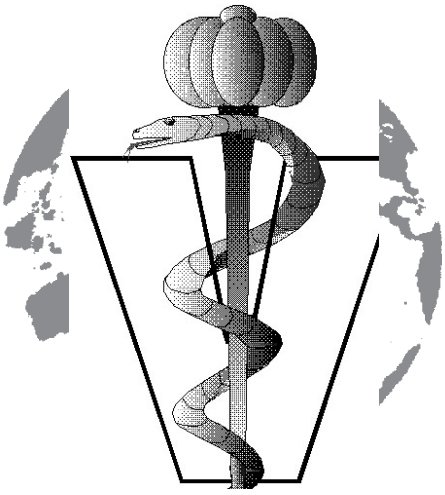

THE ANIMAL HEALTH STATUS OF NIUE

by

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SOUTH PACIFIC COMMISSION

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ABSTRACT

Aspects of the animal health status of Niue have been investigated on a number of occasions by visiting consultants. This paper seeks primarily to record the findings from two visits which took place in September 1992 and March 1994. The results of earlier surveys are also included as appropriate.

The findings indicate that all species in Niue are free from all major diseases. Diseases of public health concern elsewhere (brucellosis and tuberculosis) have not been detected on Niue. Although there has been serological evidence of infectious bovine rhinotracheitis/infectious pustular vulvovaginitis in the cattle, this appears to have been eliminated. The absence of all Ixodid ticks is a major benefit.

The pig population shows evidence of parvovirus infection but appears to be free of other important diseases. A number of samples were inconclusive for leptospirosis, but no positive cases were recorded.

Although the number of poultry samples examined was small and not representative, results served to confirm that poultry diseases which are widespread elsewhere in the region are also present on Niue. These include infectious bursal disease, infectious bronchitis, Marek's disease and *Mycoplasma gallisepticum.*

The high incidence of toxoplasmosis in the caprine population is of public health concern. The feral cat population is thought to constitute the reservoir for this disease.

The survey for bee diseases confirmed the presence of nosemosis and certain viral diseases. However there was no evidence of any major disease which could limit trade in Niue honey.

RÉSUMÉ

Des experts-conseils extérieurs ont étudié à plusieurs reprises la situation zoosanitaire de Niue. Le présent document reprend essentiellement les résultats de deux missions conduites en septembre 1992 et en mars 1994. Les résultats d'enquêtes antérieures sont également inclus au besoin.

Toutes les espèces présentes sur Niue sont exemptes des épizooties majeures. Les pathologies présentant un danger pour la santé publique dans d'autres pays (brucellose et tuberculose) n'ont pas été observées à Niue. Le dépistage sérologique a permis de mettre en évidence des cas de rhinotrachéites infectieuses bovines/vulvovaginites pustuleuses infectieuses, à présent éliminées. L'absence de tous les ixodes est à noter.

La population porcine présente des signes de parvovirose mais est indemne de toutes les autres épizooties importantes. Certains échantillons n'ont pas permis de conclure en ce qui concerne la leptospirose, mais aucun cas positif n'a été enregistré.

Bien que les échantillons de volailles examinés soient faibles et non représentatifs, les résultats ont permis de confirmer que les pathologies aviaires répandues dans d'autres pays de la région sont également présentes à Niue. Des cas de bursite infectieuse, de bronchite infectieuse, de maladie de Marek et de *Mycoplasma gallisepticum* ont été observés.

La prévalence élevée de la toxoplasmose dans la population caprine constitue un problème de santé publique. Les chats errants sont sans doute les hôtes réservoirs de cette maladie.

L'enquête sur les maladies des abeilles a permis de confirmer la présence de nosémose et de certaines pathologies virales. Toutefois, on ne constate pas de trace de pathologie majeure susceptible d'entraîner des restrictions au commerce de miel de Niue.

ACKNOWLEDGEMENTS

I gratefully acknowledge the assistance and hospitality given to me by the Director and staff of the Niue Department of Agriculture, Forestry and Fisheries, in particular the Livestock Officer, Mr Tom Misikea. I am also indebted to the owners of livestock who made their animals available for testing during the course of the survey.

I would also like to acknowledge the assistance received from the seven laboratories which participated in the analysis of samples.

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Map of Niue

INTRODUCTION

A survey of the animal health status of Niue was carried out between 1992 and 1994 by the SPC Animal Health Adviser.

The objective of the survey was to confirm the presence or absence of livestock diseases, including bee diseases, which are considered to be of economic or public health importance to the people of Niue. The information obtained during the survey will enable Niue to develop appropriate quarantine protocols to prevent the introduction of diseases not present on the island and to provide an indication of the distribution of diseases which are known to be present.

It is anticipated that the findings of the survey of bee diseases will enable Niue to access new export markets for honey. Niue is unlikely to become an exporter of livestock or livestock products. However, due to the level of movement of people between Niue and neighbouring islands, primarily New Zealand, and the tradition of presenting gifts of food, information on the animal health status of the livestock population will be of value to the quarantine services of the recipient countries.

LOCATION AND TOPOGRAPHY

Niue is a raised coral atoll of 259 km^2 located at 19 S, 170 W, approximately 480 km east of the Kingdom of Tonga. The island consists of two narrow terraces surrounding a central, saucer-shaped plateau. Where present, the soil is shallow and porous. In many areas it is restricted to pockets between the coral rocks. Surface water is entirely absent and access to the freshwater lens is limited to a few sites where there are outlets at sea level or by deep wells. Although initially covered in tropical rain forest, much of the island is now covered by secondary forest in various stages of regrowth. Soil fertility is low.

LITERATURE

There are no published records on the animal health status of Niue. However a number of unpublished reports were written on the findings during earlier visits by consultants who advised on aspects of animal health and production. Most of these reports are no longer available.

AGRICULTURE IN NIUE

The potential for agriculture is limited due to the scarcity of soil and lack of surface water. Although Niue has exported copra, pawpaw, citrus and passionfruit, the main exports are now honey and taro, with most agricultural activity confined to family food gardens.

With the exception of the government farms, one commercial poultry unit and a number of small semi-commercial piggeries, all livestock production is mainly for personal consumption, primarily at traditional ceremonies. The government has promoted cattle farming (beef and dairy), improved pig breeds (initially Berkshire and Tamworth, followed by Large Whites and, more recently, Durocs) and goats. Intensive livestock production, particularly of pigs, is apparently not feasible because of the problems associated with the need to dispose of effluent without contaminating the freshwater lens.

At the time of the final visit in 1994, the livestock populations were estimated to be as follows:

Cattle	100
Pigs	1,527
Poultry	9,716
Goats	20
Bees (colonies)	360

The cattle population consists primarily of the Government herd totalling 70 animals (mainly breeding females), plus 30 additional animals owned by private farmers. The main emphasis of the government livestock policy is now on the distribution of weaned calves to smallholders for rearing.

Early reports indicate that, at one time, the government farms carried over 1000 cattle. However, problems associated with prolonged drought, weeds and theft have led to the closure of some stations and the consolidation of the remaining animals at Vaiea Farm. An importation of Herefords from New Zealand to improve the genetic base of the government herd took place in mid-1994.

Government maintains a pig-breeding unit at Vaipapahi Research Station and supplies breeding stock, primarily Large Whites and Durocs, to farmers. Smallholder production is severely constrained by nutrition problems and lack of water.

Goat production was encouraged following the importation of 'adapted' goats from New Zealand. This has proved unsuccessful and the Agriculture Department has dispersed those animals which remained.

Commercial honey production for export commenced in Niue in 1967 with the establishment of approximately 650 hives. After reaching a peak of 2000 hives, the numbers declined because of problems associated with management and marketing, although there is still the potential to increase production to former levels. Potential markets for Niue honey have been identified in neighbouring Pacific Islands but are conditional upon the health status of the bees.

SELECTION OF DISEASES

Diseases to be investigated were selected on the basis of public health risk, economic significance and regional epidemiological importance, with particular reference to the diseases notifiable to the FAO and OIE.

Most diseases were investigated through serological sampling of a statistically significant sample of the population. In the case of bovine tuberculosis and brucellosis an attempt was made to test the entire eligible bovine population. Where possible, diseases were also investigated clinically.

Sample sizes were determined using the text *Livestock disease surveys: a field manual for veterinarians* by Cannon & Roe. In some cases it was impractical to collect a statistically significant sample.

Where earlier investigations have confirmed the presence of a disease, these are reported.

MATERIALS AND METHODS

Blood samples were collected by vacutainer from all species included in the survey. After being allowed to clot overnight, the sera were separated and stored at –20°C. If necessary, the serum was centrifuged at 2000 rpm for 10 minutes.

Samples were collected from all female cattle over the age of 12 months and all males capable of or being retained for breeding. Samples were allowed to clot overnight and the serum was separated and centrifuged at 2000 rpm for 10 minutes. All cattle were subjected to the intra-dermal caudal fold tuberculin test on two occasions, using 0.1 ml Bovine PPD 2 mg (100,000 units) per ml. Reaction was evaluated by palpation of the injection site at 72 hours.

Due to the relatively small size of the national herd, where possible, sufficient samples were selected at random and submitted for laboratory analysis to ensure a minimum level of confidence of 99 per cent of detecting a diseased animal, assuming that the disease would be present in 5 per cent of the population.

Sufficient blood samples were collected at random from the pig population to ensure a minimum level of confidence of 95 per cent of detecting a diseased animal, assuming that the disease would be present in 5 per cent of the population. Samples were allowed to clot overnight and the serum was separated and centrifuged at 2000 rpm for 10 minutes.

Due to the relatively small number of goats which remain on the island it was not possible to obtain a representative sample. It is anticipated that the existing goat population will continue to decline and there are no plans to introduce new stock.

The numbers of domestic poultry had been severely reduced by the cyclone in 1991 and as those that remained were hatching or rearing chicks at the time of the visit, the collection of samples was limited to one semi-commercial unit which made a number of poultry available for examination. The number of samples collected by Grimaud in 1991, by the author in 1992 and subsequently by the Niue Department of Agriculture are not statistically significant. However, they do serve to confirm the presence of certain diseases.

After separation, serum samples were stored at –20°C in Suva prior to shipment to the co-operating laboratories. 1 ml aliquots of sera were shipped in duplicated microtitre tubes to the Central Animal Health Laboratory, Wallaceville, New Zealand and in eppendorfs to the Veterinary Pathology Laboratory, Koronivia, Fiji; Laboratoire Territorial de Diagnostique Vétérinaire, New Caledonia; and the CSIRO Laboratory, Indooroopilly, Queensland, Australia.

Approximately 25 per cent of beehives were examined for the presence of disease. At least 25 bees were collected from about one quarter of all hives examined. Samples of brood and comb were removed from hives which exhibited symptoms suggestive of brood diseases, for culture for European and American foul brood. Samples were frozen after collection and stored at –20°C prior to shipment to the Veterinary Pathology Laboratory, Koronivia, Fiji and the Bio-environmental Bee Laboratory, Beltsville, USA (brood and comb) or the CSIRO Entomology Laboratory, Canberra (bees).

RESULTS

Diseases of cattle

81 blood samples were collected from the 97 cattle present on Niue. The herd structure was as follows:

	Herd breakdown 1992	*No. blood sampled 1992*	*Herd breakdown 1994*	*No. blood sampled 1994*
Bulls	1	1	1	1
Cows	44	44	51	51
Heifers	32	32	16	16
Steers	14	0	7	0
Female calves	4	4	5	0
Male calves	2	0	1	0
Total	**97**	**81**	**91**	**68**

OIE List A diseases

During the course of the visits it was possible to individually examine all animals clinically. There is no evidence to indicate that any exotic OIE List A diseases may be present in cattle in Niue at this time.

Bluetongue (CAHL): 60 serum samples, selected at random, were tested for bluetongue using the ELISA and were negative. Niue is probably free of bluetongue. It was not possible to ascertain if potential vectors for this disease are present in Niue.

OIE List B diseases

'Q' fever (CAHL): 60 samples were tested by CFT and were found to be negative for 'Q' fever. All caprine samples (8) were also negative and Niue is probably free of 'Q' fever.

Paratuberculosis (CAHL): 60 samples were tested for paratuberculosis by CFT. One sample gave a positive reaction. The animal did not exhibit any of the characteristic signs of Johne's disease and re-tested negative six months later. Niue is probably free of paratuberculosis.

Babesiosis (LTDV): 48 samples tested negative for *Babesia bovis* and *Babesia bigemina*. As there are no reports of Ixodid ticks on the island, Niue can be considered free of bovine babesiosis.
Anaplasmosis (LTDV): 68 samples were tested for anaplasmosis. One sample gave a positive reaction and four were considered doubtful. Although ticks are recognised as the main vector for anaplasmosis, in the absence of ticks the disease can be maintained by certain species of biting flies, including some mosquitoes and one species of *Stomoxys.* Clinical evidence of anaplasmosis has never been reported.

Leptospirosis (CAHL): 60 samples were tested by the leptospiral MAT for the following serotypes:

Serogroup	*Serotype*
Grippotyphosa	*L. grippotyphosa*
Pomona	*L. pomona*
Icterohaemorrhagiae	*L. copenhageni*
Sejroe	*L. hardjo*
Tarassovi	*L. tarasovi*
Australis	*L. australis*
Canicola	*L. canicola*
Ballum	*L. ballum*
Autumnalis	*L. autumnalis*

Three samples were found to be inconclusive for *L. bratislava.* There is no evidence to suggest that leptospirosis is a significant disease problem in cattle.

Bovine brucellosis (KRS): All samples tested negative on two occasions at the Veterinary Pathology Laboratory, Koronivia, using the Rose Bengal plate test. Additional samples have been tested for bovine brucellosis on a number of occasions previously, always with negative results. Niue can be considered to be free from bovine brucellosis.

Enzootic bovine leukosis (CAHL): 60 samples were subjected to the GDT for enzootic bovine leukosis and were negative. Niue can be considered free of enzootic bovine leukosis.

Infectious bovine rhinotracheitis/infectious pustular vulvovaginitis (CAHL): All samples were negative on SNT for infectious bovine rhinotracheitis. Niue can now be considered free of infectious bovine rhinotracheitis/infectious pustular vulvovaginitis. Samples taken in 1991 showed that one animal had serological evidence of exposure to infectious bovine rhinotracheitis/infectious pustular vulvovaginitis. The animal was subsequently slaughtered.

Theileriasis (LTDV): all samples tested negative. In the absence of the vector tick, Niue can be considered free from *Theileria buffeli*.

OIE List B—clinical/abattoir investigations

Bovine malignant catarrh: There are no clinical reports of bovine malignant catarrh having occurred in Niue. None of the natural hosts for this disease are present in Niue. (It is accepted that outbreaks can occur in the absence of natural hosts.)

Echinococcosis/hydatidosis: There are no reports which suggest that *Echinococcosis/hydatidosis* is present in Niue.

Bovine tuberculosis: All bovines on the island (97 in 1992 and 91 in 1994) were subjected to the intradermal caudal fold tuberculin test and were negative. Previous tests have also failed to demonstrate the presence of bovine tuberculosis and the disease is not considered to be present in Niue.

Cysticercosis: There are no reports to indicate that cysticercosis occurs in Niue.

Dermatophilus: No clinical cases were seen during the survey.

List C and other diseases

Ephemeral fever (CSIRO): 48 samples tested negative to the bovine ephemeral fever virus neutralisation test at 1/2 dilution. Bovine ephemeral fever virus is not considered to be present in Niue. No information is available on the presence and distribution of potential bovine ephemeral fever vectors.
Mucosal disease/bovine virus diarrhoea (LTDV): 48 samples tested negative for mucosal disease/ bovine virus diarrhoea. Niue is probably free of mucosal disease/bovine virus diarrhoea.

Ectoparasites: No evidence of bovine Ixodidae were seen during the investigation. Niue is said to be free of all Ixodidae.

Diseases of goats

OIE List A diseases

There is no clinical evidence to indicate that any exotic OIE List A diseases are present in goats in Niue at this time. However, as there has been serological evidence of the presence of certain bluetongue serotypes elsewhere in the region, samples were examined for bluetongue.

Bluetongue (LTDV): All 8 samples were negative for bluetongue by AGDT. It was not possible to ascertain if potential vectors for this disease occur in Niue.

OIE List B diseases

'Q' fever (CAHL): Testing by CFT was unable to demonstrate any serological evidence of 'Q' fever in the 8 goats that were sampled.

Caprine brucellosis (KRS): All samples were negative on RBPT for evidence of brucellosis. There is no evidence to suggest that caprine brucellosis is present in Niue.

Caprine arthritis/encephalitis (CAHL): 8 samples subjected to the ELISA test failed to demonstrate any serological evidence of caprine arthritis/encephalitis.

Echinococcus/hydatidosis: There are no reports which suggest that echinococcosis/hydatidosis is present in Niue.

OIE List C diseases

Toxoplasmosis (CAHL): 7 of the 8 samples tested were serologically positive for toxoplasmosis on LAT. Toxoplasmosis may be considered to be widespread in Niue. It is assumed that this situation is due to the large numbers of feral cats present on the island, which represent a significant public health concern.

Diseases of pigs

OIE List B diseases

Aujeszky's disease (CAHL): 60 samples were negative to the ELISA test for Aujeszky's disease. Aujeszky's disease is unlikely to be present in Niue.

Porcine brucellosis (CAHL): A number of the 60 samples examined showed a non-specific reaction on SAT. However, all samples were negative for porcine brucellosis by the BCT and CFT. There is no evidence that porcine brucellosis is present in Niue.

Trichinellosis (CAHL): 32 samples were tested by ELISA for trichinellosis and found to be negative. Niue is probably free of *Trichinella spiralis.*

Leptospirosis (CAHL): 60 samples were tested by the leptospiral MAT for the following serotypes:

Serogroup	*Serovar*	*Results*
Grippotyphosa	*L. grippotyphosa*	2 inconclusive
Pomona	*L. pomona*	All negative
Icterohaemorrhagiae	*L. copenhageni*	5 inconclusive
Sejroe	*L. hardjo*	All negative
Tarassovi	*L. tarasovi*	All negative
Australis	*L. australis*	1 inconclusive
Australis	*L. bratislava*	10 inconclusive
Canicola	*L. canicola*	All negative
Ballum	*L. ballum*	6 inconclusive
Autumnalis	*L. autumnalis*	4 inconclusive

Inconclusive reactions to the leptospiral MAT may be an indication of poor serum quality, vaccination (not applicable to Niue), cross-reaction with another serotype,natural agglutinins which are not induced by leptospiral infections, early serological response,or declining sero-response.

Grimaud (1991) found one positive animal (at Vaipapahi Government Farm) on MAT for *L. autumnalis.* The animal was subsequently slaughtered. During the 1992 survey, eight animals were selected at random from the herd at Vaipapahi for testing for leptospirosis. Two animals had titres of 1/50 for *L. bratislava* and *L. ballum.* On the basis of the present survey, there is no evidence to suggest that leptospirosis is widespread in the pigs in Niue.

Atrophic rhinitis of sows: There is no clinical evidence to indicate the presence of atrophic rhinitis.

Cysticercosis (C. cellulosae): There are no reports to indicate that cysticercosis occurs in pigs in Niue.

Echinococcus / hydatidosis: There are no reports which suggest that echinococcosis / hydatidosis is present in Niue.

Additional porcine diseases

Porcine parvovirus (CAHL): 60 samples were tested by HIT for serological evidence of porcine parvovirus. Samples with high titres confirmed that active porcine parvovirus infection is present, but it appears to be confined to two foci at present. The majority of samples exhibited low or negative titres which are indicative of a susceptible population.

The following *ectoparasites* were found:

Haematopinus suis
Sarcoptes scabiei.

Diseases of poultry

OIE List A diseases

Newcastle disease (LTDV & CAHL): All samples (1991: 5, 1992: 2 and 1993: 13) were negative by HIT for Newcastle disease. Newcastle disease has not been recognised clinically and it is unlikely that it is present in Niue.

Avian influenza / Fowl plague (LTDV & CAHL): All samples (1991: 5, 1992: 2 and 1993: 13) were negative for avian influenza by AGPT. Fowl plague is not reported elsewhere in the region and, in the absence of clinical signs, it is unlikely to be present in Niue.

OIE List B diseases

Avian infectious laryngotracheitis (CAHL): All samples collected in 1992 and 1993 were negative by the ELISA test for infectious laryngotracheitis.

Pullorum–Typhoid disease (LTDV & CAHL): All samples submitted between 1991 and 1993 (20) were negative by the agglutination test for *Salmonella pullorum* and *Salmonella gallinarum*.

Avian infectious bronchitis (LTDV & CAHL): All samples collected in 1991 were positive for infectious bronchitis on ELISA. Infectious bronchitis antigen was also detected in 2 out of 13 samples submitted in 1993. It can be assumed that infectious bronchitis is endemic in Niue.

Infectious bursal disease (LTDV & CAHL): 3 samples (of 5) were positive in 1991 by ELISA, although all samples tested subsequently (15) have been negative on the agar gel precipitation test. A strain of infectious bursal disease with low pathogenicity is known to be present in most countries in the region and it is assumed that, although samples submitted between 1992 and 1993 were negative, infectious bursal disease has probably become established in Niue.

Marek's disease (CAHL): 1 sample was positive to the AGPT for Marek's disease. Marek's disease should be considered to be present in Niue.

Mycoplasma synoviae and Mycoplasma gallisepticum (LTDV & CAHL): 3 samples were positive by the agglutination test for *M. gallisepticum* in 1991, although all subsequent tests have been negative. One sample exhibited a weak positive for *M. synoviae* in 1993. However, results from the slide agglutination test on stored sera are questionable, particularly as the serum quality in this case was reported to be poor.

Fowl pox: Reports indicate that fowl pox is endemic on Niue.

Psittacosis (LTDV): 5 samples were tested for *Chlamydia psittaci* during the 1991 survey and were negative.

OIE List C diseases

Avian encephalomyelitis (CAHL): All samples were negative on AGPT for avian encephalomyelitis. Avian encephalomyelitis is present in most countries in the region and the results indicate that the population may be susceptible.

Diseases of bees

European foul brood (KRS & BBL): 2 samples with evidence of brood diseases were negative on culture for *Melissococcus pluton.* There is no evidence to indicate that European foul brood is established in Niue.

American foul brood (KRS & BBL): 2 samples with evidence indicative of brood diseases were negative on culture for *Bacillus larvae.* There is no evidence to indicate that American foul brood is established in Niue.

Nosemosis (CSIRO & LTDV): 26 samples showed severe infection with *Nosema* on examination. Samples collected during 1991 also showed severe infestation with *Nosema apis*. Nosemosis is endemic in Niue.

Additional bee diseases

Sac brood: 2 hives exhibited symptoms consistent with the presence of sac brood. 4 samples of bees were also positive on examination (CSIRO) for sac-brood virus. Sac brood is present but at a low level.

Chalk brood: On examination of the hives, there was no evidence to indicate that chalk brood, *Ascophaera apis,* is present in Niue.

Wax moth: The greater wax moth, *Galleria mellonella* and the lesser wax moth, *Achroia grisella* are both present in Niue.

Amoeba disease (CSIRO): Malpighamoeba were present in 4 samples of adult bees.

Varroasis: No evidence of *Varroa jacobsoni* was detected during the hive inspections. As there are no previous reports to suggest that *Varroa* is present, Niue may be considered to be free from varroasis.

Acariasis (CSIRO): all samples of adult bees were negative on examination for *Acarapis woodi.* Niue may be considered to be free from acariasis.

Black queen cell virus (CSIRO) : 9 samples were positive for black queen cell virus. The virus is endemic in Niue. In most countries this virus is regarded as a minor pathogen and is controlled by requeening.

Chronic paralysis virus (CSIRO): 1 sample was positive for chronic bee paralysis virus. The disease is present but at a low level. As with black queen cell virus, the significance of the disease varies and can usually be controlled by requeening.

Kashmir bee virus, bee virus X & bee virus Y (CSIRO): all samples were negative for Kashmir virus, bee virus X and bee virus Y. Niue may be regarded as free from these viruses.

Diseases of other species

Ctenocephalides sp. are common in dogs and cats.

CONCLUSIONS

Niue appears to be free of all the major exotic diseases of livestock. There is no clinical or serological evidence to suggest that any of the OIE List A diseases or rabies are present. Future importation policies should seek to maintain this situation.

Diseases which are known to be present elsewhere in the region, such as bovine brucellosis, bovine tuberculosis, porcine brucellosis and Aujeszky's disease, also appear to be absent. Surveillance for these diseases will be maintained, although there are no indications to suggest that the diseases may be present.

Other than toxoplasmosis, there are no indications that any diseases of public health importance are present. Consideration should be given to instituting control measures for toxoplasmosis. Although the possible presence of porcine leptospirosis had been of concern previously, this survey was unable to demonstrate that the disease represents a significant threat.

There is serological evidence that certain poultry diseases of economic importance, namely mycoplasmosis, Marek's disease, infectious bronchitis and infectious bursal disease, are present and have become established. These may be responsible for production losses. As day-old chicks are imported only from New Zealand, it is assumed that the strain of infectious bursal disease present in Niue is the same as the strain which has been detected serologically elsewhere in the region. This strain is considered to be only mildly pathogenic or non-pathogenic.

To prevent future commercial losses, a vaccination programme should be introduced to control infectious bursal disease, Marek's disease and avian encephalomyelitis.

The bee industry is free from all the major diseases of bees. Although sac brood is present, it is unlikely to represent a significant threat to strong hives. The heavy infestation with *Nosema apis* will limit honey production and will require control measures and treatment of infected colonies if the industry is to achieve maximum productivity.

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ACRONYMS

AGDT	–	Agar gel diffusion test
AGPT	–	Agar gel precipitation test
BBL	–	Bio-environmental Bee Laboratory, Beltsville, USA
CAHL	–	Central Animal Health Laboratory, Wallaceville, New Zealand
CFT	–	Complement fixation test
CSIRO	–	Commonwealth, Scientific and Industrial Research Organisation
ELISA	–	Enzyme-linked immuno-sorbent assay
FAO	–	Food and Agriculture Organization of the United Nations
GDT	–	Gel diffusion test
HIT	–	Haemagglutination inhibition test
KRS	–	Koronivia Research Station, Fiji
LAT	–	Latex agglutination test
LTDV	–	Laboratoire Territorial de Diagnostique Vétérinaire, New Caledonia
MAT	–	Microscopic agglutination test
OIE	–	Office International des Épizooties
RBPT	–	Rose Bengal plate test
SAT	–	Serum agglutination test