought a litter of 10 piglets. Four died at the age of two months. Necropsy was suggestive of lungworm, with possible worms visible in the trachea. Parasitological examination for lungworm larvae was negative, but large numbers of coccidial oocysts were seen, suggesting that ***Isospora suis*** may have had a role in the deaths observed.

Feline

A one-year-old cat from the Marlborough region had severe diarrhoea. Faecal egg counts were negative, but a ***Giardia*** antigen ELISA test was positive. **Giardiasis** was diagnosed.

A four-month-old kitten in the Horowhenua district had persistent diarrhoea. A faecal egg count revealed the presence of 400 ascarid eggs per gram. *Giardia* antigen ELISA was also positive. **Giardiasis complicated by ascarid infection** was diagnosed.

A 17-week-old kitten from Upper Hutt had diarrhoea for 4–6 weeks. A faecal egg count revealed 4 650 ascarid eggs/gram of faeces, suggesting a **heavy ascarid load**. Antigen testing for giardia and cryptosporidia, and faecal cultures for *Salmonella* and *Campylobacter*, were all negative.

A breeding cattery in the Waikato region had multiple deaths in litters of kittens. A dead kitten submitted for necropsy was emaciated and had evidence of a fibrinous peritonitis with multifocal hepatic necrosis. Histology revealed the presence of a marked multifocal necrotising hepatitis with numerous fibrin thrombi and a leukocytoclastic vasculitis. Vasculitis and fibrin thrombi with associated necrosis were also visible in the spleen and brain. There was little evidence of an enteritis. **Septicaemia** with disseminated intravascular coagulation was diagnosed. Culture of filtering organs (kidney, lung) revealed the presence of ***Salmonella*** **Enteritidis** and **septicaemic salmonellosis** was diagnosed.

Canine

An unvaccinated two-month-old puppy from Hamilton had severe nasal discharge with sneezing, but no evidence of fever, anorexia or depression. Serum was submitted for testing to rule out canine distemper virus. Virus neutralisation testing for canine distemper was negative, meaning infection was unlikely. The negative titre also suggested that this puppy did not have significant maternal antibody to the disease.

A one-year-old dog in Timaru presented with inappetence and diarrhoea. Chemistry and haematology were submitted by the veterinarian. Haematology showed high numbers of nucleated red blood cells and basophilic stippling of red blood cells. Blood lead levels on this dog were > 0.7 mg/L and **lead toxicity** was diagnosed. The owners of this dog had been renovating an old house and stripping old paint, which was a potential source of exposure.

After her dog was diagnosed, the owner sought testing for herself and was also found to have elevated blood lead. Blood lead levels greater than 0.2 mg/L are considered evidence of abnormal exposure, but recent reports suggest that lead may have significant clinical effects on humans at levels as low as 0.05 mg/L (WHO, 2015).

Lagomorph

The owner of a number of backyard rabbits in the Western Bay of Plenty district had four deaths – two adults and two younger rabbits, with few warning clinical signs. A carcass was submitted for necropsy. Histology revealed the presence of multifocal hepatic necrosis with hepatocellular dissociation and microvascular thrombosis within the kidney, consistent with **rabbit haemorrhagic disease.**

Amphibian

An Archey's frog (*Leiopelma archeyi*) held in a facility in Auckland died with few warning signs. The frog was in poor body condition, and there was fracture of bones and cartilage adjacent to the kidney, associated with moderate infiltrates of granulomatous inflammation. Acid-fast stains of the granulomatous inflammation demonstrated the presence of intracellular mycobacteria. **Mycobacteriosis** was diagnosed.

Avian

A Zebra finch (*Taeniopygia guttata*) held in a facility in Auckland suffered from weight loss and depression. Necropsy and histology revealed a marked granulomatous enteritis. Numerous acid-fast bacteria were present within the inflammation associated with the intestine, and also in the liver. **Mycobacteriosis** was diagnosed.

A sun conure (*Aratinga solstitialis*) from a small group in Wellington died. A pooled faecal sample was submitted from the group for parasitology, which revealed a very high egg count of 9 216 ***Capillaria*** nematode eggs per gram. Faecal cultures for *Salmonella* were negative. **Capillariasis** was diagnosed.

Four 18-month-old chickens on a smallholding in Auckland were affected by gastrointestinal stasis and poor appetite, and died. The blood lead level in the last one to die was 0.24 mg/L (abnormal exposure level > 0.2), indicating **lead poisoning**. Elevated blood lead levels in birds producing eggs for human consumption are of concern because of the possibility of human exposure (WHO, 2015).

Zoo animal

An 11-year-old cheetah in a facility in the Auckland region had severe tongue ulceration. Histology on a biopsy specimen showed a nonspecific subacute ulcerative glossitis. PCR on a swab taken from the oronasal mucosa was positive for **feline calicivirus** infection, suggesting that this was the underlying cause of the **oral ulceration**.

A red-necked or Bennett's wallaby (*Macropus rufogriseus*) from a facility in Auckland died and on necropsy had evidence of an abcessed mesenteric lymph node. Histologically there was a large, regionally extensive area of necrosis in the mesenteric lymph node. The heart had regions of myocardial necrosis and mineralisation, and the skeletal muscle also had evidence of necrosis, with myocyte degeneration and mineralisation. Foci of non-suppurative inflammation were also noted in the adrenal gland, the wall of the intestine, and in retroperitoneal adipose tissue. Lesions were considered suggestive of **toxoplasmosis**.

Gribbles Veterinary Pathology

Bovine

Two Red Devon calves from northern Waikato were examined because of ataxia, blindness and recumbency from birth. One died and the other was euthanased for postmortem and sample collection. No gross abnormalities were identified apart from subtle internal hydrocephalus. Histopathology of the brain revealed multifocal neuropil vacuolation and spheroids (swollen axons) confined to nuclei and discrete areas of the hindbrain, midbrain, hippocampus and piriform lobe. Neither dam had been vaccinated against bovine viral diarrhoea virus (BVDv), but pooled sera from the calf that had been sent for histopathology, its dam and sire, another cow calving at the same time, and a group of neonatal calves, had a BVD antibody sample-to-positive ratio of 1.82 (> 0.75 indicates exposure to BVDv). The calf and sire were negative for BVD antigen, and a pooled serum sample was negative for BVD by PCR. It was considered likely that this was a congenital **bovine viral diarrhoea virus encephalopathy**. Other neurological syndromes associated with BVD include dysmyelination and cerebellar hypoplasia.

Three dairy calves aged 3–6 weeks from the Coromandel area developed severe diarrhoea, dysentery and dehydration, and subsequently died. A culture of a pooled faecal culture isolated ***Salmonella* Bovismorbificans**, consistent with **salmonellosis**.

Eight cows from a north Waikato dairy herd aborted over several days. ***Neospora caninum*** IFAT titres in five of them were all greater than or equal to 1:600, indicating that these were probably ***Neospora* abortions**. GGT levels were also increased in four animals (85–2 983 IU/L; reference range 3–47), consistent with concomitant liver damage caused by **facial eczema**.

A five-month-old beef heifer from Northland was sick for two days and then died. At postmortem, cardiac enlargement was suspected. Histopathology of the heart revealed large areas of necrosis, haemorrhage and neutrophilic inflammation, along with spore-forming Gram-positive bacilli, consistent with a diagnosis of **cardiac blackleg** caused by ***Clostridium chauvoei***. Any striated muscle can contain lesions of blackleg, including the heart, tongue and diaphragm.

Fungal abortion was diagnosed in five separate dairy herds from northern Waikato. Feti and placentae submitted for investigation generally had regions of opaque brown, grey or red intercotyledonary membranes and reddish-brown cotyledons. Histopathology revealed necrotising and haemorrhagic placentitis with fungal hyphae. One fetal postmortem submission did not include placenta, but histopathological examination of the brain revealed **encephalitis with thrombosis and fungal hyphae**. ***Aspergillus fumigatus*** was cultured from the stomach contents of one fetus.

Neospora **abortion** was diagnosed in an aborted Friesian fetus from the Bay of Plenty, based on the histopathological presence of multifocal necrotising encephalitis, placentitis, myocarditis, myositis and hepatic necrosis.

A Mid-Canterbury farm lost 14 nine-month-old calves from a mob of 66 over a period of about two weeks. The calves were in a crop of fodder beet, were anorexic, and some had diarrhoea. Ruminal acidosis was suspected but did not quite fit and some calves had tarry faeces. Postmortem on one calf revealed ascites and pale kidneys with perirenal oedema. Histologically the kidneys had lesions typical of **acorn toxicity**. A re-examination of the history revealed that the calves had been among oak trees a week before going on to the fodder beet and there had been a large crop of acorns on the ground. As is often the case with acorn poisoning, the animals were no longer feeding on acorns by the time they became sick.

In another case, more than 20 calves died from **acorn toxicity** on an Otago dairy farm. They were from a mob of 180 on a dairy grazing block. Two weeks earlier they had been taken out of a paddock that had little available pasture but many oak trees with large numbers of acorns on the ground. Histopathology of the kidneys of one dead calf revealed severe nephrosis, typical of acorn poisoning.

A few cattle **abortions** or **dystocias** caused by ***Salmonella*** **Brandenburg** have been diagnosed in Mid-Canterbury this season and on at least one farm the problem has been in late-gestation heifers that require help when calving. The heifers are not sick and come in to milk. These cases are a hazard to the farmer or veterinarian calving them.

In late May, 11 cows out of a mob of 130 **aborted** over a four-day period on a North Otago dairy farm. ***Salmonella*** **Brandenburg** was isolated from the placenta and stomach contents on the one aborted calf necropsied.

On a Southland dairy farm, 11 of 40 calves were found dead shortly after being placed on a new grass paddock. Tests of aqueous humour from a dead calf and the ingested grass both revealed increased concentrations of nitrate, confirming **acute nitrate toxicity**.

Fifty cows died from **ruminal acidosis** on a Southland dairy farm after they broke through an electric fence into a paddock of fodder beet and gorged themselves. They had been fed restricted amounts of the crop for the previous 10 days.

A **mucosal disease** outbreak in a mob of 150 calves on an Otago dairy farm killed 14 of them. The affected calves died 3–5 days after being noticed with diarrhoea and ill-thrift. The remaining calves were bled and tested for bovine **viral diarrhoea virus**, and five persistently infected calves were identified.

Sporidesmin intoxication from ingesting spores of the pasture fungus ***Pithomyces chartarum*** caused many cases of liver and biliary disease in many areas. Autumn spore counts in the Stratford area peaked at 800 000 per gram of pasture, and concentrations over a million were counted in the Gisborne district. GGT provides a convenient way to assess the extent of bile duct damage from sporidesmin toxicity. As a guide, animals with GGT of 100–300 IU/L are considered mildly affected by sporidesmin; 300–800 moderately affected and > 800 severely affected. In one case from the Rangitikei district, a seven-year-old Friesian-Jersey cross cow had decreased milk production and jaundiced mucous membranes. Other cows in the same herd had evidence of photosensitivity, with crusting lesions of the non-pigmented skin on the udder. Serum samples were taken from the worst-affected cow. GGT concentration was 4 014 IU/L (reference range 3–47), GLDH 2 077 IU/L (reference range 5–35) and bilirubin 78 μmol/L (reference range 0–8), confirming **severe liver disease and cholestasis from sporidesmin toxicity**. In another case, a group of one-year-old Friesian bulls in Hawke's Bay were losing weight and sporidesmin toxicity was suspected. Serum GGT concentrations ranged from 1 167–3 356 IU/L (mean 2 536) in a group of six animals sampled.

A mob of 1 200 dairy cows in the Rangitikei district were being break-fed a fodder beet crop in the early afternoon before returning to a bare paddock for the night and being fed each morning on straw mixed with urea and lucerne silage. Four cows were found recumbent and one was dead at the morning inspection. Blood samples from these four revealed serum phosphorus concentrations of 0.66, 0.75, 0.93 and 1.1 mmol/L (reference range 1.3–3.3), confirming that **hypophosphataemia** was contributing to recumbency. In addition, two of the cows had reduced bicarbonate concentrations, at 14 and 16 mmol/L (reference range 19–29), indicating that **acidosis** was also a problem. These issues were most likely related to the quality and quantity of the ration.

Two of 70 ten-month-old Friesian heifers were found dead on a Bay of Plenty dairy run-off. No signs of illness had been seen before death. The rest of them were considered well grown and had received an oral combination drench and vitamin B12 and selenium injection three weeks previously. The most significant findings at autopsy were a reddened friable distal small intestinal mucosa and watery haemorrhagic intestinal

contents. Histology revealed congestion, haemorrhage and oedema of the small intestinal mucosa, with distinctive basophilic intranuclear inclusion bodies in vascular endothelial cells. Inclusion bodies were also detected in the kidney, along with mild interstitial nephritis. No *Yersinia* or *Salmonella* spp. were isolated from the intestinal contents. These findings were consistent with **bovine adenoviral enteritis.** While bovine adenoviruses are widespread in the nasal secretions, faeces and urine of sub-clinical cattle, bovine adenovirus type 10 in particular has been isolated from outbreaks of fatal haemorrhagic enteritis in young cattle (Adair *et al.* 1996; Vaatstra *et al.,* 2016).

About 20 animals in a mob of 100 rising-one-year-old Friesian heifers became unwell on a Hawke's Bay dairy farm. Reported clinical signs included loss of condition, diarrhoea and anaemia. Feed quality, quantity and parasite control were considered adequate. The heifers had been receiving supplementary zinc to prevent facial eczema. Previous testing in the herd indicated negligible exposure to BVD (SP ratio 0.08). Faecal cultures from 10 affected heifers produced scant to moderate growths of ***Campylobacter jejuni*** (seven animals) and ***Campylobacter fetus fetus*** (three) but were negative for *Salmonella* and *Yersinia* spp. Faecal egg counts ranged from 0 to 50 eggs per gram and coccidial oocysts were present in low numbers in three of the 10 heifers. Blood test results showed decreased levels of albumin (20–22 g/L; reference range 27–29) and creatinine (32–34 µmol/L; reference range 39–181). Serum zinc concentrations in three heifers were 46, 48 and 49 µmol/L (adequate 12–18.5; toxic 27–92). Some of the heifers showed a partial clinical improvement after treatment with 20 mg/kg oxytetracycline dihydrate (Bivatop 200, Boehringer Ingelheim (NZ) Ltd). Others failed to thrive and one was euthanased. Postmortem revealed gelatinous fluid expanding the mesentery around the duodenum, and a firm, thickened, irregular pancreas. Histology confirmed the gross impression of pancreatic exocrine pancreatic degeneration with fibrosis, ductular hyperplasia and nodular regeneration. The combination of elevated serum zinc and pancreatic pathology confirmed a diagnosis of **zinc toxicity.** It was hypothesised that maldigestion allowed bacterial overgrowth in the intestine, which could explain the partial response to antibiotic treatment.

Ovine

A Romney cross lamb from Northland developed diarrhoea and died. At postmortem about a quarter of the lung volume was firmly consolidated. A prior faecal egg count was 8 800 eggs per gram. Histopathology of lung and gastrointestinal tract revealed chronic-active suppurative bronchopneumonia, abomasitis with mucous metaplasia and duodenitis with severe villous atrophy and many nematode parasites, consistent with concomitant **enzootic pneumonia and nematode parasitism**. ***Haemonchus*** and ***Trichostrongylus*** were isolated on culture.

In the Christchurch area, two adult sheep in a group of four became unwell and one died. Clinically the one live sheep was pale and very weak and she was euthanased. Large numbers of ***Haemonchus*** nematodes were seen at postmortem and this sheep also had gross lesions of **Johne's disease**. Faecal egg counts on three of the sheep were 3 700, 3 500 and 22 100 eggs per gram. While *Haemonchus* larvae are detected in faecal samples from sheep in Canterbury during larval culture, their numbers are usually small and clinical haemonchosis in sheep is rarely diagnosed in the laboratory (although it might be more common in the field). This is in contrast to *Haemonchus* infestation in alpacas, which is detected quite frequently in the laboratory.

Fourteen hoggets from a mob of 95 on an Otago farm died over 10-day period. One live affected hogget had clinical signs of weakness and depression, along with watery, brown diarrhoea. It was euthanased and postmortemed. The kidneys were pale and enlarged and surrounded by oedema, and severe nephrosis was found on histopathological examination. **Acorn toxicity** was suggested from these findings and the farmer confirmed that two weeks earlier the mob had been grazing a paddock containing oak trees.

Acorn toxicity also killed 25 of a mob of 350 ewes on an organic farm in Central Otago. The affected ewes died over a five-day period. They had grazed under an oak tree that had produced a massive crop of acorns a week earlier. Affected ewes were depressed and passed faeces covered with clotted blood. Fragments of acorns were found in the rumen of one ewe that was necropsied, and nephrosis was confirmed by histopathological examination of a kidney from this ewe.

Seven hoggets were found dead on a Southland sheep farm after grazing a frosted crop of rape. Postmortem of one dead hogget revealed brown blood, and nitrate was detected in the eye fluid, confirming **nitrate toxicity.**

Six recently purchased Merino rams were found to have lice 24 hours prior to mating. They were treated in a bath containing an organophosphate and left to dry out overnight. They were then put out with the ewes for the first cycle. For the second cycle the Merinos were replaced with Black-faced rams. All the ewes subsequently produced lambs by the Black-faced rams, suggesting that the Merinos were either **transiently infertile** or lacked libido. This could have been an effect of the lice treatment. Months later, these six rams were semen-sampled by electro-ejaculation and the semen examined. In four of the rams the semen appeared normal but two had low sperm counts and the more severely affected ram also had abnormal sperm.

Nine rams were grazing a small paddock containing minimal pasture near a house on a Gisborne property.

Four died overnight and the others developed neurological signs. The signs included quivering and trembling when approached, progressing to ataxic with a hypermetric gait, sternal then lateral recumbency, and finally paddling and dying. Post-mortem examination of one animal revealed 10–20 **horse chestnut (*Aesculus hippocastanum*)** fruits within the rumen. All the rams eventually died. Histological examination of the brain and tissues did not find any lesions. Based on the history, clinical signs and a lack of lesions, a diagnosis of **horse chestnut toxicity** was made. Alkaloids and the saponic glycoside aesculin present in horse chestnut fruit can induce excess salivation, abdominal pain and diarrhoea. If sufficient fruit are ingested, trembling, staggering and dyspnoea can develop, leading to collapse, paralysis, coma and death.

Sporidesmin toxicity inducing the disease **facial eczema** was a problem in sheep in the autumn. A hundred clinically affected sheep were noted in a mob of 900 hoggets from the Taihape area. GGT concentrations ranged from 298 to 1488 IU/L (reference range 32–70) in a sample of 20 of the worst-affected.

Outbreaks of **listeriosis** were diagnosed on two Manawatu sheep farms during April. In both cases affected sheep were on pasture only. On one farm 12 seven-month-old Romney lambs died over several days. One lamb was observed prior to death with neurological clinical signs and very poor body condition. On the other farm five 18-month-old crossbred ewes died over a week. Two ewes were observed with fine facial tremors and strabismus. The brain of one affected sheep from each farm was processed and examined by light microscopy. Each showed typical inflammatory lesions in the brainstem, characterised by neutrophilic microabscesses, rarefaction and perivascular lymphoplasmacytic cuffing.

Six-month-old Romney lambs in a mob of 400 on a Wairarapa farm started dying a day after being introduced from pasture to a rape crop. Affected lambs developed diarrhoea and lost condition prior to death. In total, 25 lambs died. The mob had been drenched 2–3 weeks prior to the onset of deaths. Autopsy of one lamb revealed watery intestinal contents, which cultured a moderate growth of ***Campylobacter jejuni*** but were negative for *Salmonella* spp. Histological sections of the intestine revealed marked villus blunting associated with numerous nematode sections compatible with ***Trichostrongylus*** sp. The abomasum had a hyperplastic mucosa with loss of parietal cells and increased mucus neck cells. Drench checking and/or faecal egg count reduction testing was recommended on the basis of severe **enteric parasitism** despite a recent history of drenching.

Neoplastic diseases were identified in two sheep death investigations during April. In one case, four mixed-age ewes on a Wairarapa farm died over four days. They were in good body condition with no signs of illness prior to death. The farmer was concerned about salmonellosis, given a history of cases on the farm, but cultures of enteric contents and mesenteric lymph node from two ewes were negative. Autopsy of one ewe revealed free fluid in the abdomen, enlargement of the mesenteric lymph nodes and thickening of both renal capsules. Microscopic examination revealed dense infiltrates of neoplastic lymphocytes in the lymph nodes, hepatic portal tracts, perirenal connective tissues, pulmonary interstitium, myocardium, and intestinal lamina propria and submucosa. The diagnosis of **lymphoma** was thought to represent a sporadic death in the examined ewe, while the cause of the other deaths was not ascertained. In the other case, a five-year-old ewe on an East Coast farm was losing condition so it was euthanased to be used for pet food. The liver was mottled and friable. Histologically, there was an infiltrative epithelial malignancy compatible with **cholangiocarcinoma.** This is an uncommon, sporadic tumour of adult sheep, with no known infectious or toxic cause.

Twelve of 940 mixed-age ewes on a plantain crop in Central Hawke's Bay died over a period of two weeks. Ewes continued to die after being returned to a grass paddock. One ewe submitted for necropsy was carrying twins and in good body condition. Findings included dehydration, deep reddening of the mucosa of the abomasum and ileum, and soft, green diarrhoea with fibrin flecks. Histological changes were most significant in the abomasum, where the mucosa was eroded and infiltrated by neutrophils, erythrocytes and fibrin. A heavy growth of ***Salmonella*** **Hindmarsh** was isolated from the intestinal contents, confirming an outbreak of **salmonellosis**.

Equine

A young adult horse from a South Canterbury property developed multiple warty lesions on the left front fetlock and pastern. Histologically these were typical **viral papillomas**.

An eight-year-old female Warmblood dressage horse in the Whanganui area was examined because of chronic lethargy. In-house diagnostics revealed anaemia and dilute urine. An oral glucose feeding test was carried out after fasting. The two-hour insulin level was 135 mU/L (normal < 85 mU/L), confirming a diagnosis of **equine metabolic syndrome**.

Cervine

A Southland deer farmer found a number of two-year-old spiker stags with **bowed front legs** when he yarded them for de-velveting in April. Blood levels of calcium, phosphorus and copper sampled from the affected stags were similar to those in unaffected animals. The cause of the problem was not identified but a similar condition has been seen in young cattle grazing poorly fertilised crops over winter.

A group of 85 seven-month-old red deer hinds on a Wairarapa farm were

introduced to a paddock of plantain and supplemented with grain and baleage. Five died within the next two days and 10 more were weak or recumbent. Postmortem of one recumbent hind found evidence of diarrhoea, abomasal thickening and marked reddening of the intestinal mucosa. Histopathological examination revealed necrosuppurative enteritis and lymphadenitis associated with large numbers of bacteria identified as ***Yersinia pseudotuberculosis*** by microbiology. This was consistent with a diagnosis of **yersiniosis**. Numerous **nematodes** were also visible within the hyperplastic abomasal mucosa, consistent with **co-existent parasite infection**.

An outbreak of unexpected deaths occurred among mixed-sex weaner deer from a herd in the Rangitikei district. In total, 12 deaths were reported from 200 at-risk animals. Blood test results from an affected weaner indicated severe anaemia. Haematocrit was 0.07 (reference range 0.3–0.6), enzymes were elevated (GGT 759 IU/L, reference range 19–60; GGT 288 IU/L, reference range 8–41), and so was bilirubin at 11 µmol/L (reference range 2–10), consistent with hepatobiliary damage and cholestasis. Postmortem was remarkable for mild jaundice, watery blood and red urine. Histology revealed haemoglobin casts in renal tubules, bile plugs in hepatic canuliculi, and midzonal hepatocellular degeneration. The presumptive diagnosis of **leptospirosis** was confirmed by a MAT of > 1:1 600 to ***Leptospira interrogans*** **serovar Pomona**.

Caprine

On a South Canterbury farm, seven adult goats in a mob of 325 had become acutely sick and died over a three-day period. Clinically they had high temperatures and dyspnoea. The problem occurred following a period of cold, wet weather. Histologically, lungs from two goats had an acute fibrinous pneumonia and both yielded a heavy growth of ***Mannheimia hemolytica*** on culture.

Porcine

In a herd of 200 eight-week-old weaned piglets in Northland, 40 showed ill-thrift and coughing and 30 died. A post-mortem examination found signs of pneumonia. Samples of lung submitted for culture produced heavy mixed growths including ***Streptococcus suis***. Histopathology of a range of tissues revealed chronic-active bronchopneumonia with polyserositis and changes suggestive of infection by ***Mycoplasma hyopneumoniae***, consistent with the **porcine respiratory disease complex**. It was considered likely that the piglets had an underlying ***M. hyopneumoniae*** **infection complicated by *Streptococcus suis* pneumonia, polyserositis and sepsis**.

Canine

An 11-week-old French Bulldog from Auckland had haematochezia and excessive faecal mucus for two weeks, despite treatment with metronidazole/spiramycin and a change of diet. Faecal culture isolated a growth of ***Salmonella*** **Agona**, and a faecal antigen ELISA test was positive for ***Giardia*** spp., suggesting that this puppy had combined **salmonella and giardia infection**.

Feline

In a litter of five Sphynx kittens from the Auckland region, one was stillborn, one was not delivered and had to be removed by caesarean section, and the remaining three died progressively over a two-week period. Post-mortem examination of the most recent death revealed a mucopurulent nasal discharge with turbinate reddening, laryngeal swelling and reddening, and red mottling of the lungs, suggestive of respiratory disease. Histopathology confirmed severe necrotising and suppurative rhinitis, laryngitis, tracheitis and bronchointerstitial pneumonia. There were occasional small intranuclear inclusion bodies within epithelial cells of the lung. A **feline herpesvirus-1** PCR performed on a nasal swab was positive, diagnosing **feline herpesviral pneumonia**.

A litter of seven-week-old Siamese kittens from the Auckland region had a period of vomiting, diarrhoea and anorexia. Most recovered, but one became collapsed and non-responsive with opisthotonus and loss of cranial nerve reflexes, and was euthanased. At postmortem there were no obvious gross abnormalities apart from a pericardial effusion and subtle meningeal reddening. Histopathology of the brain revealed a marked neutrophilic meningoencephalomyelitis with small Gram-positive coccobacilli, consistent with **listerial meningoencephalomyelitis**. Adrenalitis, myocarditis, oesophagitis and enteritis were also found, with an area of gastro-oesophageal ulceration that was considered a likely entry point for haematogenous dissemination of the bacteria. Cases of **listeriosis** in dogs and cats are rare; fever, vomiting and diarrhoea are described, with neurological signs in animals with sepsis.

A three-month-old Domestic Shorthair kitten from Auckland had intermittent haematochezia and diarrhoea. A faecal antigen ELISA test was weakly positive for ***Cryptosporidium***, and a faecal floatation test revealed moderate numbers of coccidial oocysts, suggesting that this kitten had concomitant **cryptosporidiosis and coccidiosis**.

A five-month-old Persian kitten from the Auckland region had diarrhoea. Duodenal biopsies revealed mild to moderate neutrophilic enteritis with many small basophilic objects attached to the surface epithelium of villi, consistent with **cryptosporidiosis**.

A 10-year-old male neutered Russian Blue cat from the Wellington region developed chronic bilateral nasal discharge. It had a history of successful treatment of nasal cutaneous cryptococcosis four years previously. Fluid from a nasal flush was submitted for cytological evaluation. Microscopic

examination revealed numerous round to oval encapsulated yeast cells 515 µm in diameter, some of which demonstrated narrow-based budding. Yeast cells were also occasionally seen within macrophages. There were also occasional tangles of septate hyphae and clumps of bacterial rods and cocci. These findings confirmed a recrudescence and intranasal spread of the **cryptococcosis**. ***Cryptococcus*** is an environmental organism often associated with soil or bird droppings. Immunocompromised cats are not necessarily more likely to develop infection, but will have more trouble clearing it. Differentiation of *C. neoformans* and *C. gatti* is not possible without molecular diagnostic methods.

Avian

An adult emu from the Bay of Plenty was found weak and recumbent, vomiting crop contents. The bird was euthanased and at post-mortem examination a sample of intestinal contents was collected and cultured. A moderate growth of ***Salmonella*** **Typhimurium phage type 56** was isolated from the faeces, confirming a diagnosis of **salmonellosis**.

Lesions of gizzard and proventriculus erosion and ulceration were found in about 300 of 3 000 thirty-day-old broiler chickens from the Auckland region. Histopathological examination revealed variably severe ulcerative ventriculitis with heterophilic exudates and transmural mononuclear inflammation. Occasionally, epithelial cells within glands had large intranuclear inclusion bodies consistent with adenovirus infection. **Gizzard erosion and ulceration syndrome** is incompletely understood and possibly multi-factorial, but infection by serotype 1 of **fowl adenovirus-A** is thought to play a role.

A kereru or wood pigeon (*Hemiphaga novaeseelandiae*) from the Auckland region died suddenly. At postmortem, white lesions were noted on the visceral surface of the sternum. Histopathology of one of these lesions revealed heterophilic and granulomatous inflammation with intralesional fungi, consistent with **aspergillosis;** the lesion probably arose within an air sac.

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Quarterly report of investigations of suspected exotic diseases

Exotic disease investigations are managed and reported by MPI's Investigation and Diagnostic Centre (IDC) and Response, Wallaceville. The following is a summary of investigations of suspected exotic disease during the period from April to June 2016.

Moraxella bovoculi isolated

A bacteriologist notified MPI via the exotic pest and disease hotline of a preliminary identification of *Moraxella bovoculi* from cases of infectious bovine keratoconjunctivitis (IBK), or pinkeye, in cattle. Scientists from MPI's Animal Health Laboratory (AHL), Investigation and Diagnostic Centre (IDC), Wallaceville, cultured the organism and confirmed the identification by PCR sequencing and biochemical testing. *M. bovoculi* is not thought to be a primary pathogen in IBK (the causal organism being *Moraxella bovis*), though it may be a risk factor for infection by the latter. The bacteriologist did not provide further information about the affected animals, so it was not possible to establish evidence that *M. bovoculi* was any more than an incidental finding.

Balanoposthitis in rams investigated

An unusual presentation of ulcerative balanoposthitis was notified to MPI by a veterinarian via the exotic pest and disease hotline. Three two-tooth rams in a mob of 20 had prolapsed penises with deep ulcers on the distal surface. Exotic sheep pox and endemic parapoxvirus infection (orf, or contagious ecthyma) were ruled out by PCR testing of swabs from the lesions at the IDC (Wallacevillem. Further swabs were submitted in Friis broth for Mycoplasma and ureaplasma PCR and culture. All three rams were positive for *Mycoplasma* spp., and these isolates were subjected to further molecular work to determine the species. Of concern was *Mycoplasma mycoides mycoides* large colony type, which is present in New Zealand but has not been shown to cause ulcerative balanoposthitis as it does in some other countries, notably South Africa. A combination of *M. arginini* and *M. fermentans* was isolated from the specimens on these cases. These organisms are ubiquitous in New Zealand so exotic disease was excluded and the investigation closed.

Enzootic abortion ruled out

A veterinary pathologist notified MPI via the exotic pest and disease hotline of abortions in twin-bearing hoggets, with histopathological findings of severe necrotising placentitis and fetal pneumonia on one postmortem. Twenty out of 64 ewes from a flock in Nelson had aborted over a two-week period. They had been vaccinated against *Toxoplasma* and *Campylobacter* spp., and *Campylobacter* culture had been negative. Fresh cotyledons from the placenta and a sample of lung from the aborted fetus were sent to the IDC (Wallaceville) for rule-out of enzootic abortion of ewes, an exotic differential caused by *Chlamydophila abortus*. PCR for *C. abortus* was negative. PCR for *Helicobacter* spp., which have been implicated in sheep abortions, was also negative. Further culturing by the referring laboratory isolated *Listeria ivanovii*, a common isolate in cases of sheep abortion in New Zealand.

Haemoparasites in alpaca excluded

A veterinary pathologist called the MPI exotic pest and disease hotline after finding some unusual round structures attached to red blood cells on examination of a blood smear from an alpaca. The four-year-old alpaca dam, which had had its first cria two months earlier, was exhibiting weight loss and severe regenerative anaemia. It was thought that the structures noticed in the blood might be haemoparasites and be the cause of the anaemia. Tests at the IDC (Wallaceville) for piroplasms *Theileria* spp. and *Babesia* spp., *Anaplasma phagocytophilum* and haemoplasmas (*Mycoplasma* spp.) by PCR were all negative. Haematological results were consistent with blood-loss anaemia, which in alpaca is most often caused by intestinal parasites. As the presence of haemoparasites was excluded, the investigation was closed.

Canine coronavirus excluded

A Hawke's Bay veterinarian called the MPI exotic pest and disease hotline to report that she had seen several dogs with a haemorrhagic diarrhoea that was considered to be unrelated to parvovirus or other endemic canine disease. Cases occurred from 2 March to 30 April, after which they seemed to stop. The vet also contacted the local newspaper about this so-called "mystery disease" and reported that other vets in the region had seen similar cases. At the outset it was unclear how many dogs had been affected, but over several weeks six separate cases were reported in Hawke's Bay, with two deaths reported. There were also two more cases, one each from Auckland and the Waikato. Autopsy of one dead dog from Hawke's Bay showed generalised reddening of the small intestine, but on histology the classic lesions of parvovirus were not present and nor were there any lesions pointing to any other specific disease. Faecal testing of samples from two dogs ruled out the viral pathogens canine parvovirus, canine coronavirus and canine circovirus (an emerging cause of diarrhoea in dogs in other countries), as well as *Clostridium difficile*, *C. perfringens* and *Cryptosporidium* spp. A questionnaire was developed to identify common risk factors, but answers from the eight cases did not reveal any consistent risk factors such as food, exposure to bodies of water, or other evaluated factors. In three the households concerned also had other dogs that were unaffected by disease. Owing to the small number of cases, it is unclear whether this situation represented a true outbreak; and if so, what risk factors or aetiology were involved. The exotic disease circovirus was ruled out as a cause of the apparent epidemic and the investigation was closed because the outbreak resolved, and no cause was determined.

Canine leishmaniosis excluded

A veterinarian called the MPI exotic pest and disease hotline to discuss an imported nine-year-old entire male dog that presented with inflammation of the penile and preputial mucosa. The prepuce was swollen, with papules, petechiae and ulcers present on the mucosa. Canine leishmaniosis caused by *Leishmania infantum* is an exotic differential diagnosis for canine balanoposthitis (Koutinas *et al.*, 2014). As New Zealand does not have the leishmaniosis vector (phlebotomine sandflies), the import health standard for dogs does not include *L. infantum* testing (Rawdon *et al.*, 2015). Whole-blood and serum samples along with preputial smears and scrapings were submitted to the IDC (Wallaceville), where immunofluorescent antibody (IFAT) and PCR tests were negative for *L. infantum*. Cytological examination of the preputial smears and scrapings was unremarkable. Exotic disease was ruled out and the investigation closed.

In another case, an MPI Verification Services veterinarian contacted the duty Incursion Investigator regarding a dog originating from the US, which presented with an ulcerative interdigital lesion while in quarantine. An exotic differential for skin lesions in dogs is *Leishmania infantum*. Other, endemic causes of ulcerative skin lesions in dogs include bacterial pyoderma, atopy, stress-induced lick granulomas and trauma. As previously explained, the import health standard for dogs does not include *L. infantum* testing (Rawdon *et al.*, 2015). At the Incursion Investigator's request, blood samples from the dog were submitted to the IDC (Wallaceville). IFAT and PCR tests subcontracted to an overseas laboratory ruled out *Leishmania* and the investigation was closed.

Brucella canis excluded

A veterinarian called the MPI exotic pest and disease hotline to report an epididymal abscess in an eight-year-old dog. *Brucella canis and B. suis* are exotic differentials for epididymitis in dogs. This dog was not imported but it had been used for breeding and might have had contact with imported dogs. Furthermore, it had been in contact with pig-hunting dogs and had been fed feral pig meat, a potential source of infection. A serum sample, fresh tissue and fixed tissue were submitted to the IDC (Wallaceville), where brucellosis was ruled out with a negative *Brucella* card test. General bacterial culture yielded a pure growth of *Mycoplasma* sp., from which DNA was extracted for molecular identification. Sequencing showed highest similarity (99 percent) with *M. cynos*. On histology the epididymitis could be best described as chronic-active with a high neutrophil component in the face of chronic inflammation as represented by fibrosis and granulation. The epitheliotrophic-type lesions were consistent with mycoplasma infection. Exotic disease was ruled out and the investigation closed.

Ehrlichia canis excluded

An MPI Verification Services veterinarian contacted the duty Incursion Investigator via the MPI exotic pest and disease hotline to discuss a dog in quarantine. The eight-year-old neutered male Golden Retriever, from Malaysia, was found to have blood in its urine at the end of its quarantine period. *Ehrlichia canis* can induce a thrombocytopenia and haemorrhagic tendencies and is therefore a potential exotic differential for haematuria. Endemic causes include bacterial urinary infections and neoplasia of the urogenital tract. As part of quarantine protocols the dog was examined by a private-practice veterinarian. There were no abnormal findings on physical examination, haematology or blood chemistry. Attempts to collect a urine sample were unsuccessful. Given the normal haematology results, exotic disease was ruled out and the investigation closed. The dog was released with advice to have the haematuria investigated further.

Ehrlichia canis confirmed

An AHL scientist informed the duty Incursion Investigator that a high positive IFAT titre (1:10 240) to *Ehrlichia canis* had been found in a six-year-old Whippet bitch during routine pre-export testing. Follow-up with the owner determined that the dog had lived in Australia, Singapore and Korea before being bought to New Zealand two and a half years earlier. Under the direction of an Incursion Investigator, routine haematology and biochemistry profiles were carried out. The blood work identified changes in the haemogram (mild non-regenerative anaemia with HCT= 0.32; thrombocytopenia, lymphocytosis and neutrophilia) and serum biochemistry (mild azotaemia, mild hyperglobulinaemia and hypoalbuminaemia). These signs were potentially indicative of chronic-stage ehrlichiosis. However, no parasites were identified in blood smears. A molecular assay was positive for *Ehrlichia* spp, with sequencing confirming *E. canis*. The dog received doxycycline therapy (10 mg/kg) for eight weeks and blood parameters returned to normal, apart from a persistent mild azotaemia and hypoalbuminaemia consistent with a nephropathy resulting from chronic *Ehrlichia* infection. Although *E. canis* is exotic to New Zealand and an Unwanted Organism under the Biosecurity Act 1993, no response was initiated because the risk was negligible owing to the lack of a suitable vector (the brown dog tick, *Rhipicephalus sanguineus*: Rawdon *et al.*, 2016) in New Zealand and the effective treatment with antimicrobial therapy. In consultation with MPI's Response Team, the investigation was stood down.

Ornithobacterium rhinotracheale confirmed

A poultry veterinarian phoned the duty Incursion Investigator to discuss cases of upper respiratory disease he had seen in backyard/fancy-breed chickens in Canterbury. The notifier had information from a poultry conference in Australia

where the poor sensitivity of standard laboratory approaches (both culture and conventional PCR) for detecting *Ornithobacterium rhinotracheale* had been expressed, and details of a real-time PCR assay had been made available (Blackall, 2015; Groves, 2015). Tracheal swabs from a historical case had been stored frozen. Fresh upper respiratory tract swabs were collected from a second, more recent case. Both sets of samples were submitted to MPI's Animal Health Laboratory. Testing at the IDC (Wallacevillle) identified a mixture of endemic bacterial respiratory pathogens, including *O. rhinotracheale* in two samples, and *Avibacterium paragallinarum* was found in all five samples. *O. rhinotracheale* was detected by newly implemented real-time PCR protocol (Adelwhab *et al*., 2013), after conventional PCR failed to detect the pathogen. The outbreak was characterised by upper respiratory disease, including sinusitis and localised exudative lesions ("canker") affecting areas of the mouth, tongue or pharynx, without death. Flocks responded well to routine antibiotic therapy. *O. rhinotracheale* has not previously been found in New Zealand, and is an Unwanted Organism under the Biosecurity Act 1993. As part of delimiting surveillance, testing of respiratory swab extracts held at the AHL from previous poultry disease investigations, was carried out. Fifty-nine awabs from three commercial poultry farms (broiler, free-range layer, barn layer) that had upper respiratory tract disease associated with *A. paragallinarum* were tested for *O. rhinotracheale* by PCR. Twelve samples from each farm tested positive by RT-PCR, while only one was positive by conventional PCR. The investigation concluded that *O. rhinotracheale* has a widespread distribution in both commercial and backyard poultry, and it was onlyidentified during the current outbreak thanks to new, more sensitive laboratory techniques than in the past. Disease in these cases is thought to be caused by a mixture of pathogens including *O. rhinotracheale*. Findings correspond with the literature, where *O. rhinotracheale* is most commonly identified as a co-infectant associated with other respiratory agents. In consultation with MPI's Response Team, the investigation was stood own.

Polyoma virus excluded

A pathologist reported an unusual histology finding via the exotic pest and disease hotline. A pigeon breeder reported death and illness among her birds, and a post-mortem examination of one had identified intestinal infections caused by coccidia, protozoa and adenovirus. Histology of the liver revealed inclusion bodies that were consistent with polyomavirus. While polyomavirus had been found in New Zealand in parrots and finches, it had not previously been reported in pigeons. PCR of the liver tissue at the IDC (Wallaceville) was negative for the exotic differentials polyomavirus, Pacheco's disease (herpesvirus) and psittacine adenovirus. The abundance of infectious agents in the bird pointed to management factors that needed addressing for the health of the remaining pigeons.
A pathologist called the MPI exotic pest and disease hotline to report a Derbyan parrot that on histology had hepatitis and splenitis with inclusion bodies present. The bird had appeared well before dying and there was no obvious cause of death on gross post-mortem. PCR testing at the IDC (Wallaceville) was negative for the exotic differentials Pacheco's disease (herpesvirus), avian polyomavirus and psittacine adenovirus.

Avian influenza and Newcastle disease ruled out

A Manawatu veterinarian in the Manawatu called the MPI exotic pest and disease hotline to report a die-off n backyard chickens with respiratory distress. The affected chickens were Speckled Hamburgs, a type of bantam, of which eight had died and the remaining 14 were variably affected. A hundred Hyline chickens in a separate flock sourced from a different provider as one-day old chicks, were unaffected. The property also contained recently-introduced ducks, which were not affected. Exotic causes of respiratory distress and death in chickens include highly pathogenic avian influenza (AI) and Newcastle disease (ND). Non-exotic differentials include infectious laryngotracheitis (ILT) and infectious coryza, caused respectively by ILT virus and the bacterium *Haemophilus paragallinarum*. Choanal swabs (three dry and three in bacterial medium) were obtained from three sick bantams and sent to the IDC (Wallceville), where PCR tests for AI and ND were negative. However, PCR tests yielded positive results from all three birds for ILT virus, and from two birds for *H. paragallinarum*. It appears in this case that ILT and *H. paragallinarum* are likely to have played a role in the disease outbreak. The unaffected status of the other flock most likely represents a difference in exposure or immunity (e.g., vaccination), although vaccination for ILT is reportedly quite rare in the NZ chicken industry. Diagnostic results were provided to the veterinarian, who is working with the owner to control the outbreak and prevent new cases. Exotic disease was excluded and the investigation was closed.

Newcastle disease excluded

A veterinarian called the MPI exotic pest and disease hotline to report an ELISA-positive test result for Newcastle disease, found during routine screening of poultry. The single positive result was from one of 10 birds sampled in a line of 42-day-old male chickens. Large numbers of screening tests had been conducted on the commercial enterprise over several months, and this was the only ELISA-positive case. There was no increase in mortality and no clinical signs of Newcastle disease were observed. The 10 samples were tested at the IDC (Wallaceville) by ELISA and PCR. The same sample was positive on ELISA,

but all were negative for virus on PCR. The positive result could have been due to an endemic low-pathogenicity avian paramyxovirus, which cannot be differentiated from Newcastle disease on serology, or it could have been a cross-reaction. The lack of disease presence on the farm and the solitary result were not suggestive of pathogenic Newcastle disease virus infection.

Avian mortalities investigated

A Department of Conservation ranger reported a paralysis syndrome affecting a number of bird species over a three-week period on the western side of the Firth of Thames, mostly at Waitakaruru, Miranda and Kaiawa. The syndrome was characterised by progressive paralysis, beginning with the hind limbs and progressing to head and neck, before death. The birds remained alert and continued to eat before these signs developed. This syndrome mostly affected waterfowl (mallards *Anas platyrhynchos* and paradise shelducks *Tadorna variegata*), but also 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 mallards and one each of paradise shelduck, red knot, banded dotterell, wrybill (*Anarhynchus frontalis*) and godwit (*Limosa lapponica*). These birds were euthanased and submitted chilled to Massey University for post-mortem and histological examination. No gross abnormalities were seen and no significant underlying infection or inflammation lesions were identified in any organs. The absence of haemorrhage or inflammatory lesions in key organs excluded the involvement of exotic viral diseases. Instead, botulism was suspected, based on the clinical presentation, the season (very low recent rainfall, associated with an El Nino summer) and locality (the Firth of Thames has experienced similar large-scale botulism events). Work is now underway to confirm and type the suspected botulinum neurotoxin involved, and findings support botulism as the most likely cause of the mortality event. Exotic disease was excluded and the investigation was stood down.

A veterinarian called the MPI exotic pest and disease hotline to report sudden death in seven ducks from a small flock on a lifestyle block in Gisborne. One duck died, followed by six the next day. Clinical signs included flaccidity followed by death. No samples were available at the time of notification. The primary differential diagnosis was initially considered to be botulism, which causes these clinical signs. Exotic causes of death in waterfowl include avian influenza and Newcastle disease. Although the clinical signs resembled botulism, this was considered an unlikely diagnosis because there was no standing water on the property and ducks were watered out of dishes that the owner changed frequently. The feed appeared unremarkable but was close to the end of the bag. The veterinarian advised the owner to discontinue using that bag of feed and to report any further deaths. No more ducks died and the investigation was stood down on epidemiological and clinical grounds and regarded as a possible toxic exposure.

Infectious bursal disease ruled out

A specialist poultry veterinarian called the MPI exotic pest and disease hotline to report a rise in mortality in a commercial shed of 21-day-old chickens. Post-mortem examinations and histology suggested inclusion body hepatitis (adenovirus) as the cause of illness, but the birds' bursas of Fabricius also appeared to be affected, so infectious bursal disease was ruled out. PCRs were conducted on bursa tissue at the IDC (Wallaceville), all with negative results, so the investigation was stood down.

Exotic bee mites excluded

A hobbyist beekeeper called the MPI exotic pest and disease hotline to report a drone bee covered with small mites. The mites did not appear to be *Varroa destructor* and the beekeeper had not noticed any in her hives. She had shown the bee and mites to an experienced beekeeper, who also did not recognise them. The specimens were identified by an entomologist at MPI's Plant Health and Environment Laboratory (PHEL), Tamaki, as deutonymphs (second larval stages) of a *Uroobovella* sp. (family Dinychidae). These are known to be present in New Zealand, although the taxonomy is not well known and they pose no risk to bee health. As it turned out, the "bee" submitted with the mites was actually a hover fly (family Syrphidae) and it had been caught some distance from the hives, so there was no cause for concern.

Exotic bee excluded

A member of the public called the MPI exotic pest and disease hotline after finding an unusual-looking bee or wasp. Photographs were sent to the Incursion Investigator, who ruled out exotic bee species or hornets and sent them to an entomologist at the PHEL (Tamaki) for further identification. The insect was most likely *Cryptocheilus australis*, a solitary spider-hunting wasp that is native to Tasmania and southeastern Australia, and was first recorded in New Zealand in the 1960s. These wasps are now found throughout the upper North Island, where they sting and paralyse spiders (often from the family Pisauridae) before dragging them into a nest hole in the ground and laying an egg in them. The egg hatches into a larva and eats the live, paralysed spider.

Brown dog tick excluded

A veterinarian in Christchurch called the MPI exotic pest and disease hotline to report finding hundreds of tiny red ticks on a dog belonging to a veterinary nurse. Reports of ticks on dogs in Canterbury

are always of concern because the NZ cattle tick (Haemaphysalis longicornis), is thought to be relatively rare there, it does not typically target dogs, and in January 2015 there was a brown dog tick incursion near Christchurch. Photographs of the ticks were emailed to the duty Incursion Investigator and sent to an entomologist who tentatively identified them as nymphal stages of the NZ cattle tick. The ticks were subsequently submitted to the PHEL (Christchurch), where they were confirmed as being cattle ticks and the investigation was stood down.

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Marine surveillance annual report

This annual report includes summary information for the National Marine High Risk Site Surveillance (MHRSS) programme and the Marine Invasive Taxonomic Service (MITS) for the winter and summer periods between May 2015 and April 2016.

The targeted surveillance programme for non-indigenous marine species focuses surveillance activities at 11 major 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, that present a significant risk of arriving and becoming established, and are likely to have negative consequences for New Zealand's environment and economy. 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 (http://www.biosecurity.govt.nz/pests/registers/uor) under the Biosecurity Act 1993. These include primary target species (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 (Australian droplet tunicate *Eudistoma elongatum*, Asian bag mussel *Arcuatula senhousia*, Mediterranean fanworm *Sabella spallanzanii* and 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 ports and associated marinas surveyed in the targeted surveillance programme

Sample collection

In total, 2 936 sites were surveyed during the 2015 winter sampling period (May to September) and 2 920 sites were surveyed during the summer months (November 2015 to March 2016). These figures represent 101.1 percent and 100.6 percent of the target number of sites, respectively. 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**).

Number of specimens collected by the MHRSS and sent to MITS

Eighty-one samples containing 100 specimens were sent to MITS for identification; 28 specimens were identified from the winter round and 72 specimens were identified from the summer round. Suspect specimens found at high-risk sites represented 11 taxonomic groups and included 18 non-indigenous species (**Table 3**). One of these was a new record for New Zealand: the colonial styelid ascidian *Polyandrocarpa zorritensis* (Van Name, 1931), found in Marsden Cove Marina in Whangarei Harbour during the summer survey. Two specimens of this ascidian were collected during the March 2015 survey of Tauranga Harbour, and initially identified as *Polyandrocarpa* sp. (cf. *robusta*). However, on the basis of the recent collection from Whangarei of mature, well preserved specimens, the Tauranga submission can now be confirmed as *P. zorritensis*. Thus, the Tauranga detection in the summer 2014–2015 survey is the first record of this species in New Zealand, and the detection from Whangarei in the summer 2015–16 survey is technically a MHRSS Programme range extension.

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

MITS also received 132 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 these, 376 specimens were rapidly identified, with non-urgent samples identified in 4.3 days on average and urgent samples taking 1 day on average.

Table 1: Sampling methods used for high-risk sites surveyed in 2015–2016
Species in **bold** have been collected using this method during the present or previous surveillance programmes

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. ***Theora lubrica*** ***Pyromaia tuberculata***	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.
Box (crab) traps	*Asterias amurensis* *Carcinus maenas* *Eriocheir sinensis*	*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., *Ovalipes, Hemiplax*).
Crab condos	*Carcinus maenas* *Eriocheir sinensis*	*Acentrogobius pflaumii* ***Charybdis japonica*** *Pyromaia tuberculata*	ntertidal 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, Hemiplax*). 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*
Diver searches	*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	Depends on water clarity and level of biofouling

Additional resources for the MHRSS and MITS programmes

Annual reports are available to read and download on the MPI website. The complete 2015–2016 MHRSS annual report can be downloaded here: http://www.mpi.govt.nz/document-vault/13350. Most of the information collected from marine biosecurity surveillance programmes has now been uploaded and made available via the Marine Biosecurity Porthole webpage

Table 2: Marine high-risk sites surveyed in 2015–2016, and target species found

Location	Sampling round	Target number of sites	Actual number of sites	Target species found
Opua	Winter 2015	248	253	*Eudistoma elongatum, Styela clava*
	Summer 2015–2016	248	248	*E. elongatum, S. clava*
Whangarei	Winter 2015	243	245	*Arcuatula senhousia, E. elongatum, Sabella spallanzanii, S. clava*
	Summer 2015–2016	243	245	*A. senhousia, E. elongatum, S. spallanzanii, S. clava*
Auckland	Winter 2015	486	496	*A. senhousia, S. spallanzanii, S. clava*
	Summer 2015–2016	486	494	*A. senhousia, S. spallanzanii, S. clava*
Tauranga	Winter 2015	243	253	*S. clava*
	Summer 2015–2016	243	247	*S. spallanzanii, S. clava*
New Plymouth	Winter 2015	243	245	
	Summer 2015–2016	243	243	
Wellington	Winter 2015	243	245	
	Summer 2015–2016	243	243	*S. spallanzanii1, S. clava1*
Picton & Havelock	Winter 2015	243	243	*S. clava*
	Summer 2015–2016	243	243	*S. clava*
Nelson	Winter 2015	243	243	*S. spallanzanii, S. clava*
	Summer 2015–2016	243	243	*S. spallanzanii, S. clava*
Lyttelton	Winter 2015	243	244	*S. spallanzanii, S. clava*
	Summer 2015–2016	243	244	*S. clava*
Otago	Winter 2015	243	244	*S. clava*
	Summer 2015–2016	243	245	*S. clava*
Bluff	Winter 2015	225	225	
	Summer 2015–2016	225	225	

[1]Detected on a vessel

(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 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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Table 3: Samples collected and identified by MITS from each sampling locality, 2015–2016

Non-indigenous species are in BOLD. Range extensions are in BLUE.

Location	Taxonomic Identification	
	Taxonomic group	**Species**
Opua	Algae	*Unidentified cyanophyte; Plocamium angustum*
	Ascidian	***Botrylloides leachii; Didemnum vexillum***
	Bryozoan	***Celleporaria umbonatoidea***
	Decapod	*Nepinnotheres* sp.[1]
Whangarei	Ascidian	***Polyandrocarpa zorritensis***[2], *unidentified Polyclinidae*
	Bryozoan	*Celleporina* cf. *sinuata*
	Sponge	*Phlyctaenopora (Barbozia)* n. sp.
Auckland	Annelid	***Sabella spallanzanii***
	Bryozoan	***Amathia verticillata***
Tauranga	Algae	*Ceramium* sp.[1], *Chondracanthus chapmanii, Gigartina atropurpurea, Griffithsia* sp.[1], *Haraldiophyllum crispatum, Hydroclathrus clathratus*
	Annelid	*Bispira bispira-A,* ***Sabella spallanzanii***
	Ascidian	*Botrylloides magnicoecum, Microcosmus squamiger,* ***Styela clava***
	Bryozoan	***Amathia verticillata, Celleporaria nodulosa***
	Decapod	*Philocheras hamiltoni*
New Plymouth	Algae	*Anotrichium crinitum, Dasya subtilis,* ***Grateloupia turuturu****, Hincksia granulosa, Hincksia mitchelliae, Polysiphonia* sp.[1]*,* ***Undaria pinnatifida***
	Decapod	*Liocarcinus corrugatus*
Wellington	Algae	*Antithamnionella* sp.[3]*, Bryopsis vestita, Codium* sp.*, Hincksia* sp.[3]*, Polysiphonia* sp.[3]*,* ***Stictyosiphon soriferus, Undaria pinnatifida***
	Ascidian	*Pyura subuculata, Styela plicata*
	Decapod	*Heterozius rotundifrons*
	Hydroid	*Obelia dichotoma*
	Other	Angiosperm[4]
	Sponge	***Halisarca dujardini***
Picton/Havelock	Algae	*Aeodes nitidissima*
	Amphipod	*Caprella equilibra,* ***Caprella mutica***
	Annelid	*Acrocirrus trisectus, Bispira bispira-A*
	Ascidian	*Asterocarpa humilis,* ***Ciona intestinalis****,* ***Clavelina lepadiformis****, Cnemidocarpa bicornuta, Molgula mortenseni, Pyura rugata*
	Hydroid	*Ectopleura* sp.[1]
Nelson	Anthozoan	*Anthothoe albocincta*
	Bryozoan	***Amathia verticillata***
	Decapod	*Nectocarcinus antarcticus*
Lyttelton	Algae	***Grateloupia turuturu,*** ***Schizymenia apoda***
Otago	Algae	Ectocarpaceae[1]*,* ***Griffithsia crassiuscula****, Medeiothamnion lyallii, Polysiphonia* sp.[3]
	Ascidian	***Ascidiella aspersa, Botrylloides leachii***
Bluff	Algae	*Plocamium microcladioides, unidentified red algae* (Kallymeniaceae)[4]
	Nudibranch	*Alloiodoris lanuginata*

[1]Juvenile, or lacking morphological characteristics necessary for identification

[2]This identification enabled further examination of *Polyandrocarpa* sp. material first collected in the Tauranga MHRSS in March 2015, confirming that this species was first reported in New Zealand from Tauranga; thus the Whangarei detection is a range extension.

[3]Molecular techniques required for identification to species level

[4]Freshwater plant detected on a pontoon

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

Exotic marine pest and aquatic disease investigations are managed and reported by MPI's Investigation and Diagnostic Centre and Response, Wallaceville. The following is a summary of investigations of suspected exotic marine diseases and pests during the period from April to June 2016.

Polyandrocarpa zorritensis confirmed

On 5 May 2016 the Marine Invasive Taxonomic Service (MITS) notified MPI of a new to New Zealand ascidian found at Whangarei during the High Risk Site Surveillance Programme. It was initially identified as *Polyandrocarpa australiensis*, but on closer examination was confirmed as *P. zorritensis*. This find prompted the ascidian taxonomist to re-examine another unusual specimen of *Polyandrocarpa* that had been found during the Tauranga round of surveillance in March 2015. When first examination, this specimen had only been identified to genus level, and presumptively as *P. robusta*. However, in light of the *P. zorritensis* finding at Whangarei, it was concluded that the Tauranga sample was also *P. zorritensis*.
On 10 May 2016 a commercial diving company working on a biofouling project reported unusual fouling on an LPG-loadling platform in the Manukau Harbour, Auckland. A video was submitted to MITS, where the fouling it showed was also presumptively identified as *P. zorritensis*. This was later confirmed after samples were collected and submitted. A Marine Exotic Species Note (MESN) was produced for the MITS investigation to help with the risk assessment. This species has a high reproductive potential and is known to be an aggressive invader that can rapidly colonise and overgrow substrates, including cultured shellfish. It has been reported to overgrow cultured oysters in Spain and has been seen to form 100 percent cover in several locations in San Diego and Mission bays, suggesting it can successfully outcompete species.

Asian paddle crab range extension confirmed

A commercial fisher contacted MPI in December 2015 after catching what he suspected was an Asian paddle crab (*Charybdis japonica*) in the Kaipara Harbour. Asian paddle crabs were first detected in New Zealand in 2000, are widespread in the Waitemata Harbour and Hauraki Gulf, and have been found in Whangarei and Opua. However, until recently they were not known from the west coast. A sample from the Otamatea River estuary in Kaipara Harbour was obtained from a second notifier in March 2016, and was again identified by MITS as *C. japonica.* In April 2016 another commercial fisher contacted MPI after catching what he suspected was an Asian paddle crab, this time further north in the Kohukohu reach of the Hokianga Harbour, and this was also confirmed as *C. japonica* by MITS. It is not known how this species has spread to the comparatively remote western harbours, but the possibilities include natural range extension as well as human-mediated spread via contaminated fishing or aquaculture gear, or deliberate or accidental introduction by fishers as bait.

Droplet tunicate range extended

A marine biologist contacted MPI after observing an unusual ascidian growing at Oakura Bay, Waiheke Island. Specimens were submitted to MITS and the Australian droplet tunicate *Eudistoma elongatum* was confirmed. This is an Australian native ascidian that forms large colonies, typically on muddy tidal shores and on man-made structures such as aquaculture equipment. It is a significant nuisance species to marine farming. This species was first detected in the Bay of Islands in 2005, but has since been reported in Whangarei Harbour, Rangaunu Harbour and the Sandspit estuary. This find at Waiheke Island constitutes a range extension. *E. elongatum* spreads naturally in water currents and marine farmers and boaties are encouraged to keep their boats and equipments free of fouling to help stop it spreading.

Unusual barnacles identified

A Cawthron scientist called MPI via the exotic pest and disease hotline to report several large, unusual-looking barnacles found in the rudder cavity and on the stabilisers of a cruise liner moored at Queens Wharf . The vessel was being examined as part of an MPI fouling study. The barnacles were sent to MITS and two non-indigenous species, *Megabalanus coccopoma* and *Austrobalanus imperator,* were identified. Both these species have been recorded in NZ before, but only on vessels. There was no evidence to suggest that they posed a biosecurity risk so this investigation was closed.
A vessel service centre in Hobsonville, Auckland, contacted MPI to report barnacles infesting two motor launches that had recently returned from the Bay of Islands. Both vessels had been recently cleaned and had new antifouling applied before relocating to the Bay of Islands over the summer, so the infestation was considered unusual and there was concern that a new pest species might be involved. Samples were submitted to MITS and identified as the indigenous species *Amphibalanus variegatus* and *Balanus trigonus*, plus one non-indigenous species, *Amphibalanus amphitrite*. The lattermost species was first recorded in New Zealand in 1960 and is considered established. It is not known why these barnacles were able to colonise the vessels, which otherwise had good antifouling measures in place. The results have been referred to the company to discuss with antifouling suppliers as appropriate.

Mollusc mortality events investigated

A flat-oyster farmer notified MPI of unusual mortality in oysters 40–50 mm

long. The farm concerned was within the contained zone of the Controlled Area for *Bonamia ostreae*, and although *B. ostreae* was suspected, it was decided to send samples to MPI to rule out other exotic diseases or involvement of any other pathogens. The mortality was considered unusual as this stock was less than two years old and *Bonamia* mortality is not expected until oysters are older.
Fifteen oysters were received and all tested positive at the AHL by PCR to *B. ostreae*, but negative to *B. exitiosa*, which is otherwise considered endemic in New Zealand. Histopathology revealed a heavy burden of *Bonamia*; the pathologist said it was the heaviest density he had ever seen in a flat oyster. Infection with *B. ostreae* was the most likely cause of the mortality, and exotic disease were ruled out. In the meantime, mortality had returned to within expected levels at the farm. The results were passed on to the oyster farmer and the investigation was stood down.

Fish mortality events investigated

A caller to the pest and disease hotline reported many small dead fish floating in a creek coming out of Pine Harbour Marina, Auckland. The notifier said he had never seen this before. In addition there were no reports of a storm or a pollution event that could explain these mortalities. The extremely small size of the fish and the distance from the river mouth meant it was unlikely that they were discarded baitfish. Ten whole fish were collected and sent to the MPI AHL for testing. There was a delay and the fish arrived badly decomposed, so a complete suite of diagnostic tests could not be performed. Molecular tests to rule out pilchard herpesvirus were performed, with a negative result. No further testing was possible so the investigation was closed.

Department of Conservation staff contacted MPI after observing mortality in a public display tank of native fish at the Tongariro National Trout Centre, near Turangi. Bullies (*Gobiomorphus* spp.), banded kokopu (*Galaxias fasciatus*) and koaro (*G. brevipinnis*), were affected. An investigation was initiated to rule out exotic or emerging disease agents. Six koaro, one banded kokopu and one bully were submitted chilled and whole to the MPI AHL. From the banded kokopu, two species of bacteria were isolated: *Plesiomonas shigelloides* and *Hafnia alvei*. Both these bacteria are common in freshwater environments (including New Zealand) and have been reported as opportunistic pathogens in other fish species such as trout. The koaro and bully samples were unfortunately too autolysed for laboratory testing, so it is unknown whether the aforementioned bacteria were also present in these fish. Both the kokopu and koaro had been bred in captivity by the Mahurangi Institute, from where about 150 fish were transferred to the National Trout Centre for display. They were quarantined for 4 weeks in a 10 percent salt solution to reduce the risk of pathogen or parasite transfer, and no unusual mortalities were observed during this period. After this, most of the fish were transferred to a public display tank with a spring-fed water source. Water flow rate and quality were considered excellent. Staff at the centre suspected that an increase in light levels in the display tank, or other risk factors associated with the transfer, may have stressed the fish and predisposed them to opportunistic pathogens. In support of this view, they noted that the approximately 15 fish still left in quarantine were unaffected. The staff decided to euthanase the remaining fish in the display tank soon after submitting samples to MPI, which negated any need for further testing. The investigation was closed.

A member of the public found 11 dead brown trout (*Salmo trutta*) of varying sizes over a two-week period at Lake Rotoiti, Nelson Lakes National Park. The Nelson/Marlborough Fish and Game Council was informed and it notified MPI via the exotic pest and disease hotline. Two fresh and three frozen specimens were sent to the MPI AHL, Wallaceville. Samples of spleen, kidney and liver from both fresh and frozen specimens tested negative by PCR to infectious pancreatic necrosis virus and *Aeromonas salmonicida,* two exotic differentials for fish mortalities. No unusual lesions were found on the fresh fish, but one of them cultured a light mixed growth of *Aeromonas hydrophila* and *Hafnia alvei*. Both these bacteria are very common in freshwater environments and can become opportunistic pathogens when fish are stressed, for example by low dissolved oxygen or higher-than-normal water temperatures. As this event could not be attributed to exotic disease, the investigation was closed.

A fisher contacted MPI via the exotic pest and disease hotline to report an unusual trevally (*Pseudocaranx georgianus*) caught off the Wellington coastline. The notifier became concerned because, upon filleting the fish it looked as though it was rotting from the inside, with white pockmarks in the fillet and a black spine and swim bladder. The fish was submitted to the MPI AHL as a sample consisting of the frozen head and frame and chilled, skinned fillets. Necropsy revealed that an area of the epaxial muscle mass dorsal to the abdominal cavity and vertebrae consisted of a series of overlapping 10–15-mm cavities lined with peritoneum and devoid of contents. There was no gross sign of inflammation associated with the lesion, which was interpreted as a resolved cavitating myonecrosis attributable to a bacterial or protozoal infection. There was no indication of muscle regeneration grossly. The location of the lesion, together with the submitter's observation that the swim bladder (not seen by AHL) was black, suggests that the swim bladder may have been the route of infection. Although it fits the description of swim bladder ectasia (Diggles, 2003), this condition has been very rarely seen or described, and in those cases the swim bladder malformations were random and chaotic, not bilaterally symmetrical as would be expected with a genetic problem. The submitter also mentioned that the swim bladder itself was discoloured, which would not be expected if it was normal.

Continued on page 60

Biosecurity Response Group overview

The Ministry for Primary Industries (MPI) Biosecurity Response Group (BRG) sits within the Operations Branch and is responsible for responding to the biosecurity risks posed by exotic and emerging pests and diseases found in New Zealand. The BRG is also involved in preparing for exotic diseases and potential emerging pests or diseases such as brown marmorated stink bug, foot-and-mouth disease and marine pests. This report covers activities undertaken by the BRG for the year 1 July 2015 to 30 June 2016.

MPI initiates biosecurity responses to organisms or risk goods that may affect New Zealand's primary industries or marine, freshwater and terrestrial environments (**Figure 1**). Each organism is assessed for the risks it poses, including economic, environmental, social, cultural and human health risks. An assessment is also made of:

- the complexity of any response,
- the ability of the organism to spread,
- methods available for eradication or control,
- the feasibility of eradication and resources required, and
- possible barriers to eradication or management of the organism (such as legal considerations and stakeholder and public concern).

All these questions are considered before we initiate a response. Answers to these questions may also limit our ability to eradicate the target organism, for example if it is widespread and there are limited control tools available.

Responses make use of MPI's Single Scalable Response Model (SSRM), which is based on the New Zealand Coordinated Incident Management System (CIMS) approach. This allows us to tailor the response model to the scale and complexity of each incursion or detection.

Surveillance is a vital component of any MPI response. Targeted surveillance programmes such as the National Fruit Fly Surveillance Programme and the Marine High Risk Site Surveillance Programme may lead to a response being initiated, such as the 2016 Tau fly response and the clubbed tunicate (*Styela*) response at Picton in 2013. Surveillance is also used during a response to delimit the population, monitor progress and support other response activities including containment, management and eradication.

At the end of June 2016 the BRG was managing 40 high-priority responses and seven low-priority responses (i.e., cases where a full response was not initiated). In total, 18 new cases were initiated and 17 were closed or stood down over the previous 12 months (**Figure 2**). In addition, BRG manages responses to nine pest plant species as part of the National Interest Pest Response (NIPR) programme. The Group also manages responses in partnership with a range of stakeholders such as the Department of Conservation, regional councils and industry.

The length of a biosecurity response can vary from four weeks for short responses, to 10 years for some of the more complex cases.

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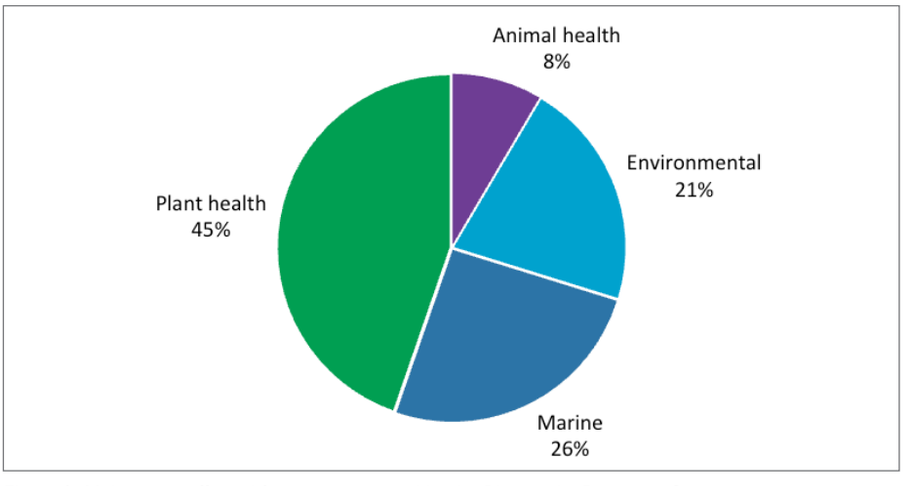

Figure 1: Main sector affected for cases managed by the Biosecurity Response Group, 1 July 2015 – 30 June 2016

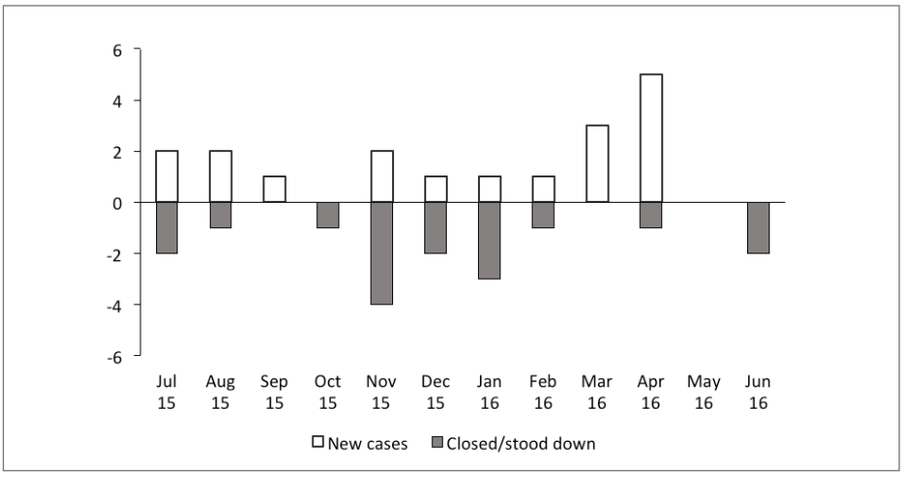

Figure 2: New cases initiated (positive bars in white) and cases closed or stood down (negative bars in black)

National Invasive Ant Surveillance Programme Annual Report 2016

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 (*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, 2016).

High-risk sites for ant entry are determined by pathway and site risk analyses undertaken annually. High-risk sites include seaports, airports, devanning sites, sea container storage 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**). GPS locations and associated data are recorded on hand-held data loggers. Samples are tracked electronically from the field to identification in the laboratory. Pottles are sent to the Flybusters Antiants Consulting Ltd diagnostic laboratory for initial identification. Suspect exotic ant specimens are sent to MPI's Investigation and Diagnostic Centres and Response (IDC&R) 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 2016 season, 44 601 pottles were deployed, with 11 pottles recording new exotic ants. Of these exotic detections, 10 were later confirmed to be independent incursions, and on one occasion the same exotic ant nest was detected as a result of ants being found in two sample pottles placed close together. After thorough searching, four of the 10 detections were confirmed to be from active nests.

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

Marine and freshwater investigations - continued from page 58

However, swim bladder aerocystitis is not uncommon in aquaculture and is associated in the literature with inflammation and infection. So the hypothesis that there was an infection and the swim bladder expanded into the muscle where there were ulcer-induced spaces to fill, is at least as credible, and in this case was considered to be the more likely explanation. No biosecurity risk was identified and the investigation was closed.

Reference

Diggles BK *(2003)*. Some pathological abnormalities of New Zealand fishes. *New Zealand Journal of Marine and Freshwater Research* 37, 705–713.

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The overall conditions from winter 2015 to summer 2016 were considered to be mixed in terms of supporting ant populations. In particular, the mild winter of 2015 (NIWA, 2015) must have encouraged general ant activity and nest expansion in early spring, but this is thought to have been counteracted by variable conditions in spring and summer, including several extreme weather events (temperature swings and numerous rainfall events throughout summer). Variable conditions, particularly temperatures, can interrupt or slow ant nest development and soil moisture deficits can also hamper some ant species. The mixed weather over January also meant that there were more weather interruptions than usual to NIAS field operations.

Four exotic species were recorded (**Table 1**), namely *Monomorium indicum, Paratrechina longicornis* (crazy ant), *Monomorium destructor* (Singapore ant) and *Monomorium* sp. All these ants and their associated nests were destroyed. The 2016 season again demonstrates the value of early intervention in preventing the establishment and spread of exotic ant species in New Zealand.

Table 1: Location and numbers of ant detections during NIAS, 2016

Species	Location	No. of nests found
Monomorium indicum	Christchurch International Airport	1
Monomorium destructor	Port of Wellington	0
Paratrechina longicornis	LPC City Depot Christchurch	0
Monomorium destructor	Port of Tauranga	1
Paratrechina longicornis	Ports of Auckland	0
Paratrechina longicornis	Ports of Auckland	1
Monomorium destructor	Port of Timaru	1
Monomorium sp.	Kmart Distribution Centre, Auckland	0
Paratrechina longicornis	NZL Container Services, Napier	0*
Paratrechina longicornis	NZL Container Services, Napier	0*
Paratrechina longicornis	Ports of Auckland	1

Figure 1: NIAS protein pottle deployed at the Ports of Auckland, with native *Iridomyrmex suchieri* workers foraging on bait

Figure 2: Surveying at the Port of Auckland during NIAS, 2016

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National Fruit Fly Surveillance Programme 2015–2016

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 the need for fruit fly treatments, 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 2015 earned $4.3 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, 2015).

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 (**Figure 1**). 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.

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**)

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. passiflorai* (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 the previous finds were found not to be from an established breeding population (as determined from heightened surveillance).

The February 2015 detection of a Queensland fruit fly population resulted in an extensive trapping programme and

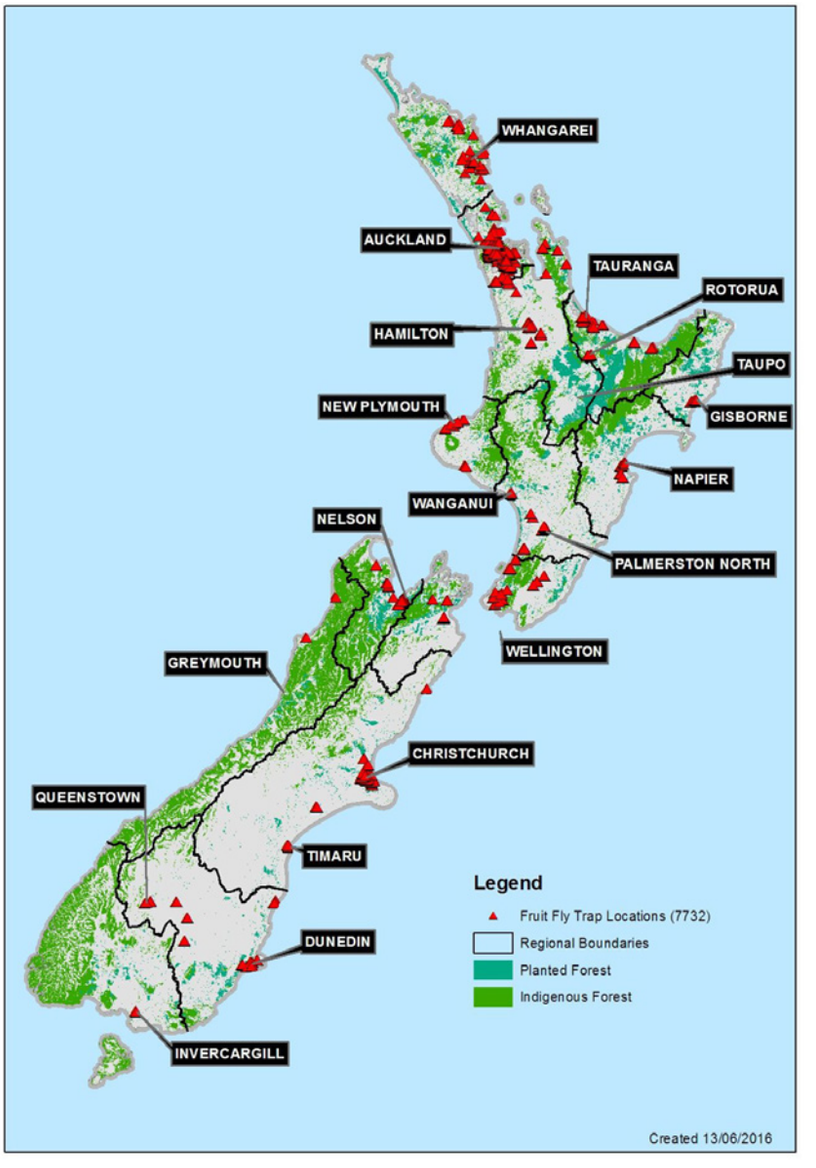

Figure 1: Map of New Zealand showing distribution of trap sites for fruit fly surveillance, 2015–2016

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

an organism management programme to eliminate the breeding population. Eradication was confirmed on 4 December 2015 and no further *B. tryoni* have been found since mid-March 2015. As a result of the recent Queensland and Tau fruit fly detections and the response to one breeding population, 27 additional fruit fly trapping sites have been added to the National Fruit Fly Surveillance Programme in Auckland and Northland regions.

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.

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 (IDC) for taxonomic identification.

Table 1: Numbers of traps and trap runs by region, 2015–2016 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**

Although the Fruit Fly Surveillance Programme season ran from mid-September 2014 until the end of June 2015, 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 14 September 2015 to 24 June 2016.

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 are 400 x 400 m, while those that

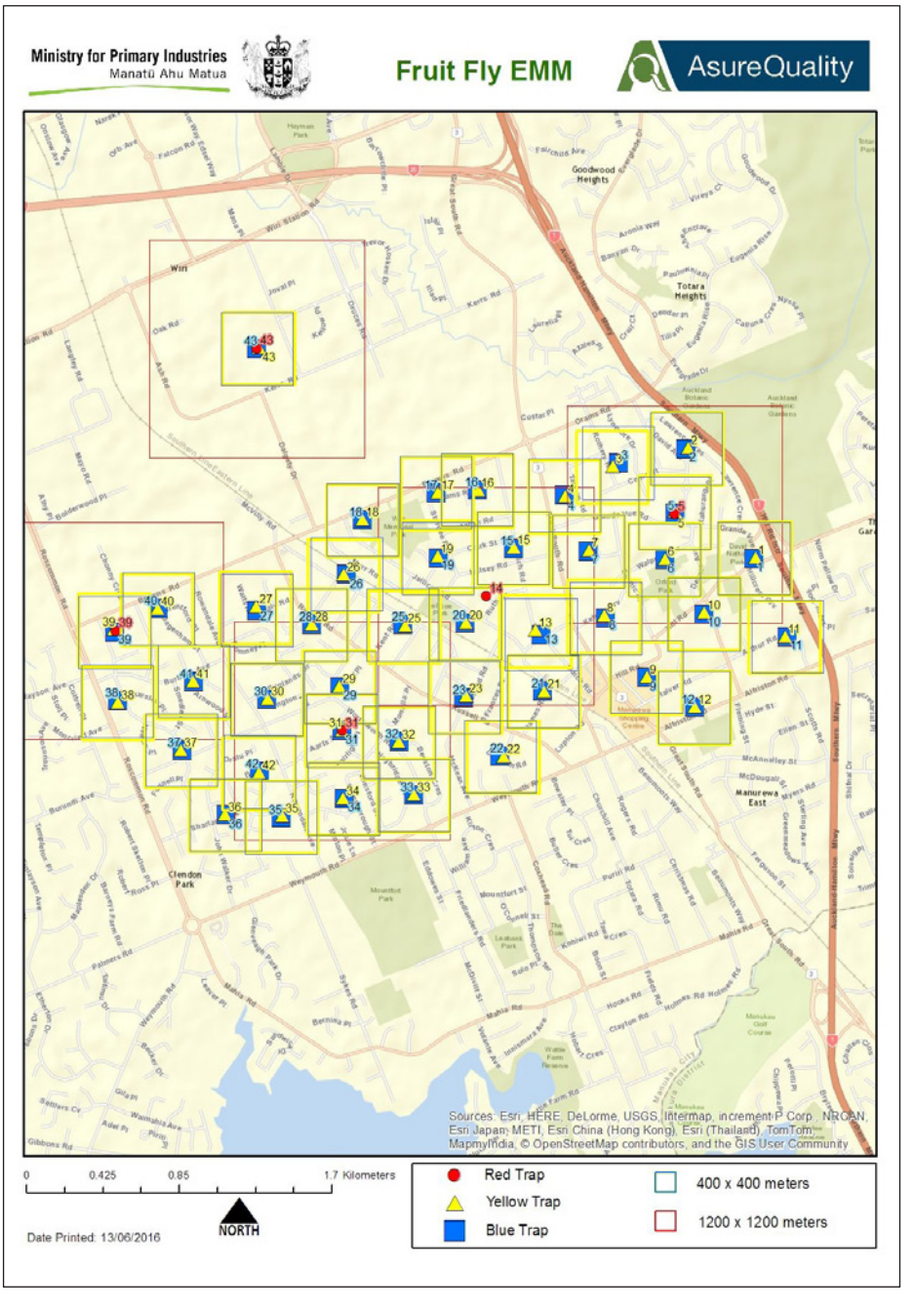

Figure 3: A grid made up of cells overlaid on an aerial photograph, showing the run of Queensland and Mediterranean fruit fly (yellow and blue) traps and Oriental fruit fly (red) traps in the southern suburbs, Auckland

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 southern suburbs of Auckland is shown in **Figure 3**.

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 from three to 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.

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

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 2015–2016 surveillance season was a success. The Auckland detection of a Tau fruit fly confirmed that the current trapping programme is working, and enabled early intervention and containment measures such as increased trapping density and fruit monitoring to be immediately put in place. No further Tau flies have been found, and as a result of this response four additional fruit fly trapping sites have been established in Auckland.

There were 2 795 routine submission events, with a total of 4 756 suspect fly samples. A further 30 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 fruit fly trap.)

Table 2 records that 4 756 suspect fly submissions were made. The Auckland and Northland regions recorded the highest number of suspect samples (1 815, or 38 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**).

More than half of the submissions (57 percent) were made from October to January (**Table 2**).

Table 2: Numbers of suspect submissions by region, 2014–2015 season

Month/ region	Auckland & Northland	Waikato & Bay of Plenty	lower North Island	upper South Island	lower South Island	Total
September 2015	254	34	33	47	0	368
October 2015	160	37	77	124	77	475
November 2015	193	25	98	206	130	652
December 2015	238	21	134	279	190	862
January 2016	299	26	100	160	125	710
February 2016	170	27	77	166	140	580
March 2016	167	41	70	111	120	509
April 2016	130	37	47	55	44	313
May 2016	102	9	29	26	19	185
June 2016	102	0	0	0	0	102
Total	**1 815**	**257**	**665**	**1 174**	**845**	**4 756**

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 January to March 2016 compared to the same time period in 2015 and 2014 is attributed to warmer temperatures and higher rainfall in 2016. This indicates that a trapping season from September to May/June sufficiently spans the period fruit flies are most likely to be caught.

As in past seasons, MPI favoured starting the surveillance programme in September to maximise the chance of detecting fruit fly incursions. 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.

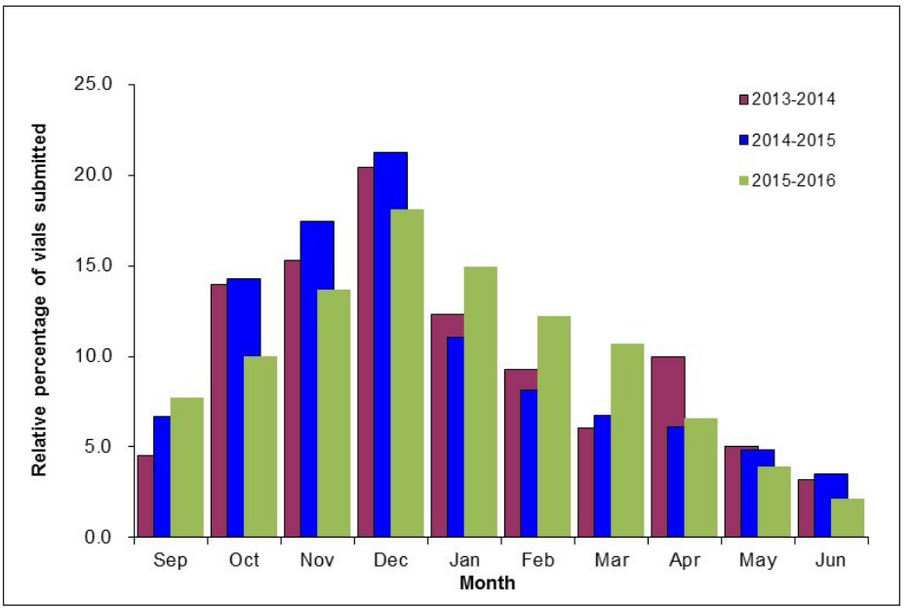

Figure 5: Fruit fly sample submissions by month and year.

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National Saltmarsh Mosquito Surveillance Programme 2015–2016

Mosquito Consulting Services (NZ) completed its contract with MPI in March 2016 for delivery of the National Saltmarsh Mosquito Surveillance Programme (NSP) and the process to select a new supplier was undertaken in 2015–2016. Mosquito Consulting Services (NZ) was again selected to continue delivering the NSP. This work is a continuation of surveillance that was begun in 2005 in response to an incursion of *Aedes camptorhynchus* (Southern saltmarsh mosquito – SSM) which was eradicated from New Zealand in July 2010. Continued surveillance is necessary because potential new risk pathways can be created in a dynamic physical environment with adaptable target species ecologies, new human enterprises and land-use changes.

The revision of the NSP specification was relatively minor, using much of the existing surveillance methodology and in many of the same locations surveyed as before. There were also changes to the weighting of a number of parameters on which surveillance effort is planned. The changes provide for a sharper focus on Transitional Facilities close to NSP surveillance sites (**Figures 1 and 2**). One change was to normalise the heavily weighted risk factor for NSP sites that previously were positive for SSM. Another change was to reduce the frequency of site visits to very-low-risk and remote saltmarsh habitat.

In 2015–2016 there were 11 194 mosquito larva and 2 938 adults from 10 species across five genera collected and processed for identification to species (**Tables 1 & 2**). This year's collection is numerically greater than the previous year's total of 8 758 larvae and 1 761 adults, but not significantly so. The long-term (2010–2016) NSP collection simple mean and standard deviation for larval and adult mosquito counts were 10 635 (s = 1 208) and 3 084 (s = 1 988) respectively (**Figure 3**). The 2015–2016 collections of larvae and adults are within one unit of standard deviation of these means. There were no unusually significant weather events recorded during the year strongly influencing background mosquito abundance.

Table 1: Larval mosquitoes identified, 2015–2016

Ae. antipodeus	714
Cx. pervigilans	10 001
Cq. irucunda	-
Ae. notoscriptus	17
Cx. quinquefasciatus	-
Ae. subalbirostris	287
Cs. tonnoiri	-
Ae. australis	101
Cq. tenuipalpis	-
Op. fuscus	74
Total	**11 194**

Table 2: Adult mosquitoes identified, 2015–2016

Ae. antipodeus	398
Cx. pervigilans	1 310
Cq. irucunda	828
Ae. notoscriptus	233
Cx. quinquefasciatus	44
Ae. subalbirostris	19
Cs. tonnoiri	95
Ae. australis	-
Cq. tenuipalpis	11
Op. fuscus	-
Total	**2 938**

Figure 1: Sampling saltmarsh mosquito habitat adjacent to a Transitional Facility

The consistency of the numbers collected each year partly reflects the consistent surveillance effort of the NSP, based on its calculated allocation of effort across a reasonably stable habitat. All of the 2015–2016 collection data was from sites designated under the previous contract specification, as with all previous years. Changes in the new contract now include increased surveillance for receptive habitat near high-risk Transitional Facilities (TFs) and these may change the annual collection norms in the future. The new contract increases surveillance effort in mosquito breeding habitats close to high-risk TFs. A habitat delimitation survey will be undertaken before November 2016 to re-define relevant NSP site boundaries. Future surveillance effort at these sites will be determined, based on the outcomes of the survey.

Adaptability in a changing world is a key capability of the NSP, to improve the probability of early detection of exotic mosquitoes exploiting New Zealand's largely unoccupied saline and associated brackish/freshwater habitats.

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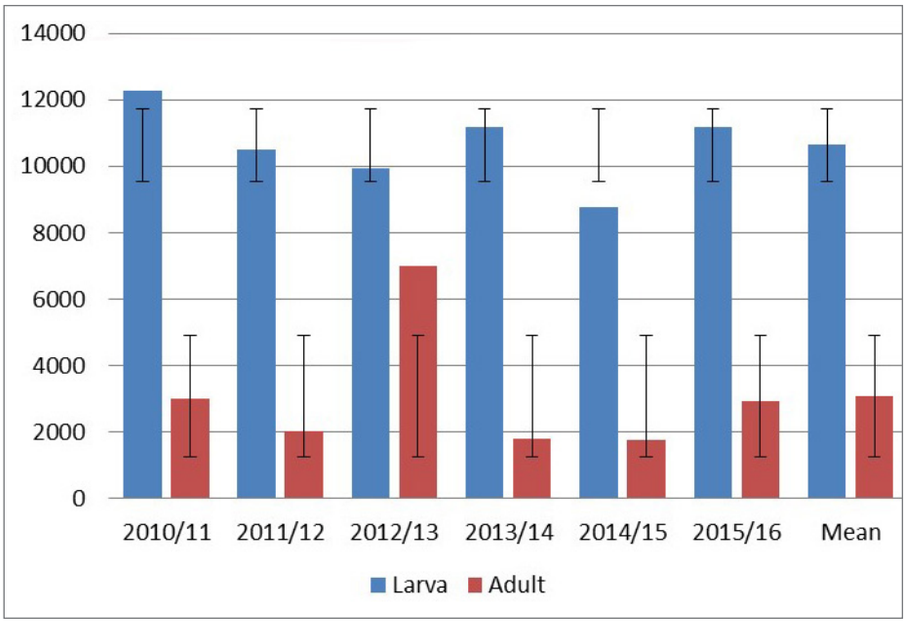

Figure 3: Annual NSP collection totals, mean and SD (bar)

Figure 2: Larvae observed in "dipper"

High risk site surveillance annual report 2015–2016

High Risk Site Surveillance (HRSS) is a post-border risk-pathway-focused surveillance programme operated by the Ministry for Primary Industries (MPI), targeting vegetation (primarily trees and shrubs) and wooden materials. The primary objective of the HRSS programme is to detect new plant pests that pose a biosecurity risk or may impact on trees and shrubs (e.g., 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 or cargo) and groups them into Risk Site Areas (RSAs) that include ports, Transitional Facilities (where containers are unloaded), tourist venues and golf courses, based upon identified clusters of sites. Relative risk and required detection probability 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 these transects. Suspect samples that may (in the opinion of the field surveyor) be a biosecurity risk are collected and submitted to the appropriate laboratory for identification. New records are recorded in MPI's Plant Pest Information Network (PPIN) database and reported for further appropriate action.

HRSS is administered by AsureQuality on behalf of MPI. SPS Biosecurity is responsible for most of the required field work throughout New Zealand and AsureQuality carries out surveillance in the Wanganui-Manawatu region. Methods used in the HRSS programme are further detailed in Stevens (2011).

Data collection for the HRSS programme is completely electronic, including the sample forms for submissions to Scion's Forest Health Reference Laboratory (FHRL). Everything is running smoothly and Scion's diagnosticians can pull up sample data electronically at the same time as they are inspecting the physical samples.

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. All risk sites and calculated risk are mapped in GIS. This enables better allocation of scarce surveillance resources and makes the programme more effective.

Probability of detection in the HRSS programme is based on Carter (1989). Using this model, it is clear that repeated surveys within RSAs increase the probability of detection. Additionally, as the risk of incursion is ongoing, repeated inspections mean incursions in a smaller population are increasingly likely to be found. For these reasons, the RSAs with the highest calculated risk were inspected up to four times during the survey season.

Results

Field surveillance

During the 2015–2016 season 403 RSAs were surveyed and 6 920 transect inspections were done. Most surveillance was carried out around Transitional Facilities or their associated vegetation-rich areas (VRAs) (90 percent of all transects).

Table 1 shows an example of calculated biosecurity risk compared to the actual transect inspections completed by region, for the 10 regions most at risk. It shows that Auckland has the highest biosecurity risk in the country; this is directly related to the volume of goods and passengers entering the country and/or being unloaded there.

Table 2 is a summary of the detection probabilities for the major risk ports. Detection probabilities have been maintained at previous levels and aligned with the calculated risk.

As part of surveillance the HRSS programme inspects more than a thousand species of tree. While production species are specifically targeted, many pests can be found on multiple hosts and in many areas there are no production species planted. To overcome this, a good cross-section of native and urban exotic tree species are also inspected. On average about 230 specimens of each species are inspected each year, and about 36 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 (IDC-PHEL) identified samples not associated with trees and

Table 1: Calculated regional risk compared with percentage of transect inspections completed in 2015–2016

Region	Calculated biosecurity risk (percent)	Completed transect inspections (percent)
Auckland	52	49.0
Bay of Plenty	12	11.3
Mid-Canterbury	11	8.4
Wellington	5	6.6
Hawke's Bay	5	3.6
Dunedin	4	2.3
Waikato	2	3.9
Southland	2	2.0
Nelson	2	1.8
Wanganui	1.0	1.6

Source: Kane *et al.*, 2016

Table 2: Summary of detection probabilities for the major risk ports, 2012–2016

Risk site	Mean detection probability 2012–2013 (percent)	Mean detection probability 2013–2014 (percent)	Mean detection probability 2014–2015 (percent)	Mean detection probability 2015–2016 (percent)
Port of Auckland	91	85	80	80
Auckland Airport/ Auckland Metro	89	88	82	88
Port of Tauranga	93	90	90	90
Port of Wellington seaport and Wellington Airport	55	60	66	66
Christchurch Airport	55	63	63	64
Port of Lyttelton	57	55	55	62

Source: Kane *et al.*, 2016

shrubs, or suspected of containing viruses, bacteria or nematodes and was responsible for validation for all new to New Zealand identifications.

From 1 July 2015 to 30 June 2015 the diagnostic labs were sent 841 submissions (**Table 3**). These were divided into potential risk organisms and identifications made from these specimens. Insect specimens and plant samples showing insect damage were the most common (52 percent of all identifications carried out during the year). Fungi were identified in 26 percent of samples. Of the remainder, many yielded inconclusive results so they were further processed by the pathology laboratory to rule out fungi as a cause of damage. In about one percent of all samples bacteria, viruses or nematodes were identified. In 21 percent of samples, no insect or pathogen could be found or identified. A total of 1 109 diagnostic identifications were made during the season, of which about 61 percent were identified to species level.

From the identifications a total of 140 PPIN reports were forwarded to MPI from FHRL. All species identifications made by FHRL were completed or fully evaluated within 15 days for their potential to be a biosecurity threat, and 95 percent of insect identifications were completed within 15 days. This is an improvement over last year.

The HRSS programme generated 125 sample submissions directly to the IDC-PHEL. In addition eight samples came via FHRL. In addition to the seven new to New Zealand PPIN reports, 19 PPIN reports were generated out of the submissions directly reported to IDC-PHEL.

Table 3: Identification types made by FHRL and PHEL, 2012–2016

Sample type	2012–2013 (percent)	2013–2014 (percent)	2014–2015 (percent)	2015–2016 (percent)
Entomology	47	61	61	52
Mycology	33	16	18	26
Inconclusive or other	20	23	21	22
Total	**100**	**100**	**100**	**100**

Source: Kane *et al.*, 2016

Table 4: Diagnostic trends from 2011 to 2015 (FHRL and PHEL)

Type	2011–2012	2012–2013	2013–2014	2014–2015	2015–2016
Submissions	740	1 106	860	651	841
Identifications	966	1 627	1 154	896	1 109
New to NZ	5	6	2	0	7
Significant to PPIN	147	228	153	135	159
Significant detections (percent of total submissions)	20	21	18	21	20

Source: Kane *et al.*, 2016

FHRL and PHEL both reported that submission quality from the field was of the same high standard as last year.

Discussion

Numbers of significant samples identified provide one measure of the effectiveness of any surveillance programme. **Table 4** shows the number of samples received and significant identifications (either new to New Zealand, new host associations or new distributions) made from 2011 to 2016. The number of new to New Zealand species detected is the highest in the last five years.

Conclusion

As demonstrated by the number of significant detections reported to MPI, the HRSS programme continues to provide effective detections of plant pests that potentially pose a biosecurity risk. The proportion of submissions classified as "significant to PPIN" has been maintained at the level achieved over the last five years. The number of new to New Zealand species reported via this programme has increased and is the highest it has been in the last five years. As the majority of new to New Zealand organisms found were species new to science, and are most likely native, their discovery indicates that changes in the focus of the programme are increasing the likelihood of effective detections.

The efficiency of the programme continues to be demonstrated by the ability to allocate surveillance resources to areas of known risk magnitude and with calculated detection probabilities for the highest-risk sites.

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Gypsy Moth Surveillance Programme annual report 2015–2016

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.

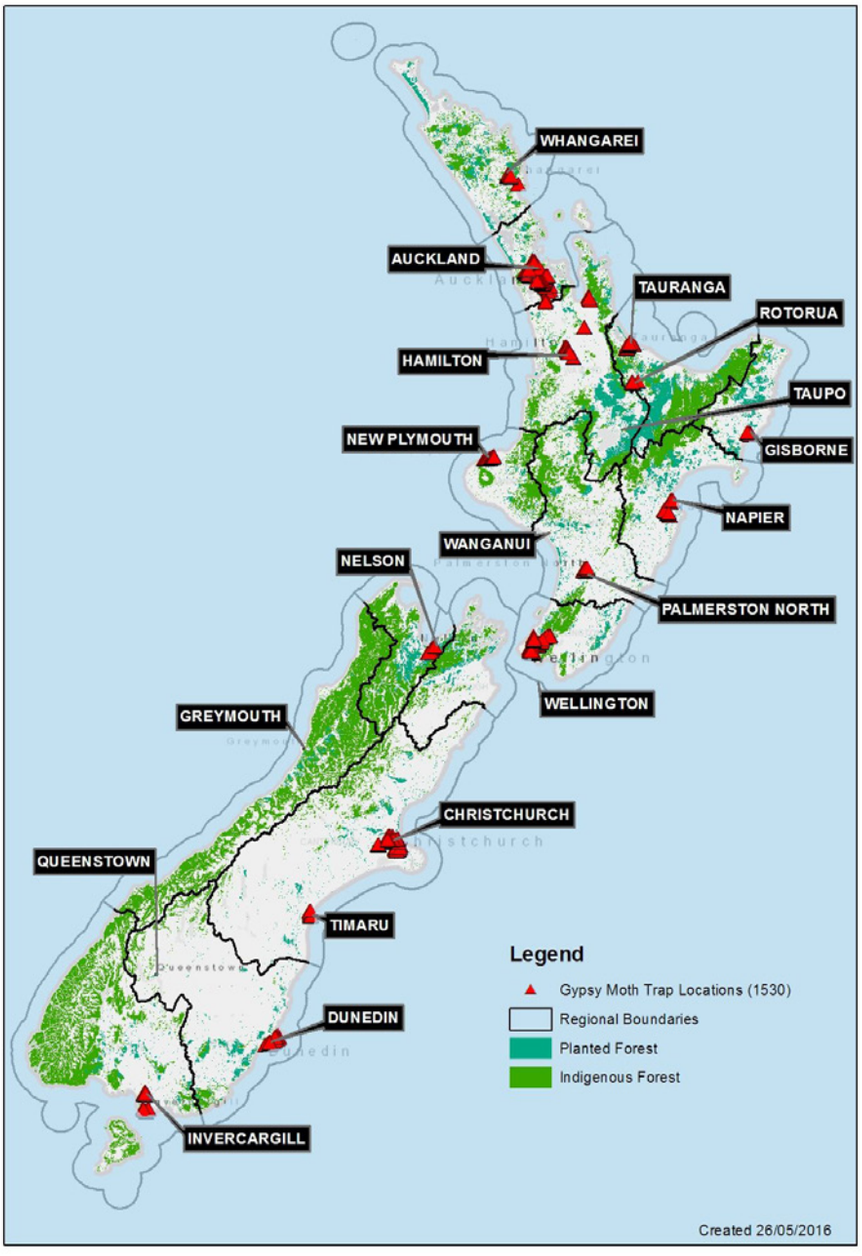

Figure 1: Map of New Zealand showing distribution of trap sites for gypsy moth surveillance 2015–2016

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

Trapping

The surveillance season for 2015–2016 ran from mid-October to the beginning of May. As usual, pheromone traps were placed in cells making up a grid that was 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 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 both 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 19 October 2015 to 4 May 2016. The number of traps per run ranged from four to 81 (mean = 44), with a total 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 this year the number of traps in a trap run varied from four to 81. 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 21 000 trap servicing/ inspection events.

In total there were 165 suspect moths submitted. The lower North Island recorded the highest number of submission events (56, or 34 percent of the total) and the highest number of suspect moths (62, or 38 percent) (**Table 1**).

The largest fraction of submissions (41 percent) was made during November and December (**Figure 4**).

The relative percentage of sample submission events made per month over the trapping season is shown in **Figure 4**. The majority of submissions are from November to January, with about 41 percent of the total being made in those two months alone. The number of samples submitted diminishes in autumn (April).

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

Table 1: Numbers of submission events and suspect samples submitted during the 2015–2016 surveillance season, by region

Region	Number of submission events	October 2015	November	December	January 2016	February	March	April	Total
Auckland/ Northland	35	1	8	5	6	5	6	6	37
Waikato/Bay of Plenty	24	5	4	5	1	3	3	5	26
Lower North Island	56	5	19	9	12	7	6	4	62
South Island	36	2	3	15	5	5	8	2	40
Total	**151**	**13**	**34**	**34**	**24**	**20**	**23**	**17**	**165**

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

Table 1 shows the number of samples submitted each month by region. The lower North Island consistently provides the most submissions almost every month, with the exception of the South Island in December and March.

No gypsy moths or new exotic moth species were found during the entire season. All moth specimens seen were native or species that have been established in New Zealand for some time. Because these species are not relevant to the GMSP, submissions are no longer identified to the family level.

Five gypsy moth traps were added to the programme at the beginning of the 2015–2016 trapping season in the Orakei area of central Auckland. This was as a result of reviewing the trapping grid at the Auckland port during the 2014–2015 trapping season.

The 2015–2016 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 sampling was robust.

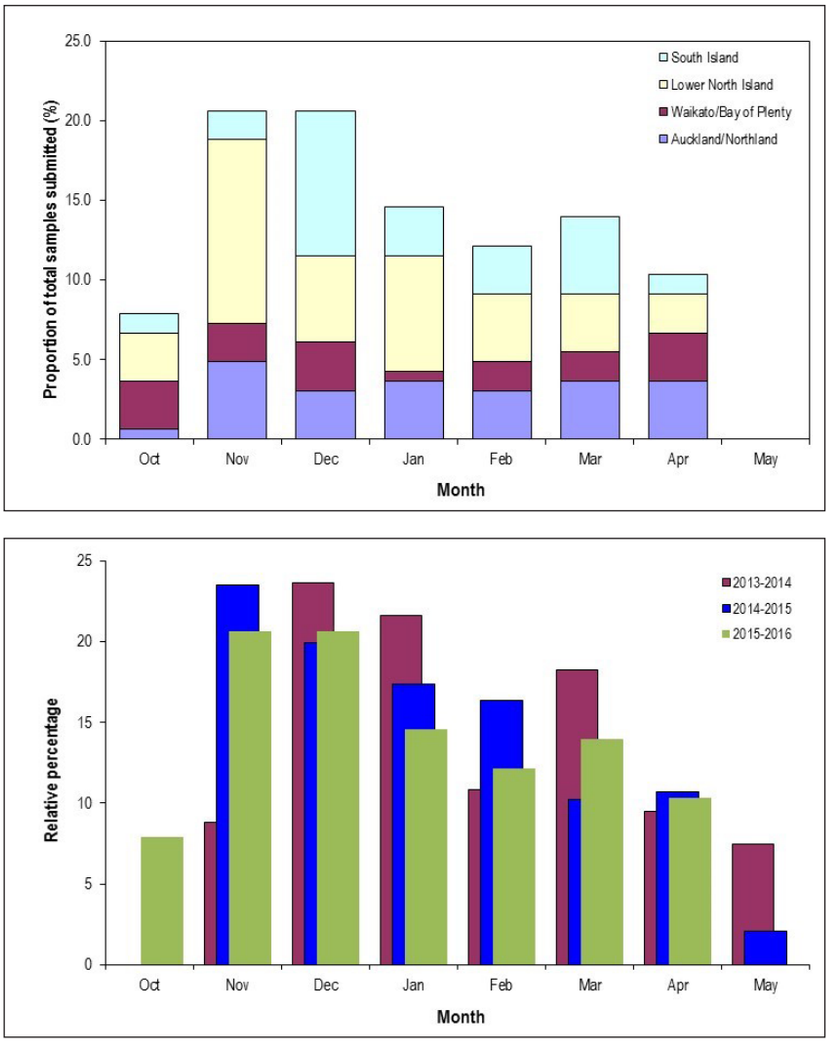

Figure 4: Percentage of gypsy moth sample submission events by month

Acknowledgements

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Plants and environment investigation report

The Ministry for Primary Industries' (MPI) Incursion Investigation (Plants and Environment) and 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 with regard to 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.

New to New Zealand plant at Auckland Domain

A sample of an unrecognised plant found in the Auckland Domain Wintergardens was sent to the Landcare Research Allan Herbarium at Lincoln for identification. The plant was determined to be a member of the family Acanthaceae but could not be identified to genus or species. It was subsequently sent to Ecogene for molecular identification and was identified as belonging to the genus *Pseuderanthemum,* but it could not be identified to species level without reference material. Herbarium staff compared the sample against five voucher specimens of *Pseuderanthemum* spp. and against various reference keys, but still could not complete the identification. There was uncertainty as to the origin of the plant and whether it had been confined to the Wintergardens orchid house for some time and had not established elsewhere. A further sample was submitted, which this time was able to be identified from its flowering parts as *Pseuderanthemum variabile*, which is exotic to New Zealand and native to Queensland and the Northern Territory, Australia. It also occurs in New Guinea and New Caledonia. This species is a tropical rainforest plant and unlikely to establish outside of greenhouses in New Zealand. The NZ climate is unsuitable and this plant species has failed to set flowers outside glasshouse conditions in Auckland. Nevertheless, to mitigate any biosecurity risk the plant and growing medium were destroyed.

Ants found through National Invasive Ant Surveillance Programme (NIAS)

A number of invasive ants were found during NIAS at ports and Transitional Facilities last summer (see also NIAS annual report, p. 60). A species of tramp ant, *Paratrechina longicornis* (known as the crazy ant) was found at a Transitional Facility that processes empty shipping containers in Christchurch. MPI sent its service provider Flybusters Ltd to the site to determine the nature of the interception. A small number of *P. longicornis* workers were seen and caught with baited traps. Attempts were made to locate the nest by surveying a wider area of suitable ant habitat. Baited traps did not yield any more exotic ants, but as a precaution the area of the original detection was treated with a residual insecticide and toxic baits were set up in favourable habitat. A follow-up visit was made and no further exotic ants were found at the site.

Tramp ants were also found at the Ports of Auckland, at the base of an electrical utility building on land that had been previously subjected to prophylactic baiting treatment after an earlier tramp ant detection. Again, Flybusters visited the site to undertake urgent measures to mitigate the biosecurity risk. Although there was plenty of ant habitat, no ants recruited to toxic baits laid on site. The area and building were sprayed with a residual insecticide as a precautionary measure. A long-term trapping device (a modified pitfall trap that sits on the concrete surface) failed to catch any exotic ants over two weeks and nor were any ants seen during the site visit. The combination of precautionary insecticide treatment and prophylactic baiting should have eliminated any exotic ants that may have been present.

In a separate incident, a nest of *P. longicornis* was found at the Ports of Auckland in a joint between concrete slabs in a barrier wall. From the level of activity the nest size was determined to be very small, with a single queen and no more than 30 workers. The area was sprayed, bait stations were set and a modified pitfall trap was deployed to see whether any more exotic ants were present. No ants were found on a follow-up visit two weeks later, and on further checking no ants of any kind were seen in the area. This indicated that the nest had been successfully eradicated.

Monomorium destructor (Singapore ant) was found at Mount Maunganui. This find was unusual in that the nest was located well outside of the port facility and near the outer limit of the buffer zone (surveillance risk area), under a floodlight on a traffic island garden at the intersection of Maunganui Rd and Rata St – a commercial shopping zone about 100 m from the actual port. It is common for this species to be attracted to electrical fittings. The nest site and the surrounding area were treated with a residue insecticide and toxic bait. A follow-up visit was undertaken and no exotic ants were found.

There was another detection of *M. destructor* further south, at the Port of Timaru, in a container storage yard close to the southern boundary. Worker ants were seen around the lamp pole base, which was treated with a residual insecticide and toxic bait. A follow-up inspection was undertaken and there were no signs of exotic ants present.

Ghost ant found near Auckland

MPI received a report of single suspect *Tapinoma melanocephalum* (ghost ant) from Puketutu Island, Auckland. The notification was made by an entomologist who was screening midge-survey collections made in 2012. The single specimen of this exotic ant was found as by-catch among samples collected by foliage-beating, and the identification

was confirmed by MPI's Plant Health and Environment Laboratory. A site visit was undertaken to determine the extent of the population, and attractant bait was laid in areas conducive to ant activity. No more ghost ants were found, but despite the cooler temperatures other ant species were very active so that if *T. melanocephalum* had been present, it ought to have been attracted by bait. A second survey was undertaken during the summer NIAS, this time under more favourable conditions, to confirm whether a population of ghost ants existed. Again, attractant baiting yielded no exotic ants so the case was closed.

Aquatic plant pests ruled out

A notifer suspected didymo in a creek in one of his paddocks in the Whanganui area. Didymo (*Didymosphenia geminata)* is an aquatic algal pest that is currently found in more than 150 South Island rivers but is unknown in the North Island. The entire South Island is a Controlled Area, meaning that people are legally obliged to prevent the spread of didymo. The specimen seen was described as orange/brown slime attached to a rock-bed substrate. A sample was sent to the National Institute of Water and Atmospheric Research (NIWA), where it was identified as *Gomphoneis herculeana*, a diatom already established in NZ. No action was needed as the diagnosis ruled out didymo and other exotic aquatic pests.

A man camping adjacent to Brown River, Rai Valley, Marlborough, noticed an unusual plant while diving in the river and thought it looked like hornwort (*Ceratophyllum demersum*). This is an invasive aquatic plant that has recently been eradicated from the South Island. He sent photos to a NIWA aquatic plant specialist, who identified it as *Elodea canadensis* (Canadian pondweed), which is widely established in New Zealand. The case was closed as there was a negative diagnosis for hornwort and other exotic aquatic plant pests.

Stinging ants reported

Two members of the public reported being stung by unusual-looking insects at Kinloch, Taupo. In the first case, the caller had never seen these insects before but said they looked like ants. He reported a burning sensation after being stung. In the second case, red rashes developed around the area of the bites. The species in both cases was identified as the crypt ant *Hypoponera eduardi*, an introduced tramp species that is well established in New Zealand. It is widespread in the North island and top half of the South Island, not considered to be a pest, and has been established in New Zealand since the late nineteenth century (Don, 2007) .

Reference

Don, W (2007). Ants of New Zealand. Dunedin: Otago University Press. 239 pp.

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Pest watch: 11 May – 30 June 2016

Biosecurity is about managing risks: protecting New Zealand from exotic pests and diseases that could harm our natural resources and primary industries. MPI's Investigation & Diagnostic Centres and Response (IDC & R) 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 11 May 2016 to 30 June 2016. 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	*Harmonia axyridis (harlequin ladybird)*	Associated with giant willow aphids on *Salix*	Auckland and Bay of Plenty	IDCR (General Surveillance)	Native to Asia but introduced to a number of countries around the world most recently Europe and South Africa.

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

- AUCKLAND
  Courier: NZCCM, Gate 2, Auckland Zoo, Motions Road, Western Springs, Auckland 1022
  Postal: PO Box 44 422, Point Chevalier, Auckland 1246

- 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

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

0800 80 99 66

Investigation and Diagnostic Centre – Wallaceville
66 Ward Street
Upper Hutt
Tel: 04 526 5600

Investigation and Diagnostic Centre – Tamaki
231 Morrin Road
St Johns
Auckland
Tel: 09 909 3568

Investigation and Diagnostic Centre – Christchurch
14 Sir William Pickering Drive
Christchurch
Tel: 03 943 3209

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