Surveillance

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INSIDE:

Quarterly report of investigations of suspected exotic disease
Plants and environment investigation report
Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases

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Ministry for Primary Industries
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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

Biosecurity surveillance continuing to play a critical role in New Zealand's biosecurity system



The newly appointed Director General, Ray Smith, has just released his first strategic plan. A focus of the plan is to support the food and primary industries by continuing to deliver exceptional support to the sectors and make some changes within MPI to make us easier to engage with. MPI's focus is on delivering four key outcomes for New Zealanders: prosperity, sustainability, protection and visible leadership. *Biosecurity 2025* acknowledges that we are all part of a biosecurity team of 4.7 million – we all have a role to play in protecting our livelihoods, lifestyles and unique environments. New Zealanders need to be engaged and active, and the campaign *Ko Tātou This Is Us* (thisisus.nz) was launched almost a year ago to help achieve that. *Biosecurity 2025* sets out to build a biosecurity team of 4.7 million New Zealanders, since it takes all of us to protect Aotearoa. *Ko Tātou This Is Us* aims to connect all biosecurity participants and existing programmes and activities across the system, while also encouraging more programmes to emerge.

The Biosecurity Surveillance and Incursion Investigation group is invested in this strategy, being primarily focused on protection, i.e. ensuring that New Zealand is protected from biological risk. Surveillance is a critical component of our multi-layered biosecurity system and underpins a wide range of decision-making and intervention measures within this system. These include, but are not limited to, early detection of new pests and diseases, determination of pest or disease freedom status for official assurances to trading partners, and contributing to our understanding of the distribution and prevalence of established biological risk to inform the management of, and to minimise, their impacts. To achieve those outcomes the group administers a number of nationally targeted surveillance programmes for pests or diseases that could affect native and exotic plants and animals, biodiversity, amenity values, human health, terrestrial environments, marine environments, our lifestyles and our cultures.

The following are some examples of recent targeted surveillance programme successes.

Culex sitiens

In February 2018, the National Saltmarsh Mosquito Surveillance programme discovered *Culex sitiens* larvae (a notifiable and unwanted species) in a small pool in marshland adjacent to Kaipara Harbour. Confirmation by Biosecurity New Zealand's Plant Health and Environment Laboratory immediately resulted in a biosecurity response being initiated. Treatment to kill larvae with Vectobac (Bti) in the detection site and surrounding area was undertaken. An extensive delimiting survey revealed further larvae in another small pool more than 1 km away, which was also treated with Vectobac, with three rounds of aerial spraying out to 5 km from the initial detection sites during summer 2019. Ongoing surveillance has not revealed any further evidence of the mosquito, and it is anticipated that if no more are found, Biosecurity New Zealand will consider declaring the species eradicated in March 2020. Further information is in the programme's annual report (p. 87) and available at biosecurity.govt.nz/protection-and-response/responding/alerts/culex-sitiens/

The National Invasive Ant Surveillance Programme

This season's National Invasive Ant Surveillance programme deployed 40,998 traps across New Zealand, from which 19 exotic ant detections were made, in Opua Marina (Northland), Auckland, Tauranga, Napier, Christchurch, Timaru and Otago seaports and airports, and in Transitional Facilities. Fifteen "urgent measures" responses were initiated by Incursion Investigators to immediately mitigate the biological risk. Follow-up inspections found that 11 of the detections were associated with established ant nests. All the exotic ants and associated nests were treated and eradicated, at a cost of about $29,000. This clearly highlights the cost-benefit of investing in surveillance for early detection – considering that $8.6 million was spent over 3 years to eradicate the red imported fire ant incursion (2006) in Whirinaki, Napier.

Fruit fly detections

The National Fruit Fly Surveillance programme detected a Queensland fruit fly, *Bactrocera tryoni* (QFF) in Devonport, Auckland. A response was immediately initiated and further surveillance resulted in several more detections of male flies in the nearby suburb of Northcote. To date there has been no evidence of a breeding population (larvae or female flies), and response activity is ongoing. See the annual report (p. 83), also biosecurity.govt.nz/protection-and-response/responding/alerts/fruit-flies/queensland-fruit-fly/.

This surveillance programme also detected a single male facialis fruit fly (*Bactrocera facialis*) in a trap in Otara, South Auckland. A response to this find was initiated alongside the QFF response, and two more male flies were found. Further surveillance throughout the summer yielded no more flies and

this response was stood down. See biosecurity.govt.nz/protection-and-response/responding/alerts/fruit-flies/bactrocera-facialis-fruit-fly/.

This edition of *Surveillance* includes annual reports that provide a useful overview of all Biosecurity New Zealand's targeted surveillance programmes, as well as many examples of investigations in response to general surveillance notifications to the Incursion Investigation team. These can be seen in the relevant sections that report on animal health surveillance (p. 5) and animal disease investigations (p. 56), marine surveillance (p. 60), aquatic and environmental health surveillance (p. 66), investigations of suspect exotic marine and freshwater diseases (p. 67), and plant health surveillance and incursion investigations (p. 71). It also includes annual reports on many other important programmes and activities that contribute invaluable information toward New Zealand's health status.

The volume of notifications and subsequent investigations undertaken as part of our general surveillance system has been steadily increasing over recent years. This is the result of changing biosecurity risks, increasing trade and tourism, increases in ecommerce, and heightened awareness of biosecurity threats among the general public and international travellers, science communities and workers in primary industry. This is also due to the success of the *Ko Tātou This Is Us* campaign (an outcome of the *Biosecurity 2025* programme). These changes have placed more pressure on those working in the general surveillance system. The general surveillance system has been well described in *Surveillance* previously (Tana, 2014). While that article focused on animal health, the description of this critical component of the biosecurity system is relevant across all sectors, including plant health, aquatic and environment health and risk goods. The need to address this pressure and further strengthen the general surveillance system was recognised in the 2019–2020 Budget, with the Crown approving additional funding for new Incursion Investigators and diagnostics capacity ($6.75 million over 4 years) and for improved community engagement ($1.77 million over 4 years). This additional funding will help raise biosecurity awareness among community groups and individuals. These initiatives will seek to improve the quality of notifications of suspected exotic pests and diseases submitted to MPI.

Work has already been undertaken to further engage with targeted members of the general public, including Māori, and intermediaries (e.g. experts, industry representatives, regional councils and community groups) to improve the quality of reporting in the general surveillance system.

Using the unifying brand *Ko Tātou This Is Us*, the funding for these resources will enable us to further develop and implement this new engagement approach and to both measure the effectiveness of, and adapt, these initiatives to improve the general surveillance system.

In closing I would like to acknowledge and thank everyone who has contributed to *Surveillance*, both past and present. You have all contributed to making this a high-quality, valuable publication that remains the authoritative source of information on biosecurity surveillance activity and the health status of our terrestrial and aquatic animal and plant populations. I particularly wanted to recognise and thank the outstanding, but often unrecognised, effort put in by *Surveillance* technical editors, Dr Jonathan Watts and Dr Lora Peacock. They work hard behind the scenes to ensure that this remains a high-quality and relevant publication, and that it is delivered on time.

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International animal trade

Risk analysis

The Ministry for Primary Industries (MPI) Animals and Aquatic Risk Analysis Team has the primary function of developing science-based biosecurity risk assessments that support the development of import health standards (IHSs), which govern how risk goods (e.g. animals and animal products) are to be safely imported into New Zealand. Where requested by the Animal Imports Team, the Animals and Aquatic Risk Analysis Team also provides technical advice to support amendments to IHSs as needed.

The team also supports post-border activities such as surveillance, animal disease emergency readiness, incursion response and risk advice for the Government Industry Agreement (GIA) by providing science and technical advice and risk assessments. The team works with internal and external stakeholders by identifying and characterising emerging animal health and aquatic health biosecurity issues, suggesting risk management options and reporting on them.

The process of drafting risk analyses includes internal and external peer review, with the draft risk analysis including options for managing any hazard. Draft risk analyses are published on the MPI website, and IHSs are subsequently developed from them.

Import risk assessments (IRAs), rapid risk assessments (RRAs), and technical advices completed during the 2018-2019 financial year are published on the MPI website at mpi.govt.nz/importing/overview/import-health-standards/risk-analysis/ and were as follows:

RRA to evaluate the change in risk profile from importation of bovine germplasm

RRAs: *Mycoplasma bovis* in bovine semen (2019) and *M. bovis* in bovine in-vivo-derived and in-vitro-produced frozen bovine embryos (2018)

An IRA for cattle germplasm from all countries was completed in 2009 to assess the risk posed by pathogenic agents associated with importing cattle semen and embryos. This risk assessment concluded that the risk estimate for exotic mollicutes including *M. bovis* was non-negligible[1] and risk mitigation measures were implemented.

Following the detection of *M. bovis* in a dairy herd in the South Island in July 2017, and subsequent efforts to eradicate *M. bovis* from New Zealand, qualitative rapid risk assessments were conducted to re-assess the risk of *M. bovis* associated with the importation of bovine semen and in-vivo-derived and in-vitro-produced bovine embryos from any country.

These RRAs considered new evidence of transmission of *M. bovis* in semen and embryos. The RRAs also considered eradication costs and societal impacts when estimating the risk. Both RRAs found that the risks from *M. bovis* in semen and embryos to be non-negligible and propose additional risk mitigation measures.

IRAs: Enzootic bovine leucosis virus (BLV) and *Campylobacter fetus* ssp. *venerealis* (Cfv) (2019)

The IRA for cattle germplasm from all countries (2009) also assessed the risks from BLV and Cfv associated with the importation of bovine semen and embryos. These pathogens were assessed to be hazards in this IRA. The IRA regarded BLV and Cfv as endemic in New Zealand at that time.

MPI's passive surveillance system has had no confirmed reports of BLV since 2008, nor Cfv since 1992. These were added to the New Zealand Biosecurity (Notifiable Organisms) Order in 2016. BLV and bovine genital campylobacteriosis have been absent since 2008 and 1993 respectively from both national dairy and beef herds.

In 2019, an IRA was developed in response to a request from the Animal Imports Team to review the risk of BLV and Cfv associated with the importation of bovine semen and in-vivo-derived and in-vitro-produced embryos. Both BLV and Cfv were considered to pose non-negligible risks in imported semen, and risk management measures were suggested. However, they were considered to pose negligible[2] risks in bovine in-vivo-derived and in-vitro-produced embryos, and risk management measures were not justified.

RRA: Formalin/alcohol preserved molluscs containing pearls (2018)

The risk analysis competed in 2005 for non-viable biological products, micro-organisms and other viable cells determined that non-viable low-risk biological products could be imported without restriction. The IHS (INESSPEIC.ALL) based on this risk assessment allows for the unrestricted importation of non-viable biological products identified as low-risk organisms.

The Animal Imports Team requested advice to confirm that this IHS is appropriate for importing molluscs preserved in formalin/alcohol and containing cultured pearls grown in fresh or salt water. In this RRA, pathogens identified in the preliminary hazard list were assessed as unlikely to remain viable in a vacuum-packed formalin/alcohol mixture.

IRA: Crocodilia from Malaysia, Singapore, Indonesia, Thailand, Papua New Guinea, northern Australia and the European Union (2019)

This qualitative risk analysis considered biosecurity risks associated with the importation of captive hatched and reared saltwater and freshwater crocodiles. From a preliminary list of potential diseases of concern associated with crocodilians, 16 were identified as hazards. Of these, seven were assessed as negligible risks on the basis

1 Non-negligible risk is defined as worth considering; significant

2 Negligible risk is defined as not worth considering; insignificant

of demonstrated host specificity. The remaining nine organisms were subject to risk assessment and three of them were assessed as moderate risks. Risk mitigation measures were suggested.

IRA: Eviscerated or trunked fish for human consumption (2019)

This is an IRA for non-viable fresh, chilled or frozen fish intended for human consumption, sourced from all countries. Commodities include eviscerated teleosts (bony fishes) and "trunked" (headed, gutted, fins and tail removed) elasmobranchs (cartilaginous fishes) and their products (including minced, salted, smoked or mechanically recovered fish) imported for human consumption. These fish could be sourced from fresh, brackish or marine waters in any country.

This IRA considered 569 potential hazards, of which 20 viruses or viral species complexes, 13 bacterial pathogens or species complexes, three fungal and four microsporidean pathogens, and five groups of metazoan pathogens, were identified as representing a non-negligible risk and risk management options were proposed.

Crustaceans for human consumption (2018)

This is an IRA for non-viable crustaceans intended for human consumption. They may be imported into New Zealand chilled, frozen or processed.

This IRA considered 141 organisms (or groups of organisms) of concern, based on expert advice and the scientific literature. A preliminary list of potential hazards included 141 organisms (or groups of organisms), of which 25 (including two zoonotic species) were identified as requiring risk assessment. Four of these were assessed as presenting a non-negligible risk.

Technical advice

The Animals and Aquatic Risk Analysis Team also provided technical advice to help develop a number of import health standards:

- bovine viral diarrhoea virus type 2 in bovine semen and in-vivo-derived embryos from European Union member states, and BVDV in cervine semen from all countries (September 2018);
- response to an inquiry from Deer Industry New Zealand regarding detection of chronic wasting disease in deer in Finland (November 2018);
- risk of Angara disease as a result of increasing the egg content in imported mayonnaise (November 2018);
- effectiveness of novel non-topical external parasiticides on ticks and fleas and the ability to block transmission of vector-borne diseases of relevance (March 2019);
- consumer-ready aquatic animal products for human consumption (April 2018);
- shelf-stable fish bait (April 2019); and
- ornamental fish mortalities in quarantine: *Gymnogeophagus balzanii, Thorichthys meeki, Corydoras* spp., *Capoeta tetrazona* and *Epalzeorhynchos frenatus*).

Animal imports

The MPI Animal Imports and Animal Trade (Imports) teams are responsible for developing and amending IHSs that stipulate biosecurity requirements for importation of live animals, germplasm and animal products. The teams also provide 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. The imports teams are responsible for issuing these permits, and 3,255 permits were issued during 2018 (**Table 1**). The number of permits is not necessarily related to the volume of trade: for example, a single permit might be issued for several horses.

Numbers of live animal imports in 2018 are listed in **Table 2**. These are estimates based on importers' stated intentions and may differ from the numbers actually imported.

Table 1: Number of import permits issued by Animal Imports Team, 2018

Category	Product type	
Animal products	Animal feed	29
	Animal product	105
	Bee	15
	Dairy	2
	Egg	12
	Equine	2
	Fibre	13
	Fish	10
	Hides/skins	4
	Meat	6
	Porcine	27
	Poultry	1
	Wool	1
	Total	**227**
Biologicals	General	330
	Restricted	183
	Total	**514**
Embryos	Bovine	18
	Laboratory animals	2
	Ovine	14
	Total	**35**
Live animals	Bovine	0
	Butterfly	4
	Caprine	5
	Dog/cat	63
	Dog/cat – quarantine	1,876
	Equine	24
	Fish	10
	Hatching eggs	9
	Insect	4
	Invertebrate	79
	Laboratory animals	54
	Marine invertebrates	7
	Ovine	3
	Rabbit	3
	Small animals	2
	Zoological	23
	Total	**2,167**
Semen	Bovine	99
	Canine	5
	Caprine	2
	Equine	21
	Ovine	17
	Zoo animals	3
	Total	**147**
Transit	All	165
	Total permits issued	**3,255**

Table 2: Live animal imports by species, 2018

Species	
Alpacas	47
Fish	31,461
Cats	1,733
Zoo animals	12
Dogs	4,191
Horses	1,582
Guinea pigs	24
Invertebrates	11,487
Laboratory animals	1,516
Ovine	5
Rabbits	3
Total	**52,061**

The following is a summary of new or amended IHSs issued during 2018.

Poultry hatching eggs and specific-pathogen-free chicken eggs

This IHS was re-issued on 4 October 2018. It was updated to reflect the change in the name of the Transitional Facility standard.

Egg products

This IHS was issued on 23 January 2018. It combines all egg-product IHSs into a single IHS and includes types of products not previously included.

Semen from zoo Asian elephants

The IHS was amended to include semen from approved zoos in the European Union. This amendment was made at the request of the New Zealand zoo industry, and re-issued on 10 April 2018.

Third-country processing

This IHS was reissued on 5 November 2018. The amendment was to incorporate a country approval process and clarify import requirements for animal products that have undergone third-country processing.

Exports of live animals and germplasm

Export figures for live animals and germplasm for 2018 are presented in **Tables 3 and 4**.

Table 3 compares live animal and germplasm exports from 2009 to 2018, and **Table 4** shows the global distribution by region, of exports for 2018.

There is continued growth in exports of poultry day-old chicks, with higher export volumes than in 2017. In total, 2,838,496 day-old chicks were exported in 2018 (**Table 3**). Hatching-egg exports decreased by just over 2 million in 2018, to a level more consistent with the period from 2014 to 2016 (**Table 3**).

There has been a significant increase in the exports of bumble bees to Asia, with 11,500 exported in 2018 (**Table 4**). While the demand for honey bees remains, in particular from Canada, continued poor weather in New Zealand meant fewer bees were available for export.

Bovine semen exports were slightly lower than the previous year, but remain strong (**Table 3**).

Live cattle exports have continued to fall since the 2014 peak of just over 85,000, and 17,319 animals were exported in 2018 (**Table 3**). Most of the cattle exported in 2018 went to China (**Table 4**).

Table 3: Comparison of live animal and germplasm exports from 2009 to 2018

	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009
Bees (packages [kg], queen and bumble)	31,906	18,646	31,211	40,675	44,116	36,737	8,776	37,180	37,523	34,621
Bovine embryos	222	196	457	437	536	850	1,801	950	943	1,077
Bovine semen	1,525,086	1,628,656	1,253,030	1,251,776	1,596,560	1,573,105	1,160,455	1,085,082	1,073,877	1,237,044
Canine semen	129	200	33	47	420	9	41	12	166	56
Caprine semen	5,556	40	4,439	300	1,266		50		Included in ovine semen	Included in ovine semen
Cats & dogs	4,349	4,164	3,507	4,045	4,278	5,980	6,151	5,873	4,247	3,999
Cervine semen	1,803	633	2,275	1,557	816	325	220	275	2,590	3,001
Equine semen	3,086	4,418	6,324	4,119	3,032	3,265	3,324	2,362	2,670	5,195
Live alpacas & llamas	126	41	80	228	200	156	456	404	198	375
Live cattle	17,319	27,306	40,506	21,186	85,732	36,573	39,636	30,499	16,150	12,847
Live deer				28			65	31	15	46
Live goats	757	18	1,184		35			979	58	190
Live horses	2,999	2,655	2,706	2,713	2,622	2,853	2,886	3,308	2,292	2,469
Live sheep	239	123	300	45,166	1,082	380	421	177	307	124
Ovine embryos	200	809	2,778	825	1,836	1,737		320	114	230
Ovine semen	3,960	9,569	6,492	5,049	5,518	1,877	7,271	11,819	4,954	10,374
Poultry (day-old chicks)	2,838,496	2,787,409	2,442,609	2,221,689	1,700,483	1,270,703	1,136,530	1,342,542	1,324,543	1,098,192
Poultry (hatching eggs)	3,563,890	5,705,973	3,700,891	4,076,927	3,036,075	2,536,565	2,365,466	3,173,403	5.185,128	3,860,755

Table 4: Volume of live animal and germplasm exports to various regions in 2018

	Africa	Asia	Australia	Canada	Central & South America	Europe	Middle East	Pacific Islands	United States	Total
Bovine embryos			186						36	**222**
Bovine semen	304,109	22,881	148,806	2,510	634,700	371,719		1,518	38,843	**1,525,086**
Canine semen	2	7	120							**129**
Caprine embryos		24								**24**
Caprine semen		5,000			68				488	**5,556**
Cats & dogs	18	365	2,712	91	16	705	13	109	320	**4,349**
Cervine embryos				110					154	**264**
Cervine semen			160	120		843			680	**1,803**
Equine semen			3,086							**3,086**
Live alpacas & llamas						126				**126**
Live cattle		17,319								**17,319**
Live goats		752	4		1					**757**
Live horses		832	2,045			34	9	6	73	**2,999**
Live pigs								23		**23**
Live sheep		162	12		41	24				**239**
Ornamental birds		220	2			4				**226**
Other		3	47						2	**52**
Ovine embryos		200								**200**
Ovine semen		86	411	413	2,769		281			**3,960**
Porcine semen								10		**10**
Poultry (day-old chicks)		1,684,498						1,153,998		**2,838,496**
Poultry (hatching eggs)		175,680					140,220	3,247,990		**3,563,890**
Zoo animals		51	7						21	**79**
Bees (packages [kg])				19,007						**19,007**
Queen bees & bumble bees		11,500		1,399						**12,899**

Number of export certificates agreed

During 2018 there were 48 Overseas Market Access Requirements (OMARs) or export certificates agreed, issued and notified as notices under the Animals Products Act 1999. Of these, 13 notices represent requirements for new markets, while the rest were amendments to existing OMARs.

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Surveillance data collected from export testing

In New Zealand all laboratory-based export testing must be conducted in laboratories that are accredited to ISO 17025 by New Zealand's accreditation body, International Accreditation New Zealand (IANZ) (MPI, 2017). These laboratories are recognised by MPI under its Recognised Laboratory Programme. The testing methodology used is in accordance with the OIE Manual (OIE, 2018). In 2018 New Zealand exports included about 17,000 live cattle, 3,000 horses, 6 million day-old chicks and poultry hatching eggs, 1.5 million straws of bovine semen and 4,300 dogs and cats (MPI, 2019). Many animals are tested to ensure that they comply with the importing country's requirements . Animals that test positive for a disease normally do not meet such requirements and so cannot be exported: for example, an EBL-positive cow cannot be exported to China.

In New Zealand there are currently eight MPI-recognised laboratories: AsureQuality Ltd in Petone, Gribbles Veterinary Pathology Ltd in Palmerston North, Livestock Improvement Corporation Animal Health Laboratory in Hamilton, IDEXX Laboratory in Palmerston North, Tegel Foods Ltd in New Plymouth, Poultry Veterinary Services in Auckland, SVS Laboratories Ltd in Hamilton and MPI's Animal Health Laboratory (AHL) at Wallaceville. These laboratories conduct a variety of testing but the majority of tests are for live poultry exports, live cattle, horses and bovine semen donors. In cases where testing cannot be conducted in New Zealand, the AHL sends samples to reputable laboratories overseas.

Reports from export testing in poultry laboratories are published annually in *Surveillance* (e.g. Mulqueen & Clarke, 2018) and so are not detailed any further in this article.

Table 1 summarises the numbers of tests and diseases tested for during the past four years in laboratories other than the AHL. Each time period is from 1 July in one year to 30 June the following year.

Although New Zealand is not officially free from enzootic bovine leukosis (EBL) and *Campylobacter fetus* ssp. *venerealis,* both were made notifiable diseases in 2016 (NZ Government, 2016). The EBL-positive tests in **Table 1** are false positives: the last reported case of EBL was in 2011, in the New Zealand Dairy EBL Control Scheme (Voges, 2012).

Some of the tests for EBL, *Campylobacter fetus* ssp. *venerealis* and *Trichomonas foetus* in **Table 1** are also reported in the article in this issue about testing of bovine semen (Clarke, 2019b). The present article details the number of tests conducted, while the abovementioned article details the numbers of animals tested.

BVD, IBR, Johne's disease, and *Brucella ovis* are all endemic in New Zealand. MPI is not aware of any confirmed reports of *Trichomonas foetus* in recent years and this dataset supports the notion that *T. foetus* has not been confirmed in export testing. Positive results for endemic diseases are not reported to MPI and there is no requirement to conduct confirmatory testing of such results.

The MPI AHL (Wallaceville) conducts testing for exotic diseases, and if any specific test is not available, samples are sent to an overseas laboratory.

Table 2 summarises the numbers of tests and diseases tested for during the past three years at the AHL. (Each year is 1 January–30 December.)

Testing for brucellosis in **Table 2** is also reported elsewhere in this issue (p. 11).

These tests did not result in any true positives except for *Leishmania* in 2016 (Bingham, 2017). All these diseases are notifiable and New Zealand is officially free from them except *Leishmania* spp. (MPI, 2019b; Rawdon et al., 2016; NZ Government, 2016). Any true positive test or other suspicion of an exotic or notifiable disease would result in an MPI investigation, and these investigations are reported in the quarterly reports of investigations of suspected exotic diseases in *Surveillance*. They are also listed in Table 2 of each AHL annual report (e.g. McDonald, 2019).

Table 1: Summary of disease tests, 2014–2015 year to 2017–2018 year, at non-MPI laboratories

Disease tested for and test used	2014–2015		2015–2016		2016–2017		2017–2018	
	Total	Positive	Total	Positive	Total	Positive	Total	Positive
Enzootic bovine leukosis (ELISA-Ab/AGID)	88,207	3*	24,212	11*	43,650	13*	22,158	8*
Bovine viral diarrhoea (ELISA-Ag)	152,752	274	54,795	89	96,237	204	39,988	76
Bovine viral diarrhoea (ELISA-Ab)	881	195	1,202	320	1,342	334	1306	247
Infectious bovine rhinotracheitis (ELISA-Ab)	71,464	4,348	43,095	4,297	53,174	6,007	25,839	2,877
Johne's disease (cattle) (ELISA-Ab/CFT/AGID)	157,813	351	56,306	361	95,518	93	39,445	70
Johne's disease (sheep) (ELISA-Ab/CFT/AGID)	33,017	91	771	36	797	10	1,061	11
Brucella ovis (sheep) (CFT/ELISA-Ab)	1,938	0	1,197	0	532	2	1,007	2
Campylobacter fetus ssp. *venerealis* (culture)	1,388	0	1,346	0	1,364	0	1,294	0
Trichomonas foetus (culture)	1,388	0	1,340	0	1,364	0	1,279	0

*These tests are false positives (see text)

Table 2: Summary of disease tests, 2016 to 2018, at the AHL

Disease tested for and test used	2016		2017		2018	
	Total	Positive	Total	Positive	Total	Positive
Avian influenza (AGID, ELISA-Ab & HI)	90	0	420	0	106	0
Babesia caballi (ELISA-Ab)	4	0	11	0	18	0
Brucella abortus (SAT)	77	0	67	0	157	0
Brucella (CFT)	724	0	646	0	765	0
Equine infectious anaemia (AGID)	320	0	388	0	291	0
Equine influenza virus (PCR)	13	0	21	0	0	0
Equine viral arteritis (VI, VNT)	954	0	544	0	977	0
Leishmania spp. (IFAT)	92	1	46	0	83	0
Newcastle disease virus (HI)	50	0	0	0	28	0

The data presented in this article provide further evidence of New Zealand's freedom from various diseases and also give some insight to the possible prevalence of endemic diseases here. However, it should be noted that the animals tested are not representative of the whole New Zealand population: some may have been already tested prior to export testing at other laboratories, so negative animals will already have been pre-selected.

MPI would like to thank the private laboratories involved that provided the source data for this article.

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Surveillance data from MPI-approved bovine semen collection centres for 2017 and 2018

In New Zealand there are seven MPI-approved semen collection centres that are also registered to export bovine semen. Cattle at these centres undergo disease testing before and after arrival. Although domestic production of bovine semen is not regulated in New Zealand, it is estimated that most if not all bovine semen produced here is collected at these centres. Three centres are approved to export bovine semen to the European Union, and comply with Directive 88/407/EEC.

MPI-approved bovine semen collection centres have strict biosecurity requirements in accordance with Chapter 4.5 of the World Organisation for Animal Health (OIE) Terrestrial Animal Health Code (World Organisation for Animal Health, 2018a). In addition, the collection, processing and storage of the semen at these centres should comply with chapter 4.6 of the OIE Code. These semen collection centres are audited at least annually by MPI Official Veterinarians. Those that are approved for export to the EU are audited at least every 6 months. Bulls are tested prior to entering the centre (as well as at least once a year) for the diseases listed in **Table 1**.

All testing is conducted at MPI-recognised laboratories. These laboratories are ISO 17025-accredited by Accreditation New Zealand (IANZ) (MPI, 2017). IANZ is a full signatory member of the International Laboratory Accreditation Cooperation and the regional body, Asia Pacific Accreditation Cooperation (IANZ, 2019). Testing methodology is in accordance with the OIE Manual (World Organisation for Animal Health, 2018b).

Test data were supplied from CRV-Ambreed in Hamilton, Livestock Improvement Corporation at Newstead (Hamilton) and Awahuri (Palmerston North), and Tararua Breeding Centre at Woodville (**Table 1**). These four centres are responsible for about 98 percent of bovine semen exports from New Zealand.

Table 1: Number of animals tested in 2017–2018 (all negative)

Disease	Number of animals tested by year	
	2017	2018
Brucella abortus	360	370*
Enzootic bovine leukosis (EBL)	707	844
Campylobacter fetus ssp. *venerealis*	773	770
Trichomonas foetus	773	770
Mycobacterium bovis	1,443	1,567

*One false positive result was obtained

There were no positive test results but one false positive result for *Brucella abortus* (which will be reported in *Surveillance*).

New Zealand is officially free from *B. abortus* and this targeted surveillance provides further evidence to support that status. Although New Zealand is not officially free from enzootic bovine leukosis (EBL) and *Campylobacter fetus* ssp. *venerealis*, both were made notifiable diseases in 2016 (NZ Government, 2016). The last reported case of EBL in the New Zealand Dairy EBL Control Scheme was reported in 2011 (Voges, 2012). This scheme is no longer operational. In 2000 it was reported that *C. fetus* ssp. *venerealis* was extremely rare in New Zealand (Vermunt, 2000). Although *Trichomonas foetus* is not a notifiable disease, MPI is not aware of any confirmed reports in recent years. New Zealand has an official control programme for bovine tuberculosis (*Mycobacterium bovis*) in cattle and deer. As of 30 June 2018 there were only 32 infected herds and the annual infected herd period prevalence was 0.1 percent (OSPRI, 2018).

Any suspicion of an exotic or notifiable disease should be reported to MPI via the 24/7 toll-free exotic pest and disease emergency hotline. This may lead to an investigation by Incursion Investigators. Reports of such investigations are published in quarterly in *Surveillance*.

MPI would like to thank CRV-Ambreed, Livestock Improvement Corporation and Tararua Breeding Centre for providing this information.

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Animal Health Laboratory

The Ministry for Primary Industries' (MPI's) Animal Health Laboratory (AHL) plays a vital role in diagnosis, research and control of new and emerging animal diseases to protect New Zealand and support trade.

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

National Biocontainment Laboratory

The National Biocontainment Laboratory project is moving closer towards practical completion – the point at which the construction work is completed and the building is handed over to MPI. Over the past 12 months, the internal fit-out of the laboratory spaces has seen the building progress from a construction shell to a state-of-the-art facility, complete with laboratory furniture, services and first equipment in place (**Figure 1**). The complex plant and systems installation (**Figures 2 & 3**) is also at an advanced stage with many components well into the commissioning phase. The quality of the lab construction and the ability to pass room leakage testing efficiently (well within the maximum acceptable rate) has surpassed all expectations.

As the project progresses into transition and certification phases, there will be a shift of emphasis towards operational readiness with the development of standard operating procedures, completion of risk assessments and preparing staff and operatives for the move – activities that will also be a particular focus for the building certifier. Transition of existing operations into the new laboratory is scheduled for 2020.

Laboratory tests for the biosecurity response to *Mycoplasma bovis*

In July 2017, sixteen milk and joint-fluid samples from cattle suspected to be infected with *Mycoplasma bovis* were submitted to the AHL for diagnostic testing. This was the small beginning of MPI's largest biosecurity response yet. In order to service the diagnostic testing for the *M. bovis* response and eradication campaign the AHL maintained on average an eightfold increase in testing capacity over the course of 2018 compared with business-as-usual testing numbers (**Figure 4**). The average monthly testing turn-around time ranged from 2 to 10 days. This is the time from when the samples were received at AHL to when the report of test results was provided to the *M. bovis* response team for decision-making on herd status and further surveillance testing, and communication with the farmer.

In addition to the testing done at AHL, a number of other NZ laboratories were contracted by MPI to undertake surveillance testing, with an estimated 350,000 additional tests conducted to the end of 2018.



Figure 1: A ground-floor laboratory with flooring, Arcoplast wall and ceiling panels, services and laboratory furniture installed



Figure 2: Exhaust fans in the upper plant space

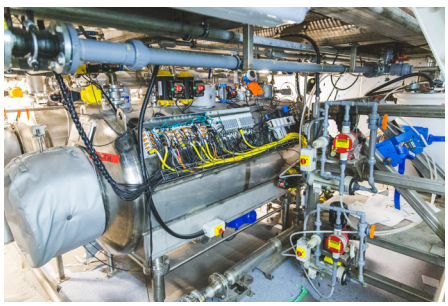


Figure 3: Thermal processing tanks in the effluent decontamination system

On the announcement of the eradication campaign and establishment of a new MPI *M. bovis* Directorate, the AHL introduced two dedicated laboratory bench and data teams (30 additional personnel) to deal with the high demand for diagnostic testing within agreed timeframes, and to support and engage with other laboratories.

Facilitating trade

The AHL functions as the national veterinary reference centre for New Zealand and one of its core functions is diagnostic testing that supports international trade by New Zealand's primary industries. In 2018 more than 7,000 tests were performed to directly support export and import (**Table 1**).

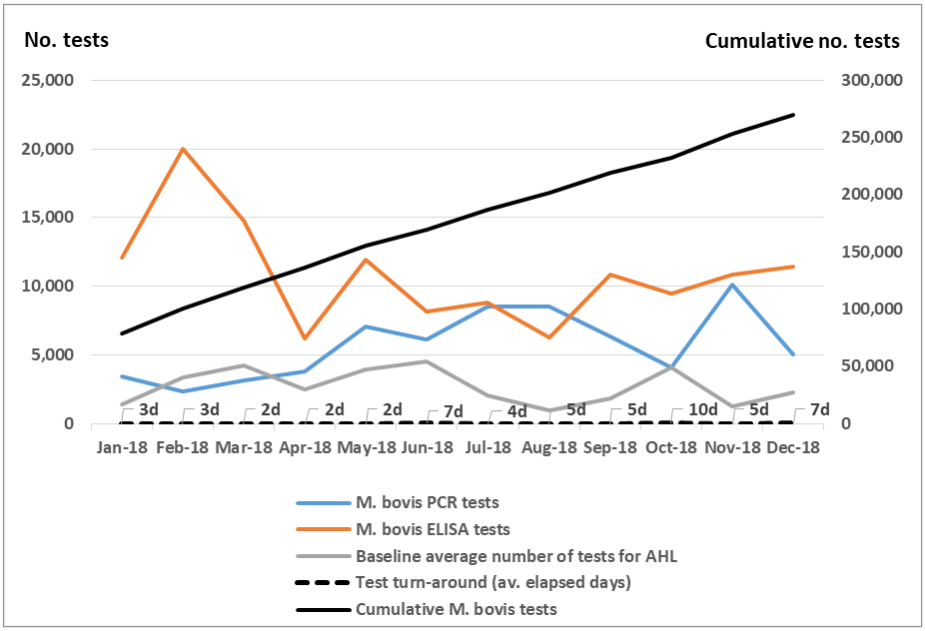


Figure 4: Monthly throughput of diagnostic tests for *Mycoplasma bovis*

Table 1: Summary of test numbers and description of work conducted by AHL, 2018

Purpose of testing	Number of tests/accessions	Description of work
Exotic disease investigations	3,757/206	(1) Testing to rule out the presence of exotic pathogens (2) Identification of reptiles and amphibians that cross NZ's borders
Cost-recovery diagnostics	3,657/318	Encompasses cost-recovered diagnostic testing and project work, much of which utilises capability not available elsewhere
Surveillance projects (Crown-funded)	440,807/6,909	Testing to support surveillance programmes including *M. bovis*, TSE, arbovirus and avian influenza
Import/export/trade (cost recovery)	7,191/782	(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)	974/152	Specific testing for AB purposes to rule out presence of various pathogens, including some exotic diseases
Quality assurance	2,070/142	The AHL participated in 84 programmes of inter-laboratory proficiency testing through nine 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

Capability

The AHL is a centre of science excellence and maintains its accreditation and certification to national and international standards. The laboratory is divided into three teams: virology, immunology, and bacteriology and aquatic animal diseases. Teams consist of expert senior scientists, scientists and technicians capable of carrying out the complex analyses and investigations presented to us on a daily basis. There are more than 450 test methods available at the AHL, many of them only available within New Zealand from the AHL. Tests range from classical and well-established techniques, for example bacterial culture, virus isolation, virus neutralisation, ELISA and microscopy/pathology, to molecular analysis and state-of-the-art technologies such as Maldi-TOF and Next Generation sequencing. Where testing cannot be offered within New Zealand, the AHL subcontracts the work overseas to accredited reference laboratories. The AHL is constantly working to enhance diagnostic capability by implementing new or improved tests to ensure we lead the way in veterinary laboratory diagnostics in New Zealand. During 2018 the AHL conducted tests for a wide range of microorganisms exotic to New Zealand scanning and active surveillance programmes (**Table 2**).

Table 2: Tests conducted for exotic disease surveillance*

Microorganism	Exotic disease investigation (number of tests)	Scanning and active surveillance (number of tests)
Abalone ganglioneuritis virus		6
Aeromonas salmonicida		390
Akabane virus		692
Alphavirus	15	
Anaplasma phagocytophilum	8	
Atadenovirus		5
Aujeszky's disease		8
Avian influenza (exotic strains)	118	6,330
Avian paramyxovirus (exotic strains)	101	1,938
Babesia cabelli	1	
Babesia canis		3
Babesia gibsonii		6
Babesia equi		3
Bacillus anthracis	6	
Bluetongue virus		698
Bovine ephermeral fever		1,217
Bovine viral diarrhoea (exotic strains)	227	
Brucella abortus	9	937
Brucella canis	7	10
Burkholderia mallei		3
Canine heartworm	2	9
Chlamydophila abortus	60	
Classical swine fever virus	5	
Coxiella burnetii	74	1
Cytopathic fish viruses		369
Edwardsiella tarda		1
Epizootic haemorrhagic disease virus		1,220
Equine infectious anaemia virus	4	
Equine viral arteritis		980
Ehrlichia canis		63
Flavivirus	27	
Foot-and-mouth disease virus	60	
Gill associated virus		6
Haplosporidian	5	
Infectious bursal disease virus (virulent strains)	28	213
Leishmania		11
Leptospira (exotic strains)	8	84
Maedi-visna virus		4
Melissococcus plutonius	7	
Mycoplasma agalactiae		54
Mycoplasma capricolum	2	
Nodavirus	8	21
Perkinsus	101	10
Piroplasma	11	1
Porcine reproductive and respiratory virus	5	456
Rabies virus		27
Ranavirus		5
Renibacterium salmoninarum		438
Theileria equi		214
Transmissible spongiform encephalopathy	3	182
Trypanosoma evansi		8
Trypanosoma equiperdum		3
Yellow head virus		6
Yersinia ruckeri (exotic strains)		390
West Nile virus	12	

*Tests conducted at AHL or subcontracted to overseas reference laboratories

Operational research projects

AHL staff led a number of science projects to improve biosecurity knowledge and capability under the MPI operational research programme.

Bee Pathogen Programme

This is a 3-year research project with field work concluding in July 2019. More than 132,000 bees were collected from all over New Zealand – from Northland to Stewart Island, and including Great Barrier Island and Chatham Island. Apiculture inspectors visited 2,595 beehives (**Figure 5**) and performed clinical inspections, conducted interviews with the beekeepers and collected bee samples that AHL and PHEL tested for pathogens and parasites. The project has amassed 31,344 data points representing more than 180 years of apiary data. Analysis of the data is in progress. The study will answer some big questions about the interrelationships between honey bee pathogens, pests, hive management, hive productivity, colony losses, climate and other factors. The project also supports one of MPI's central biosecurity aims by maintaining freedom-from-disease status with regard to exotic pathogens, by doing active surveillance for these exotic and unwanted organisms. The results of the study are being shared with industry and the public, and will be published in an international peer-reviewed scientific journal by the end of 2019.

Differentiating live from dead organisms by PCR

A proof-of-concept study has been conducted over the past 2 years to rapidly and accurately differentiate live from dead organisms by PCR. Determining whether a pathogen is live, and therefore infectious, is important in many fields of study, to inform decisions about a pathogen incursion, to differentiate vaccine strains (dead cells) from an infection, and to provide information on the number of live cells present (to determine the risk of infection). Traditional techniques can take days or even months to



Figure 5: MPI scientists Hayley Pragert and Richard Hall collect samples for the Bee Pathogen Programme from an apiary on Great Barrier Island, to be tested for honey bee pathogens and pests. Photo courtesy of Jacques Goussard

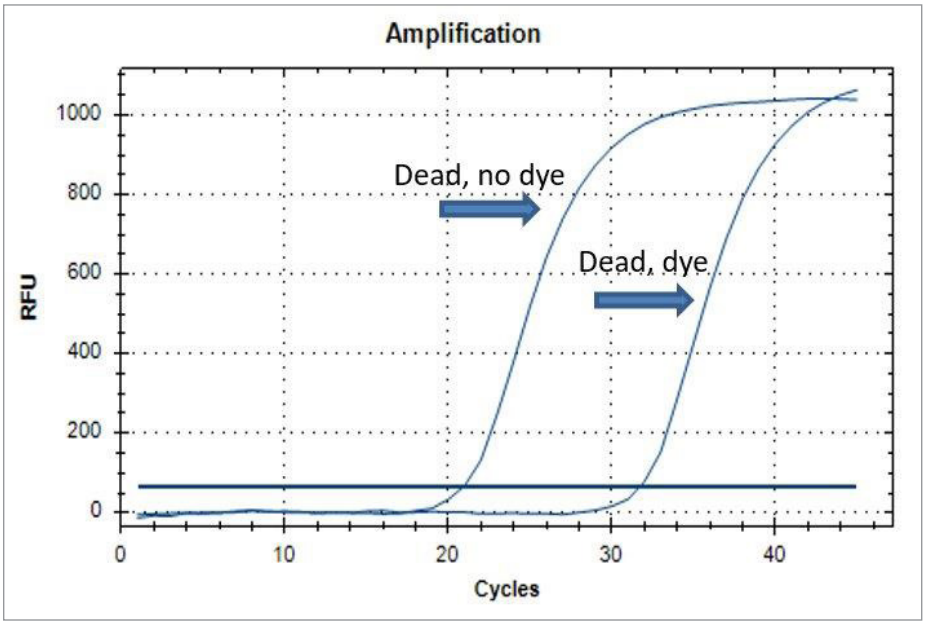


Figure 6: PCR results from a sample that contains dead bacterial cells. "Dead, no dye" indicates that the sample has not been treated with intercalating dye. "Dead, dye" indicates the sample has been treated with intercalating dye. Note the difference in the number of cycles (~10) depending on the treatment.



Figure 7: MPI scientist Rudolfo Bueno conducting a PCR test for FMD, using a vehicle in the absence of a lab at a Laos slaughterhouse

produce a result, and can provide false negative results if the target organism is outcompeted by environmental organisms or if it is in a viable but non-culturable state (a common strategy among bacteria). Viable PCR (vPCR) uses dyes that are able to penetrate the cell membrane of dead cells within a tissue sample and intercalate with the nucleic acid, but are unable to pass through intact cell membranes of live cells. Once mixed with the dye, the sample is photo-activated to produce an irreversible bond between the dye and the nucleic acid. The outcome of this proof-of-concept study is that two bacterial pathogens, *Tenacibaculum maritimum* and *Yersinia ruckeri,* (live or dead) can now be detected in salmon tissues, highlighting the potential for using vPCR for other applications.

Real-time diagnosis of FMD by PCR

During the past 2 years a field-deployable molecular-testing technology has been developed for real-time diagnosis of foot and mouth disease (FMD) and some other diseases that can mimic it. However, since FMD is not present in New Zealand, validation of the new test is more difficult. To ensure that the test is practical in the field, trials are being undertaken in countries where FMD is endemic. Field testing was carried out recently in Laos (**Figure 7**), with promising results using samples collected during slaughterhouse surveillance for FMD. Further work will be done in Myanmar.

Identifying causes of shellfish mortalities

A project is being undertaken to better identify causal factors driving shellfish mortalities and to expand our diagnostic capability. Wild shellfish are ecologically and economically important in New Zealand and since 2014 there has been an increase in the number of cases of poor health and mass mortality among them (**Figure 8**). Despite numerous investigations, causal factors have not yet been identified. Intracellular bacteria known as *Rickettsia*-like organisms (RLOs) have been observed by histopathology in shellfish collected during disease investigations, but little



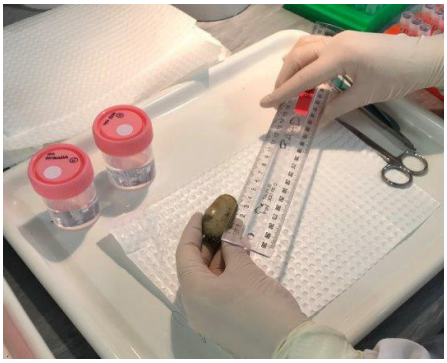


Figure 8: A wild shellfish mortality event, and follow-up testing at AHL

is known about them, including their identity or impacts on shellfish health. This operational research project will identify RLOs found in New Zealand shellfish using DNA sequence data and develop sensitive, specific molecular tests for detecting them in future.

National and international connections

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

- the OIE Biological Standards Commission, which is responsible for establishing or approving methods for diagnosing diseases of mammals, birds and bees and for recommending the most effective biological products – Joseph O'Keefe;
- the International Veterinary Biosafety Workgroup, which promotes best practice in microbiological biocontainment and safety in veterinary laboratories that have national responsibility for the health of large animals, and which operate at biosafety levels 3 and 4 – Joseph O'Keefe;
- FluLabNet, an EU-organised collaborative network on influenza – Wlodek Stanislawek;
- the 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;
- the subcommittee of Aquatic Animal Health Standards, an Australian and New Zealand committee that provides technical advice on aquatic animal health issues in support of policy planning – Diana Jaramillo; and
- the subcommittee of Animal Health Laboratory Standards, an Australian and New Zealand committee that provides technical advice on animal health laboratory diagnostics in support of policy planning – Wendy McDonald.

Staffing and structure

See **Table 3**.

Staff publications in scientific and technical journals

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Table 3: Staffing and structure

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

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Animal Health Surveillance

The following tables present animal health data collected by MPI from various sources during 2018.

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 in Australia. In all, 21 salmon farms were tested and none recorded significant mortalities.

Table 4a presents a cumulative list of investigations conducted by Incursion Investigators from MPI's Biosecurity Surveillance and Incursion Investigation animal health and aquatic and environment health teams during the period 2013–2018 that have resulted in exclusion of OIE-notifiable diseases or other significant exotic diseases.

Table 4b presents a list of significant investigations conducted during 2018 by MPI's Biosecurity Surveillance and Incursion Investigation animal health, and aquatic and environment health teams, 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: Numbers of cases and diagnoses received from veterinary pathology laboratories during 2018

Cattle	
Total sick animal cases	18,855
Abnormalities of reproductive system	119
Neospora caninum	13
C. fetus ssp. *venerealis*	0
Pestivirus infection	4
Abortion	691
Neospora caninum	121
Mycotic abortion	3
Pestivirus infection	7
Leptospira spp.	17
Congenital defects	7
Ill thrift/diarrhoea	9,664
Pestivirus infection	142
Gastrointestinal parasitism	18
Johne's disease – suspicious and confirmed	2,263
Trace element deficiency	232
Yersinia spp.	378
Rotavirus	355
Nervous signs	384
Listeria monocytogenes	4
Hepatic encephalopathy	2
Metabolic disease	34
Malignant catarrhal fever	7
Polioencephalomalacia	0
Histophilus somnus	0
Sudden death	1,017
Clostridium spp.	9
Respiratory disease	638
Sheep	
Total sick animal cases	1,524
Abnormalities of reproductive system	33
Brucella ovis	1
Abortion	247
Campylobacter fetus spp. *fetus*	32
Other *Campylobacter* spp.	5
Toxoplasma gondii	46
Salmonella Brandenburg	13
Congenital defects	0
Ill thrift/diarrhoea	466
Johne's disease	12
Trace element deficiency	20
Gastrointestinal parasitism	36
Nervous signs	74
Listeria monocytogenes	6
Polioencephalomalacia	0
Clostridium spp.	3
Respiratory disease	48
Sudden death	294
Gastrointestinal parasitism	5
Farmed deer	
Total sick animal cases	155
Abortion	1
S. zooepidemicus	0
Congenital defects	0
Ill thrift/diarrhoea	76
Johne's disease	10
Trace element deficiency	9
Yersinia spp.	8
Nervous signs	7
Malignant catarrhal fever	0
Sudden death	59
Gastrointestinal parasitism	1
Malignant catarrhal fever	3
Horses	
Total sick animal cases	5,767
Abortion	36
S. zooepidemicus	2
Circulatory disease	35
Ill thrift/diarrhoea	1,190
Gastrointestinal parasitism	19
Nervous signs	188
Respiratory disease	680
Streptococcal infection	74
Sudden death	24
Pigs	
Total sick animal cases	53
Abortion	0
Ill thrift/diarrhoea	17
Nervous signs	2
Sudden death	15
Goats	
Total sick animal cases	580
Abortion	9
Ill thrift/diarrhoea	300
Gastrointestinal parasitism	3
Respiratory disease	24
Nervous signs	25
Listeria monocytogenes	4
Caprine arthritis encephalitis	1
Sudden death	40
Clostridium perfringens D (enterotoxaemia)	0
Gastrointestinal parasitism	1
Lamoids	
Total sick animal cases	277
Abortion	2
Ill thrift/diarrhoea	123
Gastrointestinal parasitism	1
Nervous signs	17
Respiratory disease	10
Sudden death	26
Avian species	
Total number of submissions	785

Table 2: *Salmonella* serotypes isolated from animals during 2018

Serotype	Avian	Bovine	Canine	Cervine	Equine	Feline	Ovine	Reptile
Salmonella Abortusequi	0	0	0	0	0	0	0	0
Salmonella Abortusovis	0	0	0	0	0	0	0	0
Salmonella Adelaide	0	0	0	0	0	0	0	0
Salmonella Agona	0	12	1	0	0	0	0	0
Salmonella Albany	0	0	0	0	0	0	0	0
Salmonella Amager	0	0	0	0	0	0	0	0
Salmonella Amsterdam	0	1	0	0	0	0	0	0
Salmonella Anatum	0	2	0	0	0	0	0	0
Salmonella Arizonae	0	0	0	0	0	0	0	0
Salmonella Banana	0	0	0	0	0	0	0	0
Salmonella Bareilly	0	0	0	0	0	0	0	0
Salmonella Barranquilla	0	0	0	0	0	0	0	0
Salmonella Bere	0	0	0	0	0	0	0	0
Salmonella Bovismorbificans	0	229	3	0	2	3	3	0
Salmonella Brancaster	0	0	0	0	0	0	0	0
Salmonella Brandenburg	0	73	1	0	0	0	13	0
Salmonella Bredeney	0	0	0	0	0	0	0	0
Salmonella California	0	0	0	0	0	0	0	0
Salmonella Choleraesuis	0	0	0	0	0	0	0	0
Salmonella Cubana	0	0	0	0	0	0	0	0
Salmonella Derby	0	0	0	0	0	0	0	0
Salmonella Dublin	0	0	0	0	0	0	0	0
Salmonella Eastbourne	0	0	0	0	0	0	0	0
Salmonella Emek	0	5	0	0	0	0	0	0
Salmonella Enterica	0	4	0	0	0	0	0	0
Salmonella Enterica subsp. Salamae	0	0	0	0	0	0	0	0
Salmonella Enteritidis	0	3	1	0	0	0	0	0
Salmonella Fresno	0	0	0	0	0	0	0	0
Salmonella Give	0	0	0	0	0	0	0	0
Salmonella Hadar	0	0	0	0	0	0	0	0
Salmonella Havana	0	0	0	0	0	0	0	0
Salmonella Heidelberg	0	1	0	0	0	0	0	0
Salmonella Hindmarsh	0	0	0	0	0	0	23	0
Salmonella Houtenae	0	0	0	0	0	0	0	0
Salmonella Hvittingfoss	0	0	0	0	0	0	0	0
Salmonella Infantis	0	2	2	0	0	0	0	0
Salmonella Johannesburg	0	0	0	0	0	0	0	0
Salmonella Kedougou	0	0	0	0	0	0	0	0
Salmonella Kentucky	0	1	0	0	0	0	0	0
Salmonella Kiambu	0	0	0	0	0	0	0	0
Salmonella Kottbus	0	0	0	0	0	0	0	0
Salmonella Lexington	0	0	0	0	0	0	0	0
Salmonella Litchfield	0	0	0	0	0	0	0	0
Salmonella Liverpool	0	0	0	0	0	0	0	0
Salmonella Livingstone	0	0	0	0	0	0	0	0
Salmonella London	0	0	0	0	0	0	0	0
Salmonella Luckenwalde	0	0	0	0	0	0	0	0

Continued on page 20

Table 2 (continued)

Serotype	Avian	Bovine	Canine	Cervine	Equine	Feline	Ovine	Reptile
Salmonella Mana	0	0	0	0	0	0	0	0
Salmonella Mbandaka	0	2	1	0	0	0	0	0
Salmonella Meleagridis	0	0	0	0	0	0	0	0
Salmonella Minnesota	0	0	0	0	0	0	0	0
Salmonella Mississippi	0	0	0	0	0	0	0	1
Salmonella Molade	0	0	0	0	0	0	0	0
Salmonella Montevideo	0	0	0	0	0	0	0	0
Salmonella Muenster	0	0	0	0	0	0	0	0
Salmonella Nchanga	0	0	0	0	0	0	0	0
Salmonella Newington	0	0	0	0	0	0	0	0
Salmonella Newport	0	0	0	0	0	0	0	0
Salmonella Onderstepoort	0	0	0	0	0	0	0	3
Salmonella Oranienburg	0	0	0	0	0	0	0	0
Salmonella Orion	0	0	0	0	0	0	0	0
Salmonella Paratyphi	0	0	0	0	0	0	0	0
Salmonella Poona	0	0	0	0	0	0	0	0
Salmonella Potsdam	0	0	0	0	0	0	0	0
Salmonella Pullorum	0	0	0	0	0	0	0	0
Salmonella Reading	0	0	0	0	0	0	0	0
Salmonella Rideauf	0	0	0	0	0	0	0	0
Salmonella Rissen	0	0	0	0	0	0	0	0
Salmonella Rough	0	0	0	0	0	0	0	0
Salmonella Ruiru	0	7	0	0	0	0	0	0
Salmonella Saintpaul	0	2	0	0	0	1	0	0
Salmonella Salford	0	0	0	0	0	0	0	0
Salmonella Schwarzengrund	0	0	0	0	0	0	0	0
Salmonella Senftenberg	0	3	0	0	0	0	0	0
Salmonella Singapore	0	0	0	0	0	0	0	0
Salmonella Stanley	0	2	0	0	0	0	0	0
Salmonella Tennessee	0	0	0	0	0	0	0	0
Salmonella Thompson	0	0	0	0	0	0	0	0
Salmonella Typhi	0	0	0	0	0	0	0	0
Salmonella Typhimurium	1	169	11	1	10	11	7	0
Salmonella Typhisuis	0	0	0	0	0	0	0	0
Salmonella Uganda	0	0	0	0	0	0	0	0
Salmonella Victoria	0	0	0	0	0	1	0	0
Salmonella Virchow	0	0	0	0	0	0	0	0
Salmonella Wangata	0	0	0	0	0	0	0	1
Salmonella Warragul	0	0	0	0	0	0	0	0
Salmonella Weltevreden	0	0	0	0	0	0	0	0
Salmonella Westhampton	0	0	0	0	0	0	0	0
Salmonella Worthington	1	0	0	0	0	0	0	0
Salmonella Yoruba	0	0	0	0	0	0	0	0
Salmonella Zanzibar	0	0	0	0	0	0	0	0
Salmonella species unspecified	1	8	4	0	5	1	1	0
Total	**3**	**526**	**24**	**1**	**17**	**17**	**47**	**5**

Table 3: Salmonid surveillance during 2018

Pathogen tested for	No of farms	No of samples	No of positives
Viral cultures	21	1,740	0
Myxobolus cerebralis	7	420	0
Yersinia ruckeri	21	1,740	3*
Aeromonas salmonicida	21	1,740	0
Renibacterium salmoninarum	7	420	0

* The endemic strain of *Yersinia ruckeri* (serotype O1b) was isolated (serotyped by AAHL in Geelong, Australia).

Number of salmon farms tested	21
Number of farms reporting significant mortalities	0
Number of farms where significant infectious disease was detected through this scheme	0

Table 4a: Cumulative list of significant (*A) negative investigations of suspected exotic diseases, 2013–2018

Disease agents investigated and confirmed as negative	2013	2014	2015	2016	2017	2018	Total
Aeromonas salmonicida (fish) *B		2		3	1	1	7
African horse sickness	2						2
Africanised honeybee (*Apis mellifera scutella*) and Cape bee (*Apis mellifera capensis*) *B			3		1	3	7
Akabane virus	1	1	1		1		4
Anaplasmosis	3	2	2	1	10		18
Anthrax	3	4	2	4		7	20
Avian influenza: highly pathogenic notifiable avian influenza & Newcastle disease *B	4	3	5	3	3	6	24
Avian influenza: low-pathogenicity notifiable avian influenza *B	2	2	1		1	1	7
Avian polyomavirus *C	2			2			4
Babesia canis, B. gibsoni and *B. felis*	2	1	1	2	4		10
Bluetongue		2	4	1	1		8
Brucella abortus	2	2	1	1	1	1	8
Brucella canis	6	5	9	12	6	6	44
Brucella melitensis		1	1	1		1	4
Bovine herpesvirus type 5	2	2					4
Bovine theileriosis and babesiosis (exotic strains)	6	1			1	2	10
Bovine viral diarrhoea type 2a		6	1	6			13
Burkholderia mallei (glanders) and *B. pseudomallei* (melioidosis)		1	2	1			4
Canine distemper virus	1	2	3	1	1	3	11
Canine influenza			2			2	4
Chlamydophila abortus (enzootic abortion)		1		2	1	1	5
Contagious bovine pleuropneumonia	1			1			2
Ehrlichia canis	1	1		3	5	1	11
Equine piroplasmosis	3	2	3	1	5	4	18
Equine herpesvirus type 1 (abortifacient strains, neuropathogenic strains)	1	6	1	9	4	1	22
Equine infectious anaemia and equine viral arteritis	17	4	7	11	10	6	55
Equine influenza	2	3	2	2	2	1	12
European foulbrood (bees) *B	3	7	8	6	4	6	34
Exotic ticks	3	3	15	11	11	5	48
Fish, shellfish and crustacean mortality (wild or managed, marine) – for exclusion of exotic and novel infectious disease agents not otherwise listed	5	4	11	2	10	16	48
Haemorrhagic septicaemia (*Pasteurella multocida* – toxogenic strains)	3		1	1	1	1	7

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Table 4a (continued)

Disease agents investigated and confirmed as negative	2013	2014	2015	2016	2017	2018	Total
Heartworm (*Dirofilaria immitis*)			3	1	2	2	8
Hydatids (*Echinococcus* spp.)			1	4	2	2	9
Infectious bovine rhinotracheitis (exotic strains)	1		2	1	1		5
Infectious bursal disease	5	1	3	1		2	12
Israeli acute paralysis virus (bees) *B	1	3	7	1			12
Leishmaniasis				5	6	3	14
Leptospira (exotic strains)	1	3	1		3	2	10
Mycoplasma bovis	1	4		6	2 *C	Under response	Under response
Myxomatosis	2		1			1	4
Nosema ceranae (bees) *C	1	2	2	2	1		8
Perkinsus marinus (molluscs)	2	2		3	6	6	19
Porcine reproductive and respiratory syndrome		1	2		1	2	6
Poxviruses (ruminants and camelids)	1	1	2	1		1	6
Psittacine herpesvirus (incl. Pacheco's disease)	2			3	1		6
Jaagsiekte sheep retrovirus (pulmonary adenomatosis virus)					2	1	3
Q fever (*Coxiella burnetti*)	1	2		2		1	6
Rabies	1						1
Rinderpest							
Ross River virus				1	2		3
Salmonella (exotic strains)	4	2	1	1	1	2	11
Small hive beetle (*Aethina tumida*) (bees) *B		2	1	1	2	3	9
Swine fever viruses (African and classical swine fever viruses)				1		2	3
Tracheal mite (*Acarapis woodi*) (bees) *B	1	3	9	3	2	5	23
Transmissible spongiform encephalopathy agents (scrapie, BSE; chronic wasting disease, FSE) *B	4	3	5	1		2	15
Trichinella spiralis (trichinosis)	1				1	1	3
Tropilaelaps clareae and *T. koenigerum* (bees) *B	1		4	1	1	1	8
Tularaemia *(Francisella tularensis)*			2		1		3
Viral haemorrhagic septicaemia (fish)		1		1			2
Viral vesicular disease	5	4	9	16	7	7	48
West Nile virus		4	1	3	2	1	11
Enteric redmouth (*Yersinia ruckeri* – exotic strains) (fish)			1	1	2	2	6
Total	**110**	**106**	**143**	**147**	**132**	**124**	**749**

Table 4b: List of significant positive investigations of suspected exotic diseases, 2018

Disease agents/vectors investigated and confirmed as positive, and host species	Number of positive investigations in 2018
Canine influenza (dog) *D (Bingham, 2018b)	1
Infectious bursal disease virus serotype 2 (IBDV-2) (poultry) (Rawdon, 2019)	1
American dog tick (*Dermacentor variabilis*) (human) *E (Bingham, 2018b)	1
Castor bean tick (*Ixodes ricinis*) (human) *E	1
Paralysis tick *(Ixodes holocylus*) (human) *E (Bingham, 2018c, 2019)	2
Ixodes spp. tick (not otherwise able to be identified) *E (Bingham, 2019)	1
Culex sitiens (human)*D	1

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*: see Bingham (2018a,b,c, 2019) and Taylor (2018a,b, 2019).

*B Investigations reported here are in addition to the testing in the MPI active surveillance programmes for these disease agents. See Phiri (2018) (honey bee exotic pest and disease surveillance), Stanislawek *et al.* (2018) (avian influenza surveillance), Watts (2018) (TSE surveillance) and **Table 3** above (salmon surveillance).

*C These previously exotic disease agents have become established in New Zealand, either during the 2018 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 An MPI biosecurity response was established for this unwanted organism. The response ensured that the unwanted organism never established.

*E This confirmed exotic tick was intercepted soon after entry to NZ. Transmission or establishment of organisms did not occur.

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Avian influenza surveillance programme

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

Wild bird surveillance

New Zealand is not on a migration pathway for waterfowl as observed in the northern hemisphere, although vagrant waterfowl from Australia are occasionally encountered. New Zealand lies at the southeastern extremity of the East Asian–Australasian Flyway which was (and still is) of particular relevance for the introduction of novel AI especially given the spread of H5N1 across Asia from 2004. Therefore, 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 6 years of surveillance focused primarily 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 posed a very low risk for the introduction of high-pathogenicity avian influenza viruses into New Zealand, as no avian influenza virus was ever isolated. Therefore, since 2010, surveillance has focused on resident birds, mainly waterfowl.

Since 2004, non-migratory waterfowl, predominantly mallard ducks (*Anas platyrhynchos*) have 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 2018, cloacal and oropharyngeal swabs were collected from 950 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-qPCR TaqMan (Spackman et al., 2003, Heine et al., 2015). Positive or suspect samples were then tested using real-time H5 and H7 RT-qPCR TaqMan (Slomka et al., 2007; Sidoti et al., 2010) and conventional H5, H7 RT-PCRs to obtain genomic information.

Influenza A RNA was detected in cloacal or oropharyngeal samples (or both) in 60.5 percent of the 950 ducks sampled. This is lower than in the previous year (73.2 percent). However, if we analyse AIV prevalence in ducks from individual collection sites, the percentage of AIV-positive ducks varies: 62 percent at Pipiroa; 16.7 percent at Lake Te Rotokare; 90.3 percent at the Kaituna River mouth; and 66.7 percent in the Gisborne area. AIV prevalence is rather dynamic and can change from year to year.

Influenza subtype H7 RNA was confirmed by PCR in 22 samples from one location in the North Island and one H7 virus was isolated. This virus was confirmed to be non-pathogenic, based on analysis of the cleavage site of the HA gene. RNA from three H5 viruses was detected but no H5 virus was isolated. To obtain information on AIV 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 samples that tested positive for influenza A by RT-qPCR, and a number of influenza virus subtypes – H3, H4, H6 and H11 – were isolated.

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;

Table 1: Active surveillance for avian influenza viruses in wild birds, 2018

Location	Number of mallard ducks sampled	Number of samples tested (cloacal & oropharyngeal)	Number of RT/PCR positives		Confirmed
			H5	H7	H5 or H7 isolates
Pipiroa, Piako River	300	600	1	22	1 x H7*
Lake Te Rotokare, Hawke's Bay	240	480	3	0	0
Mouth of Kaituna River, Bay of Plenty	320	640	0	0	0
Gisborne area	90	180	0	0	0
Total	**950**	**1,900**	**4**	**22**	**1 x H7**

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

- availability of fresh samples (where unavailable, follow-up is instigated);
- location; and
- epidemiological trends over space and time.

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

A rapid field service is in place for sample collection and submission of unexplained bird deaths (Rawdon et al., 2007), using MPI-approved suppliers. A standardised investigation protocol coordinated by the IDC (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 DSS report of suspect exotic disease investigations. In 2018, 39 notifications were received and eight investigations were conducted (**Table 2**). Avian influenza was excluded by influenza A real-time RT-qPCR in all samples submitted for six of these investigations. In a further two avian disease investigations, endemic diseases were diagnosed and although influenza testing was not carried out, the investigation findings concluded that an endemic agent was the cause of the health event (see case histories below).

Table 2: Avian mortality notifications and investigations, 2018

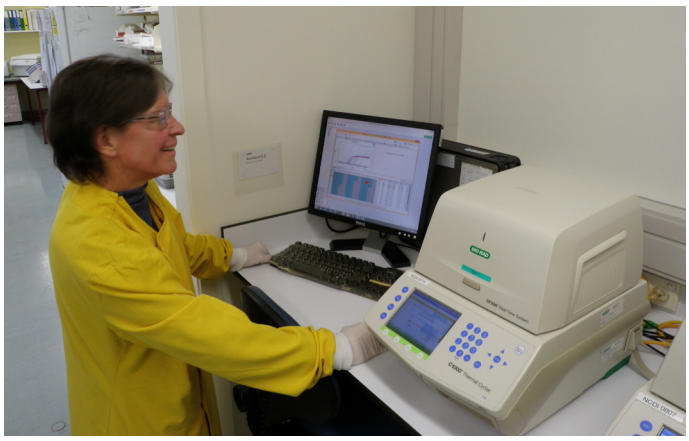
Month	Notifications	Investigations
January	2	1
February	1	1
March	3	0
April	11	2
May	0	1
June	0	0
July	2	0
August	2	1
September	1	0
October	3	0
November	3	1
December	3	1



AHL scientist Harriett Sowman collecting samples from ducks at Lake Te Rotokare



AHL scientist Della Orr collecting samples from ducks at the mouth of the Kaituna River



AHL senior technician Maree Joyce testing field samples for presence of avian influenza

Respiratory disease investigated in backyard chicken flock

A Waikato veterinarian contacted MPI via the exotic pest and disease emergency hotline to discuss two deaths in a backyard chicken flock consisting of 15 five-year-old Red Shavers. The chickens were noticed to be unwell one morning after having been fine the previous evening. One presented with respiratory distress and was described as making a rattling noise as it breathed. Another was hunched over with its head lowered and eyes closed, and had a darkened comb. Both died within 4 hours. Unfortunately the chickens were disposed of and

unavailable for necropsy. While aged modern brown layers are prone to a variety of tumours that can present as these did, two deaths out of 15 birds on one day is unusual, so the exotic differentials avian influenza and Newcastle disease had to be eliminated. While the absence of clinical signs among the 13 in-contact birds suggested exotic disease was unlikely, nevertheless cloacal and oropharyngeal swabs from them, in avian transport medium, were requested by the duty Incursion Investigator. These were submitted to the AHL, where avian influenza and Newcastle disease were ruled out by PCR testing. The investigation was closed.

Diarrhoea investigated in pigeon flock

A pigeon breeder contacted MPI via the exotic pest and disease emergency hotline to report pigeon deaths over a period of 6–8 weeks, which he believed might be due to salmonellosis. Clinical signs included inactivity, loss of appetite, weight loss, loss of flight and watery droppings, leading to death. The breeder had been treating the birds with metronidazole (dose unknown), to no effect. An avian specialist veterinarian was engaged to assist with diagnosis and rule-out of exotic agents including pigeon rotavirus (an emerging disease in Australia) and pigeon paramyxovirus. The avian veterinarian interviewed the notifier and arranged for faecal samples to be submitted to the laboratory. Samples were found to contain very high levels of *Capillaria* spp. (18,300–28,000 eggs per gram). Also known as hairworm, capillariasis is a well-known cause of diarrhoea and wasting in pigeons. The flock responded to anthelminthic dosing and no further deaths were reported by the breeder. Exotic agents were ruled out by diagnosis of exclusion, and the investigation was closed.

Suspect avian paramyxovirus type 1 in commercial layer flock

A specialist poultry veterinarian contacted MPI via the exotic pest and disease emergency hotline to discuss a disease outbreak in a layer flock with up to 20 percent mortality in an 8-week period. Post-mortem investigation had identified peritonitis and lesions in the reproductive tract that were consistent with pasteurellosis in mature layer hens, and culture yielded a heavy growth of *Pasteurella multocida*. Strains of *P. multocida* have been differentiated into Heddleston serotypes based on surface lipopolysaccharide (LPS) molecules, and bacterins based on these types are used for protective vaccination. The vaccine available in New Zealand captures Heddleston types 1, 3 and 4. The isolated strains were sent to an overseas laboratory and typed to LPS group 3, corresponding to Heddleston types 3 and 4. In an attempt to look for a predisposing cause of the infection, the veterinarian had serological testing (Bio Check ELISA) carried out for avian paramyxovirus type 1 (APMV-1) at a poultry industry laboratory. Two of three affected layer birds were seropositive, while two of five unaffected birds were also positive.

Several different pathotypes of APMV-1 are recognised. Pathogenic APMV-1 is exotic to New Zealand, while non-pathogenic APMV-1 is present in New Zealand (Dunowska et al., 2013). There were no lesions consistent with pathogenic APMV-1, and there was no intestinal pathology that can sometimes be found with very low pathogenic APMV-1 viruses. For further investigation of this seropositivity, serum samples from sick and healthy birds were submitted to the AHL, where a range of low positive titres (1:8 to 1:16) were identified in the APMV-1 hemagglutination inhibition test. These titres supported exposure of the flock to a non-pathogenic APMV-1 at some point. In addition, oropharyngeal and cloacal swabs, cecal tonsil, liver and spleen from up to 30 birds were submitted to the AHL and were found to be negative for APMV-1 by real-time PCR. The presence of an exotic APM-1 pathotype or a new emerging *P. multocida* strain was ruled out and the investigation closed.

In addition to investigating sick and dead bird reports, MPI collects data from approved veterinary diagnostic laboratories on avian submissions from veterinary practitioners. **Table 3** summarises submission data from the MPI passive surveillance system (Watts et al., 2016).

Table 3: Avian submissions to MPI's passive surveillance system 2004–2018

Year	Approved veterinary diagnostic laboratory submissions	MPI notifications	MPI investigations
2004	116	30	8
2005	340	85	8
2006	360	154*	24
2007	33	60	14
2008	120	37	10
2009	163	151**	7
2010	174	25	7
2011	142	19	7
2012	290	19	8
2013	664	19	6
2014	385	30	13
2015	503	45	14
2016	824	28	11
2017	723	18	12
2018	785	39	8

* The aberration in the number of bird mortality reports for 2006 was generated as a result of public interest following excessive media reporting – see McFadden et al. (2007).

** The aberration in the number of bird mortality reports for 2009 was due to a toxicity event in August of that year relating to grey side-gilled sea slugs (*Pleurobranchaea maculata*) in the Auckland region.

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Wildlife disease surveillance

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

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

The MPI national exotic pest and disease notification system provides for the reporting and investigation of unusual disease events in all animals, including wildlife. The MPI exotic 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 cases suspected to be caused by organisms not normally seen or otherwise detected in New Zealand. This enables the appropriate investigation of suspected cases of exotic or emerging diseases that are identified in wildlife by organisations or individuals working outside of MPI surveillance programmes.

In addition to investigating reported events, MPI undertakes annual active surveillance in wild birds for avian influenza viruses (see p. 24) and monitoring of routine disease diagnoses by veterinary diagnostic laboratories to detect possible indications of occurrence that may indicate an emerging disease requiring further investigation. MPI receives anonymised commercial laboratory summaries from wildlife cases meeting a sick animal criterion. Reports of particular interest are summarised in the quarterly articles reviewing diagnostic cases in each edition of *Surveillance*.

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

Wildlife cases processed by Wildbase Pathology

Records of wildlife mortality cases examined by Wildbase Pathology are held in the Pathology Database. Most cases involve mortalities of indigenous birds, in particular threatened species submitted by DOC for diagnosis. This database also holds some case records from surveillance activities, wildlife facilities and researchers. **Figure 1** shows numbers of avian cases compared with numbers of cases involving other types of wildlife from 2014 to 2018. The number of avian cases submitted in 2018 was slightly fewer than in 2017 and comprised more than 86 percent of all submissions. Native lizards (skinks and geckos) increased to 5 percent, while tuatara (*Sphenodon* spp.) were 1.5 percent, pinnipeds (NZ sea lions, *Phocarctos hookeri,* and NZ fur seals, *Arctocephalus forsteri*) 4.6 percent, and cetaceans (whales and Hector's dolphins, *Cephalorhynchus hectori*) 2 percent. Amphibians, native fish and bats totalled < 1 percent, as did other wild mammals (mustelids, rabbits and possums).

As in 2017, mortalities in both juvenile and adult yellow-eyed penguins (*Megadyptes antipodes*) from coastal Otago continued to be of concern. Avian malaria emerged as a major problem in all age groups and neonatal penguins continued to be affected by diphtheritic stomatitis during late spring. In late summer some adult birds succumbed to the unexplained erythrophagocytic syndrome described by Gartrell et al. (2017). Predation of brown kiwi *(Apteryx mantelli)* by dogs continued to be an important cause of mortality in Northland, and subadult brown kiwi in the central and lower North Island often succumbed to predation by mustelids. Orange-fronted parakeet/kakariki (*Cyanoramphus malherbi*) suffered moderate mortalities following a North Canterbury re-introduction programme. The birds were in poor condition and there was no evidence of predation or trauma.

Disease surveillance of highly threatened species such as kakapo (*Strigops habroptilus*), black stilt (*Himantopus novaezelandiae*), hihi/stitchbird (*Notiomystis cincta)* and the threatened or endangered species of kiwi, continued

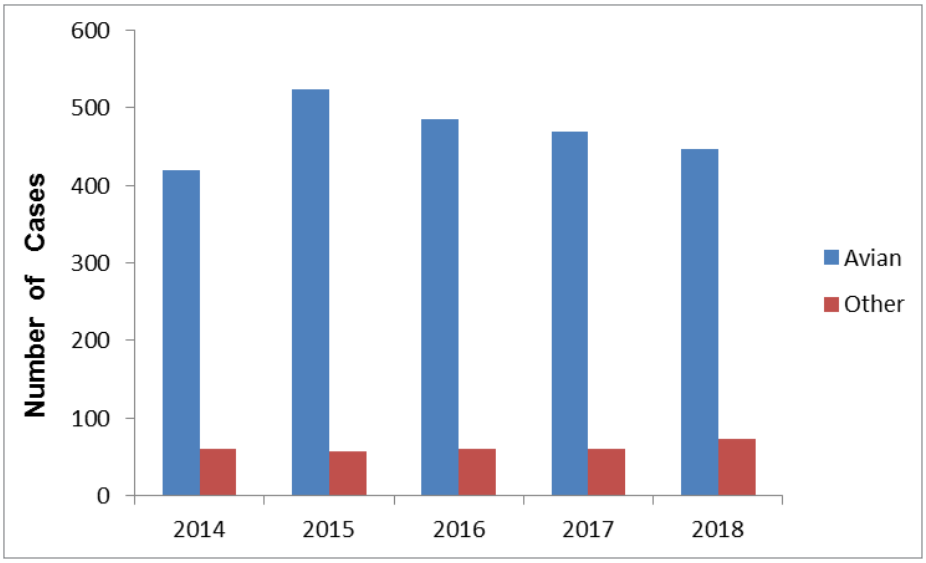


Figure 1: Number of wildlife cases in birds and other taxonomic groups recorded in the Massey Pathology and Huia Wildlife Diseases databases, 2014–2018.

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 2018 is shown in **Figure 2** and the nature of the location from which they originated is shown in **Table 1**.

Table 1: Origin of the 447 avian postmortem cases submitted to Wildbase Pathology in 2018

Source		Percentage of cases
Wild	Mainland (parks and reserves)	22
	Mainland (private land)	14
	Offshore islands	6
	Coastlines	19
Captive	Captive breeding facilities	18
	Rehabilitation facilities	5
	Zoological parks	16

The highest numbers of cases submitted were from Otago, owing to the ongoing investigation of mortalities at the breeding grounds of the highly endangered yellow-eyed penguin. Cases from Manawatu and Whanganui included those from the National Wildlife Centre at Mt Bruce/Pukaha and Tongariro National Park. The Wellington submissions included those from Wellington Zoo, Zealandia, Mana Island, Kāpiti Island and the Chatham Islands. Waikato cases included those from Otorohanga, Mangatautari and Hamilton Zoo. The Canterbury region contains Mt Cook National Park as well as captive breeding centres for threatened species at Twizel, Willowbank and Peacock Springs. Many cases submitted from the Auckland region were of threatened species from offshore islands including Tiritiri Matangi, Motutapu and Ponui. In addition, moderate numbers of cases were submitted directly from locally administered wildlife sanctuaries, situated mainly in the southern and central North Island.

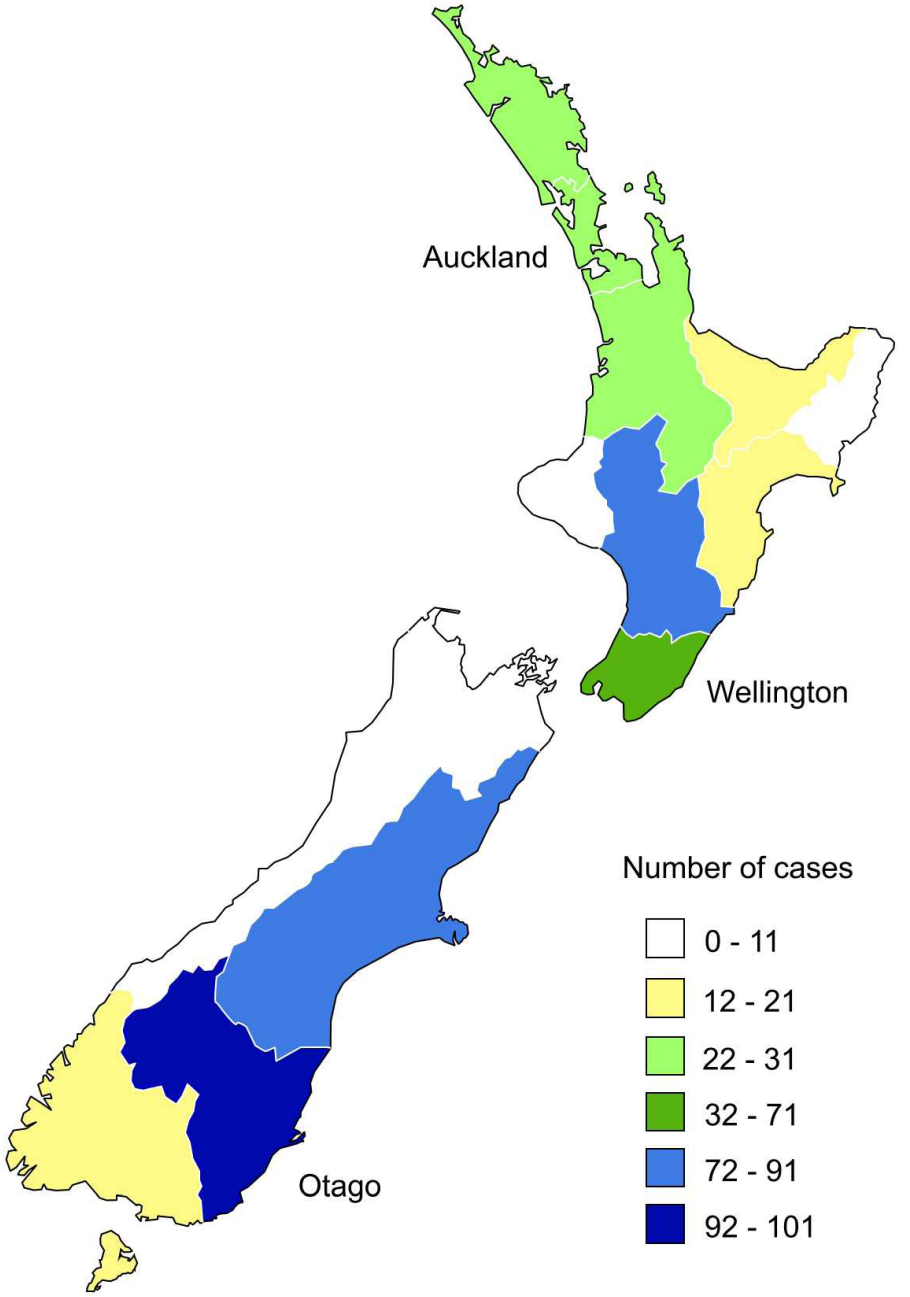


Figure 2: Number of avian cases submitted to Wildbase Pathology in 2018 by region

Wildlife cases of special interest in 2018

Threats to red-billed gulls

Once common throughout coastal New Zealand, red-billed gulls (*Larus novaehollandiae scopilinus*), have been recognised as being in decline since the mid-1990s. However, a large breeding colony remains on Kaikōura Peninsula, and this survived the 2016 earthquake and subsequent tsunami with minimal losses (Alley, 2019). Nevertheless, this population has been struggling for some time, owing to predation by cats and mustelids and a lack of suitable food during the breeding season. The gulls' preferred food during breeding is krill, and in 2016 they were only twice seen to regurgitate these crustaceans to their chicks. Instead they were feeding them on earthworms and fish larvae, which are not ideal food for raising healthy chicks (Mills, 2019).

A recent additional threat to mainland gulls has been malicious human interference. In June 2018 at least eight gulls were found dead on the ground around the Kaikōura wharf, by children and guests staying at a nearby hotel. The incident took place in the early hours of a Sunday morning and the birds are known to be active at night and to roost under lights near the wharf. Staff from Kaikōura Wildlife Rescue visited the scene and said that the birds appeared to have been shot and stamped on or run

over by a vehicle. They found only one injured live bird, on the rocks near the water, and this bird was taken to a local veterinarian to be euthanased.

The carcasses of nine red-billed gulls were frozen and submitted to Wildbase Pathology for examination. They were individually radiographed on arrival but no evidence of ballistic fragments (bullets or shot) was found in any of them. All affected birds were juveniles and most were in good body condition. All showed severe musculoskeletal trauma consistent with a blunt compressive force. Most had multiple fractures of the thoracic rib cage and some also had fractured pelvic or wing bones. In seven birds a severe external force had resulted in an increase of intra-abdominal pressure, causing herniation of the intestines and/or other internal organs through the abdominal muscles and skin or through the cloaca. Five birds also had head and neck injuries resulting in protrusion of the eyes, mandibular dislocations or skull fractures.

All these injuries were associated with haemorrhage, which in some case was severe, indicating that the birds had been alive when the injuries occurred. Despite earlier suspicions, post-mortem examination found no evidence of ballistic injuries and it was concluded that the deaths were consistent with the birds' having been run over by a vehicle.

DOC investigated the incident and a person has been charged with offences under the Wildlife Act 1953.

Veterinarians, wildlife conservationists and members of the public are encouraged to report criminal acts of this nature to MPI. This will not only help protect our threatened species but is also important because of the increasing evidence of a relationship between animal abuse and human domestic violence (Newland et al., 2019).

Avian malaria a serious threat to yellow-eyed penguins, Otago

Until 2018, only sporadic cases of avian malaria were seen in penguins in the South Island. Hunter et al. (2016) documented *Plasmodium* spp. infections that caused mortalities in three yellow-eyed penguins, a Fiordland crested penguin (*Eudyptes pachyrhynchus*) and an erect-crested penguin, *E. scalateri* (usually a subantarctic species), all in Otago. In addition, our more common little penguins (*E. minor*) have been reported to be infected, and antibodies have been detected in 11 out of 12 of those in captivity at a Napier aquarium, and in seven of 11 free-living birds sampled in the South Island (Graczyk et al., 1995). Clinical cases in little penguins are less common, although sporadic mortalities have been reported by Jansen van Rensburg (2010) and Sijbranda et al. (2017), who identified a total of four cases in 295 little penguins recorded in the Pathology Database from 1992 to 2015.

During the summer of 2018 there was a dramatic increase in the number of malaria mortalities seen in yellow-eyed penguins from Otago (**Figure 3**). The first case was in an adult bird brought into captivity in January because of a skin wound near the uropygial gland. The bird died 2 hours after admission. It displayed typical gross and histological lesions (**Figures 4 and 5**), and an acute interstitial pneumonia. *P. elongatum* was identified in the lung tissue by PCR. Over the following 6 weeks there were

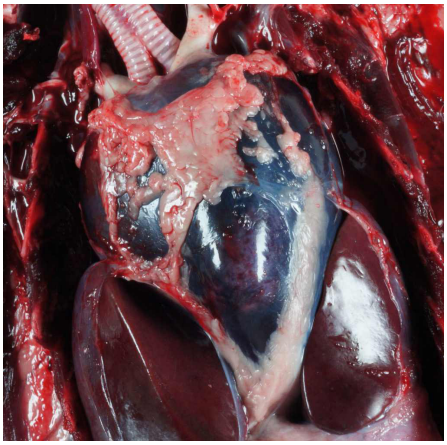


Figure 4: Severe haemopericardium and swollen liver in a yellow-eyed penguin that died of malaria

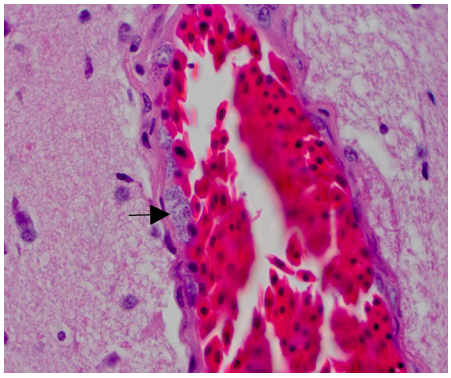


Figure 5: Photomicrograph of the brain of a yellow-eyed penguin showing meronts of *Plasmodium* within the cytoplasm of an endothelial cell (arrow). H & E stained

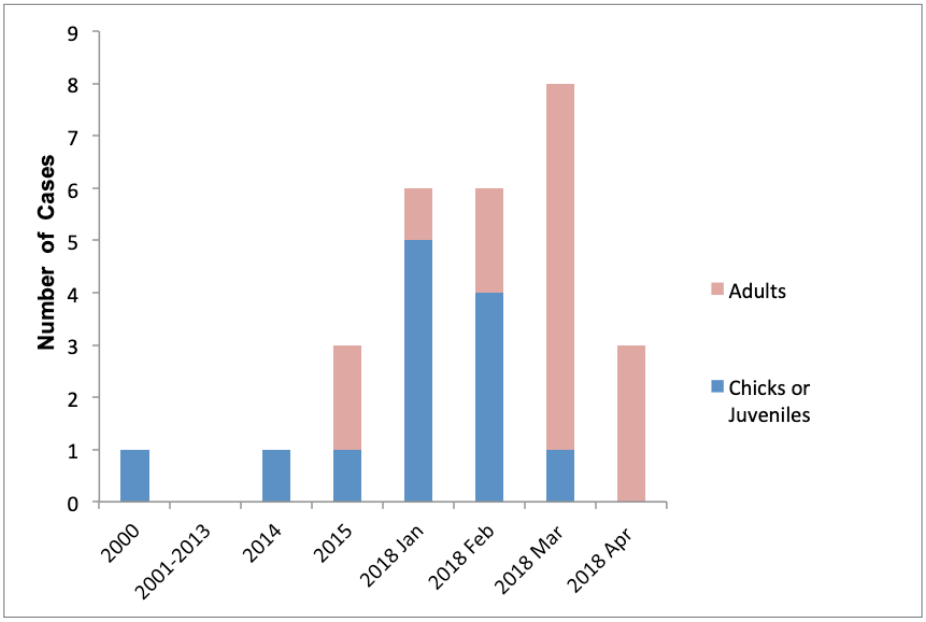


Figure 3: Number of cases of avian malaria in yellow-eyed penguins recorded in the Pathology Database, 2000–2018

11 more cases, mainly in free-living chicks that were found near their nest sites or taken into care because of poor body condition. During March and April, mortalities occurred mainly in adult birds, two of which were taken into care because of malnutrition. One of these died while in care and the other died several days after release. The remaining adult birds were found dead or distressed, on or near the beach, and were usually in good body condition.

The summer of 2017–2018 was the warmest on record in New Zealand (NIWA, 2019) and this, together with significant local rain events, was likely to have increased the abundance of mosquito vectors in Otago. It is generally thought that chronic infections in older birds provide a source of organisms for transmission to juveniles, and the pattern of infection in this outbreak could be consistent with this hypothesis. However, transmission of *Plasmodium* from subclinical infections in introduced passerines is another likely source of infection (Schoener et al., 2014).

MPI investigations

The following cases are examples of wildlife investigations undertaken by the Surveillance and Incursion Investigation Group as the result of calls to the MPI exotic pest and disease hotline.

Dead black-billed gulls, Alexandra

A DOC ranger from Alexandra reported that a member of the public had found a mass mortality of 30–40 black-billed gulls (*Chroicocephalus bulleri*) near a breeding site on the Clutha River. There were no obvious causes of death. The cause of a similar event within recent years was never diagnosed owing to advanced autolysis of the birds. Necropsies were conducted at Wildbase Pathology and it was established that starvation was the most likely cause, with no evidence of infectious disease or toxin.

Multiple swan deaths, Auckland

A veterinarian in Auckland reported neurological signs in a small flock of swans. Up to four birds were affected within a week, with head-bobbing and unsteady gait, progressing to death. The clinical signs were thought to be distinctly different from botulism. Differential diagnoses included West Nile virus (a potential exotic cause of neurological disease in birds), botulism and various toxins including lead. Choanal and cloacal swabs, and serum samples from affected swans and in-contact birds, were submitted for PCR testing to rule out exotic viruses including West Nile virus, avian influenza virus, avian paramyxovirus (the cause of Newcastle disease) and generic flaviviruses. All PCR tests were negative and lead toxicity was ruled out in live swans at the veterinary clinic. Histopathology performed by Wildbase Pathology showed non-inflammatory, degenerative lesions in the brainstem and cerebellum, consisting of vacuolar changes in some neurons. These changes were not consistent with an infectious cause, but were more likely due to an unspecified toxic injury. Further work to identify the cause was undertaken, but attempts to identify toxins are often unrewarding, as in this case. Exotic causes of neurological disease in waterfowl and poultry were excluded.

Incidence of rabbit haemorrhagic disease virus during 2018

Since 2016, a research programme has been undertaken by Manaaki Whenua – Landcare Research to monitor the occurrence of rabbit haemorrhagic disease virus (RHDV) strains in wild and domesticated rabbits.

During 2018, a total of 306 samples were analysed for RHDV strain verification from 170 locations around New Zealand. There were 55 samples from domestic rabbits and 251 from wild rabbits.

Tests identified 173 samples as positive for RHDV, representing 122 outbreaks of rabbit haemorrhagic disease. Three serotypes were identified, including the RHDV-1 Czech strain (present in New Zealand since 1997), the RHDV-1 K5 strain (released nationwide in March 2018), and a strain of RHDV-2. Four samples contained mixtures of all three strains. See **Table 2**.

The RHDV-1 Czech strain occurred in both wild and domestic rabbits throughout New Zealand, especially in early 2018. Where available, records indicate that domestic rabbits infected with this strain had not been vaccinated.

Following the nationwide release of RHDV-1 K5, this strain was detected in 36 wild rabbits at 26 locations throughout New Zealand from March to June 2018. During the same period, 23 cases of RHDV-1 Czech and four cases of RHDV-2 were detected in wild rabbits. One case of RHDV-1 K5 was detected in the South Island in November 2018. No cases of RHDV-1 K5 were detected in domestic rabbits.

Table 2: Summary of confirmed RDHV cases in wild and domestic rabbits, 2018

Time period and strains identified	Wild rabbits	Domestic rabbits	Total
1 January – 30 June	**63**	**27**	**90**
RHDV-1 Czech	23	24	47
RHDV-1 K5	36	0	36
RHDV-2	4	3	7
1 July – 31 December	**82**	**5**	**87**
RHDV-1 Czech	15	4	19
RHDV-1 K5	1	0	1
RHDV-2	66	1	67
Total	**145**	**32**	**177**
RHDV-1 Czech	38	28	66
RHDV-1 K5	37	0	37
RHDV-2	70	4	74

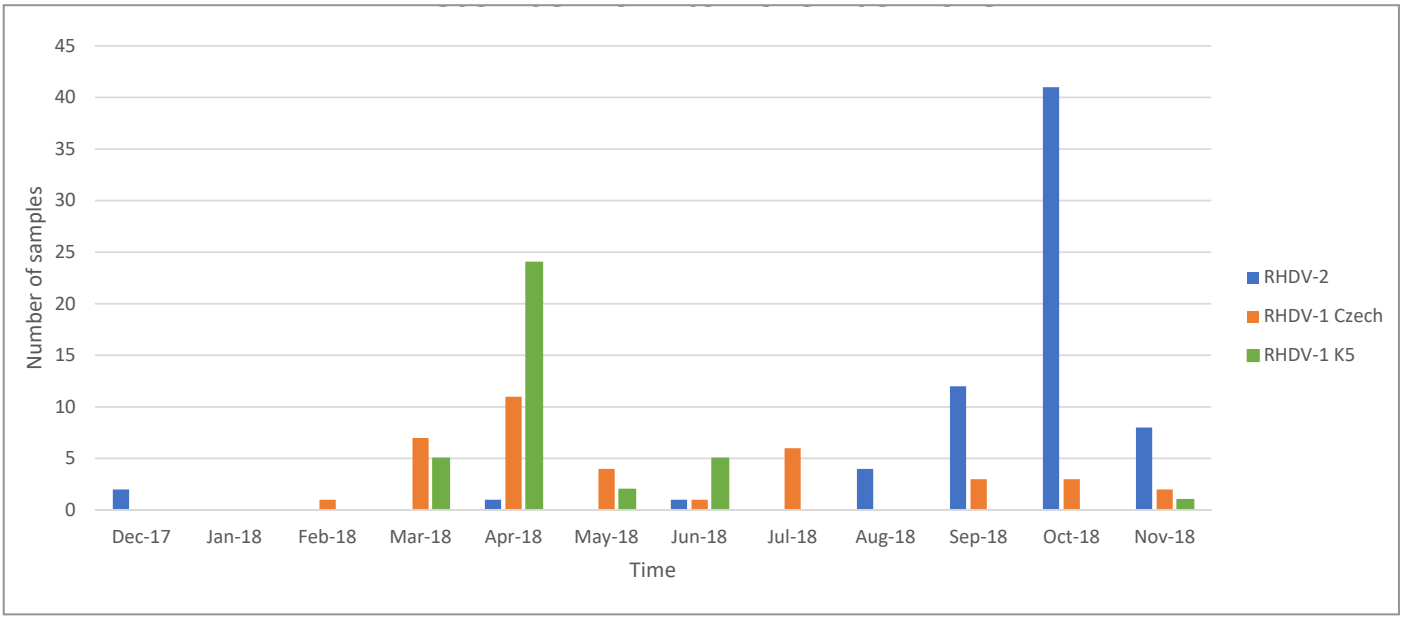


Figure 6: Numbers of RHDV cases detected in wild rabbits, 2018

RHDV-2 was first detected in a wild rabbit in April 2018, in Marlborough. Testing of historical samples subsequently revealed that the virus was also present in Bay of Plenty, in December 2017. RHDV-2 has now been detected in 49 locations including Waikato, Otago, Bay of Plenty, Marlborough, Tasman, Wellington, Wairarapa, Southland and Canterbury. Otago in particular has recorded a large number of outbreaks (36) in wild rabbits since August 2018. Four domestic rabbits from Marlborough, Tasman and Waikato have been confirmed to have died from RHDV-2. The vaccination status of the domestic rabbits infected with RHDV-2 was not known.

RHDV-1 K5 was the most common strain found in wild rabbits after the nationwide release of this strain in autumn 2017. However, increasing numbers of RHDV-2 cases were detected from early spring, particularly in Otago **(Figure 6)**.

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Transmissible spongiform encephalopathies surveillance programme

Transmissible spongiform encephalopathies (TSEs) are a group of neurodegenerative diseases caused by the proliferation in the central nervous system of an altered form of a normal intracellular protein called a prion. The main TSEs of interest in New Zealand are bovine spongiform encephalopathy (BSE) affecting cattle, classical scrapie affecting sheep and goats, and chronic wasting disease (CWD) affecting deer and elk/wapiti. New Zealand is free from these diseases.

Aim of TSE surveillance

This programme is designed to ensure early detection of any TSE incursion, and to ensure early containment and successful eradication.

The TSE surveillance and risk management measures implemented in New Zealand have been described in previous annual reports (e.g. Watts, 2018). Surveillance for CWD is not mandated by the World Organisation for Animal Health (OIE), but is carried out to assure our trade partners that New Zealand is free from this disease.

As a country with a negligible BSE risk, New Zealand performs surveillance type B, as specified by Chapter 11.4 of the OIE Terrestrial Animal Health Code (OIE, 2018a). This relies on the passive surveillance scheme described below. BSE points have been accumulated since 2005 and New Zealand has consistently maintained well in excess of the required 150,000 points.

How the programme works

TSE surveillance combines passive and active surveillance activities. Passive surveillance is carried out for all three TSEs through a targeted scheme under which veterinary practitioners submit neurological material (brain and spinal cord) from animals showing clinical signs of neurological disease. Veterinarians and farmers are compensated for supplying the samples. Submissions to the programme occur year-round, with a seasonal increase in submissions from August to October.

Active surveillance for classical scrapie and CWD has been carried out since 2010, to complement the small numbers of submissions made to the passive scheme for sheep and deer. As part of this, medial retropharyngeal lymph nodes (MRLNs) are routinely collected for testing, from clinically healthy adult animals sent to meat processing plants across the country. The required sample size (320 sheep and 320 deer per year) is designed to detect disease at a low prevalence in the population. A maximum of two animals can be collected from any one farm, to help ensure that the sampled population is geographically representative.

Until 2019, brains collected under the passive surveillance scheme were histopathologically examined at accredited veterinary diagnostic laboratories to rule out TSE lesions, and to potentially provide an alternative diagnosis. If histopathology could not rule out TSE, confirmatory testing was performed at the MPI Animal Health Laboratory (AHL) (Wallaceville), using the EU-approved Herd Check BSE-scrapie ELISA (IDEXX Laboratories Inc., Westbrook, Maine, USA). Lymph nodes from deer and sheep collected under the active surveillance scheme are tested using the Herd Check BSE-scrapie ELISA rapid test at the AHL.

The TSE surveillance programme evolves over time to respond to changing risks and advances in sampling and diagnostic techniques, to ensure the programme remains effective and meets OIE guidelines and market needs.

Results

In total, 751 samples from all species were tested by both passive and active TSE surveillance in New Zealand in 2018. All tests were negative (**Table 1**).

The level of passive surveillance of the cattle population achieved in 2018 is eligible for 21,320 BSE points.

For active surveillance of scrapie and CWD through meat plants, the sampling distribution was widespread throughout New Zealand, thus reasonably representative of the population at risk (**Figure 1**).

Trends in TSE passive surveillance

The passive surveillance scheme for TSE is focused on submissions of clinically suspect animals (or fallen cattle) from veterinarians. Although these occur year-round, there is a clear seasonal trend, with a peak from August to October each year (**Figure 2**).

The numbers of samples submitted to this programme have declined since 2005. Specifically, the number of deer and cattle brain submissions declined sharply after 2008 after the imposition of a maximum of two submissions per farm per year (**Figure 3**).

Trends in TSE active surveillance

In October 2009, the first detection of a case of atypical scrapie/Nor98 in a New Zealand-born sheep was confirmed (Kittelberger & McIntyre, 2009; Kittelberger et al., 2010). MPI strongly supports OIE's view 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, 2018b). Accordingly,

Table 1: Number of samples tested in 2018 for TSE, by passive and active surveillance

Surveillance stream	Tissue	Test type	Species	Number
Passive	Brain	Histopathology	cattle	67
Passive	Brain	Histopathology	deer	4
Passive	Brain	Histopathology	sheep	1
Active	MRLN†	Rapid Test IDEXX	deer	320
Active	MRLN	Rapid Test IDEXX	sheep	359

†Medial retropharyngeal lymph node

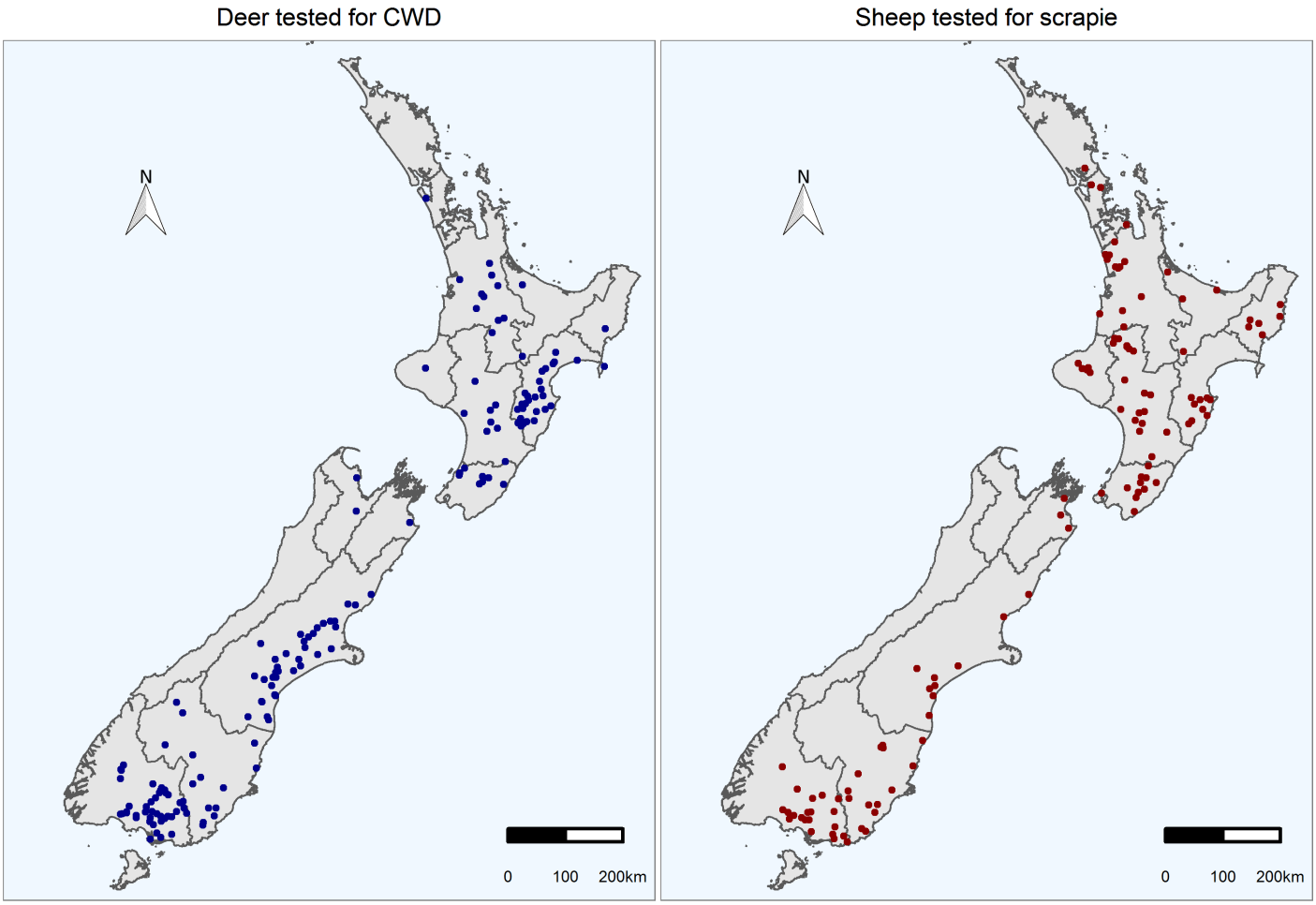


Figure 1: Locations of farms screened through active surveillance for CWD (left) and classical scrapie (right), 2018

MPI considers atypical scrapie to be a negligible biosecurity risk (Vink & McIntyre, 2014). The sensitivity of detection of the prion causing classical scrapie is higher in lymphoid tissue than in brain tissue, and the atypical scrapie/Nor98 prion is not detected in lymphoid tissue (Meloni et al., 2012). Research at the AHL (Wallaceville) has shown that testing of MRLN tissue from sheep and goats with the IDEXX TSE test has high diagnostic sensitivity and specificity towards classical scrapie (Kittelberger et al., 2014). This is the basis for currently using MRLN for active surveillance in sheep and deer.

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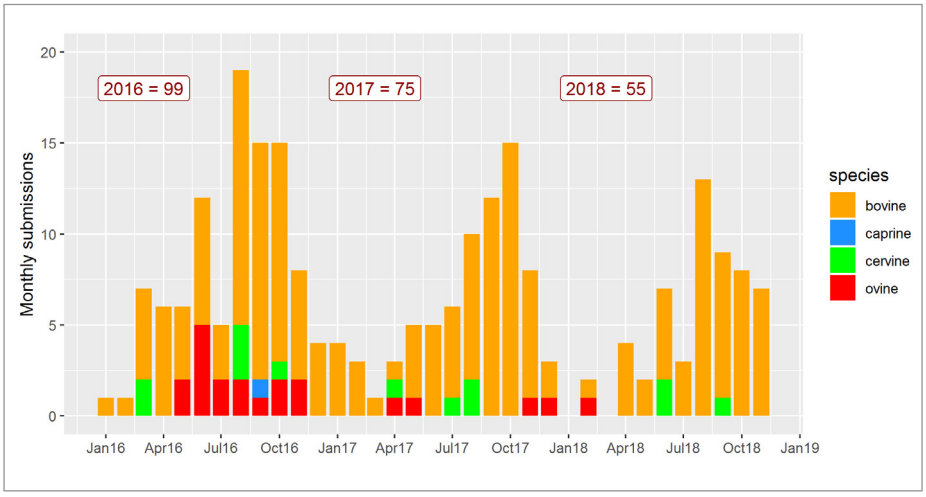


Figure 2: Passive surveillance through the incentivised scheme: monthly numbers collected, 2016–2018 (Total numbers tested each year are shown at top).

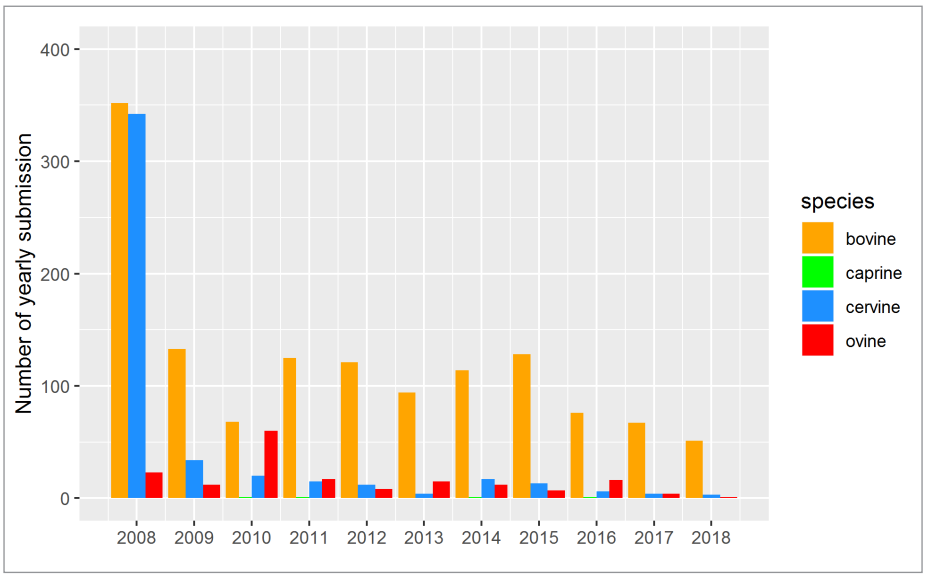


Figure 3: Annual number of brain samples tested for TSEs under the incentivised passive surveillance scheme, 2008–2018

Arbovirus surveillance programme

Introduction

The arbovirus surveillance programme was instigated in 1991 to provide assurance of New Zealand's freedom from arboviruses (particularly bluetongue virus) that affect sheep and cattle. Other arboviruses of veterinary concern include epizootic haemorrhagic disease virus, Akabane virus and bovine ephemeral fever 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). New Zealand is the only place in the world apart from Antarctica where the *Culicoides* genus is not present. However, there is a low likelihood that the route of introduction to New Zealand would be through windborne dispersal of the vector species *C. brevitarsis* from Australia owing to its wider distribution, high abundance and documented dispersal capability (Burgin et al., 2013). Studies of other arthropod incursion events suggest that *C. brevitarsis* could be blown from Australia to New Zealand in the predominant westerly winds of the region (Burgin et al., 2013).

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

The surveillance strategy has three components:

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

Early warning system

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

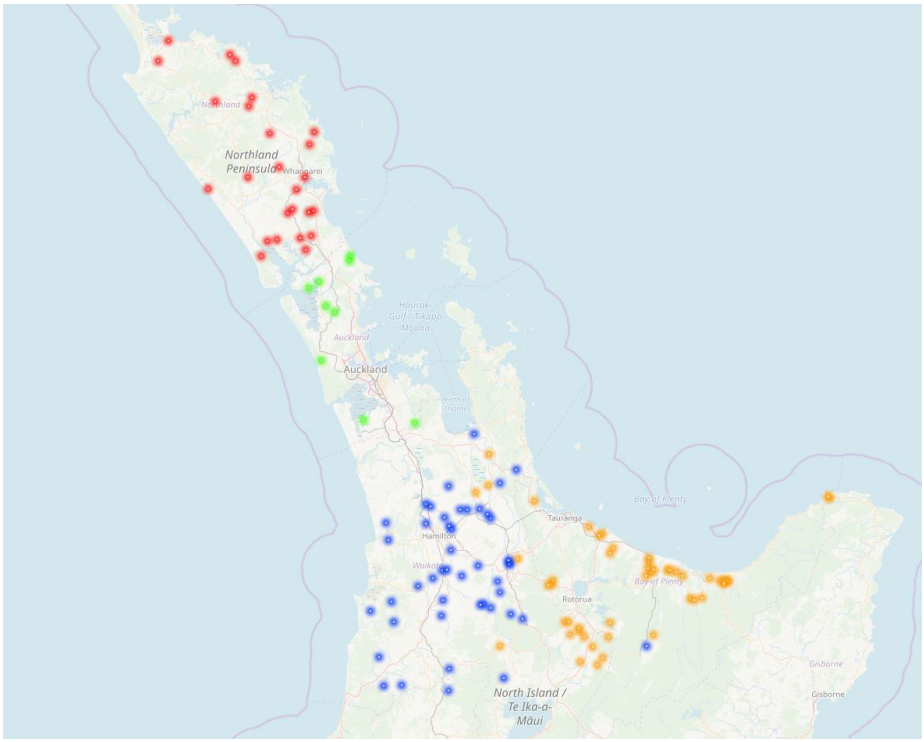


Figure 1: Locations of animal sampling for arbovirus in 2019

Herd testing

During 2019 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. (**Figure 1**). 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 (Wilson et al., 2008).

Vector surveillance

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

Twelve light traps with green LEDs (Bishop et al., 2004, 2006) were deployed this season on cattle farms. 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.

Results

The aim of herd testing is to detect serological evidence of exposure to bluetongue, epizootic haemorrhagic disease, Akabane and bovine ephemeral fever viruses. All 638 blood samples sent to the Animal Health Laboratory, (Wallaceville) in 2018 tested negative by ELISA for antibodies to these viruses. Results from the blood samples collected this season in 2019 will be confirmed in the September 2020 issue.

Light trap test results from the 2019 surveillance season

Insect samples were processed by MPI's Plant Health and Environment Laboratories (Tamaki and Christchurch) in early 2019. It was estimated that 136,632 insects were screened from 120 traps over a 10-week period, but no *Culicoides* spp. were found. There were

197 native midges (Ceratopogonidae) trapped, which suggests that the traps would catch *Culicoides* species if they were present this season.

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Honey bee exotic pest and disease surveillance report

This report summarises surveillance activities for the year 1 July 2018 to 30 June 2019.

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 notifications; 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*); and
- other exotic *Apis* species (e.g. the Asian honey bee, *Apis cerana*).

Broadly, surveillance is conducted in two ways:

- targeted – involving hive inspection and collection of samples from apiaries in high-risk areas; and
- non-targeted – involves receiving samples from low-risk apiaries, and screening notifications of suspected cases of exotic honey bee diseases from beekeepers.

Targeted surveillance

Nineteen geographic areas throughout New Zealand (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. These areas typically encompass one or more of the following: ports, airports, Transitional Facilities, cities, tourist destinations and areas of high hive concentration such as kiwifruit-growing areas. Four of these areas (Auckland, Wellington, Christchurch and Dunedin) contain sub-areas classified as "elevated-high-risk zones". Within these four areas, at least 50 percent of targeted apiaries are located in the elevated-high-risk zones.

The aim of targeted surveillance is to inspect and take samples from 350 apiaries within 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 laboratory testing and 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.

During the period covered by this report, a total of 356 apiaries were inspected as part of targeted surveillance. However, samples were collected from only 350 apiaries because the other six either had very weak hives for bee samples to be taken or sticky boards could not be inserted into the hives. In total, 954 sticky boards and 916 bee samples were submitted for laboratory testing (**Table 1**). All apiaries were inspected by Authorised Persons – Level 2 (AP2s).

Non-targeted surveillance

Each beekeeper supplying live bees for export is required to work through an apiary clearance process for every apiary from which they intend to supply bees. As part of the clearance process, they are required to provide up to 25 samples from their supply apiaries. Each sample is a pooled sample of bees taken from a maximum of 16 hives, meaning that multiple samples need to be taken from apiaries that have larger numbers of hives. These are considered low-risk apiaries and the target is to collect 300 samples from such apiaries. Tests similar to those conducted on targeted surveillance samples are also conducted on export bees, except that sticky boards are not included. During the period covered by this report, a total of 530 bee samples were collected from 388 low-risk apiaries (**Table 1**).

Each year MPI and AsureQuality Ltd receive notifications from beekeepers regarding suspected exotic bee pests, bee diseases or unusual signs in hives. AsureQuality works with MPI's

Table 1: Number of samples collected during the 2018–2019 surveillance season

Type	Apiaries inspected	Apiaries sampled	Sticky boards	Bee samples
High-risk	356	350	954	916
Low-risk		388		530
Total	**356**	**738**	**954**	**1,446**

Table 2: Laboratory test results for samples during the 2018-2019 surveillance season

Organism	High-risk		Low-risk	
	Suspect	Positive	Suspect	Positive
European foulbrood	1	0	0	0
Small hive beetle	2	0	0	0
Parasitic fly	0	0	0	0
Tracheal mite	0	0	0	0
Asian mite	0	0	0	0
Africanised honey bee	0	0	0	0
Cape honey bee	1	0	0	0
Other exotic bee species	0	0	0	0
Total	**4**	**0**	**0**	**0**

Diagnostic and Surveillance Services (Wallaceville) to screen these calls and determine whether sampling is justified. This year, six calls were received that resulted in further investigation and sampling. These included calls about suspect European foulbrood (EFB), unexplained bee deaths, suspect poisoning events, unusual insects found in hives (including suspect small hive beetles), and a bee with what appeared to be a strange "growth" but turned out to be a pollinium attached to its thorax. All investigations that resulted in testing a sample came back as negative for exotic pests and diseases (**Table 2**). In a number of other cases, on interviewing the caller it was determined that the observed signs could be explained by endemic bee diseases or beekeeper mismanagement.

Reports

Each year, AsureQuality Ltd, on behalf of MPI, reports on exotic surveillance activities in *Surveillance* and *The New Zealand Beekeeper* magazine. These reports fulfil international reporting requirements with regard to New Zealand's bee health status, and keep 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 30 June 2019 there were 9,282 beekeepers managing 918,026 hives on 59,693 apiaries. New beekeepers continue to enter the industry, with 1,550 new registrations in the 12 months to July 2019, resulting in a net increase of 733 beekeepers, 3,652 apiaries and 28,156 hives. This rapid increase over the past few years has steadied but is still climbing, though the overall increase in hive numbers is less than half compared to last year.

About a third of beekeepers have fewer 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, because far 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

In previous years a number of articles have been written for publication in *The New Zealand Beekeeper* magazine, on surveillance issues relating to exotic honey bee pests and diseases and their relevance to the New Zealand beekeeping industry. The articles tend to cover 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 under review, 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. 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, to identify 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, ATAs undertook a week-long trip to Australia for refresher training on exotic pest and disease identification, disease surveillance and control strategies, and biosecurity implementation.

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

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American foulbrood

American foulbrood (AFB) is a honey bee brood disease caused by the bacterium *Paenibacillus larvae larvae*. It has been regulated by government since 1907. The American Foulbrood Pest Management Plan (AFBPMP), under the Biosecurity Act 1993 and set up under in an Order in Council (Biosecurity Order 1998), appointed Apiculture New Zealand to oversee the AFBPMP, which is managed by the AFB Management Agency. More information can be found at www.afb.org.nz.

Key features of the AFBPMP are:

- All hives must be inspected annually for the prevalence of AFB by a beekeeper who holds a Disease Elimination Conformity Agreement (DECA) and who must report on the disease status of the hives to the AFB Management Agency or its contractor, AsureQuality Ltd.
- All non-DECA beekeepers must annually submit a Certificate of Inspection issued by a DECA holder to the AFB Management Agency or its contractor, AsureQuality Ltd.
- To attain a DECA beekeepers must first pass a competency test on AFB recognition and control, and then submit an AFB management plan to the AFB Management Agency or its contractor, AsureQuality Ltd.
- Beekeepers must submit samples of bees, brood or honey for AFB testing on request.
- Random and focused inspections of suspect hives and hive equipment are carried out by Authorised Persons.
- The killing of infested colonies and destruction of contaminated hive parts is mandatory and must be reported to the AFB Management Agency or its contractor, AsureQuality Ltd.
- All apiaries must be registered on the apiary database within 30 days of being established and all beekeepers must submit an Annual Disease Return confirming that the information on the database (including disease reports) is accurate.

Hive inspection and audit programme to 30 June 2019

AsureQuality Ltd collates beekeeping and AFB disease statistics each year for the AFB Management Agency for the period 1 July to 30 June, which encompasses a full beekeeping season. The AFB Management Agency has appointed an Operational Manager who has taken over the management of Authorised Persons. During this reporting period, Authorised Persons inspected 7,605 hives (0.82 percent of total hives) from 1,084 apiaries (1.82 percent of total apiaries). As a result of these inspections 1,692 outbreaks of AFB were discovered in 3,001 hives. Corresponding AFB infection rates for 2017–2018 were 1,739 outbreaks found in 2,812 hives.

As of 30 June 2019 there were 4,663 beekeepers with DECAs, representing 50 percent of all registered beekeepers. During this reporting period 544 new DECAs were approved. The number and percentage of DECA holders increased.

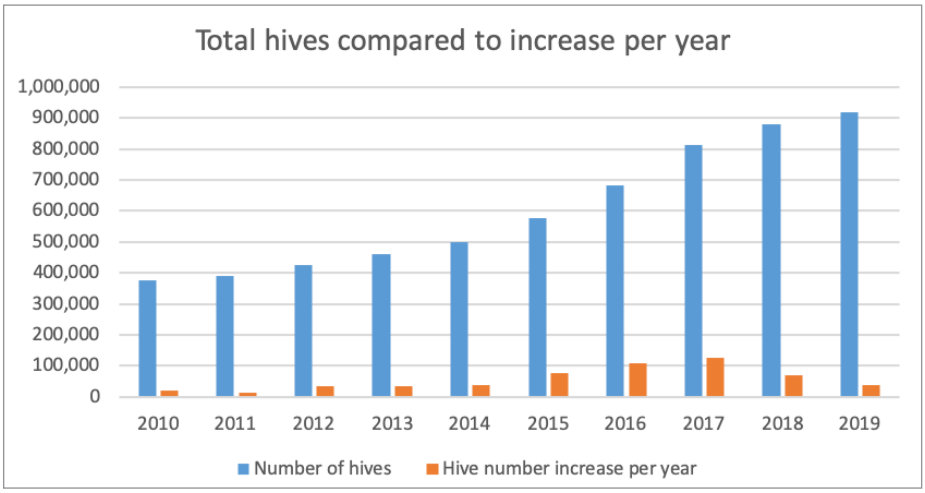


Figure 1: Total hive numbers, 2010–2019

A newly introduced DECA for hobbyists will make it easier for beekeepers with fewer than 10 hives and/or four apiaries to become DECA holders. These beekeepers are permitted to inspect their own hives for AFB and make reports to AsureQuality via APIWEB or on the approved forms.

There were 4,619 beekeepers who owned 58,379 hives on 7,426 apiaries that required a Certificate of Inspection as of 30 June 2019. This means they had to engage the services of an approved beekeeper to inspect and report on the AFB status of their hives.

Apiary register and statistics

There were 9,282 beekeepers owning 918,026 hives on 59,693 apiaries as of 30 June 2019, compared with 8,533 beekeepers, 881,185 hives and 55,527 apiaries at the same time in 2018. Over the past few years the industry has continued to grow, with a further 8 percent net increase in beekeeper numbers – the same as for the previous year. This increase represents greater numbers of both commercial and hobbyist beekeepers. Although the total number of hives increased, the increase (4.2 percent) for the period was less than in the previous year (**Figure 1**). The drastic drop in non-manuka-honey prices offered by buyers made beekeeping an unattractive farming prospect.

The main increases in beekeeping operations were again in the North Island, where 71 percent of all beekeepers are registered, and is largely driven by mānuka honey production, which is much more prevalent in the North Island. Apiary density is a very real concern for beekeepers, landowners and other stakeholders, as is the continual increase in hive numbers over the past decade.

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Annual reports from industry surveillance and disease control programmes

Brucella ovis accreditation scheme 2018

Numbers of animals tested in 2018 have increased slightly compared with 2017. The overall infection rate (reactors/samples tested) was 2 percent.

The infection rate should be treated with caution as it is skewed by several flocks with a > 25 percent prevalence 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 sample prevalence 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 shows that not all flocks with reactors were investigated any further during 2018.

Some of the 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.

Table 1: *Brucella ovis* testing and eradication, 2018

Area	Flocks with reactors*	Flocks with eradication in progress or completed
Far North & Auckland	0	0
Waikato, Waitomo & BOP	3	1
Taranaki & Wanganui	8	4
East Coast	4	1
Hawke's Bay	1	0
Manawatu & Rangitikei	1	1
Wairarapa & Wellington	1	0
Marlborough & Canterbury	5	2
Otago & Southland	5	1

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

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Infectious bursal disease eradication programme

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

During 2018, the two private poultry laboratories screened 17,171 blood samples collected under the whole-flock testing programme. There were 663 submissions to poultry laboratories. Samples were screened using the IDEXX FlockChek ELISA.

There were 328 IBD ELISA reactors: 138 reactors from 79 flocks that were re-tested (as the prevalence of reactors was < 50 percent). At retest, 13 flocks had ELISA positives and samples were sent to MPI for virus neutralisation test (VNT).

A total of 75 reactors from 11 flocks were followed up directly and sent to MPI for VNT (as the prevalence of reactors was > 50 percent). Seventeen reactors were not re-tested as the birds had been processed. (Note: where the poultry have been sent to slaughter the next placement of poultry in the shed is tested.)

Positive reactors in the VNT were investigated further by MPI's Incursion Investigation Team (Rawdon et al., 2019). In addition, as part of the export testing requirements, 83 reactors were followed up with PCR testing by MPI.

These investigations, which included assessment of health/production parameters, blood sampling, serology, collection of bursas for histology and PCR testing, all led to the conclusion that IBD type 1 was not present. Reports are published quarterly in *Surveillance* as part of the Diagnostic and Surveillance Services report of suspect exotic disease investigations.

IBD-2 in New Zealand

Investigations were carried out on three unrelated free-range chicken broiler farms as part of ongoing efforts to inform and validate New Zealand's IBD surveillance programme (Rawdon et al., 2019). The investigation involved historical samples that had been taken in 2015–2016 from three free-range broiler farms with low-level ELISA reactors detected via the poultry industry sero-surveillance programme. The farms all had healthy flocks (assessed throughout the ~6-week production cycle) with no clinical signs, increased mortality or pathology indicative of IBDV infection. Mortality figures were consistent with industry standards, with all barns on all farms demonstrating excellent performance and low mortality figures.

Histopathology of bursas from seropositive flocks was mostly within normal expected limits, with occasional bursas showing one or more changes, including mild-to-moderate lymphocyte depletion, cryptosporidiosis, or focal bacterial-associated heterophilic inflammation, and rare peri-follicular haemorrhagic change (thought to be consistent with electrical stunning prior to slaughter). There was no evidence of generalised necrosis and atrophy of bursal follicles as would be expected from pathogenic IBD infection.

A cross-sectional serological survey of all barns on every farm was carried out, and cloacal swabs and fresh and fixed tissues, including bursa, spleen and caecal tonsil, were collected on-farm and/or at processing. The investigation excluded the presence of pathogenic IBD serotype 1 viruses (IBDV-1) but identified a non-pathogenic IBDV serotype 2 (IBDV-2) virus.

As part of the investigation into potential sources of virus, cloacal swabs collected from wild mallard ducks (*Anas platyrhynchos*) during MPI's Avian Influenza Surveillance Programme were also tested, with molecular sequencing indicating a high similarity to the virus detected in the poultry broiler farms.

The investigation concluded that IBDV-2 was the most likely cause of the sporadic low-level seropositivity seen during the programme (Ashraf et al., 2006). Although it is not possible to explain the origin of the virus in the broilers, phylogenetically similar IBD-2 viruses were detected in both the free-range broilers and wild New Zealand mallards. It is reasonable to expect the occasional introduction of IBD-2 from wild birds, especially under a free-range system.

These findings support New Zealand's claim that Gumboro disease (also known as infectious bursal disease or IBD) is absent from commercial poultry, and will pave the way for the development of serotype-2-specific serological and molecular assays. Such tests will enable the rapid exclusion of IBDV-1 in poultry flocks identified with serum reactors through the ongoing IBD sero-surveillance programme.

Biosecurity response to IBD-1 detection

MPI, in partnership with the poultry industry, is responding to the detection of IBD-1 virus in an enterprise group of chicken layer farms. Routine surveillance by the poultry industry in June 2019 detected seroconversion for IBD virus on a chicken farm near Dunedin. Preliminary VNT and molecular testing as part of an MPI investigation suggested the presence of IBD-1 virus, which was confirmed by molecular analyses at the OIE reference laboratory (Ploufragan-Plouzane, France). A flock on a second farm directly linked to the index premises and part of the same enterprise group subsequently tested positive. No clinical disease or change in production parameters have been evident in either of the affected farms. Movement controls have been applied and tracing and testing of in-contact properties is in place. A nationwide delimiting survey of commercial poultry farms is underway. MPI is also undertaking a pathway assessment, but as the findings are isolated to premises with a high biosecurity status and there

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Poultry health surveillance

The following is a summary of the laboratory tests performed by the New Zealand poultry industry laboratories and the MPI Animal Health Reference Laboratory during 2018.

Table 1 is a summary of serum sample testing for major poultry diseases. **Table 2** summarises the findings of *Salmonella* serotypes isolated from poultry environments, raw feed ingredients, finished feed and carcass samples.

Poultry *Salmonella* testing from the National Microbiological Database programme

All primary processors of meat, poultry, game or ratites are required to take part in the National Microbiological Database (NMD) programme. Only suitably trained persons may carry out NMD sampling. Poultry carcasses are sampled at poultry slaughter plants (operators) and the samples are cultured with subsequent typing as detailed in the NMD programme.

Figure 1 shows the number of samples taken each year. In 2018 samples were obtained from 16 slaughter premises. There has been no isolation of fowl typhoid (*Salmonella* Gallinarum) or pullorum disease (*S.* Pullorum).

Table 1: Serological test results summary: poultry – 2018

Disease	Number tested	Number positive	Vaccination status*
Avian influenza	8,135	27*	
† Newcastle disease	7,312	0	
Egg drop syndrome '76	3,024	511	(V)
Infectious bursal disease	17,171	328***	
Chicken anaemia agent	2,626	2,169	V
Avian encephalomyelitis	4,959	3,422	V
Infectious bronchitis	13,818	5,880	V
Infectious laryngotracheitis	3,015	1,200	V
Reovirus	488	386	
Mycoplasma gallisepticum	24,471	251	
Mycoplasma synoviae	21,145	2,695	
Salmonella Pullorum	8,735	40**	

V = Most vaccinated; (V) = Some vaccinated

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

* AI reactors – samples sent to MPI for confirmation test – negative

** Pullorum reactor – samples sent to MPI for confirmation test – negative

*** IBD reactors: see IBD report, p. 42

2016 *Salmonella* survey of commercial egg layer farms in New Zealand

In 2016 samples of chicken feed, faeces, dust and egg-contacting surfaces obtained from 28 egg production farms were tested for presence of *Salmonella* (Kingsbury, 2018). Farms surveyed were representative of New Zealand commercial egg-layers and included free-range, conventional cage, colony-cage and barn-reared birds.

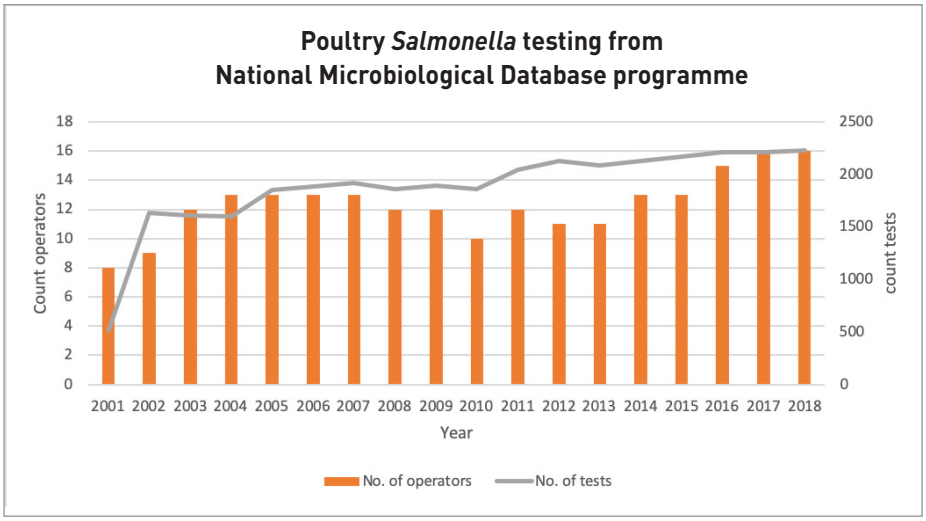


Figure 1: NMD poultry sampling for *Salmonella*, 2001–2018

Table 2: Serotypes of *Salmonella* isolated during 2018

Salmonella isolates	Number of isolates: Feed sources**	Number of isolates: Broiler samples*
Agona		24
Derby		3
Bovismorbificans		4
Infantis	2	9
Senftenberg		13
Rissen		1
Livingstone		16
Anatum		1
Give		1
Typhimurium		1
Typhimurium 42		2
Species group B	1	
Species group C		14
Mbandaka	5	46
Anatum		2
Salmonella non-typed	4	
Stanley		3
Salmonella non-motile	1	
Total positive/ total tested:	**13/2,877**	**140/3,142**

2,209 are National Microbiological Database samples

* Samples include environmental swabs, neck flap, ceca and whole carcass rinse birds

** Samples include feed ingredients

Salmonella was identified in 43 of the total of 323 samples. Five serotypes were identified: S. Infantis, *S.* Typhimurium, *S.* Thompson, *S.* Anatum and *S.* Mbandaka. There was no isolation of fowl typhoid (*S.* Gallinarum) and pullorum disease (*S.* Pullorum).

This survey is in addition to the annual *Salmonella* testing previously reported in *Surveillance*.

Reference

Kingsbury J (2018). Microbiological survey of commercial egg layer farms in New Zealand for the presence of *Salmonella*. Institute of Environmental Science and research Ltd. 45pp. Available online: www.mpi.govt.nz/dmsdocument/33732-microbiological-survey-of-commercial-egg-layer-farms-in-new-zealand-for-the-presence-of-salmonella

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are no clinical signs, MPI is considering whether this finding may be vaccine-associated, as is suspected with the previous incursion in 1993. For updates on this emerging situation please refer to the OIE WAHIS interface:

https://www.oie.int/wahis_2/public/wahid.php/Diseaseinformation/WI

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

Rawdon TG, Stanislawek WS, Soubies SM, Eterradossi N, Buckle KN, Jones B (2019). Detection of infectious bursal disease virus serotype 2 (IBDV-2) in New Zealand poultry and waterfowl. *Surveillance* 46(1), 4–7.

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Quarterly review of diagnostic cases

SVS Laboratories

Bovine

Five animals from a group of 17 nine-month-old steers in Waikato presented with bloody, mucoid faeces. The animals were also depressed and anorectic and had swollen prepuce sheaths. Acorn toxicity was suspected. Serum samples from three of the animals showed marked azotaemia, with high creatinine (1,232, 1,242 and 806 mmol/L; reference range 55–130) and high urea (73.4, 89.3 and 53.7 mmol/L; reference range 2.7–12.3) that supported renal failure caused by **acorn toxicity**. Faecal samples showed medium to high numbers of coccidia and strongyle eggs. Culture for *Yersinia* sp. and *Salmonella* sp. was negative.

Two dairy heifers from Waikato aborted. Fresh and fixed placental samples (specifically the cotyledons) were submitted. Histology revealed **suppurative and necrotising placentitis** with fungal hyphae. A PCR test on the fresh placenta identified ***Mortierella wolfii.***

A group of ill-thrifty R1 Friesian heifers in eastern Bay of Plenty had brown rough hair coats and chronic diarrhoea. Six out of 150 animals at risk had died over the previous 3 months. Ten serum samples were submitted to the laboratory for copper analysis. Serum copper levels varied from 2.8 to 5.9 umol/L (reference range 8–20), confirming **copper deficiency**.

In Waikato 44 yearling steers from a group of 70 were found dead. The animals had been well the day before and the surviving steers were not sick. Samples of vitreous humour from three dead animals had nitrate levels > 50 mg/L (< 10 is normal; 10–20 suspect for exposure; > 20 indicates excessive nitrate exposure), confirming **nitrate toxicity**.

Another group of 10 mixed-aged cows from Bay of Plenty were found dead in a new grass paddock. Ocular fluid from three of the dead animals had nitrate levels of 50 mg/L, again confirming **nitrate toxicity**.

A 2-year-old Friesian cow from Waikato presented with a mass in the parotid area of the neck. A biopsy from the lesion showed pyogranulomatous and eosinophilic deep dermatitis with colonies of bacteria surrounded by eosinophilic Splendore-Hoeppli material. This lesion is most consistent with **actinobacillosis**.

A rising-2-year-old Friesian heifer from Northland presented with respiratory signs. She did not respond to treatment with oxytetracyline and ketoprofen, and died 5 days after the onset of clinical signs. The heifer had been previously treated with abamectin in late April. Two other animals on the farm had died previously but the deaths had not been not investigated. An on-farm postmortem revealed numerous firm nodules throughout the caudal and cranial lung lobes. Histology revealed a severe **thromboembolic suppurative pneumonia with vasculitis** and intralesional fungal hyphae. ***Mortierella* sp.** was cultured from fresh lung tissue.

Fixed skeletal muscle from a 2-year-old Hereford bull killed by a commercial butcher in Whakatane presented with multiple yellow-green foci that lacked purulent material. Histopathological findings showed an eosinophilic necrotising myositis. **Eosinophilic myositis** is relatively rare in cattle and the literature suggests that it may be due to degenerated *Sarcocystis* cysts. Characteristic gross lesions in cattle are green, green-brown or grey-green focal stripes or patches that fade to off-white when exposed to air. Some lesions may be restricted to single muscles or widespread through all skeletal muscles, including the heart. Individual lesions may be 2–3 mm in diameter and over time may take on granulomatous characteristics as muscle fibres undergo degeneration.

An aborted fetus from a Bay of Plenty dairy cow was submitted to the laboratory. Four other cows from the same herd had previously aborted. The estimated gestational age, based on crown-rump length and fetal characteristics, was 6 months. Grossly, the placenta was markedly oedematous and had grey to tan material in the intercotyledonary areas, consistent with a **placentitis**. PCR of the fetal stomach contents identified ***Ureaplasma diversum***.

Equine

A 3-day-old colt with diarrhoea of 2 days' duration became anorectic and pyrexic. The foal had a left shift with 2.3 x 10^9/L band neutrophils (reference range 0.0–0.2 x 10^9), a monocytosis (1.1 x 10^9/L; reference range 0.1–0.5 x 10^9) and hyperfibrinogenaemia (4.8 g/L; reference range 0.5–4.3). Serum amyloid A was markedly increased at 2,950 mg/L (reference range 0–8). Albumin and globulin concentrations were also reduced, at 19 g/L and 13 g/L respectively (reference ranges 25–35 and 24–44). IgG level was 423 mg/L, suggesting **inadequate passive transfer** (> 800 mg/L is consistent with adequate passive transfer and < 400 mg/L is indicative of failure of passive transfer). A faecal PCR test revealed the presence of ***Clostridium difficile*** toxins A and B as well as *C. perfringens* alpha toxin and *C. perfringens* enterotoxin genes, suggesting infection with ***Clostridium perfringens* type A**.

Poultry

A flock of 30-week-old broiler breeders from Auckland had increased wet excreta, causing the litter to deteriorate faster. Histological examination revealed that the small-intestinal lamina propria was expanded by macrophages, lymphocytes and occasional heterophils. Scattered meronts containing large numbers of merozoites were also present in the lamina propria, and a diagnosis of **coccidiosis** was made.

Failure of endochondral ossification (**rickets**) was diagnosed in two groups of 5-to-6-week-old chickens from the Auckland area. One group of birds were sitting on their hocks and had an unsteady, stiff gait. The other group was clinically normal. Grossly, the birds had expansion of the proximal tibial physis. Histology confirmed failure of endochondral ossification, which was characterised by expansion of the zone

of hypertrophy up to 6 mm wide in the affected group and 2–3 mm in the unaffected group. The zone of hypertrophy was minimally expanded in the submitted femurs. In all birds the zone of proliferation had no significant lesions. In this case the lesions supported phosphorus deficiency. In addition, submission of both the proximal tibia and the femoral head enabled these growth plates to be compared. The proximal tibial physis is more sensitive than the femoral physis for diagnosing rickets in poultry.

Canine

A 2-month-old puppy from Waikato was described as off-colour. The puppy was not vaccinated for leptospirosis. Blood and urine samples were submitted to the laboratory. There was a mild mature neutrophilia (13.9 x 10^9/L; reference range 2.9–13.6 x 10^9) with monocytosis (2.0 x 10^9/L; reference range 0.2–1.4 x 10^9) and a mild increase in urea (16.6 mmol/L; reference range 2.6–10.2). However, the urine specific gravity was 1.042, suggesting adequate renal concentrating ability. A urine PCR test was positive for ***Leptospira* sp.** *Leptospira* organisms can occasionally be found in the urine of dogs without apparent clinical signs, so it is uncertain whether this was related to the illness. This case highlights the **zoonotic potential of dog urine**, even in the absence of disease.

Blood samples from a 6-year-old Heading dog from Hawke's Bay were submitted to the lab. No history was provided. The dog had a mild, mature neutrophilia (16.4 x 10^9/L; reference range 2.9–13.6 x 10^9) and monocytosis (2.0 x 10^9/L; reference range 0.2–1.4 x 10^9), consistent with inflammation. There was a marked azotaemia characterised by high creatinine (1,007 umol/L; reference range 45–135) and urea (61.1 mmol/L; reference range 2.6–10.2). There was also evidence of liver disease, with bilirubin at 263 umol/L (reference range 0.0–6.0), ALP at 970 U/L and ALT at 165 U/L (reference ranges 1–185 and 1–75 respectively). A *Leptospira* rapid test IgM antibody assay was positive, confirming a clinical case of **leptospirosis.**

A 2-year-old intact female dog from the Bay of Plenty presented with a skin lesion above the eye. The lesion continued to worsen despite antibiotic and steroid treatment. PCR of hair from the lesion was positive for ***Trichophyton interdigitale***, one of the three common fungi causing ringworm in companion animals.

A 3-year old French Bulldog from Hamilton presented with progressive lameness and developed a large, fluctuant swelling over the craniolateral tibia that extended from the joint capsule down the cranial proximal tibia. The lesion was minimally responsive to antibiotics and steroids. Multiple fixed synovial biopsies with prominent nodular proliferations were submitted for evaluation. Histologically, the lesion was characterised by sheets and nodules of spindle cells supported by myxomatous stroma. Nodules were separated by bands of dense fibrous connective tissue or areas of more densely cellular areas of the tumour. The lesion was most consistent with a diagnosis of **synovial myxoma.** Synovial myxomas are the most common neoplasms occurring in the joints of dogs. Although they do not metastasise, they can be highly invasive as seen in this case. The lesions can produce abundant viscous fluid.

A 12-year-old male neutered Miniature Schnauzer from Hamilton had a progressively enlarging mass at the base of the penis, extending into the penile sheath and corpus spongiosum. A wedge biopsy was submitted in fixative. Histologically, the lesion consisted of polygonal cells with abundant eosinophilic granular cytoplasm, forming tubules, islands and sheets separated by bands of fibrous connective tissue. Neoplastic cells were seen in multiple lymphatic vessels. In the absence of immunohistochemistry, a presumptive diagnosis of a **malignant extratesticular Sertoli cell tumour** was made. Extratesticular testicular tumours have been described in previously neutered dogs and cats. In this case, testicular cells may have been transplanted into a subcutaneous location during orchiectomy if the tunica albuginea was incised and the testis squeezed too firmly. Development of tumours at extratesticular sites has been reported 4–12 years after surgical castration in dogs that were neutered at 6–12 months.

Feline

A 19-year-old male neutered cat from Waikato presented with swelling of the left nostril. The lesion was initially treated as a bee sting reaction but did not resolve. One week later purulent material was present on aspiration. The lesion did not respond to treatment with antibiotics and non-steroidal anti-inflammatory drugs. A wedge biopsy of the lesion was taken for histology, which revealed a **pyogranulomatous deep dermatitis** with numerous fungal organisms that had a thick, clear capsule and were consistent with ***Cryptococcus* sp**.

Gribbles Veterinary Pathology

Bovine

An Angus steer on a Canterbury feedlot had a high fever, respiratory distress and a purulent discharge from the eyes and nose. Histopathological examination revealed a lymphocytic vasculitis in the brain and rumen, with a severe rumenitis. The lesions were typical of **malignant catarrhal fever** caused by **ovine herpesvirus type 2**.

A significant proportion of a group of 67 eight-month-old Friesian calves on a Canterbury farm were anorexic, depressed and losing weight. Some had diarrhoea and some had melena. Eighteen calves had died or been euthanased. The calves had been grazing under oak trees 4 days previously. Necropsy of two calves revealed excessive pleural and abdominal fluid, with perirenal oedema and pale kidneys. Fixed kidneys were submitted to the laboratory for histopathological examination. In both animals there was renal tubular necrosis, consistent with **acorn toxicity**.

In a group of 70 eight-month-old calves on a Nelson property, one was found dead and another two died the next day. Four

days previously they had been treated with an excessive dose of a pour-on anthelmintic preparation. Samples were sent to the laboratory from one calf that was dehydrated and had diarrhoea. Serum creatinine and urea were elevated (creatinine 1,292 mmol/L, reference range 39–181; urea 89.6 mmol/L; reference range 2.7–11.9). The kidney had lesions of tubular necrosis consistent with toxic renal injury. The lesions resembled those caused by acorn (*Quercus*) or *Amaranthus* toxicity. A diagnosis of ***Amaranthus* (redroot) toxicity** was made when an examination of the paddock revealed they had been eating *Amaranthus*.

An 8-month-old Hereford cross heifer, one of a group of 15 on a South Auckland property, had a rapidly growing ventral cervical mass associated with dyspnoea, dysphagia and hypersalivation. Necropsy showed that the mass surrounded the oesophagus and trachea. Histopathological examination revealed sheets of neoplastic lymphocytes and nests of epithelial cells resembling thymic tissue, consistent with a **thymic lymphoma**. This tumour characteristically occurs in yearling beef cattle and is not associated with bovine leukaemia virus (enzootic leucosis).

A group of 15-month-old Angus bulls from South Auckland were noted to be in poor body condition. A panel of tests including haematology, serology and serum chemistry was performed on blood samples from six animals. All had low serum copper concentrations of 2–4 µmol/L (reference range 7–20), supporting a diagnosis of **copper deficiency**.

A group of 4-week-old dairy calves from the Waikato developed diarrhoea and began dying 2–5 days after the type of milk powder being used to feed them was changed. Faecal culture yielded ***Salmonella* Typhimurium**, supporting a diagnosis of **salmonellosis**. The dietary change may have been a trigger for this disease.

Four of a group of eleven 8-month-old Friesian cross calves from South Auckland died suddenly after they were moved into a fresh paddock. Necropsy of one animal showed pulmonary oedema and congestion as well as gastrointestinal haemorrhage and congestion. Histopathological examination of the brain was unremarkable and no *Salmonella* spp. were isolated from a faecal sample. The attending veterinarian was aware of a recent case of **sodium fluoroacetate (1080) toxicity** nearby and so a sample of muscle was tested for this. The fluoroacetate concentration was 0.004 µg/g (limit of detection 0.001), confirming exposure and supporting the diagnosis.

Four dairy cows from a herd of 520 in Northland aborted over a period of 4–5 days. The cows were clinically normal and the fetuses were grossly unremarkable. The farmer commented that poor-quality, mouldy baleage had been fed about a week previously. Histopathological examination of multiple tissues from one fetus showed a neutrophilic pneumonia and there was a heavy growth of an ***Aspergillus*** species in the fetal stomach contents. ***Aspergillus fumigatus*** genetic material was detected in the stomach contents by PCR. These results were all consistent with a diagnosis of **mycotic abortion**.

Seven of a group of 11 adult beef cows on a Rangitikei farm died suddenly within 2 days of being moved from sorghum regrowth feed to a paddock of rape stalks. At necropsy, the carcasses of the cows were bloated and partially autolysed. Some had blood coming from the nose. Gross examination and histopathology of tissues from two cows failed to demonstrate any specific cause of death, but samples of aqueous humour collected from six of the dead cows tested positive for nitrate. Semiquantitative analysis of the rape stalks indicated a nitrate concentration of > 2 percent, compatible with a high risk of toxicity. The final diagnosis was **nitrate toxicity.**

Seven of a group of recently calved Friesian heifers developed severe respiratory disease. They had been grazing away from the home farm in South Waikato, but had recently returned. All had fevers over 40°C and three died. Necropsy findings included reddening and consolidation of the cranioventral lung lobes and a diffuse green/brown crusty necrotic exudate lining the trachea. Histopathological examination revealed necrotising and ulcerative tracheitis and bronchitis with intranuclear viral inclusions and suppurative bronchopneumonia associated with bacteria. PCR tests were strongly positive for bovine herpesvirus type 1 (BHV-1) and *Mannheimia haemolytica*. The final diagnosis was **infectious bovine rhinotracheitis (IBR) and mannheimiosis**. The latter may have been associated with exposure to BHV-1 during the stress of calving and transport.

Four Jersey cows from a group of 250 on a South Waikato dairy farm developed respiratory distress over a period of several weeks. Despite treatment, two cows died. Necropsy of one revealed subcutaneous emphysema over the thorax and consolidation of the cranioventral lung lobes. Histopathological examination revealed severe bronchopneumonia with intralesional bacteria and plant fragments, consistent with **aspiration pneumonia.** Inhalation of dusty supplementary feed was the suspected cause.

Urgent veterinary attention was sought for a moribund yearling Friesian bull from a group of 40 on a New Plymouth farm. One of the other bulls had died 3 days previously. The moribund bull was dead when the veterinarian arrived. Necropsy findings included severe dehydration and watery yellow diarrhoeic contents in the intestines and colon. The abomasum, small intestine and colon were reddened and oedematous. Bacterial culture of intestinal contents was negative for *Salmonella* and *Yersinia* spp. Histopathological examination revealed multifocal abomasal and intestinal haemorrhage accompanied by basophilic intranuclear inclusion bodies in endothelial cells, consistent with a diagnosis of **bovine adenoviral infection.**

An Angus steer from a Canterbury beef feedlot died after showing respiratory clinical signs. Histopathological examination showed fibrinosuppurative pleuropneumonia, meningitis and vasculitis with bacterial colonies. Bacterial

culture of the lung yielded a heavy growth of ***Histophilus somni,*** confirming the attending veterinarian's clinical suspicion of **histophilosis**.

A 3-year-old Hereford steer from a Taranaki farm developed a 15-cm-diameter mass under the lower jaw, which slowly increased in size over several months. The mass was sampled when the steer was killed for butchering. Histopathological examination revealed a fibrotic mass with focal pyogranulomas centred on characteristic club colonies of eosinophilic Splendore-Hoeppli material, consistent with a diagnosis of **actinobacillosis.**

Severe parasitism was a frequent cause of ill-thrift among rising-1-year-old cattle during autumn 2019. In one case, two emaciated collapsed 7-month-old Hereford cross calves on a Manawatu smallholding were euthanased. Necropsy was conducted on one calf and faecal samples were collected from both. The faecal worm egg counts were 7,450 and 2,050 eggs per gram. Bacterial culture of faecal samples yielded light and moderate growths of ***Yersinia pseudotuberculosis***. Histopathological evaluation revealed significant intestinal mucosal atrophy, which was compatible with severe **enteric parasitism.** No lesions consistent with yersiniosis were seen, but these can be focally distributed so are not always detected.

Two 3-year-old cows on a Taranaki dairy farm aborted in April. The placenta from one of these was submitted to the laboratory. It was positive for ***Mortierella wolfii*** on PCR testing, supporting a diagnosis of **mycotic abortion**.

Two of ninety 6–10-month-old Friesian finishing steers died on a Hastings property. Prior to death, one steer, which appeared clinically dehydrated with mild scours, had serum biochemistry testing that showed a marked azotaemia with creatinine 1,199 umol/L (reference range 39–181) and urea 60.3 mmol/L (reference range 2.7–11.9). Hyperphosphataemia, hyperkalaemia, hypocalcaemia and hypermagnesaemia were also present. Faecal culture was negative for *Salmonella* and *Yersinia* spp. and a faecal worm egg count showed 50 strongyle eggs per gram (considered to be of low clinical significance). Necropsy revealed pale, swollen kidneys and petechial haemorrhage of intestinal mucosa. The farmer reported that the animals had access to oak trees and acorns. Acute kidney injury secondary to **acorn toxicity** was considered the most likely diagnosis.

A number of cases of **zinc toxicity** were diagnosed in cattle in Waikato during April and May when animals were being treated prophylactically with zinc to control facial eczema (sporidesmin toxicity). Affected animals typically presented with anaemia and haemoglobinuria, and serum zinc levels were often very high, examples being animals with serum zinc concentrations of 183, 224, 294 and 312 umol/L. Suggested serum zinc levels for adequate control of facial eczema are 18–34 umol/L.

Theileriosis was the cause of several cases of anaemia in adult dairy cows in Waikato. In one case an older dairy cow was found to have lost significant weight. It had a reduced appetite, pale mucous membranes and an elevated heart rate. Her haematocrit was 0.10 (reference range 0.24–0.36) and the haemoglobin concentration was 31 g/L (reference range 85–130). Structures typical of ***Theileria* spp.** were seen on the red blood cells in a blood smear. In another case, two autumn-calving dairy cows were noted to be moving more slowly than usual, and on examination were anaemic and jaundiced. They had haematocrits of 0.16 and 0.08 (reference range 0.24–0.36) and again, structures consistent with *Theileria* parasites were seen when blood smears from these animals were examined. In some other cases, PCR was used to confirm the diagnosis.

A 5-year-old Friesian cow from Otorohanga aborted at 6 months' gestation. The cow was not pyrexic and the placenta appeared grossly normal, but the fetus was autolysed. Histopathological examination revealed placentitis with numerous intravascular bacterial colonies. ***Salmonella* Agona** was cultured from the fetal stomach contents, consistent with a diagnosis of ***Salmonella*-induced abortion**.

A 4-year-old Friesian cow from Taranaki presented with hyperaesthesia, head-pressing, compulsive walking along the fenceline and reluctance or inability to move backwards. Her vision and gait were normal. She was treated with calcium, magnesium, vitamins B1 and B12 and an anti-inflammatory drug but next day the head-pressing and compulsive walking were worse. Penicillin was given but the following day ataxia of the hindlimbs and forelimb knuckling was observed. The cow became recumbent and could not rise so it was euthanased. The brain and spinal cord were submitted to the laboratory to screen for transmissible spongiform encephalopathy. Histopathological examination revealed suppurative multifocal subacute meningoencephalitis with rare vasculitis, supporting a diagnosis of **listeriosis.**

Acorn toxicity was a common diagnosis in young cattle in Waikato this autumn. In one case six of 20 Charolais yearlings were noted to be very lethargic, inappetant, grunting, and breathing with open mouths. They had distended (but not bloated) abdomens and diarrhoea. Biochemistry testing revealed severe azotaemia, with creatinine concentrations 8–10 times the upper limit of normal. One animal was euthanased and histopathological examination revealed a severe subacute tubular necrosis consistent with acorn toxicity. In a second case, a bull calf was presented with weight loss, inappetence and severe dehydration. It was reported to be drinking a lot and dribbling urine. Acorns were abundant in the paddocks where it was grazing. The serum creatinine concentration was 1,063 umol/L (reference range 39–181). In a third case, a rising-1-year-old beef heifer presented with weight loss, polydipsia and haemorrhagic, gelatinous faeces and serum creatinine of 1,676 umol/L.

Seven cows aborted on a north Waikato farm in May. Serum samples were collected and three of the seven had titres

> 1:2,000 in the IFAT test for *Neospora* antibodies. Another had an antibody titre of 1:1,000 while the other three animals were below 1:600. Titres > 1,600 in this test are considered to support an association between *Neospora* infection and abortion, if no other causes are found. In the absence of any evidence of other causes, **neosporosis** was considered the most likely cause of these abortions.

Nineteen dairy cows from a Waikato farm had high somatic-cell counts. Milk samples from these animals were submitted to the laboratory for microbiological testing. ***Pseudomonas aeruginosa*** was isolated from 14 of the 19 samples. This was a very unexpected result. Questioning of the farm staff revealed that the samples had been collected into a jug before the milk was poured into the sample pots that were sent to the laboratory. Sampling was repeated using the correct technique and no *Pseudomona*s was isolated.

Ovine

Ten of a group of 100 ram lambs on a Canterbury property had severe lesions of epididymitis, with marked testicular swelling. At necropsy of two animals, large amounts of purulent material, which was fluid in one animal and inspissated in the other, were observed in the epididymis. There was marked surrounding fibrosis. A heavy, pure growth of *Histophilus somni* was recovered from the purulent material from both lambs. **Epididymitis** caused by ***Histophilus somni*** is a known entity in young rams and can affect a significant proportion of the group, as in this case. This bacterium is a normal commensal of the reproductive and upper respiratory tracts, but the factors that enable it to colonise the epididymis and cause disease are poorly understood.

On a Marlborough property 20 of 450 ewes and 10 of 90 hoggets in different groups developed severe signs of photosensitivity. Two of the ewes were necropsied. Serum samples were collected from these two ewes and also from seven hoggets. On histopathological examination, one ewe had mild portal changes in the liver and the other had damage to medium-sized bile ducts, with oedema and early periductal fibrosis. All nine animals sampled had raised serum GGT, with eight > 1,000 IU/L and one > 2,000 (reference range 0–60). These histological and biochemical findings were consistent with a diagnosis of **sporidesmin toxicity (facial eczema)**.

An 8-month-old Romney lamb from Kaipara was found to have a fracture of the proximal femur. Radiographs revealed that the bone cortices were very thin. Histopathological examination confirmed a thin bone with few trabeculae, consistent with **osteopenia leading to pathological fracture**. Possible causes included a congenital disorder (e.g. osteogenesis imperfecta), nutritional deficiencies (e.g. copper, phosphorus, protein) or parasitism. However, the cause was not identified in this case as no further information was available.

A group of fifteen 2-year-old Suffolk and Suftex (a breed derived from Suffolk and Texel) stud rams on a farm in Northland were noted to have weight loss and anaemia. Subsequently several ewes on the same property developed similar clinical signs. Parasitism was ruled out by faecal worm egg counts and precautionary treatment with triple-combination anthelmintics. Serum biochemistry and copper tests on two sheep were largely unremarkable, but a mild non-regenerative anaemia was identified in one (RBC 7.82 x 10^{12}/L; reference range 9–15 x 10^{12}). PCR for ***Mycoplasma ovis*** was positive in both animals. *M. ovis* is an obligate red-blood-cell parasite of sheep and goats that causes haemolytic anaemia, predominantly in lambs. It has also been linked to ill-thrift. However, as many *M. ovis* infections can be subclinical, detection of the organism without corresponding pathological changes or clinical history may be incidental. Previous cases of *M. ovis* have been restricted to the lower South Island, and to our knowledge this is the first record from sheep in Northland.

A pet ewe in Hamilton was presented inappetant, weak, lethargic and anaemic, and had dark-coloured, pasty faeces. Haematological testing revealed a severe anaemia (haematocrit 0.09; reference range 0.27–0.45). A faecal worm egg count showed 42,750 strongyle eggs per gram. It was considered likely that these eggs were the result of an infection with adult ***Haemonchus* sp**. worms, which are particularly prolific egg-producers. These findings supported the attending veterinarian's clinical suspicion of **haemonchosis**.

Two pet sheep from Waikato presented with skin lesions around the eyes and ears and were pruritic. Marked elevations in serum GGT were found in both animals, at 1,140 and 1,864 IU/L (reference range 0–55). A diagnosis of **hepatogenous photosensitivity** as a result of **sporidesmin toxicity (facial eczema)** was made.

Caprine

A group of six Saanen goats from Auckland had a history of very poor hoof and coat quality. One buck was also losing weight and had dental problems. Screening tests on that goat, including a haemogram, serum biochemistry and trace-element testing, were generally unremarkable, but serum zinc was low (8 µmol/L; reference range 10.7–30.4), suggesting a diagnosis of **zinc deficiency**. In goats this can present as rough hair coat, alopecia, overgrowth of the dental pad, small testes and fissures on the feet. High-calcium diets can predispose goats to zinc deficiency.

On a property in Canterbury nine Himalayan tahr (*Hemitragus jemlahicus*) were found dead over a period of about 10 days. At necropsy the attending veterinarian observed pneumonia and peritonitis. Samples from two animals were sent to the laboratory. Histopathological examination revealed similar changes in the lungs of both animals. There was widening of the interlobular septa and lymphatics, with proteinaceous fluid; the alveoli were filled with proteinaceous fluid and there were variably abundant infiltrates of neutrophils and fibrin. The diagnosis was **acute fibrinous pneumonia**, and ***Mannheimia haemolytica*** was isolated. This organism normally resides in the upper respiratory tract of cattle, goats, and sheep (and

presumably also tahr). It is thought that some stress factor allows the bacteria to proliferate and cause disease. Cold stress, transport stress, yarding and handling and possibly other diseases (e.g. viral) are among the potential stressors.

Cervine

A group of 200 weaner deer were given an anthelmintic and mineral drench, and later the same day were transported by truck for 4–5 hours to a property in Otago. The deer appeared clinically well on arrival. About 10–14 days later there was a change of feed to a silage and grain mixture, which the animals were initially reluctant to eat until they became hungry enough after a few days to begin eating it eagerly. A few days later the animals started to die and within 4–5 days most were dead, while those remaining were in poor body condition. The attending veterinarian suspected ruminal acidosis from the history, but noted lesions in the lung at necropsy that were consistent with lungworm infection. Tissue samples were submitted to the laboratory. Copper and selenium concentrations in the liver were within normal limits. No *Salmonella* species was isolated from intestinal contents. Histopathological examination revealed that the mucosa of the rumen was intact, with viable adherent protozoa, ruling out significant acidosis. Within the lung, many airways contained **lungworm** larvae admixed with eosinophils, neutrophils and karyorrhectic debris. Adult nematodes were present in large airways and there was marked bronchial mucosal hyperplasia. Moderate numbers of lymphocytes, plasma cells and eosinophils expanded the interstitium, and alveoli were often enlarged and coalesced. This was considered to be a **verminous pneumonia** with bronchial mucosal hyperplasia and alveolar emphysema. The lesions were considered severe enough to be the cause of death.

Equine

A mass was excised from the vulva of a Miniature pony mare on an Otago property. The mass was a **squamous cell carcinoma** and the immediately adjacent epidermis had enlarged cells with pale blue cytoplasm, consistent with **papillomavirus infection**. Papillomavirus infection is believed to have a role in the development of squamous cell carcinoma of the penis in some horses and it may well be the same for some squamous cell carcinomas occurring on the vulva of mares.

A 6-year-old Andalusian stallion on a Tasman property developed two 10–15-mm-diameter subcutaneous nodules while under treatment for cutaneous sarcoids with topical chemotherapy (5 percent fluorouracil cream). The nodules were excised for histopathological examination to rule out the possibility that they were additional sarcoids. This revealed two similar lesions composed of lymphocytic and granulomatous inflammation interspersed with pleomorphic fungal elements. **Equine cutaneous fungal granulomas** are thought to be caused by traumatic implantation of opportunistic fungal organisms. No fresh material was received from the lesions, so the type of fungus present could not be identified.

A 10-year-old pony from Hastings was reported to have eaten material from an avocado tree. Clinical signs included a swollen face, irregular heartbeat, elevated heart rate (50 beats per minute), respiratory crackles and inappetence. Biochemistry revealed a marked increase in creatine kinase (10,760 IU/L, reference range 169–628), a moderate increase in aspartate aminotransferase (1,169 IU/L; reference range 219–473) and mild increase in bilirubin (71.5 umol/L; reference range 17–41). This indicated a significant myopathy, which along with the other clinical findings and history was consistent with a diagnosis of **avocado plant toxicity**.

A heavy growth of ***Streptococcus equi* ssp. *equi*** was cultured after a nasal swab was taken from a 5-month-old Thoroughbred filly in Matamata that presented with pyrexia and a purulent nasal discharge. This confirmed a diagnosis of **equine strangles.**

A large abdominal abscess was found during the necropsy of a 5-month-old filly in Waikato. ***Streptococcus equi* ssp. *equi*** was cultured from purulent material recovered from the abscess. The filly had a history of **strangles,** with classical presentation 3 months before the necropsy and the abscess was considered to be a sequela of that disease.

Porcine

An 8-year-old male Kunekune pig on a New Plymouth property developed an irregular growth in the mouth, at the angle of the jaw. Histopathological examination confirmed a diagnosis of **squamous cell carcinoma.** These locally destructive tumours are a recognised entity in the oral cavity of aging pigs.

Avian

A blue penguin (*Eudyptula minor*) from the Auckland area had a cloacal mass. Histopathological examination revealed an ulcerative cloacitis with eosinophilic intracytoplasmic inclusions in the squamous epithelial cells, consistent with poxvirus inclusions. **Avipoxvirus** infections have been documented in many species of penguin, and all species are probably susceptible. The disease affects both captive and wild penguins and is more common in chicks than adults, suggesting that adults have acquired immunity or more robust immune function. Increasing prevalence often coincides with weather-related increases in arthropod vector populations, but transmission also occurs by direct contact with abraded skin, mucous membranes, contaminated airborne particles or infected tissue. Subsequently this bird developed a significant lymphocytosis, with an estimated count of 64 x 10^9/L (normal blue penguins have a mean of 4.7 x 10^9 with standard deviation of 2.2 x 10^9) and was euthanased. Histopathological examination revealed a lymphocytic cholangitis, pancreatitis and gastroenteritis, with lymphocytic reactive hyperplasia in the spleen, heart, skeletal muscle, lung and air sacs. Trematodes and eggs (presumptive *Renicola* sp.) were found in the lumen of large collecting ducts in the kidney. The lymphocytic inflammation and reactive lymphoid hyperplasia in multiple organs may have been due to a combination

of antigenic stimulation in a young bird, the previous pox infection and endoparasites. Penguins are also very susceptible to *Plasmodium* spp. infection, which is also associated with a lymphocytosis. Although no *Plasmodium* parasites were definitively identified in this bird, a subclinical infection could not be ruled out.

Multiple doves and barrabands in an Auckland aviary died over several weeks. Histopathological examination revealed hepatitis, coelomitis, meningitis, epicarditis, myocarditis, nephritis, pneumonia and adrenal adenitis with basophilic intracytoplasmic bodies that were consistent with *Chlamydia* spp. elementary bodies. Subsequent ELISA tests of fresh liver samples were positive for *Chlamydia* antigen, supporting a diagnosis of **chlamydiosis.** The most common species to infect birds is *C. psittaci*, a zoonotic disease sometimes known as psittacosis or ornithosis. In birds it ranges in presentation from an inapparent subclinical infection to an acute, subacute or chronic disease affecting wild and domestic birds and is generally characterised by respiratory, digestive or systemic infection. Infections occur worldwide and have been identified in at least 150 avian species, particularly colonial nesting birds like egrets and herons, as well as ratites, caged birds (primarily psittacines), raptors and poultry. Among domestic poultry, turkeys, ducks and pigeons are most often affected, while infection of chickens is infrequent. Long-term inapparent infections lasting months to years are common and considered to be the normal chlamydia/host relationship. The same strain of the organism may cause mild disease or subclinical infection in one species, but severe or fatal disease in another.

Wild doves and pigeons found dead in the Auckland area had tan-to-yellow nodules in the pharynx and oesophagus. Histopathological examination revealed a severe subacute ulcerative pharyngitis and oesophagitis with structures suspicious of protozoa (presumptive *Trichomonas* spp.) and superficial, mixed bacteria. This was consistent with **trichomoniasis** with secondary superficial mixed bacterial infection. There was no evidence of poxviral infection or candidiasis. ***Trichomonas gallinae*** is a worldwide disease entity in wild and captive pigeons and doves. The severity of disease depends on the virulence of the strain, immune status of the bird, and magnitude of debility from concurrent disease. Juvenile birds are most commonly infected.

Six of 300 layer chickens aged 30–60 days on a North Otago property developed unilateral limb weakness. Histopathological examination revealed widespread infiltrates of atypical lymphoid cells in the sciatic nerves, iris, heart, brain and visceral tissues, confirming the clinical suspicion of **Marek's disease**, which is caused by **gallid herpesvirus type 2**.

This year there was a very successful breeding season for the endangered native flightless parrot, the kakapo (*Strigops habroptilus*), with unusually large numbers of eggs laid and hatched. However, a significant number of birds died and the deaths were associated with fungal infections caused by *Aspergillus* spp. In one typical case, a sample of lung from a 2-month-old female chick was submitted for microbiological culture and yielded a moderate growth of a fungus identified by MALDI-TOF MS as ***Aspergillus flavus* complex**. This confirmed **aspergillosis**. Interestingly, in this case, there was also a heavy growth of ***Klebsiella pneumoniae***. A variety of factors, including concurrent diseases and factors affecting immunity, may be playing a role in the deaths of these birds. Intensive investigations are ongoing.

Canine

An 11-month-old female Border Terrier from King Country died suddenly 20 minutes after exercising in a rural area where cholecalciferol and potassium cyanide baits had been laid for pest control. There were no significant findings at necropsy but stomach contents tested positive for cyanide, confirming a case of **cyanide toxicity**.

A 19-week-old male Labrador puppy from Wellington had recurring diarrhoea. A faecal sample was submitted for faecal worm egg count and coccidial oocyst examination, *Giardia* ELISA test, *Cryptosporidium* ELISA test and microbiological culture. Both the ***Giardia*** and ***Cryptosporidium*** ELISA tests were positive and culture yielded a moderate growth of ***Salmonella*** Typhimurium (phage type 56 variant). Neither worm eggs nor coccidial oocysts were seen on faecal examination. Salmonellosis is uncommon in companion animals, and has often been associated with concurrent infection and/or compromised immunity.

Feline

A 10-year-old female spayed Domestic Shorthair cat from Hamilton developed glaucoma in the right eye. The glaucoma was briefly controlled with medication prior to a sudden deterioration, which necessitated enucleation. Histopathological examination of the eye revealed severe pyogranulomatous endophthalmitis with occlusion of the drainage angle and retinal detachment. Colonies of bacteria were visible within the inner aspect of the cornea, confirming a diagnosis of **septic implantation syndrome.** This condition occurs in cats and dogs as the result of penetrating injury.

A 1-year-old female Domestic Shorthair cat from Christchurch presented with a 3-month history of chronic diarrhoea. Physical examination revealed thickened small intestines. Intermittent treatment over 2 months with a product containing spiramycin and metronidazole, followed by prednisone treatment for a month, resulted in minimal improvement. Faecal tests were negative for *Giardia*, *Cryptosporidium*, *Tritrichomonas fetus* and worm eggs, but a *Salmonella* species was isolated after sample enrichment. This was subsequently confirmed as ***Salmonella* Typhimurium (phage type 12 variant)**. **Salmonellosis** in cats is colloquially known as "songbird fever" owing to its association with cats that hunt and eat birds.

Lagomorph

A pet rabbit from Coromandel died suddenly and was presented for necropsy. It had been recently vaccinated and an adverse drug reaction was one of the differential diagnoses

being investigated as a possible cause of death. At necropsy the uterus was enlarged, red and oedematous, with red-brown, flocculent contents including a 3-cm-diameter mass of fleshy tissue. Histopathological examination revealed that the mass was partially organised placenta. The cause of death was considered likely to be **septic shock secondary to retained placenta and metritis.**

New Zealand Veterinary Pathology

Bovine

On a farm in Waipa, 15 of 500 three-year-old dairy cows were affected with icterus and submandibular oedema/bottle jaw. The animals had shown poor performance after calving. Clinical issues included retained fetal membranes, ketosis, laminitis and anorexia. One cow had died. Haematology was performed on six affected animals and selective serum biochemistry was performed on eight (**Table 1**). All animals showed mild to severe anaemia. In two of six animals, ***Theileria* sp.** was detected on the blood smear; one of these animals had severe anaemia compared with the others and it is quite possible that *Theileria* infection was contributing in that case. The animals had low normal to decreased total protein and albumin levels, with one showing severe hypoalbuminaemia approaching the level that would be expected to cause oedema/effusions. GGT was high normal or elevated in all animals, with three showing marked elevation indicating significant hepatopathy. All animals tested negative for liver fluke by serum ELISA. In four of the seven animals able to be tested, serum zinc levels were significantly above the prophylactic range. These results suggested more than one process was likely contributing to clinical disease and poor performance in the herd. **Zinc toxicity** may have been contributing to ill-thrift and anaemia in at least some of the cases, but the high GGT in some animals was also concerning for recent facial eczema or potentially other **hepatobiliary disease**. The possibility of other enteropathy (e.g. haemorrhage, endoparasitism, Johne's disease) was also a concern, but further testing was not pursued. About a month later, additional samples were submitted as the number of animals affected had increased to 100, with 15 deaths. A fresh liver sample revealed a zinc level of 240 mg/kg (reference range 25–100), consistent with persistently elevated zinc. Histology of the kidney revealed mild diffuse nephrosis with pigment accumulation, suggestive of haemolysis (this may be seen with *Theileria* infection as well as zinc toxicity), and there was also **ulcerative mycotic omasitis**. The abomasal lesions may have been the result of previous or chronic ruminal acidosis, which could explain some of the clinical presentations including laminitis and anorexia. Unfortunately, pancreas was not submitted; this tissue is more likely to show the classic histological lesions of inflammation and fibrosis associated with zinc toxicity.

A farm in Waikato had loss of condition in some rising 3-year-old cows. They had previously been drenched with zinc, but after they were dried off, zinc was spread on maize instead. One cow presented recumbent and dehydrated with abdominal pain. Another had died with similar signs. Haematology revealed polycythaemia with HCT of 0.42 (reference range 0.24–0.40) and mild hyperfibrinogenaemia (7.6 g/L; reference range 2.0–7.0), both of which were likely due to dehydration. Serum zinc was 69.0 µmol/L (prophylactic range 20–35), confirming **zinc toxicity**. In addition there was evidence of **hepatopathy** (GGT 249 IU/L; reference range 0–36, and GLDH 249 IU/L; reference range 8–41), which may be seen with excessive zinc as well as copper toxicity, brassica ingestion, or facial eczema. There was also moderate (likely pre-renal) **azotaemia**, with creatinine 247 µmol/L (reference range 55–130) and urea 37.7 mmol/L (reference range 2.7–12.3).

An adult Friesian cow from Whangarei died suddenly overnight. On post-mortem examination the intestinal contents appeared haemorrhagic, with no evidence of torsion. Culture of intestinal contents isolated ***Salmonella* Agona**. This is not a commonly reported serotype in cattle, and infection with this serotype in humans is not often directly linked with eating beef.

A calf-rearing operation in Whangarei experienced sudden death in 10 out of 200 eight-week-old calves. The calves were observed to run normally to the feeder, followed by excitation, agonal struggle and death over the course of about 1 minute.

Table 1: Haematology and biochemistry results for eight dairy cows tested
(ref. = reference range)

Sample	RBC (ref. 5.0–7.7 x10^{12}/L)	HCT (ref. 0.24–0.40)	*Theileria*	Albumin (ref. 23–38 g/L)	Total protein (ref. 60–86 g/L)	GGT (ref. 0 –36 IU/L)	Serum zinc (prophylactic range 20–35 µmol/L)
1	2.9	0.18	None seen	23	66	199	85
2	4.0	0.24	None seen	20	60	35	56
3	1.1	0.09	Present	22	61	186	36
4	4.7	0.21	None seen	21	57	94	30
5	3.3	0.21	Present	25	59	36	Insufficient
6	4.2	0.22	None seen	20	58	48	89
7				13	39	36	51
8				20	62	38	38

Monensin toxicity was suspected clinically. Histopathology of heart muscle revealed moderately severe generalised chronic cardiomyopathy with fibrosis, compatible with the suspicion of **ionophore toxicity**.

A 1-year-old Angus bull from Waipa presented with anaemia, pyrexia and haematuria. Haematology revealed severe anaemia with a haematocrit of 0.10 (reference range 0.26–0.48) and no visible *Theileria* organisms. Serology was negative for *Leptospira* serovars Pomona and Hardjo. Serum biochemistry revealed severely elevated zinc levels of 278 µmol/L (reference range for facial eczema prophylaxis 20–35). A diagnosis of **zinc toxicity** was made, which likely explains severe anaemia caused by haemolysis in this case.

A farm in Waipa had an outbreak of scouring with rapid weight loss and pyrexia involving 60 out of 85 ten-month-old Jersey heifer calves, with three deaths. ***Yersinia pseudotuberculosis*** was isolated from three faecal samples submitted. Bovine **yersiniosis** can occur sporadically or in clusters, most commonly affecting animals 6–12 months old. Stress factors, including weaning, transport, inclement weather and concurrent endoparasitism are risk factors for outbreaks such as this. If injury to the intestinal mucosa has been severe, ill-thrift may persist despite clearance of the infection.

A 3-year-old Jersey cow from New Plymouth presented unwell and blind, with very poor body condition and tarry faeces. Serum biochemistry revealed a severe elevation in GGT (3,552 IU/L; reference range 0–36), indicating severe **hepatopathy** (sometimes caused by facial eczema). Blindness in this case may have been due to **hepatic encephalopathy**.

Twenty of fifty 2-week-old Friesian and Hereford calves on a Manawatu farm had lethargy, pyrexia and scours, and three died. Scours included casts and blood. One animal developed neurological signs, with frothing at the mouth and absence of a menace reflex, so it was euthanased. ***Salmonella* Bovismorbificans** was isolated from the liver and mesenteric lymph node of this animal, and also from the faeces of two other affected calves.

An outbreak of sudden death affected 24 of 117 ten-month-old replacement Friesian heifers in Manawatu. The heifers had been put on to a break of new grass a day later than planned (and were therefore hungry), and this coincided with cloudy weather. The surviving animals had cyanotic mucous membranes. Ocular fluid samples from six of the dead calves all had nitrate levels > 25 mg/L, consistent with **nitrate toxicity**.

A single crossbred adult cow from New Plymouth developed disseminated cutaneous masses a few weeks prior to death. Histopathology of a mass revealed a diffuse infiltrate of neoplastic lymphoid cells showing multifocal epitheliotropism. A diagnosis of **epitheliotropic lymphoma** was made. This is considered part of the sporadic bovine leukosis syndrome, and although the disease generally has slow progression it is often only diagnosed when advanced, as in this case.

A dairy herd in Manawatu had multiple cases of conjunctivitis and to a lesser extent keratoconjunctivitis, mainly affecting heifers (18 out of 300 at-risk animals). ***Moraxella bovoculi*** was isolated from a conjunctival swab taken from an affected animal, and was identified by Bruker Maldi biotyping. While *M. bovis* is historically considered to be the primary agent involved in **infectious bovine keratoconjunctivitis**, *M. bovoculi* and *M. ovis* can also be involved.

Several cases of suspected acorn toxicity were seen this quarter. When a 9-month-old Hereford cross steer was found dead in Horowhenua, ventral subcutaneous oedema was noted on the midline, with mild ascites present. On post-mortem examination retroperitoneal haemorrhage and jejunal serosal ecchymotic haemorrhages were noted. Histopathology revealed extensive renal tubular necrosis, which along with the haemorrhage and oedema is consistent with **acorn toxicity**. This is usually caused by eating acorns, although oak leaves and young shoots can also be toxic.

In another case, a yearling Angus/Hereford cross steer from Waikato presented with anorexia, getting up and down, and passing tarry faeces. There was a possibility of exposure to acorns. Serum biochemistry revealed marked azotaemia (creatinine 1,793 µmol/L; reference range 55–130, and urea 77.0 mmol/L; reference range 2.7–12.3), consistent with nephrotoxicity that can be seen with **acorn toxicity**.

In a third case, in the Waipa district two of three 6-month-old Wagyu cross steers presented with poor body condition, anaemia, depression and gut stasis with melena. Again, there had potentially been exposure to acorns. Moderate to marked azotaemia was present, with one animal tested showing creatinine of 897 µmol/L (reference range 55–130) and urea of 65.1 mmol/L (reference range 2.7–12.3). This was considered compatible with **acorn toxicity**. GGT was also elevated at 153 IU/L (reference range 0–36), suggestive of concurrent **hepatopathy** (e.g. sporidesmin toxicosis).

Ill-thrifty calves with dirty tails were present on a South Waikato property, with one 11-month-old female Hereford calf found dead. Faecal egg count for the dead calf revealed 1,350 strongyle eggs per gram, and no *Salmonella* or *Yersinia* was isolated on culture. Parasitology was subsequently performed on six additional calves, and strongyle eggs were found in five of six animals. Counts ranged from 400 to 1,750 eggs/g. A drenching history was not provided. In addition, serum selenium was low in the additional calves tested, with a mean value of 88 nmol/L (reference range 150–3,500), and serum B12 was also low, at < 92 pmol/L in half of the calves (reference range 93–1,000). In the dead calf, liver selenium was 187 nmol/kg (reference range 850–10,000 nmol/kg) and vitamin B12 was 345 nmol/kg (reference range 370–3000). These findings indicated that a combined problem of **endoparasitism**, **selenium deficiency** and **hypovitaminosis B12/cobalt deficiency** was present in these animals. The deficiencies may have contributed to impaired immune function, exacerbating the endoparasitism.

Ovine

A small flock of 30 mixed-age Dorper cross sheep in Whangarei had a recurring history of a small number of animals losing condition and dying or having to be euthanased. Two animals had recently died, including one adult ewe after a long wasting process. Six hoggets had a similar appearance, with very poor body condition and no scouring. Three affected hoggets diagnosed with anaemia at the submitting vet clinic tested negative for Johne's disease on serum ELISA, and had normal serum pepsinogen levels. Only in one animal was there a mild increase in GGT (84 IU/L; reference range 32–70). In all three animals significant numbers of strongyle eggs were detected in the faeces, ranging from 900 to 2,900 eggs per gram). A diagnosis of **endoparasitism** was made, with strong concern about **haemonchosis**, given the concurrent history of anaemia.

Synovial fluid submitted from a sheep in Nelson was presumably associated with joint swelling or lameness, although no clinical history was supplied. Cytology revealed severe neutrophilic inflammation. About 3 weeks later there had been no improvement or response to treatment, and a second sample was submitted. ***Actinomyces* sp.** was isolated from enrichment culture. **Septic arthritis** in sheep is usually secondary to septic omphalophlebitis (navel ill), or due to entry of bacteria through other skin wounds.

Multiple 2-year-old Romney cross ewes from Manawatu region presented with ill-thrift or weight loss and evidence of pancreatic necrosis. Liver zinc levels were elevated in three out of four animals tested, with results of 58, 130, 250, and 280 mg/kg (reference range 25–100). These findings supported a diagnosis of **zinc toxicity**. This may result in histological lesions in a wide range of tissues, but the pancreas is the most consistently affected organ (Allen et al., 1983).

A single 3.5-year-old backyard ram from Wellington was emaciated, with extremely pale mucous membranes and scours. The animal died during transport. Haematology revealed profound anaemia (haematocrit 0.05; reference range 0.27–0.45) and a marked panhypoproteinaemia with albumin of 14 g/L (reference range 21–41) and globulin of 22 g/L (reference range 35–47). Pseudohypocalcaemia caused by albumin loss was also noted (calcium 1.79 mmol/L; reference range 2.00–2.70). **Endoparasitism** was confirmed, with 1,700 strongyle eggs per gram, and given the probable blood-loss anaemia there was a strong suspicion of **haemonchosis**.

Multiple ewes in a mob of 2-year-old Romneys on a Manawatu farm were showing clinical signs of photosensitivity, including swollen faces and drooping ears or eyes. Sixteen of 82 animals were affected and three died. Zinc supplementation history was uncertain. Serum GGT was moderately to markedly increased in 15 of 16 animals initially tested, with elevated values ranging from 80 to 1,342 IU/L (reference range 32–70). GGT was also variably and sometimes markedly elevated in 60 of 62 of the remaining ewes, with a group mean of 845 IU/L. These findings were consistent with **facial eczema**.

Multiple mature Friesian cross cows from a farm in Taupo presented with clinical eczema involving non-pigmented areas of the skin. Some animals also showed weight loss and diarrhoea. Serum samples from five affected cows were submitted. Two were positive for **Johne's disease** on serum ELISA, while four showed marked elevations in GGT (227–1,837 IU/L; reference range 0–36), supportive of **facial eczema**.

Equine

A single 2-year-old Thoroughbred stallion from Matamata-Piako presented as a unilateral cryptorchid. The retained testis was removed laparoscopically, and was found to be grossly abnormal, enlarged and fluid-filled. Histological examination revealed that most of the testis was displaced by cavitated tissue with a periphery composed of tissue consistent with neuropil matrix containing glial cells. Epithelial elements were not seen despite examination of numerous sections. The adjacent epididymis was histologically unremarkable. It is considered most likely that this lesion was a **testicular teratoma** and that tissues arising from other germinal layers were probably present in small amounts elsewhere in the mass. The possibility that this was a neural choristoma cannot be completely excluded, but such lesions have not, to the author's knowledge, been reported in horses. Testicular teratoma is occasionally associated with unilateral cryptorchidism in horses and may prevent normal descent of the testis.

A 3-year-old sport gelding from Taupo was slow to get up in the morning, and on examination there appeared to be weakness in the back end when walking. Bloodwork revealed mild anaemia, with HCT of 0.26 (reference range 0.31–0.52) and very low blood selenium (220 nmol/L; reference range 1,600–3,200). Following this result, three other horses from the property were also tested for blood selenium, with results of 300, 230, and 180 nmol/L, confirming that **selenium deficiency** was a significant issue in the group. Clinical presentations of selenium deficiency in horses can include cardiomyopathy, other skeletal myopathy (sometimes restricted to muscles of mastication) and nodular panniculitis.

An 8-month-old Warmblood filly from Waipa presented with clinical signs of myopathy, suspected to be due to hypoglycin A toxicosis. Serum biochemistry revealed severe **myopathy**, with CK > 200,000 IU/L (reference range 232–629 IU/L) and AST 11,242 IU/L (reference range 244–460). Cardiac troponin I was also severely increased, at 1,001 ng/L (reference range 0–95), indicating concurrent **cardiomyopathy**. **Hypoglycin A** has previously been demonstrated in seeds of sycamore, maple and box elder in New Zealand (McKenzie et al., 2016) and is associated with **equine atypical myopathy**.

Caprine

An outbreak of sudden-onset ataxia and stiffness affected four of a group of 40 goats from Kaipara. The animals died relatively rapidly, with no clinical response to thiamine treatment. All were in good body condition, with no visible lesions on post-mortem examination other than some evidence of chronic

pleurisy. Histopathology of the brainstem revealed perivascular mononuclear cuffing and foci of necrosis accompanied by gitter cells and neutrophils. A histological diagnosis of **chronic encephalitis** consistent with **listeriosis** was made.

A 3-year-old female goat from Hamilton presented with an exophytic cutaneous mass on the dorsum to the right of the spine. Histopathology revealed **cutaneous haemangiosarcoma** with secondary ulceration and inflammation. Vascular neoplasia is occasionally diagnosed in goats, with haemangiosarcoma more common than haemangioma.

A female goat from Hamilton presented with progressive loss of condition and weakness that did not respond to anthelmintic treatment and dietary supplementation. Post-mortem examination revealed thickening of the ileum, with slightly corrugated mucosa, thickened serosal lymphatic vessels and enlarged regional lymph nodes. Histopathology confirmed that the changes were due to granulomatous inflammation with intralesional acid-fast bacteria, and numerous similar microscopic lesions were also present in the liver. A diagnosis of **Johne's disease** was made.

Avian

A 6-year-old female backyard duck from Auckland presented with a large, bleeding wing mass of 2 weeks' duration. Histopathology revealed **haemangiosarcoma** with secondary bacterial infection. In poultry, haemangiosarcoma has been associated with avian leucosis virus (ALV) subgroup J. Haemangiosarcoma (epithelioid variant) has previously been reported in a duck that was positive for ALV, but negative for the oncogenesis-associated subgroup J (Piccione et al., 2017).

Twelve of 15 pheasants in Kāpiti demonstrated neurological signs (non-specified) and died within 12 hours. Histopathology revealed severe necrotising hepatitis and typhlitis with intralesional protozoal organisms consistent with ***Histomonas meleagridis***. In general, pheasants are less susceptible to **histomoniasis** than other species such as turkeys, but significant disease outbreaks may still occur in young pheasants, or may be associated with stressors or heavily contaminated soil.

A captive North Island kaka (*Nestor meridionalis*) from the lower North Island presented with ataxia and crop stasis, and died shortly after admission. Marked dehydration and some regurgitation was noted on post-mortem examination. The liver lead level was elevated (38 mg/kg), supporting a diagnosis of **lead toxicity**. No reference range has been established for kaka, but as an indication, liver lead levels > 18 mg/kg are considered toxic in chickens.

Reptilian

A single 16-month-old male captive bearded dragon (*Pogona* sp.) presented with swelling of the left elbow and right hock. A lung field opacity was also noted on radiographs. Purulent material aspirated from the swollen joints was negative on aerobic and anaerobic culture. Cytology of the aspirated material revealed predominantly macrophages, with occasional heterophils. Throughout the smears there were numerous yellow-to-brown refractile crystalline spicules consistent with urate crystals (see **Figure 1**), which were present individually and in aggregates. A cytological interpretation of **articular gout** was made. This can be associated with dietary factors (especially when diets rich in animal protein are fed to herbivorous reptiles), renal disease, starvation and dehydration. Given the presence of a lung opacity, the possibility of concurrent visceral gout was also a concern.

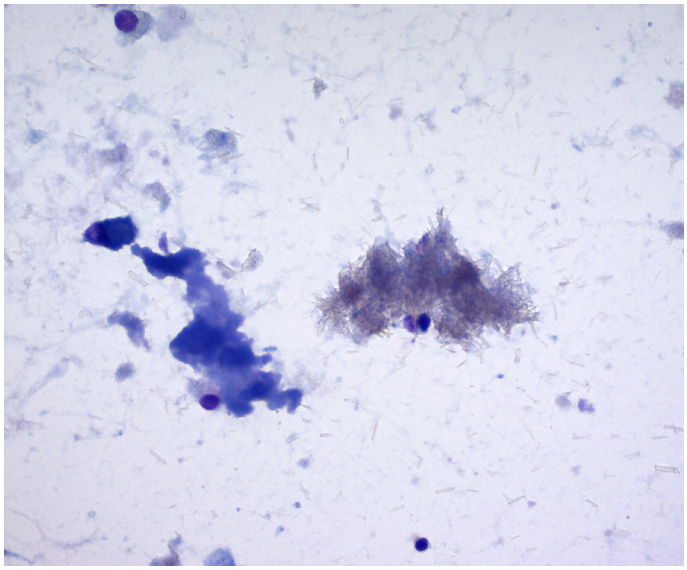


Figure 1: Material aspirated from swollen joints of a bearded dragon (*Pogona* sp.), showing cytology consistent with urate crystals (200x). Courtesy of Jon Meyer, NZVP.

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Quarterly report of investigations of suspected exotic diseases

Exotic disease investigations are managed and reported by the MPI Investigation and Diagnostic Centre (IDC), Wallaceville. The following is a summary of investigations of suspected exotic disease during the period from April to June 2019.

Exotic ticks excluded

A general practitioner notified MPI via the exotic pest and disease hotline that a New Zealand tourist had returned 2 days previously from Indiana, USA, with a tick attached. The tick was removed and submitted to MPI's Plant Health and Environment Laboratory (PHEL) for identification. It was identified as the nymph of *Ixodes scapularis* (black-legged tick). This species is known to vector a number of exotic agents, including the agent for Lyme disease, but the patient had not shown any symptoms of disease. The person was advised to thoroughly hot-wash their clothing and to monitor themselves for ill-health and any further ticks over the next few weeks. These measures prevented establishment and no further action was required.

A traveller in a group returning from Greenup County, Kentucky, USA, called the MPI exotic pest and disease hotline after finding a tick on his body 9 days later. The tick was identified at PHEL as an engorged adult female *Amblyomma americanum*, (Lone Star tick). The travellers were directed to treat all their clothing in a household clothes dryer, using the Centres for Disease Control (CDC) advice on temperature and time requirements. Also, their suitcases were treated with a pyrethrin insecticide (Nelson et al., 2016). The travellers were advised to monitor themselves for any ticks over the next month. The adult female tick had been found and removed from the patient before it had finished feeding, so it had not had the opportunity to lay eggs. These measures prevented establishment and no further action was required.

Salmonella Barranquilla identified

A veterinary pathologist called the exotic pest and disease hotline to report the isolation of *Salmonella* Barranquilla from three bovine faecal samples from south Waikato – the first time that this serotype had been isolated from animals or people in New Zealand. The isolate was identified by the Enteric Reference Laboratory at the Institute of Environmental Science & Research Ltd. The duty Incursion Incursion Investigator (II) followed up with the submitting veterinarian. Three mixed-age cows from a spring-calving herd of 800 had presented over 2 days in early March with profuse, bright-green diarrhoea. Two of them were pyrexic and one was mildly dehydrated. The cows responded to treatment, as did another unconfirmed subsequent case. There were no further cases. The only associated risk event was that the cows had inadvertently been turned out onto a paddock on which dairy-shed effluent had recently been applied. *Salmonella* Barranquilla has been isolated overseas from birds and cattle (Anonymous, 2018; Edrington et al., 2019) and in food poisoning events in humans (Anonymous, 2019). There are no reports of enhanced pathogenicity associated with this serotype. The finding is interpreted as a baseline surveillance find and the investigation was closed.

Enzootic bovine leukosis excluded

A Massey University veterinarian called the exotic pest and disease hotline to report a 2-year-old beef heifer with suspect enzootic bovine leukosis (EBL) after histology identified lymphomas in multiple organs. EBL is caused by bovine leukemia virus (BLV), an agent thought to be absent from New Zealand's dairy herd. However, there is also a sporadic, non-contagious form of lymphoma, and it is not possible to differentiate between them on the basis of histology. The lymphoma specimens were submitted to the AHL, where molecular assays (for BLV RNA and BLV-provirus DNA) were negative. The investigation was closed.

Canine parvovirus strain 2c identified

A veterinary pharmaceutical company technical adviser called the exotic pest and disease hotline to report the outcome of a pharmacovigilance investigation. An 11-month-old male Labrador Retriever had presented to a veterinary clinic with clinical signs consistent with canine parvovirus type 2 (CPV-2) infection. A faecal sample tested positive by ELISA for CPV-2 antigen and the dog responded to symptomatic treatment. The dog had been vaccinated at 13 weeks with a combination vaccine that included CPV-2 vaccine. Molecular diagnostics at Massey University's Veterinary Virology Laboratory identified the CPV-2c subtype – the first report of this subtype in New Zealand. The dog was New Zealand-born and from a single-dog household. It had not been in contact with imported dogs, but was a regular visitor to local parks, beaches and other public places. Canine gastroenteritis attributable to CPV-2 infection was first identified in 1978. The virus is transmitted by direct oral or nasal contact with faeces containing virus, or indirectly through contact with virus-contaminated fomites. If protected from sunlight and desiccation it can persist for many months and possibly years in the environment (Mitchell, 2019). The original CPV-2 was later replaced in the field by CPV-2a (1979) and CPV-2b (1984). CPV-2c emerged in 2001 and has been subsequently found worldwide (Miranda et al., 2016). In a New Zealand study, only the CPV-2a variant was found (Ohneiser et al., 2015). No association has been found between CPV-2 variants and severity of clinical disease (Mitchell, 2019), and commercially available CPV-2 vaccines are believed to cover all known field variants of CPV-2 (Armstrong, 2014). The identification of CPV-2c in this dog is interpreted as a baseline surveillance find.

Backyard chicken mortality investigated

A backyard chicken keeper called the exotic pest and disease hotline to report that 15 of her 40 chickens had died over the previous 2 weeks. Chickens were often found dead after a short period of illness, and frequently had faeces around their vents. The notifier was reluctant to call a veterinarian because of the perceived cost. The birds were hens and roosters kept in an enclosed, outdoor aviary with a floor covered with dirt and rock, which the notifier said was difficult to clean thoroughly. No anthelmintics, coccidiostats or other non-organic medication had been used on the flock, and within the past month the notifier had received two or more birds back into the flock after they had turned out to be roosters. Four chickens, including two found dead and two freshly euthanased, were submitted to a veterinary pathology laboratory. On gross examination, all four birds were in thin body condition, with various lesions. One was dehydrated, with urates in the ureter; one had egg-yolk peritonitis, one had a heterophilic granuloma in the lung, three had splenomegaly, and all four had intestinal inflammation. Histologically, there was widespread intestinal coccidiosis, nematode and cestode infestation. The caeca of all birds contained free, invasive histomonads (*Histomonas meleagridis*) amidst granulomatous typhlitis, along with intraluminal nematodes. Widespread parasitism was diagnosed as the cause of the mortalities, and exotic causes of death were excluded. The owner was directed to speak to a veterinarian about implementing appropriate parasite control, and was urged to re-surface her coop so it could be regularly cleaned. The investigation was closed.

Small hive beetle excluded

An AsureQuality Apiary Officer called the exotic pest and disease hotline to report the possibility that small hive beetle (*Aethina tumida*) larvae were present in a bee colony managed by a Canterbury beekeeper. Photos indicated that the specimens were unlikely to be small hive beetle larvae, but nevertheless the sample was submitted to PHEL. The absence of small hive beetle was confirmed after the larvae were identified as the fly *Megaselia scalaris* (Diptera: Phoridae). This species is already known to be present in New Zealand. Exotic pests were ruled out and the investigation was stood down.

Tracheal mite excluded

An AsureQuality Apiculture Technical Adviser called the exotic pest and disease hotline regarding an apiary where three out of six hives had suffered mass mortality. The presentation suggested a poisoning event, but an infestation with the exotic tracheal mite *Acarapis woodi* could present similarly. A sample of bees was submitted to PHEL for examination by an entomologist. There were no tracheal mites, so the exotic disease component of the investigation was closed. Residue testing on another sample of dead bees for up to 60 commonly used pesticides did not identify any pesticide. Exotic disease was excluded and a poisoning event remained the most likely explanation for the mortalities seen.

European foulbrood excluded

An AsureQuality Apiary Officer reported that larvae in a diseased Canterbury hive had signs consistent with European foulbrood (EFB), which is caused by the exotic bacterium *Melissococcus plutonius*. The beekeeper was a hobbyist with only four hives. Two of these were diagnosed with American foulbrood, but larvae in the colony under investigation showed signs often associated with EFB. Samples of affected larvae were collected and sent to the AHL, where *M. plutonius* was excluded by PCR testing. Exotic disease was excluded and the investigation was closed.

Chigoe flea suspected

A doctor called the exotic pest and disease hotline to report that a New Zealander had returned from overseas with suspected tungiasis. The affected person had been travelling in Africa, including Ethiopia where *Tunga penetrans* (jigger, chigoe flea) is known to occur in poor communities. The patient had two sites on one foot where the flea could have bitten. Unfortunately the specimen recovered from one of these sites had been discarded by the medical centre where the affected patient had been examined, so diagnosis could not be confirmed. Although the risk of fleas becoming established was remote, mitigation steps were applied to the affected person's home. A dog that had visited the household was treated with imidacloprid, the household environment was intensively vacuum-cleaned, and hypercypermethrin flea bombs were used.

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Investigation of suspect exotic diseases – a case study

Human botfly myiasis in New Zealand

Summary

A call to the MPI exotic pest and disease hotline from a hospital emergency department physician resulted in the confirmation of a case of human myiasis caused by the human botfly, *Dermatobia hominis* (Diptera: Oestridae). While this fly is a significant parasite of cattle in Latin America, it does not pose a biosecurity threat to New Zealand, as the climate is unsuitable. However, with increasing international travel, more cases of human myiasis caused by *D. hominis* can be expected.

Case history and presentation

A 22-year-old woman returned to New Zealand in mid-April from a 4-month holiday in South America. Four weeks previously she had spent 10 days in Manu National Park, Peru. On leaving the park she had developed itchiness and within 10 days noticed sores at the site, which she attributed to insect bites. A week after returning to New Zealand her mother examined the sores and noticed a "tail" (which turned out to be the respiratory spiracle of an insect larva) protruding from one of them. The affected woman presented at a hospital emergency department, where three larvae were removed by applying gentle pressure at the base of each lesion, catching the "tail" with forceps, and gently extracting it.

The attending physician called the MPI exotic pest and disease hotline for assistance in identifying the larvae, which were suspected to be human botfly larvae. The duty Incursion Investigator had the larvae submitted to the PHEL (Tamaki), where they were confirmed as second-instar larvae of the human botfly, *Dermatobia hominis* (Diptera: Oestridae) (**Figure 1**). After removal of the larvae the lesions healed uneventfully.



Figure 1: *Dermatobia hominis* second-instar larvae from a returned New Zealand traveller. Photo: Ben Boyd, PHEL (Tamaki)

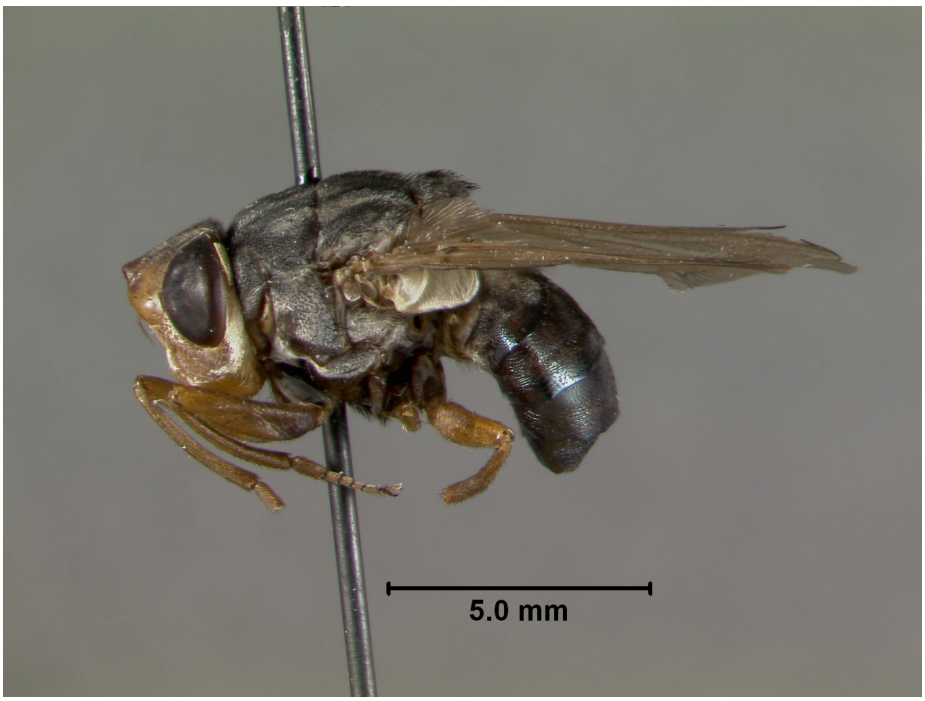


Figure 2: Lateral view of an adult human botfly, *Dermatobia hominis*. Photo: Lyle J. Buss, Entomology & Nematology Department, University of Florida

Description and life history

The adult human botfly is 12–18 mm long (**Figure 2**). It is also known as the tropical warble fly, human warble fly, or torsalo, and is native to Central and South America, from Mexico in the north to Paraguay and Argentina in the south. It may also be established in Saudi Arabia (Akhter et al., 2000).

D. hominis has an unusual lifecycle. The adult female lays her eggs on the underside of a blood-feeding arthropod, usually a mosquito captured by the botfly in flight. It may also lays its eggs on ticks. As the mosquito or tick takes blood from its host, the fly's eggs react to the change in temperature, hatch, and the larvae enter the skin. The larvae breathe through two posterior spiracles that lie flush with the skin of the host – the "tail" described above – and feed on wound exudate. First to third instar development takes 30–40 days in the

host. When the larva is fully developed it crawls out of the host and pupates in soil, developing into an adult in 30–60 days in a humid and warm environment (about 20ºC). Adult botflies live for up to 9 days. While larval stages may be found in most domesticated animal species and in humans, cattle and dogs are most commonly infected.

Significance

D. hominis is the most common cause of human furuncular myiasis in tropical Latin America, manifesting as a boil-like inflammatory papule with a central opening exuding a serosanguinous discharge (Clyti et al., 2014). The botfly is one of the most important parasites of cattle in Latin America, with significant economic impact. Penetration of the hide results in inflammation, pain and accompanying production losses (Reichard et al., 2018) as damaged hides are condemned at slaughter. In southern Brazil the botfly is believed to play a role in the pathogenesis of lechiguana, a sporadic chronic disease of cattle that presents as large usually solitary subcutaneous swellings on the scapula, neck, chest and ribs, accompanied by local lymph node enlargement (Reichard et al., 2018).

Relevance to New Zealand

Botfly infestation should be considered as a differential diagnosis in apparent skin infections seen in any patient with a history of travel to Latin America. It can be misdiagnosed as a bacterial skin infection (Zammarchi et al., 2014). Derraik et al (2010) document four confirmed and two presumed cases of human myiasis attributed to *D. hominis* in New Zealand between 1996 and 2009. There have been at least two further cases, in 2005 (Alan Flynn., pers. comm.) and 2017 (Allen Heath, pers. comm.). All reports involved tourists arriving in or returning to New Zealand from parts of Latin America where *D. hominis* is endemic. Increasing tourism is likely to lead to more such cases. However given its bioclimatic requirements the human botfly is unlikely to establish in New Zealand (Derraik et al., 2010).

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Marine surveillance annual report

This annual report includes summary information for the Marine High Risk Site Surveillance (MHRSS) national programme for the winter and summer periods from June to March 2019 inclusive, and the Marine Invasive Taxonomic Service (MITS) from July 2018 and June 2019.

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

The majority of marine pests targeted are listed in the New Zealand Register of Unwanted Organisms (mpi.govt.nz/protection-and-response/finding-and-reporting-pests-and-diseases/registers-and-lists/) under the Biosecurity Act 1993. These include primary target species that are not currently detected in New Zealand (Northern Pacific sea star *Asterias amurensis*, European shore crab *Carcinus maenas*, the marine aquarium weed *Caulerpa taxifolia*, Chinese mitten crab *Eriocheir sinensis* and Asian clam *Potamocorbula amurensis*), and secondary target species that are locally present in various places around New Zealand (Asian bag mussel *Arcuatula senhousia*, Australian droplet tunicate *Eudistoma elongatum*, Mediterranean fanworm *Sabella spallanzanii*, and clubbed tunicate *Styela clava*). All unidentified suspect samples collected during targeted and general 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). General surveillance includes public submissions via the MPI exotic pest and disease hotline. All identifications are subsequently entered into the marine non-native species database for future reference. The data are accessible at marinebiosecurity.org.nz.

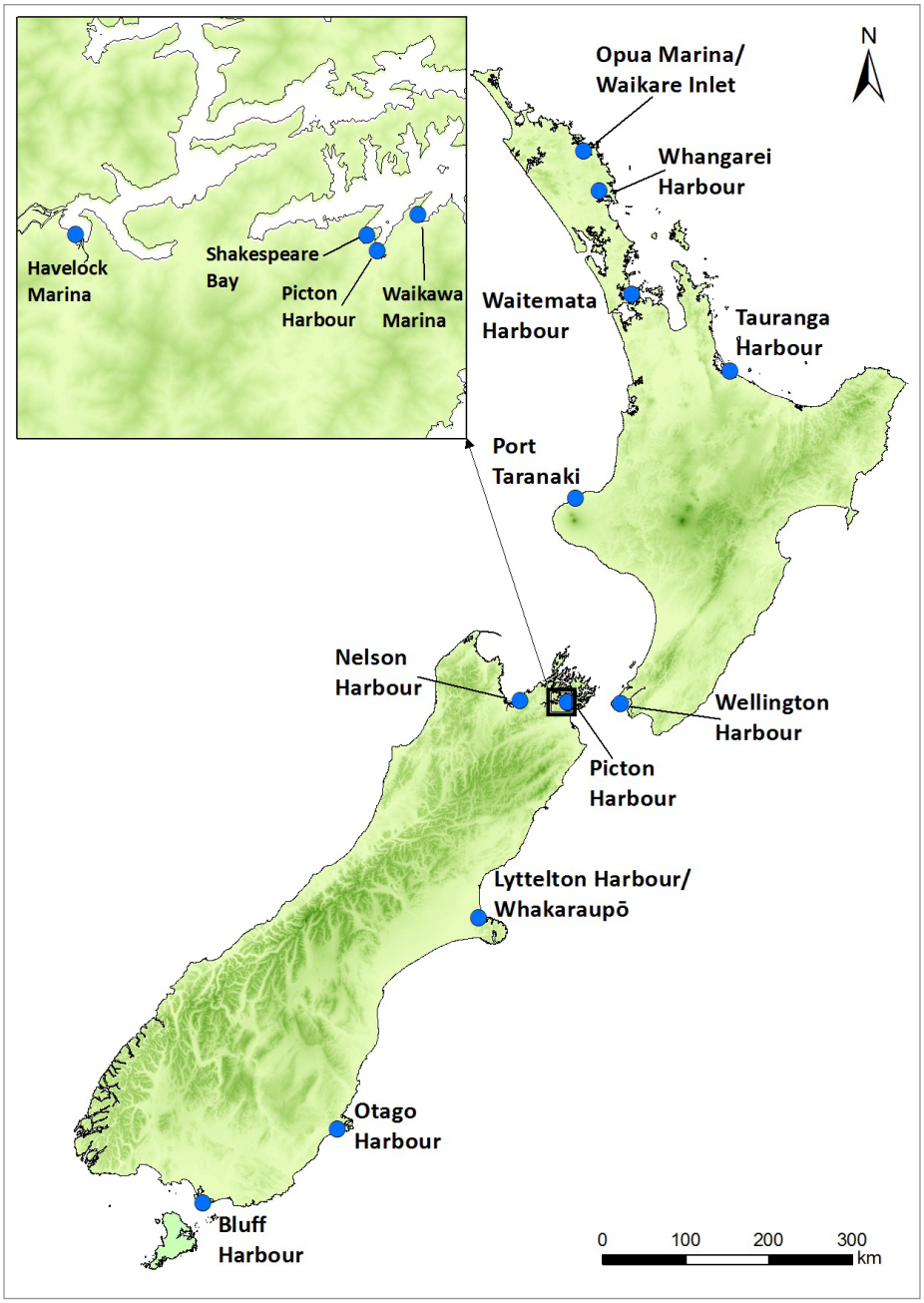


Figure 1: Locations of the 11 high-risk sites covered by the Marine High Risk Site Surveillance (MHRSS) programme

Sample collection

In total 2,922 sites were surveyed during the 2018 winter sampling period (June to September), and 2,943 sites during the summer sampling period (November 2018 to March 2019). These figures

represent 100.7 percent and 101.4 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 (habitat traps) and diver and shore searches (**Table 1**).

No primary target species were detected during the survey period across all MHRSS sites (**Figure 1**), but at least one of the four secondary target species was found in seven of the ports surveyed (**Table 2**). For the samples submitted via non-MHRSS activities, four new-to-New-Zealand species and 17 range extensions were detected, respectively (**Table 4**).

Table 1: Sampling methods used for high-risk sites surveyed in 2018–2019

Representative list of non-indigenous species that are likely to be detected with each sample method. Species in bold have been detected using this method during the present or previous surveillance programmes.

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness
Epibenthic sled tows	***Arcuatula senhousia*** *Asterias amurensis* *Caulerpa taxifolia* *Carcinus maenas* ***Eudistoma elongatum*** *Potamocorbula amurensis* ***Sabella spallanzanii*** ***Styela clava***	***Acentrogobius pflaumii*** ***Chaetopterus* sp.** ***Charybdis japonica*** *Didemnum* sp. *Grateloupia turuturu* *Hypnea* sp. ***Metapenaeus bennettae*** ***Pyromaia tuberculata*** ***Theora lubrica*** ***Tritia burchardi*** ***Undaria pinnatifida***	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, as well as some crab and fish species.
Crab (box) traps	*Asterias amurensis* *Carcinus maenas* *Eriocheir sinensis*	*Acentrogobius pflaumii* ***Charybdis japonica*** ***Metapenaeus bennettae*** ***Pyromaia tuberculata*** ***Styela clava***[1]	Adjacent to wharf pilings and other artificial habitats. Shores and shallow subtidal habitats, breakwalls and saltmarsh, with a focus on habitats with complex physical structure.	Area sampled depends on dispersion of bait odour. High replication possible.	Quick to deploy and recover, so high replication is possible. Effectively samples other species of crabs (e.g. *Hemiplax hirtipes*, *Notomithrax* spp. and *Ovalipes catharus*) and echinoderms (e.g. *Patiriella regularis*, *Coscinasterias muricata*). Also samples a wide range of fish species. Biofouling species may also be incidentally captured with this method if attached to mobile organisms attracted to the traps (e.g. *Styela clava* attached to masking crabs).
Crab condos	*Carcinus maenas* *Eriocheir sinensis*	*Acentrogobius pflaumii* ***Charybdis japonica*** ***Metapenaeus bennettae*** *Pyromaia tuberculata* ***Tritia burchardi***	Intertidal and shallow subtidal banks of rivers. Particular focus on brackish-water habitats with complex physical structure (e.g. saltmarsh or fringing vegetation).	High replication possible. Availability of suitable estuarine habitat may limit deployment.	Effectively samples other species of crabs (e.g. *Austrohelice crassa*, *Hemiplax hirtipes*). Higher rates of detection of crabs than baited traps in some conditions.
Diver searches	***Arcuatula senhousia*** *Asterias amurensis* *Carcinus maenas* *Caulerpa taxifolia* *Eriocheir sinensis* *Eudistoma elongatum* *Sabella spallanzanii* ***Styela clava***	***Amathia verticillata*** ***Botrylloides giganteum*** ***Caprella mutica*** ***Chaetopterus* sp.** ***Charybdis japonica*** ***Clavelina lepadiformis*** ***Didemnum* sp.** ***Grateloupia turuturu*** *Hypnea* sp. *Pyromaia tuberculata* ***Undaria pinnatifida***	Wharf piles, marina piles and pontoons and other artificial structures; intertidal and shallow subtidal reefs.	Good: large numbers of piles or areas of hard substratum can be searched in detail.	Feasibility dependent on water currents, weather, water clarity and safety issues for divers.
Shoreline searches	***Arcuatula senhousia*** *Asterias amurensis* *Carcinus maenas* *Caulerpa taxifolia* *Eriocheir sinensis* ***Eudistoma elongatum*** *Sabella spallanzanii* ***Styela clava***	***Amathia verticillata*** ***Chaetopterus* sp.** ***Charybdis japonica*** ***Clavelina lepadiformis*** ***Didemnum* sp.** ***Grateloupia turuturu*** ***Hypnea* sp.** ***Undaria pinnatifida***	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 clava*. Access to intertidal areas may be limiting.

[1]Incidentally, as specimens attached to masking crabs (*Notomithrax* spp.) caught in traps.

Table 2: Marine high-risk sites surveyed in 2018–2019, and non-indigenous species found

Location	Sampling round	Target number of sites	Actual number of sites	Target species[1]	Non-target species
Ōpua	Winter 2018	248	254	*Eudistoma elongatum, Styela clava*	*Didemnum vexillum, Ectopleura* spp., *Pyromaia tuberculata, Theora lubrica, Tritia burchardi*
	Summer 2018–2019	248	262	*Eudistoma elongatum, Sabella spallanzanii, Styela clava*	*Botrylloides giganteum, Celleporaria umbonatoidea, Didemnum vexillum, Ectopleura larynx, Ectopleura* spp., *Polycera hedgpethi, Pyromaia tuberculata, Theora lubrica, Tritia burchardi*
Whāngārei	Winter 2018	243	243	*Arcuatula senhousia, Eudistoma elongatum, Sabella spallanzanii, Styela clava*	*Acentrogobius pflaumii, Arenigobius bifrenatus, Charybdis japonica, Didemnum vexillum, Ectopleura* spp., *Metapenaeus bennettae, Pyromaia tuberculata, Theora lubrica, Tritia burchardi*
	Summer 2018–2019	243	246	*Arcuatula senhousia, Eudistoma elongatum, Sabella spallanzanii, Styela clava*	*Arenigobius bifrenatus, Charybdis japonica, Didemnum vexillum, Ectopleura* spp., *Metapenaeus bennettae, Omobranchus anolius, Pyromaia tuberculata, Symplegma brakenhielmi, Theora lubrica, Tritia burchardi*
Auckland/ Waitematā	Winter 2018	486	488	*Arcuatula senhousia, Sabella spallanzanii, Styela clava*	*Acentrogobius pflaumii, Celleporaria nodulosa Charybdis japonica, Ciona intestinalis, Ciona savignyi, Ciona* spp., *Didemnum vexillum, Diplosoma listerianum, Ectopleura* spp., *Limaria orientalis, Metapenaeus bennettae, Omobranchus anolius, Pyromaia tuberculata, Symplegma brakenhielmi, Theora lubrica, Tritia burchardi, Undaria pinnatifida*
	Summer 2018–2019	486	498	*Arcuatula senhousia, Sabella spallanzanii, Styela clava*	*Acentrogobius pflaumii, Amathia verticillata, Celleporaria nodulosa, Charybdis japonica, Ciona savignyi, Didemnum vexillum, Diplosoma listerianum, Ectopleura* spp., *Limaria orientalis, Metapenaeus bennettae, Omobranchus anolius, Pennaria disticha, Pyromaia tuberculate, Symplegma brakenhielmi, Theora lubrica, Tritia burchardi, Undaria pinnatifida*
Tauranga	Winter 2018	243	249	*Styela clava*	*Botrylloides giganteum, Celleporaria nodulosa, Ciona* spp., *Didemnum vexillum, Ectopleura* spp., *Grateloupia turuturu, Pyromaia tuberculata, Undaria pinnatifida*
	Summer 2018–2019	243	246	*Styela clava*	*Amathia verticillata, Charybdis japonica, Ciona* spp., *Didemnum vexillum, Ectopleura* spp., *Polyandrocarpa zorritensis, Polycera hedgpethi, Undaria pinnatifida*
New Plymouth/ Port Taranaki	Winter 2018	243	244	None	*Didemnum vexillum, Polycera hedgpethi, Theora lubrica, Undaria pinnatifida*
	Summer 2018–2019	243	245	None	*Didemnum vexillum, Ectopleura* spp., *Polycera hedgpethi, Theora lubrica, Undaria pinnatifida*
Wellington	Winter 2018	243	243	None	*Amathia chimonidesi, Ciona intestinalis, Ciona savignyi, Ciona* spp., *Clavelina lepadiformis, Colpomenia bullosa, Didemnum vexillum, Theora lubrica, Undaria pinnatifida*
	Summer 2018–2019	243	246	None	*Ciona* spp., *Clavelina lepadiformis, Didemnum vexillum, Striaria attenuata, Theora lubrica, Undaria pinnatifida*
Picton & Havelock	Winter 2018	243	243	*Styela clava*	*Ciona intestinalis, Clavelina lepadiformis, Polycera hedgpethi, Theora lubrica, Undaria pinnatifida*
	Summer 2018–2019	243	243	*Styela clava*	*Chaetomorpha linum, Ciona* spp., *Cladophora vagabunda, Clavelina lepadiformis, Ectopleura* spp., *Polycera hedgpethi, Theora lubrica, Undaria pinnatifida*
Nelson	Winter 2018	243	244	*Styela clava*	*Acentrogobius pflaumii, Amathia verticillata, Ciona intestinalis, Clavelina lepadiformis, Didemnum vexillum, Polycera fujitai, Polycera hedgpethi, Theora lubrica, Undaria pinnatifida*
	Summer 2018–2019	243	244	*Styela clava*	*Acentrogobius pflaumii, Amathia verticillata, Ciona* spp., *Clavelina lepadiformis, Didemnum vexillum, Ectopleura crocea, Ectopleura* spp., *Grateloupia turuturu, Limaria orientalis, Theora lubrica, Undaria pinnatifida*
Lyttelton	Winter 2018	243	244	*Styela clava*	*Ascidiella aspersa, Caprella mutica, Ciona intestinalis, Ciona savignyi, Ciona* spp., *Clavelina lepadiformis, Didemnum vexillum, Polycera hedgpethi, Theora lubrica, Undaria pinnatifida*
	Summer 2018–2019	243	245	*Styela clava*	*Ascidiella aspersa, Caprella mutica, Ciona intestinalis, Ciona savignyi, Ciona* spp., *Didemnum vexillum, Theora lubrica, Undaria pinnatifida*
Otago	Winter 2018	243	245	*Styela clava*	*Ascidiella aspersa, Ciona savignyi, Didemnum vexillum, Undaria pinnatifida*
	Summer 2018–2019	243	244	*Styela clava*	*Ascidiella aspersa, Didemnum vexillum, Schizymenia apoda, Undaria pinnatifida*
Bluff	Winter 2018	225	225	None	*Undaria pinnatifida*
	Summer 2018–2019	225	225	None	*Caprella mutica, Undaria pinnatifida*

[1] Only secondary target species are listed, as no primary species were detected during these surveys

Number of specimens collected by the MHRSS and sent to MITS

In total, 109 specimens were sent to MITS for identification: 63 from winter and 46 from summer. Suspect specimens found at high-risk sites represented 15 major taxonomic groups and included 21 non-indigenous species (**Table 3**).

Six range extensions of previously recorded exotic species were detected during the MHRSS surveys. The bryozoan *Amathia chimonidesi* was found in Wellington Harbour for the first time during the winter survey and has been previously found in Waitematā Harbour. The fish *Acentrogobius pflaumii*, found in Nelson Harbour, has been previously found in Ōpua Marina/ Waikare Inlet, Waitematā and Whāngārei harbours. The nudibranch *Polycera fujitai,* found in Nelson Harbour, has been previously found in Waitematā Harbour. The nudibranch *Polycera hedgpethi*, found in Port Taranaki and Nelson Harbour, has been previously found in five MHRSS locations (Ōpua Marina/Waikare Inlet, Lyttelton, Picton, Tauranga and Wellington harbours) and three non-MHRSS locations: Gisborne Harbour, Waihinau Bay (Pelorus Sound) and Ruakaka Bay (Queen Charlotte Sound). The hydroid *Ectopleura crocea*, found in Nelson Harbour, has been previously been found in Bluff, Lyttelton, Otago, Picton, Tauranga, Wellington and Whāngārei harbours. The hydroid *Ectopleura larynx*, found in Ōpua Marina/ Waikare Inlet, has been previously found in Nelson, Picton, Tauranga, Waitematā and Whāngārei harbours.

Table 3: Specimens collected and identified by MITS from each MHRSS sampling locality, 2018–2019

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

Location	Taxonomic identification	
	Taxonomic group	Species
Ōpua	Ascidian	*Aplidium* sp.
	Bryozoan	***Celleporaria umbonatoidea***
	Hydroid	***Ectopleura larynx***
	Isopod	*Cleantis tubicola*
Whāngārei	Ascidian	***Didemnum vexillum***
	Barnacle	*Amphibalanus variegatus*
Auckland/ Waitematā	Alga	*Ceramium* sp.
	Anthozoan	*Culicia rubeola*
	Ascidian	*Botrylloides magnicoecum*, ***Ciona savignyi***, *Didemnum incanum, Didemnum* sp., ***Didemnum vexillum***, ***Diplosoma listerianum***, *Microcosmus squamiger, Mycale (Carmia) tasmani, Polyzoa reticulate, Pyura rugata*
	Bryozoan	***Celleporaria nodulosa***, *Gregarinidra* sp.
	Hydroid	***Pennaria disticha***
Tauranga	Alga	***Grateloupia turuturu***
	Ascidian	*Aplidium nottii, Asterocarpa humilis,* ***Botrylloides giganteum***, *Botrylloides leachii, Metandrocarpa thilenii, Microcosmus squamiger, Styela plicata*
	Bryozoan	***Celleporaria nodulosa***
	Decapod	Brachyura1, Liocarcinus corrugatus, Hemiplax hirtipes
	Echinoderm	*Astropecten* sp.
	Hydroid	*Aglaophenia laxa*
New Plymouth/ Port Taranaki	Ascidian	*Botrylloides leachii*
	Gastropod	*Potamopyrgus estuarinus*, Gastropod eggs[2]
	Hydroid	*Ectopleura* sp.
	Nudibranch	***Polycera hedgpethi***
Wellington	Alga	*Grateloupia stipitata*, Rhodophyta[3], ***Striaria attenuata***
	Ascidian	*Agnezia glaciate, Aplidium adamsi,* ***Clavelina lepadiformis, Ciona intestinalis***, *Didemnum incanum,* ***D. vexillum***, *Molgula mortenseni, Pyura cancellata, Pyura pulla, Pyura subuculata*
	Bryozoan	***Amathia chimonidesi***
	Decapod	*Ebalia laevis, Petrocheles spinosus*
	Sponge	*Haliclona* sp.

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Table 3 (continued)

Location	Taxonomic identification	
	Taxonomic group	Species
Picton/Havelock	Alga	***Chaetomorpha linum, Cladophora vagabunda***, *Cladostephus spongiosus*, Ectocarpaceae[3], *Gracilaria chilensis*
	Annelid	*Acromegalomma suspiciens, Spirobranchus polytrema* complex[4]
	Ascidian	Unidentifiable sample
	Echinoderm	*Rynkatorpa uncinata*
	Nudibranch	***Polycera hedgpethi***
Nelson	Alga	*Codium gracile*, ***Grateloupia turuturu***
	Decapod	*Liocarcinus corrugatus*
	Fish	***Acentrogobius pflaumii***
	Hydroid	***Ectopleura crocea***
	Nudibranch	*Lamellaria cerebroides*, ***Polycera hedgpethi***, ***Polycera fujitai***
Lyttelton	Ascidian	*Asterocarpa humilis, Cnemidocarpa nisiotis, Cnemidocarpa bicornuta, Pyura cancellata, Pyura picta*
	Bivalve	***Magallana gigas***
	Crab	*Pagurus albidianthus*
Otago	Alga	*Rhodoglossum gigartinoides*, ***Schizymenia apoda***
	Fish	*Bovichtus variegatus*
	Nudibranch	*Aphelodoris luctuosa, Janolus novozealandicus*
Bluff	No samples submitted	

1 Megalopa stage; species identification not possible.
2 Species identification not possible.
3 Genetic sequencing required for further taxonomic elaboration.
4 A group of similarly related species that are morphologically difficult to distinguish.

Number of specimens collected via non-MHRSS activity and sent to MITS

MITS also received 55 samples that were collected and submitted as part of MPI investigations into exotic marine organisms from July 2018 to June 2019, generally after notification via the exotic pest and disease hotline. Over this period four new to New Zealand species and 17 range extensions were detected by this method (**Table 4**). From all submissions to MITS, 283 specimens were identified. Identifications of samples submitted as part of MPI investigations into exotic marine organisms were completed rapidly, with non-urgent samples identified within 6.8 days and urgent samples taking 1 day on average, respectively. Identifications of samples submitted via MHRSS were completed in 7.8 days on average.

Additional resources for the MHRSS and MITS programmes

Annual reports and the updated New Zealand Marine Pest Identification Guide are available to read and download from marinebiosecurity.org.nz/surveillance and marinebiosecurity.org.nz/speciesid respectively. Information collected from marine biosecurity surveillance programmes has been uploaded and made available via the Marine Biosecurity Porthole webpage, 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, examine distribution records for individual species, and download the data for further analysis. It also provides information about significant marine pests, updates on current marine biosecurity projects and access to a variety of past reports that have been commissioned by MPI or completed by NIWA. All these are available for download.

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Table 4: Specimens collected and identified by MITS via non-MHRSS activity, July 2018 – June 2019
Range extensions are in **BLUE**. New to New Zealand are in **RED**

Location	Date[1]	Taxonomic identification	
		Taxonomic group	Species
Ōpua	July 2018	Annelid	*Sabella spallanzanii*
Mahurangi	July 2018	Ascidian	*Eudistoma elongatum*
Mahurangi	October 2018	Annelid	*Sabella spallanzanii*
Mahurangi	October 2018	Ascidian	*Didemnum vexillum*
Parengarenga Harbour	November 2018	Alga	*Undaria pinnatifida*
Parengarenga Harbour	November 2018	Bryozoan	*Watersipora subatra*
Manukau Harbour	November 2018	Mantis shrimp	*Oratosquilla oratoria*
Bucklетons Bay	February 2019	Ascidian	*Eudistoma elongatum*
Parengarenga Harbour	April 2019	Ascidian	*Parablennius intermedius*
Karitane	May 2019	Alga	*Bonnemaisonia hamifera*
Great Barrier Island	May 2019	Ascidian	*Clavelina oblonga*
Kaipara Harbour	May 2019	Ascidian	*Botrylloides giganteum*
Kaipara Harbour	May 2019	Ascidian	*Eudistoma elongatum*
Kaipara Harbour	May 2019	Ascidian	*Diplosoma listerianum*
Kaipara Harbour	May 2019	Hydroid	*Ectopleura crocea*
Kaipara Harbour	May 2019	Mollusc	*Tritia burchardi*
Manukau Harbour	May 2019	Nudibranch	*Okenia pellucida*
Manukau Harbour	May 2019	Decapod	*Charybdis japonica*
Manukau Harbour	May 2019	Hydroid	*Ectopleura crocea*
Orewa Beach	June 2019	Alga	*Solieria sp.*
Akaroa Harbour	June 2019	Amphipod	*Hirayamaia mortoni*

1 Date when the sample was submitted to MITS. Formal identification can be delayed, depending on the taxonomic method used.

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Aquatic and environment health surveillance and incursion investigation annual report

The Ministry for Primary Industries (MPI) Aquatic and Environment Health team supports surveillance and incursion investigations by rapidly detecting and managing risks from new pests and diseases that may have impacts on the primary production, aquatic and environment sectors. Surveillance activities protect New Zealand's natural resources by early intervention against potentially harmful organisms. As a result of general surveillance (especially reporting via the MPI exotic pest and disease hotline) or detection of risk species through one of the targeted surveillance programmes, an investigation may be undertaken that may lead to initiation of a response, depending on the risk identified. The team is diverse in scope and all members are regarded as trusted specialists. Our advice is accepted throughout MPI and the biosecurity system.

Surveillance enables New Zealand to demonstrate that it is free of pests and diseases that might otherwise close access to overseas markets. The work of the Aquatic and Environment Health team includes the general biosecurity surveillance programme as well as national targeted surveillance programmes for exotic invasive ants, saltmarsh mosquitoes, arboviruses in cattle, and marine pests (for which annual reports are presented in this issue of *Surveillance*).

The scope of the Aquatic and Environment Health team's incursion investigation activities include:

- investigations into aquatic pests and diseases;
- inspecting risk goods associated with animals;
- evaluating the risks associated with imported Asian food and traditional Chinese medicine products (TCMs); and
- managing incursions by new to New Zealand terrestrial vertebrate pests.

Reports of suspected exotic pests and diseases in *Surveillance* currently focus on marine and freshwater species, but we intend to report on other incursion investigations in future.

The team also manages the ApiWellBeing operational research project, the annual bee colony loss survey, and provides specialist advice on apiculture, aquatic animal health, insect vectors of animal arboviruses, exotic ants and development of biosecurity systems. Core activities also include targeted research projects and readiness activities to support the work of Biosecurity New Zealand. The Aquatic and Environment Health team also provides specialist advice for some biosecurity responses.

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Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases: April to June 2019

Range extension of non-indigenous red alga confirmed

Auckland Council contacted MPI after a large drift of red alga that was washed ashore at Red Beach and Orewa, north of Auckland, was identified as *Solieria* sp. (Rhodophyta: Solieriaceae) by a NIWA expert, who received a sample from a member of the public. This is a non-indigenous red alga that was first reported from New Zealand in 1992, and until now was only known from Manukau Harbour, Kaipara Harbour and the Orakei Basin (Nelson et al., 2015). Its detection in the northern Hauraki Gulf represents a significant range extension. It can become a nuisance when it forms dense mats that may wash ashore or clog commercial fishers' nets (Nelson et al., 2015). Reproductive structures have never been found in samples of the alga when examined, so identification beyond genus has not yet been possible. The range extension was added to the Marine Invasives Taxonomic Service records and the investigation was stood down.

Range extension of non-indigenous hydroid confirmed

The non-indigenous hydroid *Ectopleura crocea* (Cnidaria: Tubulariidae) was collected during an Auckland Council marine pest survey of the Kaipara Harbour. This represents a range extension for this species, which previously has been recorded from Tauranga, New Plymouth, Lyttelton, Whangarei, Dunedin, Picton, Wellington, Nelson and Manukau.

Paua mortality, Kaikoura

A scientist from the Paua Industry Council contacted MPI to report mortality in wild black-foot paua *(Haliotis iris*) (Gastropoda: Haliotidae) at Mangamaunu Bay, near Kaikoura. During the previous week a number of dead paua had washed ashore, and the notifier was concerned that the mortality rate appeared to be increasing. The notifier had also received information that more paua had washed up further along the beach. No other organisms appeared to be affected. All paua had been scavenged, so that only empty shells remained.

A week later a further report of paua mortalities in the area was received, and this time samples were able to be collected and sent to the MPI Animal Health Laboratory (AHL). Tests were negative for *Perkinsus* spp., abalone viral ganglioneuritis virus and withering syndrome. Unfortunately the paua were too decomposed for histological examination.

The most significant finding was the accumulation of abundant gravel and sand within the lumen of the digestive tract of specimens examined. This suggested there may have been significant turbulence in the water column, which could have reduced the availability of food and/or the ability of the paua to feed adequately and avoid ingesting gravel and sand. This area of the beach had also experienced increased sedimentation when the Hapuku River changed course after the 2016 Kaikoura earthquake, and is known to experience strong swells that can move boulders and dislodge paua from the substrate.

It was concluded that the paua mortalities were likely to be associated with an environmental stress rather than a disease, and the investigation was stood down.

Tuatua mortality, Northland

An increase in the number of dead tuatua (*Paphies subtriangulata*) (Bivalvia: Mesodesmatidae) and empty tuatua shells (predominantly large individuals) on Ninety Mile Beach was reported to MPI. Samples were submitted to the AHL to test for disease. Overall, the animals appeared to be in fair body condition and there were no signs of an infectious agent. Scattered *Rickettsia*-like organisms (RLOs) were present but it was uncertain whether they were significant. Histology showed that the animals tested had recently spawned. Spawning is known to be a stressful event in shellfish and increases their metabolic demand. It was considered possible that the tuatua mortality was related to a lack of sufficient food, spawning and possibly other undetected environmental factors, rather than a disease process. The investigation was stood down.

Clam mortality, Horowhenua

A mass shellfish mortality on Waiterere, Hokio and Waikawa Beaches in Horowhenua was reported to MPI. Meteorological data showed that there was heavy rain and a temperature drop just prior to the notification, although sea-surface temperatures remained high. At first, Horizons Council and MPI were unable to find live samples for disease testing, but noted that 95 percent of the affected shells were the clam *Dosinia anus* (Bivalvia: Heterodonta), and that tuatuas (*Paphies subtriangulata*) appeared unaffected.

A third visit was successful in locating live *Dosinia*, and these were submitted to the AHL for disease testing. A high level of tissue breakdown alongside bacterial growth was detected, and all samples had recently spawned. Bacteria, post-spawning stress and thermal stress caused by high sea-surface temperatures may have collectively caused disease in this population. Alternatively, thermal and post-spawning stress may have predisposed them to bacterial infection.

It was agreed that more samples should be tested, and these were taken about a month after the event was first reported (and about 3 weeks after the first samples had been received). Like the first samples, the second lot were also mostly post-spawning animals, but the majority appeared to be in good body condition and did not have the same level of tissue breakdown as previously seen. This may indicate that they were recovering, or had not been exposed to the same organisms or stressors as the first samples.

It was concluded that this mortality was likely multi-factorial, and stressors such as unfavourable environmental conditions and/or spawning may have been involved. Testing ruled out any primary pathogens as a cause, so the investigation was stood down.

New to New Zealand fish species, Northland

Two horned blennies, *Parablennius intermedius* (Actinopterygii: Blenniidae), were seen on a wharf pile at Te Hapua Wharf, Parengarenga Harbour. This species has not previously been reported in New Zealand. The two fish were seen on two successive days at a depth of 2 metres on the same piles by NIWA divers during a recreational diving trip. None were seen at Te Pau Wharf, about 3 nm away. No specimens were collected and the species was identified from photos.

Parablennius spp. (known collectively as combtooth blennies) are found in the Atlantic, western Pacific and Indian Oceans. *P. intermedius*, commonly known as the horned blenny, is native to the southwest Pacific Ocean and has been reported from northern Queensland to southern New South Wales in Australia, as well as New Caledonia and the Solomon Islands. Adults are found in subtropical estuaries and coastal bays, typically occupying shallow water (0–10 metres). It is possible this species could become established (if it is not already) in the subtropical conditions of northern New Zealand. This species does not have an invasive history, so no further action was recommended and the investigation was stood down.

New to New Zealand seaweed species, Otago

NIWA notified MPI that one of its algal taxonomists had found a new to New Zealand seaweed, *Bonnemaisonia hamifera* (Rhodophyta: Bonnemaisoniaceae), at Waikouaiti Estuary, Otago. An unusual bloom had been initially observed by members of the public, and NIWA had responded to photos uploaded to the internet. NIWA obtained samples and subjected them to molecular analysis, and the result was a 100 percent match with a sample of *B. hamifera* from Japan. The native range of this species is the northwest Pacific (D'Archino & Nelson, 2019). After taxonomist evaluation, this species does not appear to be invasive, so no further response was recommended.

Dogfish mortality investigated

A member of the public notified MPI after seeing 20–30 dead fish, which he suspected were spiny dogfish (*Squalus acanthias*) (Chondrichthyes: Squalidae), while walking on Peka Peka Beach, Kāpiti. The fish were along the tideline and had been heavily scavenged by seagulls. Fisheries New Zealand was contacted because this incident could be the result of by-catch dumping. Fisheries officers attended and confirmed that the fish were spiny dogfish. Under certain reporting conditions, commercial fishers are allowed to discard dogfish by-catch. It was concluded that these fish were most likely discarded by-catch, and no infectious disease was involved, so the investigation was stood down.

Worms in blue cod investigated

Fisheries New Zealand staff were notified by a commercial fish processor that unusual worms had been found in the gut of blue cod (*Parapercis colias*) (Actinopterygidae: Perciformes) caught at the Chatham Islands. Fish stomachs were full of fine, hair-like worms, and there was concern that when the fish were processed they could contaminate the product. The worms had not been observed before by the processor, and blue cod caught from several locations appeared to be affected.

Worms from the gut contents were collected and submitted to the Marine Invasives Taxonomic Service for examination, where they were identified as belonging to the genus *Eunice*. The samples were in fairly good condition apart from being slightly digested. They did not appear to be reproductive, and were likely ingested from the benthos during the fishes' normal feeding activities. While they could not be identified to species, a number of local species are known to occur and several are undescribed. It was concluded that these species were unlikely to be exotic, and the investigation was stood down.

New to New Zealand amphipod investigated

NIWA notified MPI following the identification of what appeared to be a new to New Zealand amphipod, *Hirayamia mortonii* (Crustacea: Amphipoda). A single female specimen had been collected by Environment Canterbury during an intertidal survey at Robinsons Bay, Akaroa Harbour, in 2017, but was only recently identified. The taxonomist was 90 percent certain of the identification, but examination of both male and female specimens is required to validate this species

H. mortonii is native to the Hong Kong region of the South China Sea. It is in the subfamily Corophiinae, of which four species in two genera have already been reported from New Zealand. Many species are well-known biofoulers of hard surfaces, including vessel hulls and harbour structures. They are mostly known from the northern hemisphere, but some species have become well established in equivalent southern hemisphere environments, likely arriving as hitchhikers on vessel hulls (Fenwick, 2019).

While this species has not previously been recorded outside its native range, the wide distribution of other members of this family may suggest that a population of *H. mortonii* could establish in New Zealand. There is also the possibility that *H. mortonii* may already be established in New Zealand and may have a wider distribution than already thought, as it is difficult to distinguish from *Paracorophium excavatum* (a closely related and similar-looking native amphipod) without consulting an amphipod expert (Fenwick, 2019). Its likely impact in New Zealand is unknown, especially as there are no published records from outside its native range. However, presumably it could compete with or displace other native amphipods

that share similar habitats, such as *P. excavatum* (Fenwick, 2019).

Response options to manage a small, mobile crustacean are few. There is limited information on its potential impact in New Zealand, and it could already be established or more widespread in New Zealand than originally thought, owing to its similarity to the native *P. excavatum*. Therefore no further response was recommended and the investigation was stood down.

Rainbow trout with lesions investigated

Fish & Game Otago notified MPI after a member of the public brought in a rainbow trout (*Oncorhynchus mykiss*) (Actinopterygii: Salmonidae) with lesions around the gills. It had been line-caught in a reservoir and had lesions around the gills.

Only one fish was reported, although another similar case had been reported to Fish & Game 2 years ago from the same catchment. Reservoir water levels were reportedly high and fishing activities had been otherwise normal.

The fish was tested for exotic diseases at the AHL. It tested negative to *Aphanomyces invadans*, *Yersinia ruckeri*, *Aeromonas salmonicida* and *Lactococcus garvieae*. No other cases were reported, and the investigation was stood down. It was concluded that the lesions were most likely due to injury and a secondary bacterial infection.

Brown trout with lesions investigated

Since late 2018 a local angler had been catching brown trout (*Salmo trutta*) (Actinopterygii: Salmonidae) with unusual spots on them in the Taieri catchment. He had noticed an increase in the prevalence of affected fish, from an estimated 40 percent to about 60 percent. He informed Fish & Game Otago, who notified MPI. A single fish presented with areas of haemorrhage on the skin, the sclera of both eyes, pelvic and pectoral fins. It tested negative at the AHL for RLOs and *Lactococcus garviae* (both present in New Zealand). Histology showed no evidence of an infectious process, so the "spots" were unlikely to be due to a primary pathogen. Histology did, however, show some abnormalities that could be associated with heat and/or other stress, or a toxin. It was concluded that the lesions were more likely to be associated with environmental stress than a disease, and the investigation was stood down.

Pipi decline investigated

A member of the public reported to MPI that pipi (*Paphies australis*) (Bivalvia: Mesodesmatidae) were dying or displaying ill-health near Marsden Cove, Whangarei Harbour. The Incursion Investigator (II) requested that specimens be sent to MPI's AHL for exotic disease testing and presence of RLOs. The Northland Regional Council advised that there had been no adverse environmental or pollution events in the area.

Tests found no evidence of exotic disease, and no significant abnormalities were seen on macroscopic examination. Light to moderate infection of RLOs was found in most of the specimens. RLOs are commonly found in shellfish mortalities, but their significance is unknown. They were found in gill and digestive tract tissue, where they could compromise the ability of animals to respire and digest food. However, it was noted that specimens were undergoing gonad reabsorption, a metabolically stressful event. This process, in combination with high sea temperatures and the presence of RLOs, could stress the animals and weaken the population. Alternatively, the combination of high sea temperature and the metabolic stress described could predispose the animals to RLO infection. As no exotic disease was detected the investigation was closed.

Suspected exotic mollusc investigated

MPI was contacted by a marine scientist after a suspect Asian date mussel (*Arcuatula senhousia)* (Bivalvia: Mytilidae) was found in a core sample collected in the Marlborough Sounds. The preserved specimen was sent to the Marine Invasives Taxonomic Service, where it was identified as *Trichomusculus barbatus*. This species is native to New Zealand and widely distributed. As there was no biosecurity risk, the investigation was stood down.

Toheroa mortality investigated

A mortality event involving toheroa (*Paphies ventricosa*) (Bivalvia: Mesodesmatidae) along Ninety Mile beach was reported to MPI. Samples collected and sent to the AHL were found to be in good body condition, with well-developed reproductive tissue. There was no evidence of significant inflammation or tissue breakdown. No cause of the mortality event was apparent in the animals examined. With no evidence of a biosecurity issue, the investigation was stood down.

Eel mortality investigated

A member of the public contacted MPI after noticing dead eels (*Anguilla* sp.) in a stream in the Hutt Valley, Wellington. Three dead eels were found on the day of the notification, and four more the following day. The Hutt City Council was notified and conducted a site visit. At least three more dead eels were found upstream from the initial site, bringing the total to 10 eels. Nothing of concern was noted in terms of stream health. The stream did appear to have a reduced flow, but it was not stagnant. This stream is considered a drain, and historically was fed by water pumped from a bore situated close upstream. The pump had apparently failed a few years ago and was never replaced, so the stream only flowed when there was sufficient rain to sustain it. One of two eels collected by an II was in suitable condition for histopathological examination at the AHL. An accumulation of iron within the tissues and cells was noted. This can be a secondary effect of increased red blood cell breakdown, increased dietary iron, or exposure to chemicals or other metals that may cause bio-accumulation of iron. Parasites (similar to apicomplexans) were found in the macrophages in the blood cavities of organs, but their significance could not be determined. As only one eel was

suitable for examination, it was not possible to determine whether these factors were common to all affected eels. The cause of the mortalities remains uncertain, but environmental factors that went undetected at the time may have also contributed. No further dead eels were reported, so the investigation was stood down.

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Plant Health Surveillance and Incursion Investigation annual report

The Ministry for Primary Industries (MPI) Incursion Investigation team and Plant Health and Environment Laboratory (PHEL) investigate and diagnose suspect exotic pests and diseases in the plant and environment sectors. Incursion Investigators (IIs) and scientists are based in Auckland, Wellington, Rotorua and Christchurch. These teams provide field investigation, diagnostic testing and technical expertise to detect and report new pest and diseases affecting plants and the environment. They support surveillance and response functions, and carry out research and development for better diagnostic tools and processes to manage biosecurity risks.

Surveillance and incursion investigation work is an integral component of New Zealand's multi-layered biosecurity system. The team is the first line of defence against unwanted pests and diseases that breach the border. The IIs respond to these breaches, gather information to validate reports, and manage the immediate risk. When the incursion investigation team cannot mitigate the risk, a larger biosecurity response may be initiated.

Targeted surveillance

Surveillance enables New Zealand to demonstrate that it is free of pests and diseases that otherwise would close access to overseas markets. As part of that process, the Plant Health team undertakes the fruit fly, gypsy moth and high risk site surveillance programmes (for which annual reports are presented in this issue of *Surveillance*).

Passive surveillance

Passive or general surveillance relies on members of the public, industry groups, plant health professionals and scientists to report suspect plant pests and diseases that are not present in New Zealand. It provides a mechanism for people to report pests like ants and brown marmorated stink bugs (BMSB) that are associated with imports and require urgent measures to manage the biological risk. Passive surveillance also enables established but previously unrecorded pests and diseases to be reported and managed, and provides information about New Zealand's pest and disease status. During the year, the Plant Health team managed 1,323 notifications (**Figure 1**) through passive surveillance. Of these, 342 cases (26 percent) were evaluated by IIs and immediately stood down because no biological risk was found. Compared with 2018, the number of cases that were able to be immediately stood down decreased by 28 percent, resulting in significantly more cases that required further investigation (873; 66 percent) to determine the magnitude of the risk.

A small number of notifications (108; 8 percent) were redirected to agencies with management responsibility for the particular pest concerned. These notifications included pest plants listed in the National Pest Plant Accord (NPPA) that are unwanted organisms and banned from sale, propagation and distribution throughout New Zealand and are typically managed by regional councils and local authorities. An example is water hyacinth (*Eichhornia crassipes*), an aggressive, fast-growing weed that crowds out native aquatic plants and animals, altering ecosystems, destroying habitats and blocking irrigation systems. Water hyacinth is a notifiable organism and one of the pests being eradicated under the National Interest Pest Response led by MPI in partnership with regional councils. There were eight reports of velvet leaf (*Abutilon theophrasti*), an unwanted organism that is being managed through the Velvetleaf Programme run by MPI and regional councils, industry groups such as Federated Farmers, Rural Contractors New Zealand, the Foundation for Arable Research, Beef + Lamb New Zealand and DairyNZ. Some reports were redirected to MPI border clearance staff and approved operators of Transitional Facilities (TFs), as the goods had not cleared the border. TFs are MPI-approved facilities for receiving imported goods. Other reports redirected from the Plant Health team related to insects not associated with imported goods; for example a swarm of flies at an Auckland fish market and large spiders by a Nelson river. These are general surveillance enquires and managed by PHEL.

Most reports (910) were provided by members of the public, and 526 of those (58 percent) were investigated further, a 20 percent increase in public reports requiring investigation compared with the 2018 year (367). That increase could be explained in part by public awareness

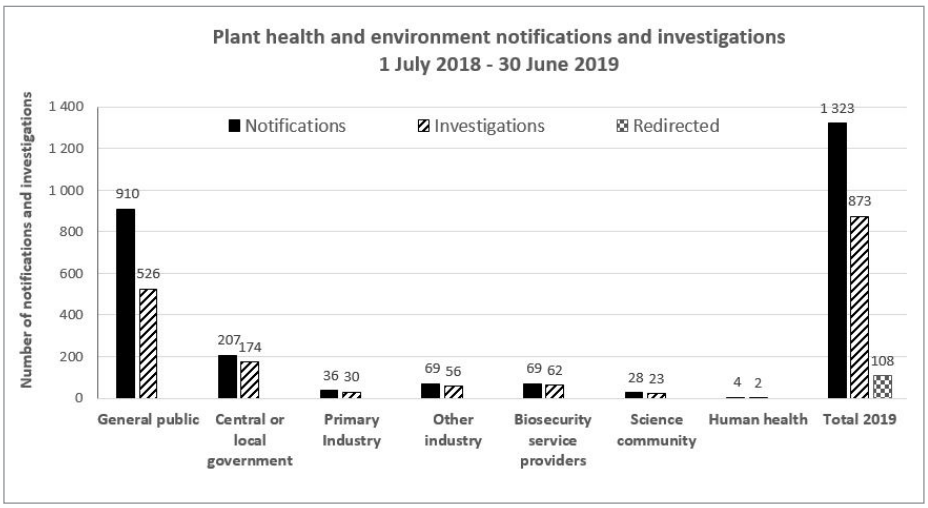


Figure 1: Notifications to and investigations by the Plant Health team for the year ended 30 June 2019

campaigns undertaken by MPI through platforms such as Facebook and Twitter, highlighting significant pests such as BMSB at major international airports. Additionally, the complexity and biosecurity risk associated with some notifications required the IIs to conduct more exhaustive investigations to rule out any biological risk.

Similar to the previous year, the relative proportion of notifications from other sectors that required further investigation (government 84 percent, industry 83 percent, biosecurity service providers 90 percent and the science community 82 percent) was much greater than those reported by members of the public (58 percent), indicating that the expertise of those sectors contributed to the significance of their reports. The recording of industry notifications was changed this year so we could better understand the significance and value of "other industries" reporting to MPI, including vehicle-testing centres, car importers and detailers, panelbeaters, supermarkets and other major retailers such as Bunnings and Mitre10 that commonly receive imported goods. The proprietors of those businesses provide an important opportunity to report suspect exotic pests that have breached the border. During the 2019 year, 69 notifications were reported to the exotic pest and disease hotline by other industries, compared to 36 notifications from primary industry.

Post-border surveillance is complicated by the diversity of plant species present in New Zealand (about 25,000) and other associated organisms. Real or suspected incursions are reported from diverse environments, including towns, cities, farms, orchards, parks and reserves, and TFs. Given the complexity and number of reports to be processed and the number of actual incursions found, MPI's plant health surveillance expenditure is well justified.

When the issue is more widespread, urgent measures are used to provide local control while further actions are considered, and may lead to a wider response. **Figure 1** shows there were 526 general public investigations, compared to 345 (excluding human health) from other reporters. Regardless of the disparity, the number of investigations that required urgent measures to promptly contain and manage the biological risk at hand was similar (100 and 101 investigations, respectively). That would tend to validate the importance and effectiveness of reports from biosecurity service providers, central and local government, industry and the science community.

Figure 2 shows the outcomes of the 873 investigations in 2018–2019 (compared with 583 in the 2018 year), of which 486 (cf. 322 in 2018) were negative, ruling out suspected unwanted or notifiable organisms. The number of investigations increased by 33 percent in 2019 compared with 2018, but the number of negative investigations was similar (56 and 55 percent respectively).

This year, confirmation of a biological risk transpired for the 254 reports investigated that were categorised as positive. The corresponding figure for 2018 was 164. Similar to 2018, there were 82 inconclusive investigations (9 percent), where it was not feasible to determine the presence or absence of a biological risk and further investigation was not warranted. Forty-one active investigations were still in progress at the end of the reporting period. A small number of positive investigations (10; 1 percent) were transferred to other operational units within MPI for further action, and eight of those resulted in a biosecurity response. These included two cases of exotic fruit fly (Diptera: Tephritidae) caught in surveillance traps in Auckland: the Queensland fruit fly (QFF) (*Bactrocera tryoni*) in Devonport and the Pacific fruit fly (*B. facialis*) in Otara. Such finds defend the investment in our targeted surveillance programmes. The Biosecurity 2025 Direction Statement acknowledges that all New Zealanders have a role to play in protecting our biosecurity. Raising public awareness will help the public to recognise biosecurity issues and report them to MPI, often via the exotic pest and disease hotline.

Notable investigations are reported quarterly in *Surveillance,* and examples for the April to June period are presented below.

Investigations transferred to Response Group

Fruit-fly detections

Three fruit-fly detections were reported in the last issue of *Surveillance* (for the period January to March). Another case was reported by AsureQuality in April, after a single male fruit fly was caught in a surveillance trap at Stafford Park, Northcote, Auckland. The trap had been deployed as part of an ongoing response to the last report of fruit fly in that area. Photos provided were assessed

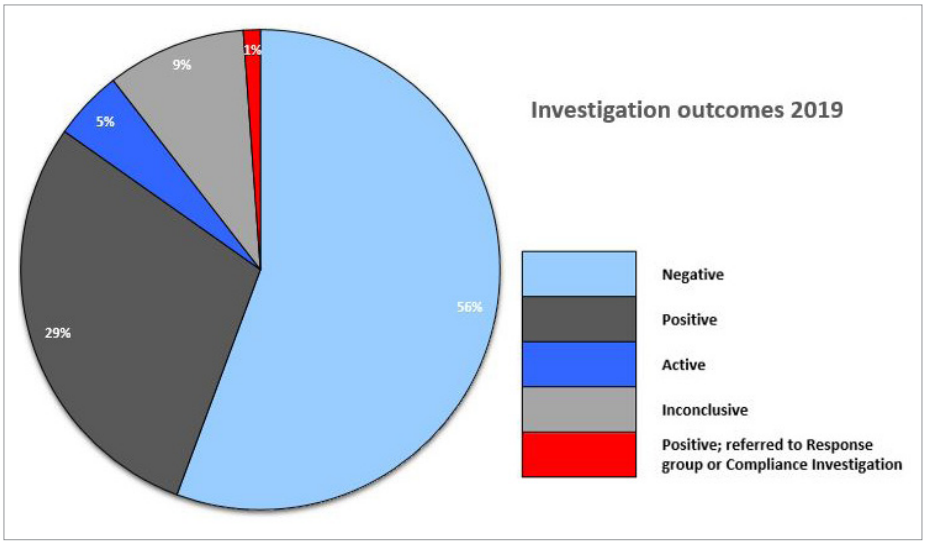


Figure 2: Outcomes of further investigations to determine whether there was a biosecurity issue in initial reports, for the year ended 30 June 2019

by PHEL managers, who agreed the insect was a QFF. The insect was sent to PHEL (Tamaki), where entomologists confirmed the identification using morphological characteristics. PHEL notified the Chief Technical Officer, who in turn informed the MPI Response Incident Controller. A site visit was conducted by an II, a PHEL entomologist and AsureQuality staff. In keeping with the standard QFF response procedure – and because only male QFF are attracted to pheromone traps – host fruit (guava, feijoa, apple and citrus) were collected from three adjacent properties to see if any female QFF had laid eggs in them; none were found. The investigation was transferred to the Response Group as part of the ongoing response to the last report of fruit fly in this area.

Investigation positive; establishment prevented through urgent measures

These investigations found organisms that were not known to be present in New Zealand, and under circumstances that enabled treatments to be applied and biosecurity mitigation confirmed. They typically involved imported goods and containers.

Brown marmorated stink bug (BMSB) cases

A single live male BMSB, *Halyomorpha halys* (Hemiptera: Pentatomidae), was found on a side-table inside the entrance of a residential property at Mt Maunganui. An II and a BMSB sniffer dog and handler visited the location and inspected the house and property but no further BMSB were found. Although no association could be determined with goods recently imported onto the property, it is situated 500 metres from a commercial zone with numerous large retail stores and other businesses containing imported goods. Several TFs operating in that area were visited and staff (who were already aware of BMSB) were interviewed, but no recent events suggested an association with the single insect found nearby. A commercial kiwifruit orchard within 300 m of the property was also visited and the BMSB sniffer dog inspected the inside and outside of a dwelling at that property plus two nearby parks. All were negative for BMSB. However, following discussion with industry partners (BMSB Council), BMSB surveillance was initiated as a precaution. This involved using lures and sticky card traps placed about 250 m apart in the surrounding area. There were 16 trap sites, extending out to about 800 metres from the detection site. Traps were examined every 2–3 days for the first 2 weeks, and then every 2 weeks for 12 weeks, but no further BMSB were found. The investigation concluded that there was not an established BMSB population in the surveyed area.

A Hastings company selling cleaning products and systems received vacuum-cleaner kits imported from Italy by airfreight as non-risk goods in March. A live suspect BMSB and two green vegetable bugs (GVB), *Nezara viridula* (Hemiptera: Pentatomidae) were found inside the plastic wrapping. Another bug was found under a pallet, but was squashed and could not be identified. The situation was managed by an MPI Quarantine Officer (QO), who collected the bugs and inspected and contained the packaging material. The QO and TF staff had inspected the vacuum cleaners and the facility before calling the exotic pest and disease hotline. No further bugs were found. The II requested photos of the bugs, from which PHEL entomologists confirmed the identifications as one male BMSB and two male GVB. Fumigation of the risk goods using methyl bromide was organised by the II, and BMSB fact sheets were provided to the TF staff. A post-fumigation inspection revealed no more BMSB.

Exotic ant detections

In this quarter, 16 exotic ant detections were made through the National Invasive Ant Surveillance (NIAS) programme (see report, p. 81). These detections were most frequently associated with the ports of Auckland, Tauranga, Napier, Timaru and Otago, underpinning the importance of the NIAS programme.

Fly pupae in car parts from Japan

Multiple fly pupae, apparently alive, were found associated with car parts imported from Japan. The imported consignment contained many low-risk items that had been distributed to retail outlets of a national chain specialising in vehicle parts and accessories. The fly pupae were in the packaging and associated with a single packaged item at one of the retail stores. The II issued an instruction to kill the insects by freezing the goods. Communication with other retail stores did not result in any further finds of fly pupae when other risk goods were examined. Presence of the pupae was consistent with some organic material having been spilt on the packaged goods and discovered by phorid or other flies, which then consumed the material and pupated. The biosecurity issue was mitigated and no further action was considered necessary.

Live scorpion from South America

A live scorpion was found by a member of the public inside his partner's luggage after returning from a holiday in Central and South America. An II visited the property to collect the scorpion and inspect the bags. No more scorpions were found. A PHEL entomologist considered that Nicaragua was the most likely country of origin and identified the scorpion as *Centruroides bicolor* (Scorpiones: Buthidae).

Wasp on goods from Italy

MPI received a report that a live wasp had been found trapped in plastic packaging inside a cardboard box that contained new industrial gearboxes from Italy. Staff checked all cardboard boxes from this consignment but did not find any further wasps. Photos provided were inconclusive for a species identification by PHEL, so the II visited the site, inspected the cardboard boxes and collected the specimen. PHEL confirmed that the wasp was a steely-blue wood wasp, *Sirex juvencus* (Hymenoptera: Siricidae). This is an exotic species and perhaps the most commonly intercepted siricid. Siricid larvae are wood borers that tunnel through wood and later emerge as adults. With this new information, the II immediately returned to the store to inspect the wooden pallets on which the cardboard boxes had arrived. A second adult wasp was found emerging from an exit

hole in a wooden pallet from the same consignment, and further inspection revealed an exit hole in another wooden pallet, which may have been where the first wasp came from. Six wooden pallets from this consignment were cut up, placed in shrink-wrapped cardboard boxes and disposed of by deep burial. The II was unable to inspect another 10 wooden pallets from this consignment as they had already been distributed. The store did not have records of the precise destinations but the pallets could have gone to Christchurch, Rakaia, Rotorua, Auckland and Tauranga. The likelihood of establishment was considered low because of the low winter temperatures and the need for both male and female wasps to emerge at the same location. Staff of the TFs where the goods were de-vanned were made aware of this event but they did not report any further wasp sightings. The facility where the wasps were found has been added to the forestry High Risk Site Surveillance programme for follow-up inspections. MPI Intelligence and Plant Imports teams were notified for their awareness. Plant Imports notified Italy of these detections through MPI Market Access.

Wood borers

Live borer beetles were found in two wooden panels being unwrapped to assemble a mesquite (*Prosopis* sp.) timber pool and shuffleboard table imported from the US, which had been delivered the previous day. The panels were immediately re-sealed to contain the suspect exotic pests. An II inspected the wooden panels and the table to confirm that live borer beetles were present. Specimens were submitted to PHEL entomologists, who identified the powder-post beetle, *Trogoxylon aequale* (Coleoptera: Bostrichidae), a species not present in New Zealand. The table was fumigated with methyl bromide to kill the organisms and mitigate the biological risk. This consignment had an offshore fumigation certificate that stated the treatment met the requirements for mitigation of the presence of BMSB. However, the thick lacquer coating on the table many have reduced the efficiency of the original fumigation, so the fumigation standard MPI FPT6 was used, as opposed to the usual approved treatment required for wooden products. The failure of the offshore treatment was reported to the MPI Regulation & Assurance Treatments & Inanimate Pathway team.

A Trademe customer contacted MPI after finding a live larva eating through a recently purchased wooden bedframe imported from China. An II inspected the bed and collected the specimen for identification. Borer are not usually detected until they emerge from the wood as adults, but this larva had tunnelled close to the surface and dislodged the outer layer of paint. PHEL identified the specimen as the velvet long-horned beetle, *Trichoferus campestris* (Coleoptera: Cerambycidae), a regulated species. An alternative to methyl bromide fumigation was required because some of the wood was painted on all four sides, which would limit gas penetration. The bedframe was shrinkwrapped and contained at a TF while other wooden furniture from the consignment was recalled. All the furniture was placed in a refrigerated container and frozen at -25°C for 7 days before being returned to the seller, who was advised that in future their supplier should improve fumigation efficacy by removing or minimising barriers such as sealed plastic packaging, or fumigate before painting or lacquering. For awareness, the MPI Standards, Facilities and Pathways, and Targeting and Intelligence teams were informed of this investigation.

A member of the public reported dust and holes in a wooden chopping board from India that they had received as a Christmas gift the previous year. The II advised the notifier to immediately place the board in the freezer and after 7 days to send it to PHEL for destructive sampling. PHEL entomologists retrieved 30 Oriental woodborer or lesser auger beetles, *Heterobostrychus aequalis* (Coleoptera: Bostrichidae), and six adult powder-post beetles, *Lyctus africanus* (Coleoptera: Bostrichidae). The importer was notified and recalled all remaining stock for quarantine destruction. This was the second investigation of exotic borer in this product from the same importer, who is now working with the Treatments & Inanimate Pathways team to improve the efficacy of the offshore treatment. The Standards and Facilities and Pathways team was also informed.

Photos of a suspect borer beetle from a pallet suspected to be from the Philippines were submitted to MPI. The II advised the notifier to contain the pallet, inspect the detection area for more insects and submit a specimen to PHEL for identification. A PHEL entomologist confirmed the Oriental woodborer or lesser auger beetle, *Heterobostrychus aequalis*. This species is not reported to be present in New Zealand, so the infested pallet and another suspected infested pallet were collected by the II, chopped into pieces under quarantine and frozen for 7 days.

Investigation positive; urgent measures limit harm

These investigations resulted in detection of organisms that were not known to be present in New Zealand, and in circumstances where treatments could be applied to all retrievable items, usually recent imports. There may be some residual risk associated with items that could not be retrieved.

Seeds not declared at the border

A representative of the kiwifruit industry notified MPI that a kiwifruit grower had been given undeclared hybrid squash seeds by a traveller who had brought them back from overseas and planted some. After consulting with the II, the notifier advised the traveller to dig up and burn the seedlings and surrounding soil. The notifier advised that the import had been accidental and the traveller had forgotten to declare the seeds on arrival. The traveller had been co-operative since realising that the importation was illegal, and handed over all remaining seeds, which were delivered to the II for destruction.

A woman ordered bonsai water-lily seeds via Ebay but was concerned when they arrived that they had been declared as "beads" by the seller. After a discussion with the II, the notifier sent the seeds

to MPI for destruction as they did not comply with the import health standard. Information on the correct process for importing seeds into New Zealand was provided to the notifier, but she advised that she would not be importing any more seeds.

Live insects in garlic from China

Many small live suspect exotic insects were found in bagged garlic bulbs imported from China and purchased from a Te Awamutu supermarket. Specimens submitted to MPI were identified as the onion aphid, *Neotoxoptera formosana* (Hemiptera: Aphididae), a species present in New Zealand and previously intercepted on garlic imported from China. Since this species is established in New Zealand no further action was required.

Live red-back spider on grapes from Australia

A member of the public reported a live spider in a bunch of Australian red grapes purchased from an Auckland supermarket. The grapes had been stored in the refrigerator between purchase and detection of the spider. Video footage of the spider confirmed that it was still alive, though lethargic. It was identified as a red-back spider, *Latrodectus hasseltii* (Araneae: Theridiidae), which is no longer an unwanted organism because it is considered to be established in New Zealand (though regulated under the Biosecurity Organism Register for Imported Commodities). The supermarket chain's national produce manager was notified and supplied the consignment number. The phytosanitary certificate indicated that the grapes had been treated with sulphur dioxide and carbon dioxide to the approved standard. The grapes had been inspected and released at the border 2 weeks previously so the entire consignment had already been distributed to retail stores and had probably already been sold and eaten. No further reports of live spiders in Australian grapes were received. The Horticulture Product Imports team was notified and contacted its Australian counterparts. Trace-back by the Australian Department of Agriculture confirmed that the consignment had been treated to the appropriate standard, but it was possible that the spider had entered the consignment from packaging used after the treatment. A follow-up audit will be carried out when the table-grapes season resumes next year.

Investigation positive; no action taken

These investigations revealed organisms that were not previously known to be present in New Zealand, but no action was taken. Typically, they included cases where a risk assessment indicated that a new to New Zealand organism (or a newly described indigenous organism) had become well established and was considered unlikely to damage economic, environmental, social and cultural values. Alternatively, the organism may have already been established and been under management by MPI and/or local authorities. It is worth noting that only the Environmental Protection Authority (EPA) can make the official determination under s26 of the Hazardous Substances and New Organisms Act 1996 (HSNO) that an organism is present in New Zealand (and therefore not a new to New Zealand organism). If the EPA has not made an official determination, MPI does not have the legal mandate to determine whether an organism is a new organism or not. In that situation, MPI can only state that its status is "undetermined".

New to New Zealand weevil on *Eucalyptus*

Plant and Food Research Ltd (PFR) reported finding two weevils on *Eucalyptus* leaf material in Auckland. The weevils were found on leaves being collected to feed a population of gum-leaf skeletoniser, *Uraba lugens* (Lepidoptera: Nolidae) in a PFR containment facility. PFR had collected the material from Ngati Ōtara Park in south Auckland, but had also collected material from *Eucalyptus* trees in Owairaka, central Auckland. The material collected from these sites had been mixed, so it was not clear from which location each weevil had been collected. The weevils were identified as *Haplonyx* sp. (Coleoptera: Curculionidae). Molecular analysis was not able to identify the insects to species, as the genus *Haplonyx* is diverse and difficult to diagnose. It is unclear how long the species has been present in New Zealand. *Haplonyx* larvae grow in *Eucalyptus* flowers or fruit buds and the adults may live inside galls created by other insects. Further inspection of Ngati Ōtara Park found no more specimens. However, in April a *Haplonyx* sp. sighting at Waterview, near Owairaka, was uploaded to iNaturalist. This was probably another detection of the same species and suggests the first specimen was more likely from material collected at Owairaka, rather than Ōtara. It appears likely that a population of *Haplonyx* weevils is established in this area. However, there have been no records of significant damage to eucalyptus trees there, and the biosecurity risk is likely to be low because the damage is predominantly to flower buds. No further action was considered necessary.

Undetermined new scale insect in kiwifruit

AsureQuality reported a suspect new to New Zealand armoured scale insect, the spined scale, *Oceanaspidiotus spinosus* (Hemiptera: Diaspididae), on a sample of green kiwifruit (*Actinidia deliciosa* var. "Hayward") from an orchard in Tauranga. At the time of notification, *O. spinosus* was an unwanted organism under the Biosecurity Act 1993, and suspected to be a new organism under the HSNO Act 1996, given that it was unrecorded in New Zealand before 29 July 1998. A PHEL entomologist confirmed the identification by morphological tests. AsureQuality also found suspect *O. spinosus* on the same variety of green kiwifruit harvested from an orchard in Te Puke, 15 km away from the original detection. These fruit were tested as part of a national industry survey of scale insects. AsureQuality subsequently found *O. spinosus* in a number of other Tauranga orchards, as well as orchards in Gisborne, 180 km away, and some of these were on another variety, gold kiwifruit (*Actinidia deliciosa*, var. "Gold3").

MPI staff prepared a technical report on the spined scale to understand what risks this species might pose in New Zealand. *O. spinosus* is a polyphagous armoured scale insect whose preferred host appears to be palms. Reported hosts that are economically or culturally important to New Zealand include asparagus, avocado, citrus, eggplant, grapevines, kiwifruit and some common ornamental plants. Although it is present in many kiwifruit-producing countries, no reports were found of this species being a pest of kiwifruit or any other horticultural crop. All information found was consistent with its being an occasional pest of avocados, tea and ornamentals, particularly in nurseries.

The spined scale has been reported as a tropical species, so any impact may be limited by climate in New Zealand. It also has a known natural enemy established in New Zealand – a small parasitic wasp, *Signiphora flavella* (Hymenoptera: Signiphoridae). Diaspidid populations in general appear to be unusually susceptible to control by natural enemies. It is considered likely that existing spray programmes for kiwifruit scale insects, along with the established natural enemy, will provide effective control. Furthermore, host plants are rarely killed by infestations of diaspidids, so it appears unlikely that the scale insect will reach high enough numbers to significantly harm its hosts.

Nevertheless, MPI approached Government Industry Agreement (GIA) partners to see if they thought a response was appropriate, as per their protocols. GIA partners stated that, because this is a minor pest, they have no concerns about its effects on production, but it could pose an issue with market access. They agreed with MPI's recommendation to stand down this case, and were advised to work with the Plant Export and Market Access teams to address their concerns. These teams have begun work to clarify access issues in kiwifruit and avocado export markets.

O. spinosus crawlers can be spread by wind, and adult males are mobile, so the species is probably already more widely distributed than currently known. The unwanted organism status of *O. spinosus* was removed, because evidence suggests it is widely distributed, a minor pest, and it may be adequately controlled by existing spray programmes and the established parasitic wasp.

New to New Zealand fungus associated with *Aleurodiscus parmuliformis*

During sequencing of some cultures from the International Collection of Microorganisms from Plants (ICMP), Manaaki Whenua – Landcare Research (MWLR) detected an apparent fungal contaminant in a culture generated from spores of an endemic wood-rotting basidiomycete fungus, *Aleurodiscus parmuliformis*. The sample of *A. parmuliformis* had been collected in 2006 from a fallen branch of an unknown tree species at the Rangitoto Station Reserve, Waikato. The ITS sequence of the contaminant exactly matched sequences from an authentic culture of *Sarocladium terricola*. A PHEL pathologist confirmed this as *S. terricola*, a species that was not reported as present in New Zealand immediately before 29 July 1998, so it could be a new to New Zealand organism under the HSNO Act 1996, section 2A. However, since it was found associated with an endemic wood-rotting fungus, in an area filled with native trees, it could be a previously unidentified endemic species. The genus *Sarocladium* includes 18 species that have been reported as plant pathogens or saprobes. *S. terricola* was first described in 2014 and is commonly found in soil and on plant material. It has also been found growing as a saprophyte on withered grapes, but no records suggest that it is a plant pathogen. The MPI Response Group and the Department of Conservation were informed of this detection.

Suspect new to New Zealand *Colletotrichum* fungi on avocados from Northland

A Christchurch plant pathologist reported two suspect new to New Zealand fungi, *Colletotrichum fructicola* and *C. siamense,* on avocado fruit and stems from Northland. He found a number of different species but these two were not recorded as present in New Zealand (though they may have been recorded as *"C. gloeosporioides* species complex" in the past). These two species were isolated in six of the samples collected from seven orchards in Northland. A PHEL pathologist validated the identifications using DNA sequence data. Both these fungi have been identified as part of the *C. gloeosporioides* species complex, a complex that comprises of at least 22 different species that have only been able to be recently identified by molecular diagnostic technology. The *C. gloeosporioides* species complex has been present in New Zealand since the 1960s and reported from avocados. The identification of *C. fructicola* and *C. siamense* appears to be a result of taxonomic reclassification within the complex, rather than a detection of species that are new to New Zealand. A report to the Response team acknowledged the biosecurity issue, but stated that there was no biosecurity risk and recommended no further action.

Investigation for high-impact pests: negative

Of the 340 notifications investigated this quarter, in 213 cases (**Figure 1**) high-impact pests or diseases were proven not to be present or the pest was already recorded as present in New Zealand. While these investigations are negative for biological risk, they still require the same work as investigations where significant organisms are found.

Suspect illegal import of edible fungi

A Trademe listing offering an identified strain of oyster mushroom, *Pleurotus pulmonarius* (Agaricales: Pleurotaceae) was reported by a commercial mushroom producer, who said that the mushroom growing kits used a strain of *P. pulmonarius* not present in New Zealand, and likely illegally imported. On investigation the II revealed that *P. pulmonarius* is an edible fungus present in New Zealand and its importation is not regulated by strain. The investigation found no evidence of a biosecurity risk or non-compliance.

Suspect BMSB in a Transitional Facility

A TF in Tauranga reported a live suspect BMSB on the floor of its Auckland retail outlet. The insect could have come from chairs imported from Italy. The container had been fumigated prior to arrival in New Zealand. However, there was no biosecurity risk as photos submitted to PHEL identified the brown shield bug, *Dictyotus caenosus* (Hemiptera: Pentatomidae), a species present in New Zealand and commonly mistaken for BMSB.

Suspect Mediterranean fruit fly in a fig orchard

A member of the public who was aware of the recent MPI response to fruit fly reported that he had seen a Mediterranean fruit fly, *Ceratitis capitata* (Diptera: Tephritidae), in his fig orchard. He was unable to catch the fly but believed it might have deposited eggs into one of his fruit. The fig was collected by an II and dissected by a PHEL entomologist. No sign of fruit-fly eggs was found, and the description provided by the notifier was inconsistent with Mediterranean fruit fly.

Live ants in a new vehicle imported from Korea

A colony of live ants was found when a new, recently imported vehicle was being worked on prior to sale. Imported from Korea into Auckland, the vehicle had been stored at Wiri, South Auckland, before being transported to a Dunedin car dealership. Staff of the workshop where the ants were discovered contacted MPI border staff directly, resulting in a QO visiting and applying permethrin insecticide to the risk area. The colony was clearly visible and able to be effectively treated and destroyed. Ants were collected and identified by PHEL as *Technomyrmex jocosus* (Hymenoptera: Formicidae), the white-footed house ant, a species long established in New Zealand. As this species is absent from Korea, it appears likely that the ants colonised the vehicle after it arrived in New Zealand.

New to New Zealand fungal pathogen on cacti

An external diagnostic service provider tentatively identified the suspect new to New Zealand fungus *Bipolaris cactivora* (Pleosporales: Pleosporaceae) on cactus samples from a nursery. A PHEL pathologist validated the identification by morphology and molecular sequencing. *B. cactivora* is not an unwanted organism and predominantly affects members of the family Cactaceae. An unvalidated record of *B. cactivora* is recorded in the Plant Pest Information Network from 1994, suggesting the disease has been present in New Zealand for some time. It may be adequately controlled by existing nursery spray programmes regardless, the biosecurity risk is considered very low. *B. cactivora* is known to occur in Australia, Mexico, the US, Japan, Vietnam, Korea and Malaysia.

Totara dieback reported in Taumarunui

A member of the public was concerned about dying totara trees (*Podocarpus totara*) in Taumarunui. He said that the number of trees affected appeared to have increased from 10 to 40 over the last several years, and that he was aware of other dying totara. MPI biosecurity contractors went to the area and to a second site 10 km away, accompanied by a biosecurity officer from Horizons District Council, who showed them where there were other totara with similar symptoms. At both sites the fungi *Pythium* sp. and *Phacidium* sp. were isolated from the soil and foliage, respectively. At one site, *Paraphaeosphaeria* sp. was isolated from the foliage, and from the other site, *Phytophthora pseudocryptogea* was isolated from the soil. All of these fungi are present in New Zealand and do not present a biosecurity risk. The cause of the dieback remains unclear, and it is unknown which fungal species, if any, contributed to the dieback symptoms. The biosecurity officer stated that the symptoms appeared to be worse during the cooler, wetter months of winter and that younger totara appeared to be more susceptible, while the older trees appeared to be recovering well. The notifier was advised and asked to report any signs of new or worsening symptoms.

Suspect new to New Zealand nematode found in *Pinus radiata*

A biosecurity contractor, SPS Biosecurity, observed unexplained mortality of trees in thinned stands at Kaingaroa Timberlands during a forest health assessment (FHA). Close examination failed to determine the cause, as there were no obvious fungal disease symptoms or insect activity. A small group of three trees and a lone dead tree were cut into discs and examined. Despite the trees' declining state, the lower sections were extremely wet and cross-sections of one sample were stained blue. The staining was too regular to have been caused by the typical blue-staining ophiostomatoid fungi (which vary from pathogenic to saprophytic and are often found during FHA inspections). The extent of tree mortality was not recorded but no other dead trees were seen nearby.

The samples were initially sent to Scion for fungal diagnostics, then to PHEL for bacteria and nematode diagnosis. A Manaaki Whenua – Landcare Research (MWLR) scientist ruled out the notifiable and unwanted pine wilt nematode, *Bursaphelenchus xylophilus*. However, from morphological and molecular analysis the nematologist identified *Bursaphelenchus hildegardae* (Nematoda: Parasitaphelenchidae) in high numbers, and PHEL validated the DNA sequence. Described in 2006, *B. hildegardae* was first isolated in Germany in 2000 from *Pinus sylvestris* and the bark beetle *Hylurgops palliatus* (Coleoptera: Curculionidae). Only limited information is available on this nematode; it is not known whether it is a pathogen of pine trees or has contributed to the death or decline of pine trees at Kaingaroa Timberlands. Nor is it known how this nematode was transmitted to New Zealand.

Taxonomically, *B. hildegardae* belongs to the *eggersi* group, which is distinct from the *xylophilus* group. Two *Bursaphelenchus* species have been reported in New Zealand: *B. eggersi* and *B. fungivorus*. *B. eggersi* has been

reported as established in a number of forests between Auckland and Nelson, but no reference specimens were available for validation. *B. fungivorus* (a member of the *kevini* group) was reported from edible mushrooms. The association of this species with pine trees showing any wilting symptoms has not been reported in the field.

The biosecurity investigation following this discovery aimed to establish its distribution and abundance at Kaingaroa Timberlands, and its association with its hosts, as well as collecting historic data on the presence of the genus in New Zealand. The investigation was conducted with and supported by the forestry sector. MPI commissioned a delimitation survey and *B. hildegardae* was found as far as 3.8 km from the detection site, with no evidence that it was causing decline in the trees. Tests have not been carried out to establish whether *Bursaphelenchus* spp. can be pathogenic to pine trees, but a literature review suggests that they are not dangerous to trees, and this view was supported by an international expert on the genus (Helen Braasch, pers. comm., 2019). The literature on this group in New Zealand is very limited, with only two published studies (Dale, 1967, 1971), on *B. eggersi* and *B. fungivorus* respectively.

Results from the present investigation suggest that the 1967 record of *B. eggersi* may be a misidentification, and that the specimens seen were in fact *B. hildegardae* but misidentified because the latter species was not yet known to science. Therefore *B. hildegardae* may have been in the country for a very long time but not recorded until now.

Results from other tests carried out by Scion and PHEL did not identify any other organisms of a potential biosecurity concern. Mycologists at both laboratories independently isolated *Grosmannia huntii,* a sap-stain fungus commonly associated with the beetle *Hylastes ater* (Coleoptera: Curculionidae) on pine trees in New Zealand and not regarded as a biosecurity risk. *Curtobacterium* sp. was the only bacterium identified. It belongs to the *C. flaccumfaciens* species complex and may be an undescribed species. This bacterium is unlikely to be the primary pathogen of radiata pine and does not pose a biosecurity risk. In agreement with the forest sector representatives, the investigation was closed.

Suspected illegal importation of seeds

The notifier discovered that a member of a Facebook group, Permaculture in New Zealand, was recommending importing seeds from two websites, and stated that the member had imported seeds twice in the past 12 months. The II was not able to find any evidence to suggest the importation of seeds was illegal or that the member had imported seeds illegally in the past. A message was sent to the member advising him that seeds must be listed on the Plant Biosecurity Index before they could be imported, and the import must also meet the IHS – Seeds for Sowing. He was provided with links to MPI websites that explain the proper process for importing seeds and was asked to contact MPI if he suspected his seeds did not met the IHS. MPI Intel was notified of this case for their awareness and follow-up of any future breaches of the IHS.

Seeds from flowerseeds.co.nz ex Greece

The notifier's staff received tomatillo seeds, *Physalis ixocarpa* (Solanales: Solanaceae) in an envelope from Greece after placing an order for these seeds via flowerseeds.co.nz. The staff member thought they had purchased New Zealand seeds because of the New Zealand domain name, ".co.nz". The packets were correctly labelled with the full scientific name, but arrived without an MPI stamp to indicate they had been inspected. *P. ixocarpa* is present in New Zealand and seeds are permitted entry provided that they meet the relevant import health standard. As the seeds had been purchased for research purposes and were already correctly labelled, the II arranged for them to be inspected. The seeds met MPI's biosecurity requirements and were released for use by the company. The II informed MPI's Intelligence team about this case.

MPI has received similar calls from members of the public in the past and had already spoken with the website operator to facilitate changes to the website. For example, in 2018 the website operator removed an invalid New Zealand address from the website, and added text under the "contact us" tab and "shipping information" section to make it clear that their supplier is based outside New Zealand. The website operator also changed the designation of non-basic seeds that require border clearance, listing them as "out of stock" so that New Zealanders could no longer purchase them from the website. Although these were improvements, some New Zealand seed buyers do not check the "contact us" tab or "shipping information" section because of the New Zealand domain name, as this case shows. MPI intelligence will follow this matter up with the Commerce Commission, as the domain name is misleading. For the meantime, the II has asked the website operator to make it clearer that the seeds are from an overseas supplier.

Indian mangoes for sale on Facebook

MPI was notified of a Facebook advertisement for imported Indian mangoes. The notifier had previously worked for a company importing fresh produce, and suspected that the online company was not meeting biosecurity requirements. The II searched through the Auckland-based company's Facebook page and webpage and found nothing to suggest any infringement, but consulted the Intelligence team as a precautionary measure. Intelligence staff reported that the company has a TF in Auckland and imports its goods through the cargo pathway, so they are routinely inspected by MPI. Intelligence staff traced the most recent consignment of mangoes, which had been inspected in mid-May and released. The Facebook advertisement had been posted 3 days later, which suggests that the advertised mangoes were probably from the same consignment and therefore met MPI's biosecurity requirements.

Inconclusive investigations

An investigation may have an inconclusive outcome when it is not possible to determine the presence or

absence of a biological risk but further investigation is not warranted even though the Incursion Investigator may have conducted a substantive investigation.

Apple hammerhead viroid found in exported apple plants

A literature search uncovered a scientific paper (Szostek et al., 2018) reporting apple hammerhead viroid (AHVd) from plant material imported into the US from New Zealand. The paper reported the detection of AHVd from New Zealand apple plants at the Clean Plant Centre Northwest, in the state of Washington. AHVd is a recently described viroid, widely distributed in many countries and not definitively associated with disease. Further research is required into its pathogenicity. The plants had been exported from New Zealand in 2016–2017, but no further details such as region, exporter or cultivar were available. As that information is required to collect samples for validation of AHVd in New Zealand, MPI has requested the information from Clean Plant Centre Northwest. There is no definitive biosecurity risk to date and the case has been closed, but it may be re-opened once the information is received.

New fungus found on a maritime pine tree, Tauranga

An undescribed fungus, *Seiridium* sp. (Xylariales: Sporocadaceae) was isolated and identified on maritime pine, *Pinus pinaster* (Pinales: Pinaceae), during a forest biosecurity survey. This fungus is likely to be a species new to science. The initial identification was completed by Scion and subsequently validated by the PHEL Mycology and Bacteriology team. Symptoms observed by SPS Biosecurity when collecting the sample included one canker about 1–2 cm in diameter on one branch. *Pinus radiata* trees were located nearby but there is no evidence to suggest this fungus could impact *P. radiata* or other commercially important forestry species in New Zealand. Many species of *Seiridium* are plant pathogens, and some cause cypress canker disease. However, there are only a few natural infection records of *Seiridium* on trees of the pine family (e.g. *S. abietinum* on *Abies* and *S. cardinale* on *Cedrus*), and these are not major pine pathogens.

A site visit was carried out by the II, a forest pathologist from SCION, and a forest surveyor from SPS Biosecurity. Extensive sampling was carried out on the infected tree and other maritime pines nearby, as well as several other species where cankers were visible, including *P. radiata*, *Acacia* sp., *Salix* sp. (willow) and cypress trees at a separate site about 2 km away. The investigators noticed significant physical damage and evidence of branch-rubbing on the maritime pine tree where the first sample was collected. This tree was located at the front of a cluster of maritime pines facing a large, open area of scrubland and is likely to be highly exposed to wind. The tree is located 5–10 metres from a new shed and concrete pad and a small power station. The investigators concluded that the space beside the tree was likely to have been used as a turn-around bay, resulting in damage by vehicles or machinery to the lower branches. This damage had made the tree more susceptible than others in the area to pathogens and opportunistic organisms.

Dying pine trees, Mt Maunganui

A dead young pine tree and another pine tree with some dying tips were observed at a seaside park at Mt Maunganui. The pine tree was identified as *Pinus nigra* (black pine) by PHEL and staff of the Allan Herbarium at Manaaki Whenua – Landcare Research. PHEL isolated *Fusarium equiseti*, *F. solani* and another *Fusarium* sp. from the soil. *Fusarium* spp. have been reported to cause disease in pines, especially damping-off of seedlings and root or stem rot of young plants. However, none of these fungi were directly isolated from the submitted root material. They might be the causal agents of the dieback symptoms, or opportunistic pathogens might have infected plants stressed by environmental factors such as wind and salt spray.

The mycorrhizal fungus *Phialocephala* sp. was isolated from the roots, and DNA sequencing suggests it is closely aligned to *P. fortinii*, an ectomycorrhizal fungus previously found from roots of *Pinus* spp. in New Zealand. The fungus *Lophodermium pinastri* was also isolated from the foliage. It is most likely an endophyte on pines and was not considered to be the causal agent of the needle-cast symptoms observed. Two undescribed *Diaporthe* species were isolated, one from foliage and one from a branch with foliage and cones. Neither matched sequences previously analysed at PHEL. The *Diaporthe* sp. isolated from foliage was genetically identical to an isolate from fish eggs in Korea, and the second *Diaporthe* sp. was 99.8 percent genetically similar to this isolate. *Diaporthe* species have a worldwide distribution and have been associated with twig and branch canker, dieback, shoot blight and root and fruit rot. It is not known whether either of these fungi contributed to the dieback observed. It is likely that they are endophytes, like many *Diaporthe* species. Although the cause of death remains unknown, root-rot fungi were identified and they may have been opportunistic pathogens on a tree that was already stressed owing to the park's proximity to the ocean. The biosecurity risk was determined to be low and the case was closed.

Live insects inside bamboo stakes

When an orchardist stuck an imported bamboo stake into the ground, it broke apart and revealed dust and live insects. A sample was sent to PHEL, where live wasps of the family Bethylidae (Insecta: Hymenoptera) were identified. These wasps are known to parasitise borer, so they could indicate the presence of live borer. There was a potential biosecurity issue because borer species that attack bamboo are unknown in New Zealand. Unusually, no borer specimens were found despite the presence of the live wasps and a large amount of borer damage and frass. The wasps could not be identified, but could be a local species, given that the stakes had been stored outdoors in unsealed packaging for about a month previously. All the bamboo stakes purchased by the orchardist were steam-treated by autoclave as a precautionary measure. The supplier said they had not received any other reports of live insects, and provided import documentation that

they believed was for this consignment of bamboo. The documentation met MPI's import health standard for imported bamboo, and furthermore, the bamboo canes had been more heavily fumigated than usual. The II provided the supplier with a fact sheet about bamboo borer and asked them to watch for any signs of borer activity. The MPI Facilities and Pathways team was informed.

Live beetle in navel orange from the US

A live beetle was found in the "navel" of a navel orange imported from the US and purchased from a Wellington supermarket. A PHEL entomologist identified it as *Paraphloeostiba gayndahensis* (Coleoptera: Staphylinidae), a rove beetle that is already present in New Zealand. However, this species is native to Australia and established in Europe, the US and New Zealand, which shows its ability to be invasive. Whether the beetle originated in New Zealand as a contaminant within the local supply chain or came from the US could not be determined.

Unusual flies in coconut husk from Asia

The notifier reported unusual flies with a distinctive black spot on each wing. They were associated with coconut husks, possibly from India. The flies were very similar to the spotted-wing drosophila (*Drosophila suzukii*), which the notifier had read about in a recent issue of a farming magazine, but they had a slightly skinnier abdomen. Four specimens were found on an internal windowsill. The notifier was concerned because he had grapes and citrus in his garden. He said that he never bought imported fruit and the only imported plant material on the property was ground-up coconut husk purchased from Farmlands 12 months previously and used as mulch around trees. The specimens were shown to the citrus manager at a fresh produce distributor, who did not recognise the insect. The specimens were disposed of without photographs being taken.

The insect's description was discussed with an MPI entomologist, who suggested it could be a fruit-fly look-alike such as *Pygophora apicalis* (Diptera: Muscidae), which is present in New Zealand and has a distinctive spot on each wing. Alternatively, it could be a member of the family Dolichopodidae or the Pallopteridae, as both of these have species in New Zealand with a single spot on each wing and they are frequently mistaken for regulated fruit-fly species. The notifier was informed of this opinion and asked to collect and photograph the specimens next time. The investigators considered this was unlikely to be a regulated fruit-fly species because it had been found on a window sill, not near fruit, and the insects were unlikely to have been associated with the coconut husk (which was the only imported product on the property). The notifier agreed to collect a specimen if he saw more of the flies and was advised that no further action was warranted.

Insect inside a couch from China

MPI was notified of an unusual rhythmic scraping noise coming from inside a sofa imported from China more than a year ago. The sofa was constructed of bare hardwood framing sealed underneath polyester material and padding. PHEL entomologists suggested that the noise was typical of longhorn beetle larvae (Coleoptera: Cerambycidae). The notifier cut a hole in the base of the sofa to access the area of concern, but had trouble getting a clear view because of nails and narrow gaps between the framing. The II used an endoscope to gain a better view, but still could see no evidence of borer activity such as holes, frass or beetles, and could not rule out a biosecurity risk. The II suggested localised borer treatment, methyl bromide fumigation, or heat treatment. Acknowledging the low level of establishment risk presented by a single larva, the notifier and the II agreed to use a localised borer treatment. A spray for killing borer was applied twice to the bare wood inside the couch. The notifier was asked to report any further signs of insect activity. The II contacted the importer, who confirmed this was their first report of wood-boring activity. The importer was also asked to report any signs of insect activity.

Cocoon on dog bed from Australia

The notifier found a cocoon attached to a new dog bed imported from Australia. Photos showed an unusual moth pupa that appeared to be almost ready to emerge. However, a PHEL entomologist determined that it was a desiccated, long-dead moth of the family Noctuidae (Lepidoptera: Noctuidae). There are many moth species in this family in both New Zealand and Australia, so it was not possible to determine whether it was exotic or endemic; but in any case a dead moth pupa does not pose any biosecurity risk.

Suspect red-back spider from Australia

A vehicle compliance company found a suspect red-back spider (*Latrodectus hasseltii*) under a vehicle imported from Australia. The underside of the vehicle was sprayed and the notifier was advised to check nooks and crannies for further signs of spiders or nests. The photo provided showed a juvenile spider, which is difficult to distinguish from the native katipo spider (*L. katipo*). The notifier had destroyed the spider so a specimen was not available to confirm the identification. Facilities and Pathways teams were notified for their awareness.

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National Invasive Ant Surveillance Programme annual report

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 and businesses where food is readily available. They also threaten natural biodiversity by displacing native invertebrate species and encouraging horticultural pests.

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

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

For a third year in a row, dome-type ant traps (a long-term trapping system) were used on a trial basis at the Ports of Auckland and 3D-printed traps that are similar to the dome traps with better modifications were also trialled. These traps consist of a base section containing a glycol-filled capture chamber coated with Teflon and three types of attractive baits (honey, peanut butter and fish oil), with a plastic dome cover over the top (**Figure 2**). Ants attracted to the baits fall into the capture chamber and are preserved in the glycol. The general principle is the same as with a pitfall trap but the capture chamber is raised and housed in a unit that can be deployed on hard surfaces (i.e. no ground excavation is required). These traps can be left deployed for days or weeks before being retrieved and contents examined. Work has been ongoing to modify the design of the dome trap through 3D printing to improve operational deployment in the field (Ross, 2018).

Twenty-two dome traps and four 3D-printed traps were tested in the multi-cargo area of the Ports of Auckland for 7-day spells during the period from 20 January to 8 February 2019, giving an effective total of 198 trap-days. The multi-cargo area is a known hot spot for exotic ant activity (FBA Consulting, 2017) and is also the type of environment the dome and 3D printed traps were designed to monitor. Pottle surveillance was also undertaken in the area where the traps were deployed, to compare the performance of dome traps, 3D-printed traps and pottles.

GPS locations and associated data are recorded on hand-held data loggers. All samples are tracked electronically from the field to identification in the laboratory. Pottles, dome and 3D-printed traps are sent to the Flybusters Consulting diagnostic laboratory for initial ant identification. Suspect exotic ant specimens are sent to MPI's Plant Health and Environment laboratory (PHEL), Tamaki, for validation of identification. 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.



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



Figure 2: A 3D-printed dome trap deployed at Ports of Auckland

Results

In the 2019 season, 40,998 pottles were deployed nationally, with 19 pottles recording exotic ants. Of these, 11 were confirmed

from active established nests (**Table 1**). Three dome traps caught exotic ants, one of which was confirmed to be from an active, established nest (**Table 2**). Four exotic incursions were not found to be associated with any nests during follow-up inspections. The 19 detections produced 15 urgent measures responses and all detections of exotic ants and associated nests were eradicated from the sites where they were found.

The timing of pottle deployment varies from year to year owing to variations in site selection and weather. Weather significantly 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).

The weather from winter 2018 to summer 2019 was considered to be variable but good for supporting ant populations. In particular, the mild winter and early spring would have encouraged ant activity and nest expansion early on in the season. Early summer was more variable, with high rainfall slowing ant activity and then more settled, dry and hot conditions resulted in a surge of ant activity in February.

Six exotic species were recorded in pottles (**Table 1**), including *Tapinoma melanocephalum* (ghost ant) *Paratrechina longicornis* (crazy ant), *Trichomyrmex destructor* (Singapore ant), *Monomorium dichroum* and *M. indicum* (no common names). Also, for the first time this year *Lepisiota* sp. was detected. This shows that the NIAS system is working well in picking up a variety of exotic species. Results from this season demonstrate the value of early intervention in helping to prevent the establishment and spread of exotic ant species in New Zealand.

Table 1: Location and numbers of ant detections during NIAS, 2019

Species	Location	Number of nests found
Tapinoma melanocephalum	Auckland International Airport	1
Paratrechina longicornis	Port of Tauranga	1
Tapinoma melanocephalum	Port of Tauranga	multiple
Paratrechina longicornis	Port of Napier	1
Paratrechina longicornis	Port of Tauranga	0
Monomorium dichroum	Port of Tauranga	1
Paratrechina longicornis	Port of Timaru	1
Monomorium dichroum	Christchurch (Transitional Facility)	1
Lepisiota sp.	Ports of Auckland	0
Monomorium dichroum	Ports of Auckland	1
Monomorium dichroum	Port of Otago	1
Monomorium indicum	Mt Maunganui (Transitional Facility)	0
Trichomyrmex destructor	Port of Timaru	1
Monomorium dichroum	Port Otago	0
Tapinoma melanocephalum	Opua Marina, Northland	1

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Table 2: Location and numbers of ant detections in dome and 3D-printed traps at Ports of Auckland during NIAS, 2019

Species	Number of detections in traps	Number of nests found
Paratrechina longicornis	2	1
Pheidole fervens	8	0
Brachymyrmex obscurior	4	0

National Fruit Fly Surveillance Programme annual report

New Zealand's National Fruit Fly Surveillance Programme (NFFSP) 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 detect fruit-fly incursions in time to eradicate them, and to provide direct evidence that New Zealand is free of these pests.

About a hundred species of tephritid fruit flies are listed on the MPI website as regulated organisms. The absence of economically important pests enables host produce to be cultivated without use of control measures, and exported without treatment, thus facilitating market access and reducing production costs. As an indication of how important this is, horticultural exports in 2018 earned $5.5 billion, of which 80 percent came from plants that are potential fruit-fly hosts (Horticulture New Zealand, 2019).

Use of the three fruit-fly lures, cuelure, trimedlure and methyl eugenol, in the NFFSP enables a broad range of species in the genera *Bactrocera* and *Ceratitis* to be targeted, particularly Queensland fruit fly (*B. tryoni*), Mediterranean fruit fly (medfly) (*C. capitata*), and Oriental fruit fly (*B. dorsalis*).

Since 1989 there have been 12 detections of economically important fruit flies via the NFFSP: nine in Auckland and three in Whangarei (**Table 1**).

Prompt investigation of these events resulted in quick determination that a population of flies was not present, or that a breeding population did exist – as in the case of medfly (1996) and Queensland fruit fly (2015 and 2019). These detections resulted in prompt, sustained action to eradicate and prevent establishment of the flies. Intensified surveillance in all the other cases did not yield further flies, and it was concluded that these cases probably arose from discarded infested fruit brought in by travellers from overseas.

The three most recent detections of exotic economically important fruit flies occurred during the 2018–2019 season, two of these being *B. tryoni* while one

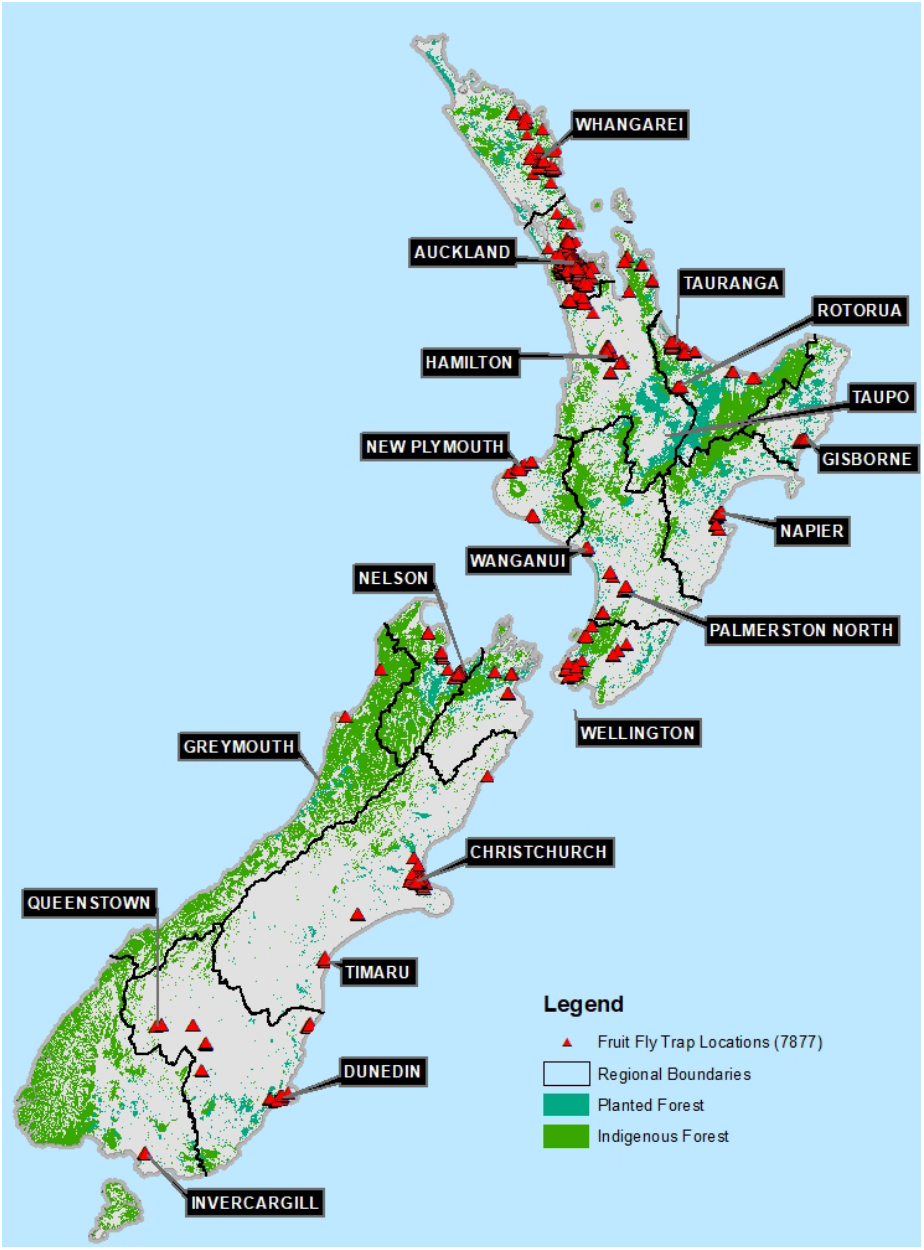


Figure 1: Distribution of trap sites for fruit-fly surveillance, 2018–2019

Table 1: Detections of fruit fly in New Zealand, 2018–2019 season

Species	Location	Date	Outcome
Bactrocera passiflorae (3 flies)	Auckland	1990	Increased surveillance, no further finds
B. tryoni	Whangarei	1995	Increased surveillance, no further finds
B. tryoni (2 flies)	Auckland	1996	Increased surveillance, no further finds
B. papayae	Auckland	1996	Increased surveillance, no further finds
Ceratitis capitata (2 flies)	Auckland	1996	Successful eradication programme
B. tryoni	Auckland	2012	Increased surveillance, no further finds
B. tryoni	Whangarei	2014	Increased surveillance, no further finds
B. tryoni	Whangarei	2014	Increased surveillance, no further finds
B. tryoni	Auckland	2015	Successful eradication programme
B. tau	Auckland	2016	Increased surveillance, no further finds
B. tryoni	Auckland	2019	On-going response
B. facialis	Auckland	2019	Increased surveillance, no further finds

Table 2: Numbers of traps and trap runs by region, 2018–2019 season

Region	Number of trap runs	Number of traps
Auckland/Northland	71	5,006
Waikato/Bay of Plenty	20	812
Lower North Island	28	928
Upper South Island	20	757
Lower South Island	12	374
Total	**151**	**7,877**

was the tropical species *B. facialis*. In the case of *B. facialis*, intensified surveillance trapping and fruit monitoring for larvae detected two more *B. facialis*, but no further detections over a period of time suggested that no breeding population was present. However, in the case of *B. tryoni*, intensified surveillance trapping detected 10 more of the flies over a period of several months, with the last detection in mid-July. A biosecurity response is currently underway to follow up the multiple detections of adult male *B. tryoni* in Auckland. Larval surveys and fruit monitoring have been undertaken but no eggs or larvae have been detected.

AsureQuality has conducted fruit-fly surveillance for MPI for nearly 20 years, and prior to that as part of the former Ministry of Agriculture and Fisheries and the Ministry of Agriculture and Forestry. In all, 7,877 fruit-fly traps were serviced fortnightly in 151 individual "trap runs" by AsureQuality staff, covering urban localities exposed to international traffic and/or centres of horticultural production. A typical trap run is a set of about 52 traps (but varies from seven to 104) that are serviced by a trained trapper (**Table 2**). Traps with cuelure and trimedlure baits are placed in 400 x 400 m grids, while those with methyl eugenol, which has a wider effective sampling area, are placed in 1,200 x 1,200 m grids. Traps are placed according to a ranking system based on host status, with fruiting host trees given top priority. Separations and placements reflect practice in other countries (e.g. Australia and the US) and lure attractiveness. An example of a run in south Auckland is shown in **Figure 2**.

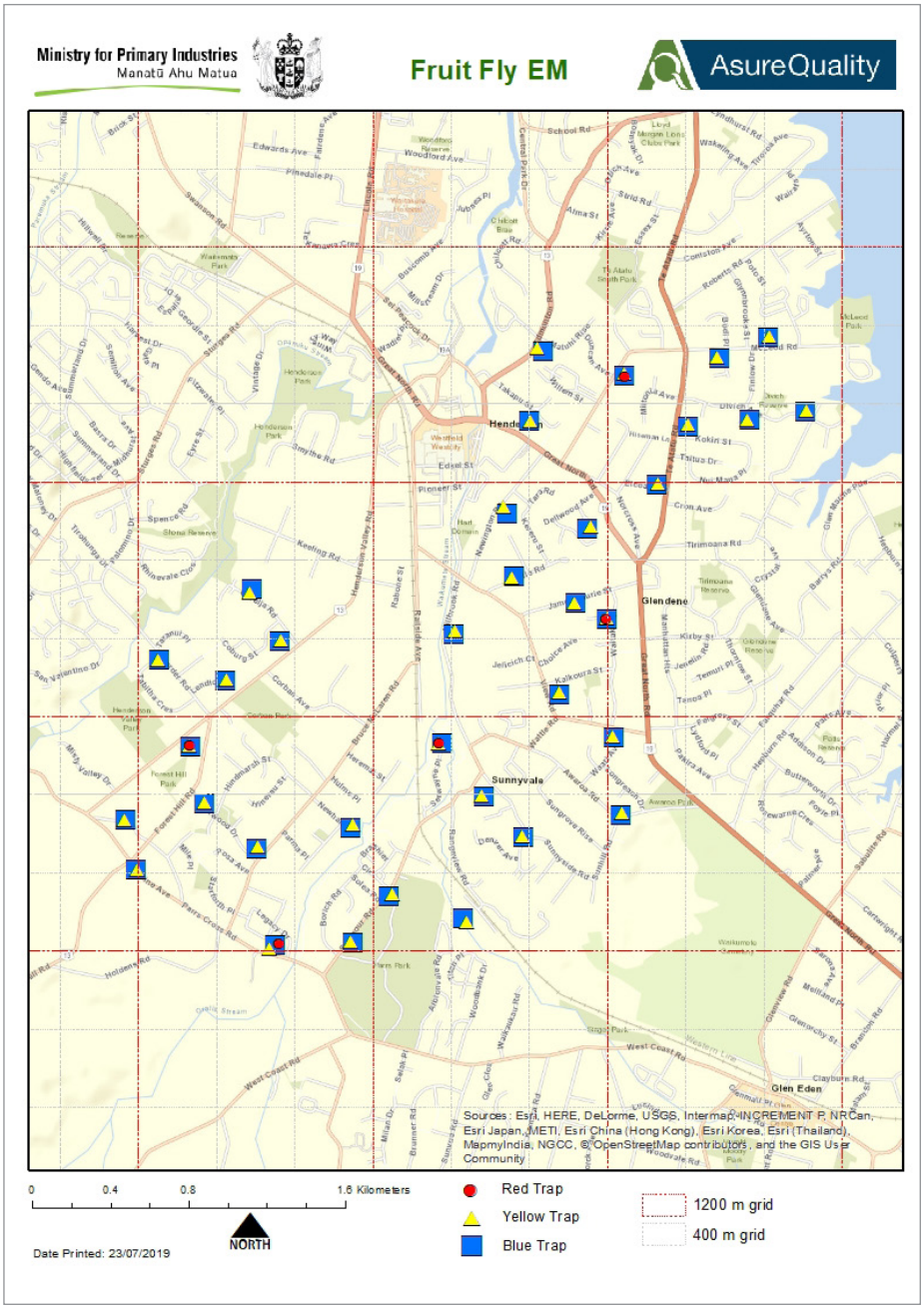


Figure 2: A grid made up of cells overlaid on a map, showing runs of Queensland and and Mediterranean fruit-fly traps (yellow and blue) and Oriental fruit-fly traps (red) in west Auckland

Commercial pheromone-impregnated lures and plastic strips impregnated with dichlorvos insecticide are used in the Lynfield traps. Each trap is inspected every 13–15 days. Suspect flies are collected and submitted to entomologists at the Plant Health and Environment Laboratory (PHEL) for identification.

MPI specifies the start and end dates for trapping, and the season runs for longer in northern districts, reflecting the warmer climate. The trapping season covers those months when population development and flight activity can be predicted to occur (Stringer et al., 2013). In 2018–2019, trapping occurred from 1 October to 1 July.

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 canopy of selected trees (**Figure 3**). To avoid the possibility of interference between lures, the traps are placed at least 3 m apart, and also at least 3 m from any other

insect trap in the area (e.g. codling or gypsy moth traps).

Trappers are required to submit for identification any fly 3–15 mm long. Suspect flies are sent to the diagnostic laboratory within 2 working days of checking the trap. Records of nil catches are also kept, to confirm that traps have been checked. New traps are used at the start of each season, and all traps and lures are destroyed within 2 weeks after the end of the season. Trappers attend refresher courses every year on trap servicing, where they are also updated on any changes of procedure.

MPI operates the programme to a quality-assurance regime that covers documentation, training and auditing. Auditing includes checks on chemicals in lures and insecticide strips, checking traps throughout the season, and monitoring performance against key performance indicators (KPIs). This ensures that the programme remains effective even when detections of fruit flies are rare, one-off events.

Results

In the 2018–2019 season there were 2,857 submissions to PHEL, involving 7,107 suspect flies, compared with 6,869 in 2017–2018. **Table 3** provides a breakdown of submissions by region.

Table 3: Numbers of suspect submissions by region, 2018–2019 season

Month	Auckland/ Northland	Waikato/Bay of Plenty	Lower North Island	Upper South Island	Lower South Island	Total
Oct 2018	766	30	86	145	86	**1,113**
Nov 2018	672	31	170	299	181	**1,353**
Dec 2018	660	103	173	298	221	**1,455**
Jan 2019	488	50	124	243	187	**1,092**
Feb 2019	291	29	53	95	115	**583**
Mar 2019	249	42	59	42	65	**457**
Apr 2019	185	30	55	68	71	**409**
May 2019	154	33	35	58	60	**340**
Jun 2019	163	55	0	0	0	**218**
Jul 2019	75	12	0	0	0	**87**
Total	**3,703**	**415**	**755**	**1,248**	**986**	**7,107**

The Auckland and Northland regions recorded the most submissions: 3,703 (52 percent).

The number of suspect sample submissions followed a similar pattern to previous years (**Figure 4**), with most submissions coming during the period from October to January. The total number during the same period this season was higher than in 2017–2018. This was likely the result of the above-average temperatures. Fewer submissions in February to July were also noted and may have been due to the high rainfall causing less fly activity than usual for the time of year. Another cause may have been that trappers have gained more experience in separating out the by-catch.

The NFFSP is undertaken with a rigorous quality-assurance system in place. Checks are carried out to evaluate the performance of both lures and trappers. Analysis of the lures revealed that they contained more than MPI's minimum requirement of 90 percent of the manufacturer's declared content of 2,000 mg active ingredient per lure. Marked specimens placed in traps enabled the trappers to be audited throughout the season. Altogether 79 marked specimens were planted, of which 66 (84 percent) were collected



Figure 3: Fruit-fly trap containing cuelure for Queensland fruit fly

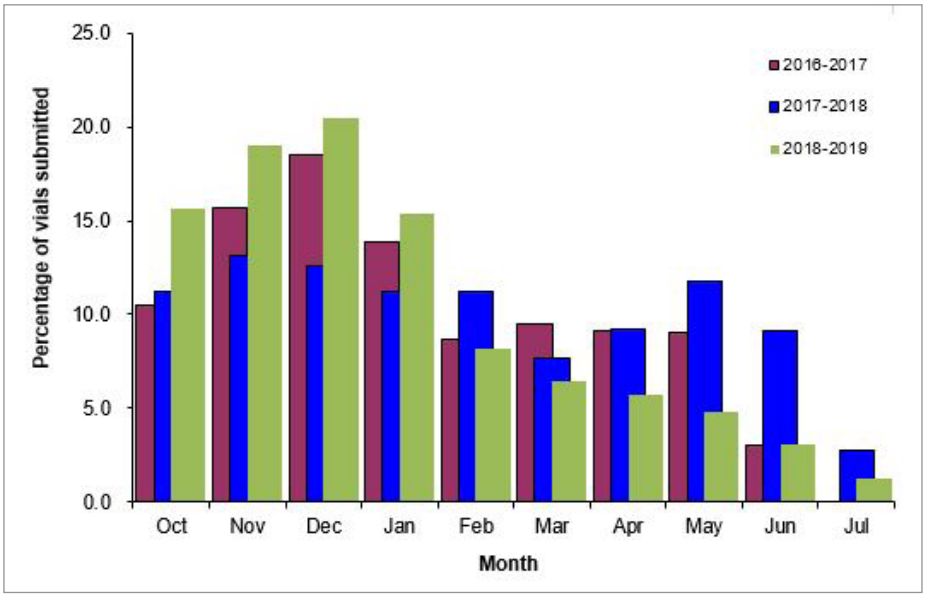


Figure 4: Percentage of fruit fly sample submissions by month, 2016–2019.

and submitted to the lab. Follow-up action was taken to trace the other 13 by re-checking traps, providing feedback to trappers and conducting further tests of performance. Full records were kept and it was concluded that key performance indicator targets were met for the season.

Trap placement is reviewed every season in three of the areas surveyed – this time in Bay of Plenty at Tauranga/Mt Maunganui, Opotiki and Whakatane. It was found that the Bay of Plenty traps are spread over a wide area but are not set in a grid pattern. During the beginning of the 2019–2020 season trappers will look for alternative trapping sites to better align the trapping array into a grid pattern and prevent bunching and scattering of trapping sites. Shifting of any traps needs to be done as part of a structured process to minimise any effect on the overall grid of the area.

The 2018–2019 programme met its objectives. Three new fruit-fly incursions were recorded (Devonport, Northcote, and Otara), and quality assurance demonstrated that the trapping network was effective.

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National Saltmarsh Mosquito Surveillance Programme annual report

For the reporting year 1 July 2018 to 30 June 2019 the National Saltmarsh Mosquito Surveillance Programme (NSP) continued maintaining a watch for exotic mosquito species across more than 780 catalogued saltmarsh habitat locations nationwide. The NSP reports there were no new detections of exotic mosquitoes in the post-border habitats it monitors. In addition to the programmed surveillance in 2018-2019, the NSP provided ongoing enhanced surveillance operations supporting the *Culex (Culex) sitiens* eradication response that followed its detection by the NSP in March 2018 at the south end of Kaipara Harbour. This detection, at 36°37'50.89"S, 174°24'24.08"E, remains the southernmost record of *Cx. sitiens*, by some 2° of latitude.

There was anecdotal information that larvae of *Cx. sitiens* would likely overwinter at this location, triggered by the expected minimum temperature of < 10°C from April to October. Such overwintering would likely render them refractory to planned eradication treatments with the only available mosquito larvicide *Bacillus thuringiensis israelensis* (Bti). The post-winter timing for commencing aerial Bti treatments was determined by Darryl McGinn of Mosquito Consulting Services (NZ) Ltd, by assessing *Cx.* over-wintering behaviour to determine the conditions under which the inactive larvae would resume active feeding. That study was conducted during winter 2018 in Brisbane, Australia, where *Cx. sitiens* was still plentiful. The NSP monitored the *Cx.* response zone from July 2018 in order to advise MPI Readiness and Response when temperatures were approaching a level where Bti treatments would become effective (**Figure 1**).



Figure 1: Surveillance of *Cx. sitiens* by trapping and temperature monitoring

Three programmed aerial applications of Bti were managed by MPI Readiness and Response in November and December 2018. The NSP provided post-treatment efficacy surveillance and follow-up ground-based Bti applications to areas that could not be covered aerially. Three further cycles of intensive habitat surveillance were undertaken by the NSP in January, February and March 2019. During this time 1,571 larvae and 102 adult mosquitoes were collected, but no further *Cx. sitiens* were found.

In 2018–2019 the NSP collected 21,634 larvae and 197 adult mosquitoes and identified them to 10 species that are either native or historically introduced and regularly collected in New Zealand (**Tables 1 & 2, Figure 2**). This was the greatest number of larvae yet reported, and far more than the long-term average of 13,447 (s.d.= 4,554) per year. No exotic saltmarsh mosquitoes were detected (**Tables 1 & 2**). The 2018 detection of *Cx. sitiens* was a positive motivator for NSP field officers undertaking programmed NSP site surveillance, and may account for some of the reported increase in larvae collections. However, the trend towards finding larger numbers of mosquito larvae each year since 2014 may be a subtle indicator of increasing receptivity of the post-border environment to a growing number of exotic mosquitoes.

Table 1: Larval mosquitoes identified, 2018–2019

Aedes antipodeus	2,259
Culex pervigilans	18,893
Aedes notoscriptus	5
Culex quinquifasciatus	50
Aedes subalbirostris	244
Aedes australis	94
Opifex fuscus	89
Total	**21,634**

Table 2: Adult mosquitoes identified, 2018–2019

Aedes antipodeus	20
Culex pervigilans	134
Aedes notoscriptus	14
Culex quinquifasciatus	7
Aedes subalbirostris	15
Aedes australis	6
Coquillettidia tenuipalpis	1
Total	**197**

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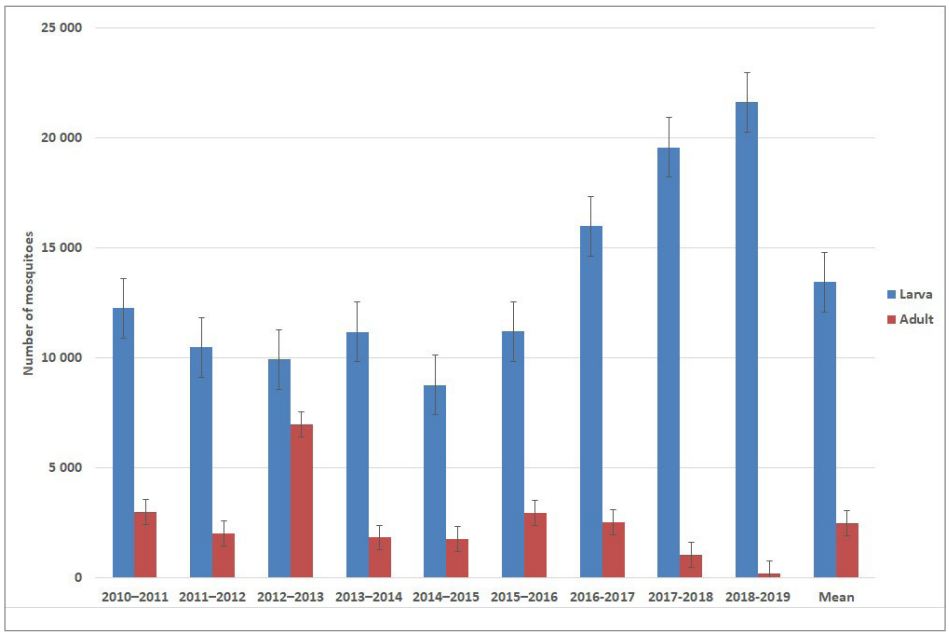


Figure 2: 1 July 2010 to 30 July 2019 NSP collection totals, with mean and SD bar

High-risk site surveillance annual report

High-Risk Site Surveillance (HRSS) is a Ministry for Primary Industries (MPI) surveillance programme designed to monitor post-border risk pathways, primarily targeting trees, shrubs and wood. The main objective of HRSS is to detect new plant pests and diseases that may pose a biosecurity risk, negatively impacting native forests, urban trees, plantation forests and other trees.

Methods

The HRSS programme identifies high-risk sites by considering entry pathways and associations with international travellers, cargo and mail (especially international parcels). Sites are selected by taking into account information from which conclusions on pest exposure can be drawn, such as the volume of traffic, time since arrival, and associated activities such as the opening of sealed containers and inspecting used vehicles. The programme surveys ports and airports, Transitional Facilities (where containers are stored and unloaded), tourist venues and other facilities used by international visitors, such as golf courses. Relative risk and required probability of detection are calculated using a new computer program developed by MPI, NZFOA, Scion, AgResearch and the Australian Centre for Excellence in Biosecurity Risk Analysis (CEBRA). The purpose of the program is to improve the allocation of surveillance resources. Further details are provided below.

Risk Site Areas (RSAs) are established where there are clusters of high-risk sites, for example in areas of the North and South Islands that are near international seaports and airports and associated infrastructure with attendant biosecurity risks. Within RSAs, surveillance transects are assigned, taking into account the biology of various pests and by identifying areas of potential host vegetation from aerial photographs. Each RSA is furnished with sufficient transects to meet predetermined targets for probability of detection. Along each transect, field surveyors thoroughly inspect trees, shrubs and woody material, looking for leaf damage, trunk cankers, lesions, insect boring and tracking, fungal fruiting bodies and other signs of infection or infestation. The field surveyors are highly trained and experienced, enabling them to recognise signs that may indicate biosecurity risks. Suspect samples are collected and submitted to an MPI-approved laboratory for identification, and new records are validated. Where there is a possibility of a new pest or disease that might need further investigation, a report is lodged through MPI's exotic pest and disease hotline (0800 80 99 66) for further action. Validated records are lodged in MPI's Plant Pest Information Network (PPIN) database and reported quarterly in *Surveillance*. Each transect therefore provides a discrete, repeatable quantum of surveillance activity. Field surveyors also have discretion to take samples outside transects where a biosecurity issue is suspected. All sample locations are recorded in a geographic information system (GIS) database in case further action is required.

HRSS field work is administered by AsureQuality, but undertaken by SPS Biosecurity throughout New Zealand. HRSS methods are further detailed in Stevens (2011).

Data collection is fully electronic, which improves efficiency and reduces errors. This includes information that accompanies sample submissions to the Scion Forest Health Reference Laboratory (FHRL). Digitising information has also enabled improved communication and information sharing: for example, diagnosticians are able to access transect data and locality maps while examining samples, and this helps them to draw some conclusions in the lab.

During the survey season HRSS staff were deployed to assist in MPI-led responses that required their specialist skills, and consequently there were delays in achieving targets early in the season. However, a concerted effort by the field staff meant all targets were achieved by the end of the season, at the end of May 2019.

Working together, representatives of MPI, NZFOA, Scion, AgResearch, and CEBRA have produced a new risk-based model, which has again helped to improve allocation of surveillance effort this season. The model is based on Bayesian network analysis and optimally allocates surveillance resources throughout the areas where they are needed. The model identifies significant pathways and potential establishment sites for exotic organisms, then calculates the risk of exposure along each pathway and maps the risk using GIS software. The risk is assessed using knowledge gained from detailed pathway surveys. Information on the location of host species and estimates of establishment likelihood using climate models is used to map establishment risk. Once establishment risk is mapped, these results and information about the surveillance methods including cost and effectiveness are used by an optimization model to allocate surveillance resources across the country. The model provides estimates of maximised surveillance sensitivity within the constraints of a predetermined budget, thus improving detection probabilities and improving MPI's management options when incursions are detected.

Compared with the previous HRSS model, the new model includes new risk pathways and assesses the risk of wider spread across the urban landscape. Because of this, a large number of new transects have been needed in new areas, and in order to meet budgetary constraints this process has been spread over 2 years. In all, 1,060 new transects were established in 2017–2018, and 353 were established in 2018–2019.

Results

Field surveillance

During 2018–2019, 712 RSAs were surveyed and 6,994 transect inspections were completed. Surveillance priorities were adjusted to compensate for other priorities and to enable output from the new model to be implemented. Also this year the new Forest Biosecurity Surveillance (FBS) programme was initiated to provide extra protection for forest plantation species. FBS is jointly funded by the forest industry (via the Forest Growers Levy Trust, Inc.) and MPI. In response, the HRSS programme reduced the number of inspections of plantation forest trees such as radiata pine, and increased the focus on other host species including native plants, fruit trees, and forage and shelter species.

Table 1 shows, for the five biological regions most at risk, the actual effort expended by the programme for each region over the past two years. The model shows that Auckland has the highest biosecurity risk in the country, which presumably is directly related to the volume of passengers and goods entering the country and being unloaded there. For example, more than 55 percent of the sea containers entering the country during 2018 passed through Auckland.

Table 1: Calculated regional effort in 2018–2019 compared with 2017–2018

Biological region	2017–2018 (percent)	2018–2019 (percent)
Auckland	39	42
Bay of Plenty	11	11
Canterbury	11	10
Wellington	7	7
Waikato	5	5
Other regions	27	25

The programme inspected 1,265 different plant species during the 2018–2019 season and more than 70 percent of the transects inspected contained at least one native species. As part of a test of the flexibility of the programme, a group of representative genera related to native at-risk plants (other than trees or shrubs) were targeted during transect inspections. Ten species from five different genera (*Carex, Juncus, Libertia, Poa* and *Ranunculus*) were found in 617 different transects.

Diagnostics

Most diagnostic input to the HRSS programme was provided by Scion's Forest Health Reference Laboratory (FHRL), and covered entomology and mycology. MPI's Plant Health and Diagnostic Laboratory (PHEL) provided virology, bacteriology and nematology input and validated any new to New Zealand records.

Samples submitted consisted of both damaged plant material and suspect organisms such as insects or fungal fruiting bodies. From June 2018 to June 2019 the diagnostic labs received 814 submissions, generating 1,101 diagnostic outcomes (some submissions contained several organisms to be identified). Most of the submissions (44 percent) involved insects, and 29 percent involved fungi. **Table 2** shows the percentages of submissions for the past 6 years, and shows that the proportion of samples involving fungi has increased. The remaining 31 percent of samples yielded inconclusive results when first examined but were further studied to rule out other causes. About 3 percent of the identifications were of bacteria, viruses or nematodes, and no cause was identified in 25 percent of all samples. In these latter samples, the signs seen were caused by environmental factors, old damage where the causal organism was no longer present, or the field surveyors were encountering hosts they had not seen before.

Table 2: Summary of identifications carried out by FHRL and PHEL, 2014–2019

Sample type	2014–2015 (percent)	2015–2016 (percent)	2016–2017 (percent)	2017–2018 (percent)	2018–2019 (percent)
Entomology	61	52	42	40	44
Mycology	18	26	34	29	29
Inconclusive or other	21	22	24	31	27
Total	**100**	**100**	**100**	**100**	**100**

Of the organisms identified, 64 percent were identified to species level (up from 59 percent last year) and 20 percent to genus level. The programme yielded eight new to New Zealand records and 141 new host or new distribution records. The new to New Zealand records have been evaluated for risk and will be published in *Surveillance* Pest Watch tables once they have been validated. All identifications made by FHRL were completed or fully evaluated for risk within 15 days after submission, and 88 percent of insect identifications were completed within that time (an improvement on last year). The PHEL received 124 submissions.

Table 3 summarises the numbers of samples received and lists identifications regarded as significant (species new to New Zealand, new host associations and new distributions) for the period 2013 to 2019.

Table 3: Diagnostic trends, 2013 to 2019 (FHRL and PHEL)

Type	2013–2014	2014–2015	2015–2016	2016–2017	2017–2018	2018–2019
Submissions	860	651	841	843	791	814
Diagnostic outcomes	1,154	896	1,109	1,117	935	1,101
New to NZ	2	0	7	9	4	8
Significant to PPIN	153	135	159	164	156	141
Significant detections (percent of total submissions)	18	21	20	20	20	18

Conclusion

The percentage of detections regarded as significant has changed little over the past 6 years. Detection of new to New Zealand species is a key measure of the effectiveness of this surveillance programme. With regard to the detection of significant pests and diseases, MPI is considering how the programme contributes to stakeholder relationships, such as Government Industry Agreements and agreements with the Department of Conservation.

MPI has continued to use a modelling approach to help ensure optimal deployment of resources, and used an updated model for the first time in 2017–2018. The model and its results are being evaluated, and improvements will be incorporated during the 2019–2020 season.

Implementing the FBS programme was challenging for HRSS owing to the perceived overlap of surveillance activities. An external review identified several areas where potential overlaps could be mitigated. These changes are being implemented and when finalised should lead to a stronger biosecurity surveillance system.

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Gypsy Moth Surveillance Programme annual report

Gypsy moth, *Lymantria dispar*, is a severe defoliator of trees with a wide host range and is regarded as a high-impact economic and environmental pest. A major outbreak of gypsy moth in New Zealand could have a severe impact on forestry, horticulture, tourism and amenity plantings in urban parks and gardens. There could also be impacts on indigenous flora.

In response to the growing risk from increased trade, in 1992 the Gypsy Moth Surveillance Programme (GMSP) was developed to provide early warning of incursions, to enable eradication and provide verifiable evidence that New Zealand is free of this pest. To achieve this, the GMSP conducts seasonal monitoring with pheromone traps placed on favoured hosts at high-risk locations such as around sea ports and container depots. In addition to the trapping, a public communication programme is carried out, using letters, leaflets, cards and reports to promote the biosecurity message to the public and stakeholders.

AsureQuality, as a provider of biosecurity services, has delivered the GMSP under contract to the Ministry for almost 20 years.

Trapping

The surveillance season runs from late spring to late autumn and about 1,500 pheromone traps are deployed. Traps are placed in grids that cover the high-risk areas identified by MPI. Each cell in the grid measures 750 x 750 metres and contains a single pheromone trap for the duration of the season. The minimum size of each grid is two adjoining cells, to provide a greater opportunity of attracting moths into the effective sampling area of the traps. In coastal areas a buffer zone consisting of a line of traps is used to intercept any moths that might fly to land from nearby vessels. 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 in a grid, a host tree as close as possible to the grid-cell centre is selected for trap placement. A hierarchical ranking of the most suitable host trees is used. The traps are attached to the trunk or a branch of the selected tree, 1.3–2 metres above the ground. Rarely, if nothing else is available, an artificial structure may be used. Green delta traps (**Figure 3**) with two sticky internal sides are used, and are labelled "Gypsy Moth Trap", displaying the MPI and AsureQuality logos, and a

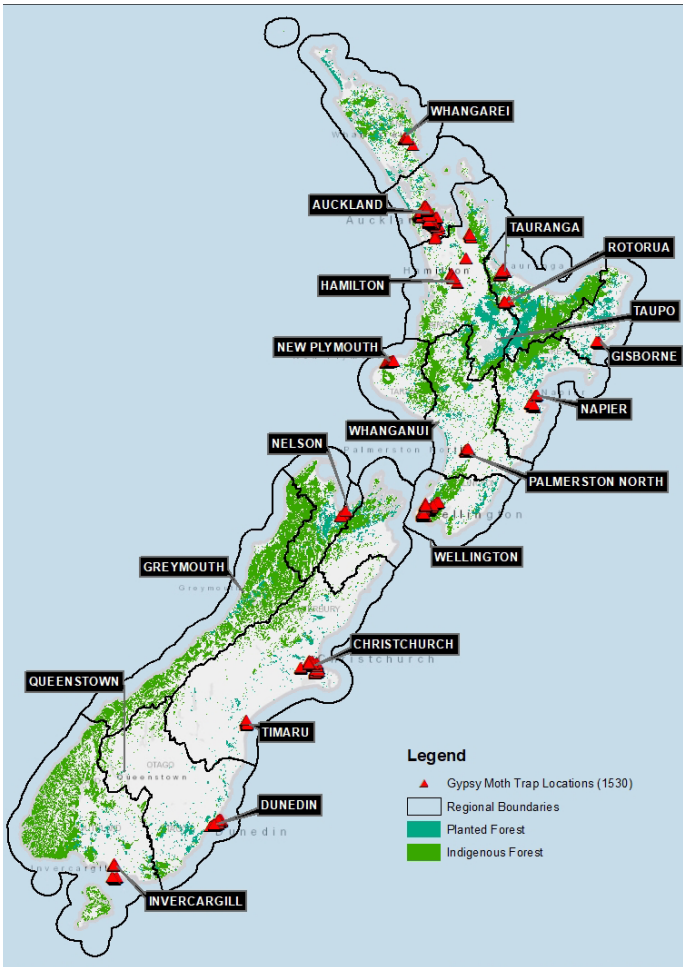


Figure 1: Map of New Zealand showing distribution of trap sites for gypsy moth surveillance, 2018–2019

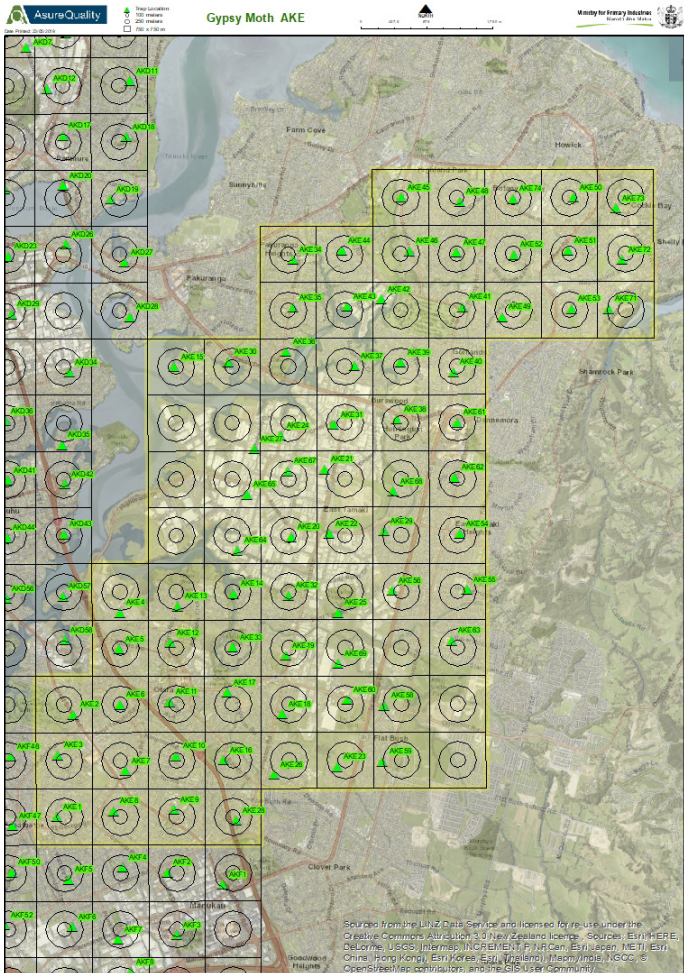


Figure 2: Example of a trapping grid overlying a topographical map, Flat Bush, Auckland. Each cell within the grid measures 750 x 750 metres.



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

freephone contact number. Each trap contains disparlure, the main sex pheromone of the gypsy moth. New traps are used at the start of each season and lures are replaced once during the season, after they have been in the field for 12–14 weeks. Used traps and lures are destroyed at the end of the season. To avoid the possibility of interference, traps are not placed in trees bearing other pheromone traps, e.g. for fruit flies.

The programme is run under a quality assurance programme that requires robust system documentation and record-keeping, and annual training courses for trappers. Lures are independently tested and calibrated before each season and traps are replaced immediately if they are missing or damaged. The system is audited, and continuous updates and improvements are made as appropriate.

Results

The trapping season ran from 22 October 2018 to 26 April 2019. This corresponds to the expected flight period for *Lymantria dispar* if it is ever introduced to New Zealand. The number of traps per run ranged from four to 83 (mean = 43), 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 every 13–15 days. Suspect moths are submitted to Scion entomologists for identification to family level. Scion is a New Zealand Crown Research Institute and an authority on forest biosecurity, with expertise in insect identification.

During the season there were 20,173 trap site visits and 179 suspect moths were submitted for identification. Most submissions came from the lower North Island region and included 65 suspect moths (**Table 1**). The greatest number of submissions (31/month) occurred in November, January, February and April (**Figure 4; Table 1**).

The percentages of sample submission events by month are shown in **Figure 4**. The majority of submissions (97 percent) were received from November to April inclusive. Sample submission was consistent with previous years, with the peak period occurring from November to April inclusive, the warmer months of the year.

Table 1 shows the number of suspect moths submitted each month by region. The lower North Island region provided the most submissions, in November, December, January and April. There was also an unexplained spike in the South Island in February, with all other areas being fairly consistent in the remaining months. Overall the number of sample submissions this season decreased by 28 percent over 2017–2018 (179 vs 249).

No gypsy moths were found during the season. Moth specimens submitted were mainly members of the family Noctuidae (65 percent). Other moth families seen in this year's samples include: Geometridae (7 percent), Erebidae (7 percent), Oecophoridae (3 percent), Crambidae (3 percent) and Hepialidae (~ 2 percent). Twenty-one specimens from other moth families made up the remaining 12 percent.

All Key Service Indicator targets were met for the programme during the season. Six gypsy moth lures (3 from 2017 and 3 from 2018) were tested for their levels of disparlure, the major sex pheromone of the gypsy moth. It was concluded that all these lures would be adequate for monitoring male gypsy moths, as they met the minimum requirement of 275 µg. Chemical analysis

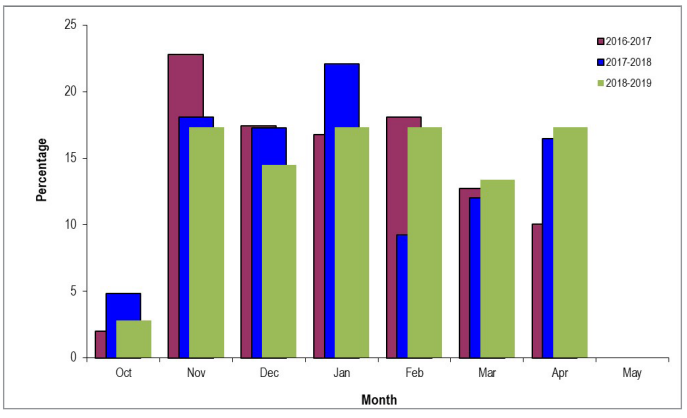


Figure 4: Percentage of suspect gypsy moth sample submissions by month

Table 1: Number of suspect gypsy moths submitted each month by region

Region	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	Total
Auckland/ Northland	0	2	5	7	7	8	11	40
Waikato/Bay of Plenty	2	4	0	5	3	7	4	25
Lower North Island	1	14	13	11	9	5	12	65
South Island	2	11	8	8	12	4	4	49
Total	**5**	**31**	**26**	**31**	**31**	**24**	**31**	**179**

was undertaken at the end of the season for three lures randomly selected from Auckland, New Plymouth and Christchurch. Results showed that the lures still contained 325, 272 and 265 µg respectively. This is within the limit recommended by Leonhardt (1990), which is also accepted by MPI.

Marked look-alike gypsy moth samples were planted in some traps throughout the season to test the efficacy of the trappers in recognising and submitting real gypsy moths. Altogether 34 marked specimens were planted, of which 31 (91 percent) were successfully collected and submitted to the lab. In the three cases where marked specimens were not submitted, follow-up action was taken which included re-checking traps, providing feedback to trappers and conducting further tests of performance. These records are kept and reported to MPI together with follow-up actions that are taken.

Trappers are also encouraged to submit specimens of interest that they may encounter while trapping. This season the exotic poplar sawfly (*Cladius grandis*) was found during the GMSP, resulting in a biosecurity investigation. This demonstrates the value of having trained people in the field who can enhance the general surveillance programme.

During each season, as part of the programme a review is conducted of trap placement in three of the areas surveyed. This season the areas selected were Lower Hutt, Porirua and Wellington Port/CBD. The review revealed that there were some sites used for rubbish collection and disposal outside the boundaries of each grid, but it was noted that the rubbish they receive is from within the trap grid. The area outside the grid is also well covered by the Forestry High-Risk Site Surveillance (HRSS) programme. Therefore no changes were made to the current grid and trap placement.

The 2018–2019 GMSP met its objectives. No new incursions of gypsy moth were detected. Large numbers of samples were collected and identified, and the sampling programme was scientifically robust. The programme also met all quality assurance requirements.

Acknowledgements

MPI would like to thank AsureQuality and Scion for their contribution to this report.

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National Brown Marmorated Stink Bug Pilot Surveillance Programme annual report

The Brown Marmorated Stink Bug (BMSB) pilot Surveillance programme was initiated during the 2018–2019 high-risk season for the monitoring of *Halyomorpha halys* (Hemiptera: Pentatomidae), a pentatomid bug from Asia that is now a significant pest in the US, Europe and Georgia. BMSB is a high-impact pest that feeds on a wide variety of horticultural and amenity plants, causing significant economic losses in many horticultural crops. BMSB is also a significant nuisance pest owing to its habit of aggregating in very large numbers (thousands) during winter in dwellings and other structures.

MPI recognises that import pathways for BMSB are not limited to particular commodities. Rather, high-risk pathways exist for the accidental importation of BMSB, associated with inanimate objects thought to be of low risk, such as international shipping, imported used vehicles and containers from BMSB-infested countries. MPI established a pilot BMSB surveillance programme to provide an early warning of BMSB incursions, both to facilitate eradication and to provide assurances of New Zealand's freedom from this unwanted organism.

The programme consisted of seasonal monitoring for BMSB using lure traps placed on or near specific hosts at 25 targeted Transitional Facility locations in Auckland (16) and Christchurch (9) (**Figures 1 & 2**). The Transitional Facilities were selected using import and BMSB interception data to provide a list of high-risk sites. Any suspect specimens caught were sent to the MPI Plant Health and Environment Laboratory for diagnostic identification.

All sites were ground-surveyed for the presence of potential host trees prior to trap establishment. MPI decided to include several native flowering and fruiting trees (e.g. titoki, *Alectryon excelsus* and karaka, *Corynocarpus laevigatus*) as potential host trees, because of the wide host range of BMSB (Leskey et al., 2012) (> 100 host plants in 45 families). This effort included placing traps on wooden stakes, or host plants and a small number of unknown hosts, to help provide information on the influence of host type on detection using lures and traps. All trap sites were established by 26 October 2018 and the programme was run for 24 weeks, concluding on 12 April 2019. The programme included one lure change after 12 weeks.

Lure traps and visual inspection methods were applied at each site. Site inspections consisted of a combination of trap servicing and vegetation searches within 5 m of the trap, using beating sheets (**Figure 3**). It has been shown that both methods are effective for detection of BMSB (Morrison et al., 2015). As this was a pilot programme, surveyors were asked to regularly inspect potential host trees outside the designated 5 m search area when time permitted, as BMSB may be attracted to the lure but not be trapped, or not be found within 5 m of the trap. The manufacturers of the lure stated that the effectiveness of the BMSB lures extended further than 5 m, so it was considered prudent to occasionally widen the search when time permitted. The lure used was the Trece® Pherocon BMSB dual lure, which has two components: a high-dose 4x lure of 20 mg of BMSB pheromone and 200 mg of the aggregation component, and one sticky card trap was also used for the duration of trapping. This lure is designed to attract adult and nymph BMSB and is currently considered

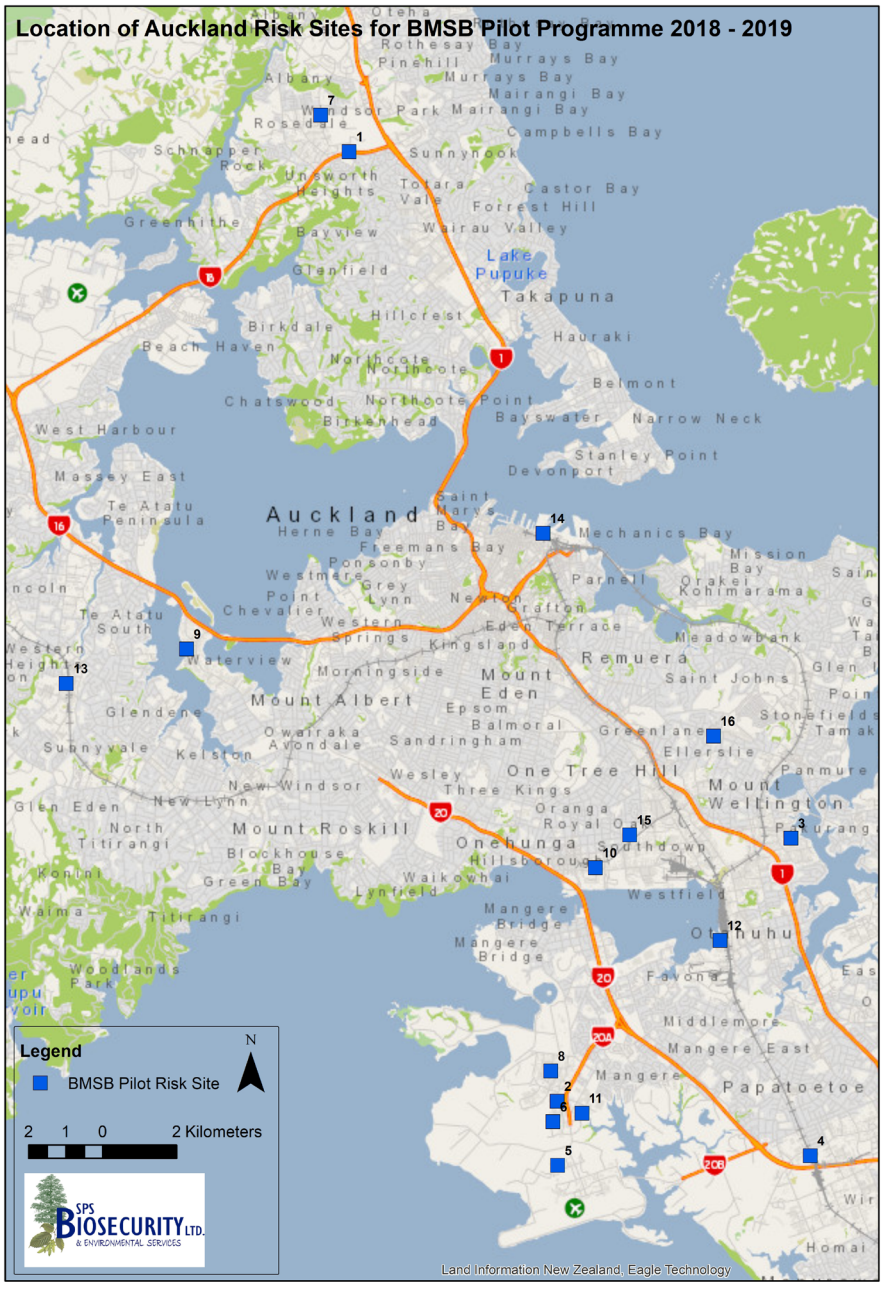


Figure 1: Location of nominated risk sites for the BMSB pilot programme in Auckland, showing pilot site numbers

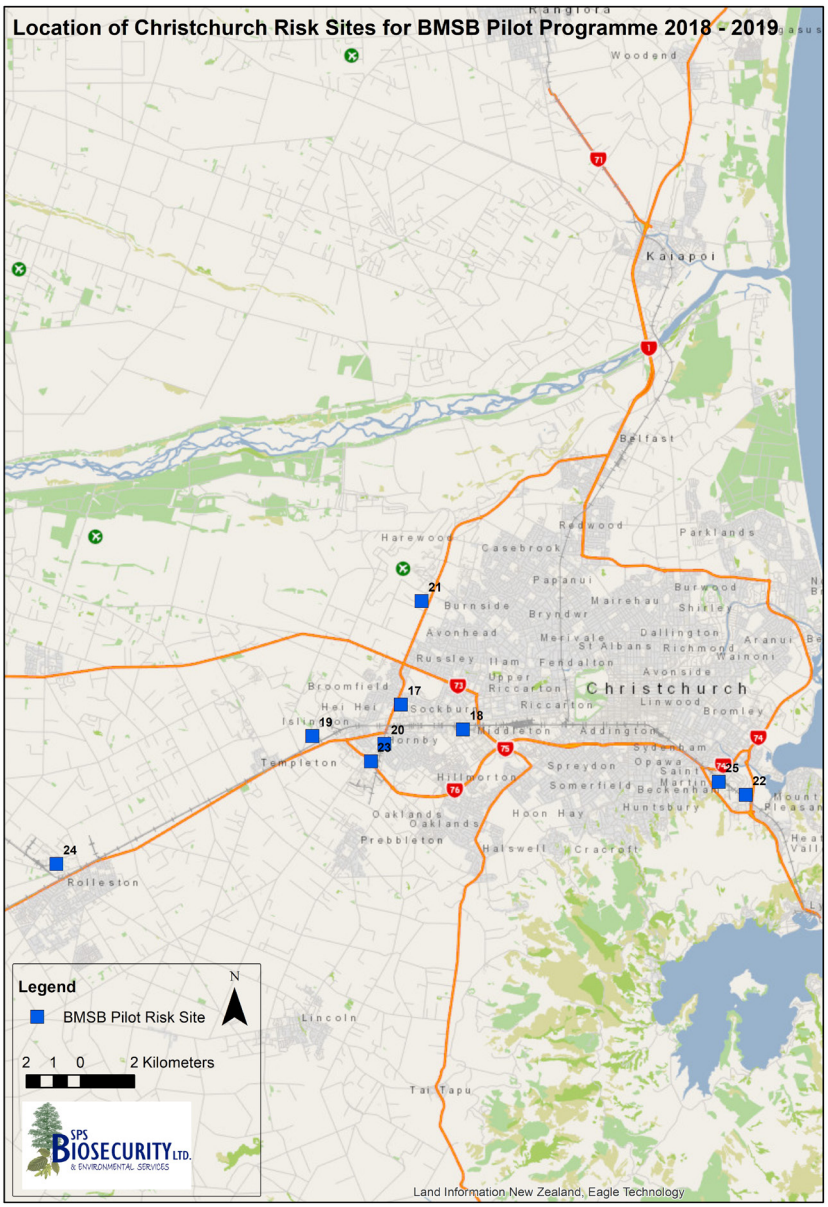


Figure 2: Location of nominated risk sites for the BMSB pilot programme in Christchurch, showing pilot site numbers



to be the best lure available. Traps were inspected every 10 +/- 1 working days for signs of suspect pentatomids.

During the pilot programme, three separate MPI BMSB investigations were undertaken to deal with possible incursions of BMSB at different locations around New Zealand. Trapping and vegetation searches were implemented using the same procedures as the pilot programme, but for a 12-week period. These results have also been included in this report.

Results

A total of 264 samples were collected from BMSB trap sites, from both traps and vegetation searches. Of that total, 258 were pentatomid specimens and six were non-pentatomids. No BMSB were found during the pilot or investigation field activities. Sixty-three percent (162/258) of all submissions were from native hosts.

The most common pentatomid identified from these samples was *Nezara viridula* (green vegetable bug), with 97 specimens. However, *Glaucias amyoti* (Australasian green shield bug) was the most common pentatomid in the sticky traps (21 specimens). *Cermatulus nasalis* (brown soldier bug) was one of the least common species, with four specimens, and only one specimen of *Oncacontias vittatus* (forest shield bug) was collected (**Table 1**).

Table 1: Pentatomid species sampled from BMSB pilot and MPI investigation trap sites, and type of sample collection

Pentatomid species	Total number of samples	Samples collected from trap	Samples collected from vegetation < 5 m from lure	Samples collected from vegetation > 5 m from lure
Nezara viridula	97	7	68	22
Glaucias amyoti	78	21	45	12
Montethiella humeralis	52	2	32	18
Cuspicona simplex	26	0	16	10
Cermatulus nasalis	4	2	1	1
Oncacontias vittatus	1	0	1	0
Total	**258**	**32**	**163**	**63**

Figure 3: BMSB sticky trap and lure (on tree at right), with associated foliage-beating inspection

Table 2: Pentatomid species sampled during BMSB pilot and investigation surveillance, and phenology of associated plant host

Pentatomid species	Phenology of plant host				
	Flowering	Immature fruit	Mature fruit	Ripening fruit	Vegetative
Cermatulus nasalis	0	0	1	0	3
Cuspicona simplex	1	4	7	9	5
Glaucias amyoti	7	5	9	20	37
Montethiella humeralis	2	6	22	17	5
Nezara viridula	16	6	13	26	36
Oncacontias vittatus	0	0	0	0	1
Total	**26**	**21**	**52**	**72**	**87**

Table 3: Summary of trap numbers and type of BMSB surveillance, showing total samples taken and proportion collected outside 5 m radius of trap sites

Bioregion (Crosby codes)*	Number of traps	Surveillance type/s	Number of samples and percentage collected more than 5 m from trap
Auckland (AK)	26	Pilot, Investigation	225 (21%)
Bay of Plenty (BOP)	16	Investigation only	28 (50%)
Mid Canterbury (MC)	9	Pilot only	10 (30%)
Southland (SD)	5	Investigation only	1 (0%)

*Crosby (1998)

Table 4: Summary of samples collect for all weather condition categories, for BMSB pilot and investigation trap clearances

Weather condition	Number of pentatomid-positive samples	Number of pentatomid-negative samples	Number of trap clearances with no sample taken	Number of trap clearances with samples taken	Proportion of clearances that resulted in sampling	Total trap clearances
Cloudy	44	3	284	36	**11.3%**	**320**
Rain	8	0	69	5	**6.7%**	**74**
Sunny	204	3	303	120	**28.4%**	**423**
Windy	2	0	58	2	**3.3%**	**60**

Pentatomid samples were collected from all five categories of plant host phenology (**Table 2**). The data indicate that four of the species collected exhibited a preference for mature and ripening fruit as well as vegetative parts of the plant. Too few specimens of *C. nasalis* and *O. vittatus* were collected to draw any conclusions as to their preferences.

The highest numbers of samples (225, 85 percent) were collected in the Auckland bioregion (**Table 3**). This region had the highest number of traps and was also the only bioregion with both pilot and investigation traps. Proportionally, the Bay of Plenty had the most samples collected outside the 5 m radius search area, partly due to the sites being orchards and parks, which provided sufficient opportunity to conduct additional inspections on suitable hosts. More than 50 percent of all specimens collected (154/258) were adult insects, and nymphs made up a large proportion of the remainder. Egg masses were rarely found and only collected for *Cuspicona simplex* and *Glaucias amyoti*, making these species the only pentatomids to have all three life stages sampled. The only sample of *Oncacontias vittatus* (forest shield bug) collected was an adult. Adult *Nezara viridula* (Australasian green vegetable bug) was the most collected pentatomid species and life-stage.

The highest number of samples collected was over the period January to March (**Figure 4**, following page). This was consistent across the pilot programme and active MPI investigations over this time, as would be expected during the warmest months. Both the pilot programme and the investigation sites showed a notable decrease in samples collected in April compared with March.

Almost half of all trap clearances (48 percent) were carried out in sunny conditions, although cloudy conditions were also commonly recorded (**Table 4**). Rainy and windy conditions were the least frequent, partly because trappers avoiding conditions when vegetation searches and sheet-beating were impractical. This is also reflected in the likelihood of collecting samples in rainy and windy weather. Almost 30 percent of trap clearances carried out in sunny weather resulted in a sample collection. The average time a sample was collected (11:39 AM) was similar to the average time a trap clearance was carried out (11:46 AM).

Quality-assurance checks were carried out to evaluate the performance of the trappers. All trappers undertook compliance checks during the surveillance monitoring. These audits were carried out to ensure that the trappers were undertaking the inspections, sample submissions and reporting for BMSB field activities to meet the standard required. Compliance checks were also carried out on trappers used for the MPI investigation activities, although only trappers used for the pilot programme received marked specimen audits. Five marked specimens were placed during the programme and only one was not received by the diagnostic laboratory. Weather conditions may have played a role in the loss of this specimen, as rain and wind may have removed it from the sticky board. Follow-up investigation found the marked specimen was not present on the trap after the trap clearance was completed.

In conclusion, the BMSB pilot surveillance programme processes and procedures enabled delivery of results that were robust and carried out within budgetary constraints. It is recommended that a national BMSB surveillance programme be implemented in the upcoming 2019–2020 monitoring season and beyond.

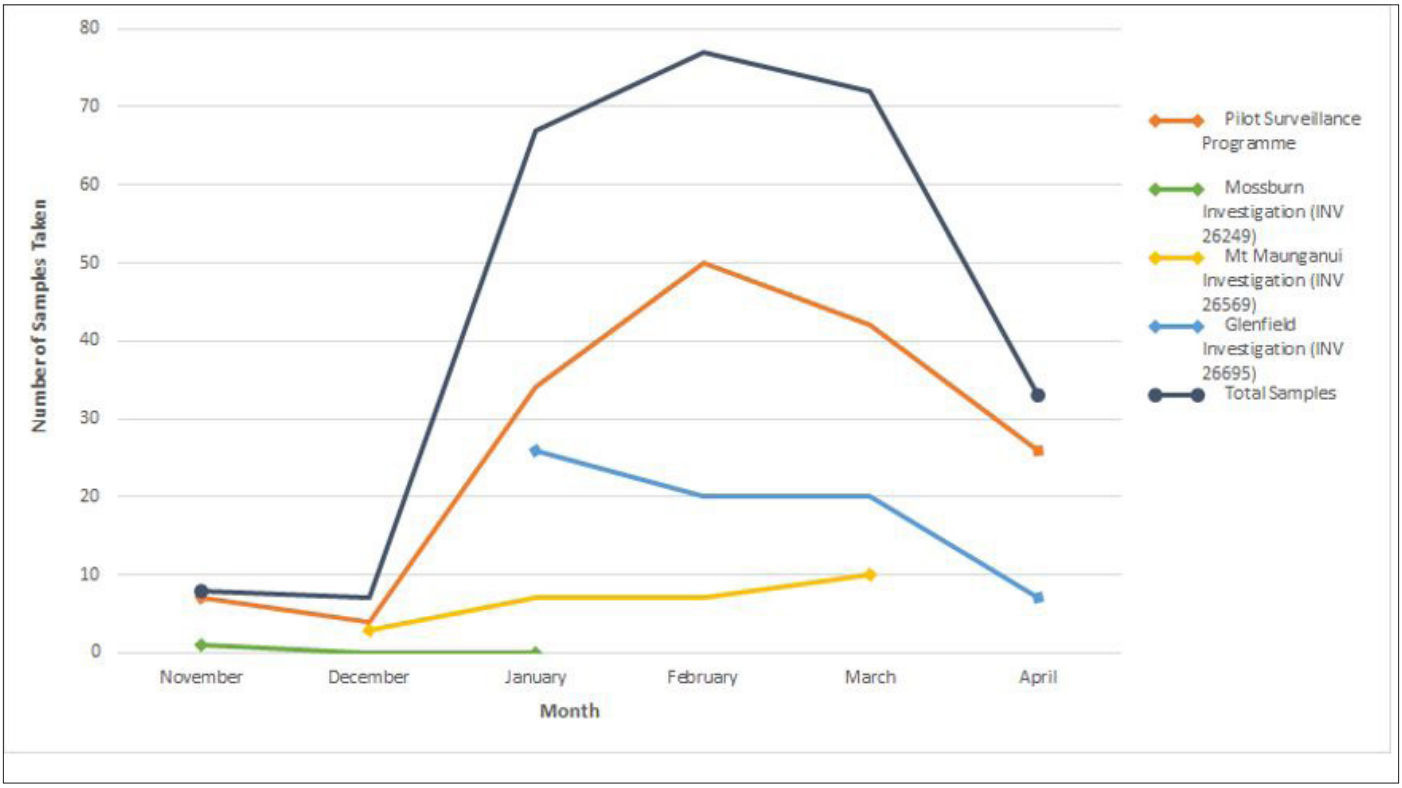


Figure 4: Samples taken during BMSB pilot surveillance programme and MPI investigations, showing totals for each month

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PEST WATCH: 4 May – 23 July 2019

Biosecurity is about managing risks: protecting New Zealand from exotic pests and diseases that could harm our natural resources and primary industries. MPI's Diagnostic and Surveillance (D&S) 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 4 May to 23 July 2019. 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
fungus	*Colletotrichum kinghornii* no common name	*Phormium tenax* harekeke, NZ flax	Auckland	PHEL (High-Risk Site Survey)	Likely endemic to New Zealand.
fungus	*Mariannaea camptospora* no common name	*Pinus radiata* radiata pine	Auckland	PHEL (General Surveillance)	Isolated from root material. Not recorded as a plant pathogen.
fungus	*Pezicula* sp. no common name	*Coriaria arborea* tutu	Fiordland	PHEL (High-Risk Site Survey)	Isolated from tutu. Represents an undescribed species.
insect	*Xylosandrus crassiuculus* granulate ambrosia beetle	*Quercus palustris* pin oak	Auckland	SCION (High-Risk Site Survey)	Survey undertaken – beetle widely established in the Auckland region.
insect	*Cladius grandis* poplar sawfly	Gypsy moth trap (sticky board)	Dunedin	SCION (General Surveillance)	Widely distributed over Europe, Asia and North America.
insect	*Oceanaspidiotus spinosus* spined scale, spinose scale	*Actinidia deliciosa* kiwifruit	Bay of Plenty	AsureQuality (Export Pre-clearance Programme)	Reported to have a wide host range.

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

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

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