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Epidemiology and Control of Leptospirosis in Farmed Deer in New Zealand.

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in Veterinary Clinical Science

At Massey University, Palmerston North, New Zealand.

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2006

Abstract

Leptospirosis has been reported in farmed deer in New Zealand since 1980 but knowledge was limited. Studies presented in this thesis investigated the epidemiology and distribution of infection associated with serovars Hardjobovis, Pomona, and Copenhageni in farmed deer, efficacy of a vaccine and the influence of maternally derived antibody, and aspects of exposure of humans to leptospirosis. Serology, bacteriology, and pathology were employed as determinants of infection and vaccine efficacy.

A serological survey of 2016 deer from 110 herds confirmed leptospirosis throughout New Zealand with 61.3% of herds infected with Hardjobovis and 3.6% with Pomona alone, 16.4% with dual infections with those serovars, and none with Copenhageni, giving an overall herd prevalence of 81.3%.

Epidemiological studies involved serological analysis of samples from a serum bank involving weaner, yearling and adult deer (n=10/group) from 15 farms sampled 3-monthly for 21 months, and intensive blood and urine sampling of young deer on three farms over 1-2 production cycles (n=15-65/group). Infection with Hardjobovis followed an age-related endemic cycle with some animals infected by 3-4 months of age and seroconversion peaking at up to 57% at 12-15 months and mild kidney lesions typical of a host-adapted organism. Infection with Pomona followed an epidemic pattern with seroprevalence of up to 100%, more severe kidney lesions, clinical signs and evidence of reduced growth and reproduction, typical of an accidental host relationship. *Leptospira* were observed in 30.4% of urine samples and 37.0% of kidneys.

Vaccination with "Leptavoid 3" (Schering-Plough Animal Health Ltd) was studied on one non-infected, one Hardjobovis infected, and two dual Hardjobovis/Pomona infected herds. Vaccination produced sustained titres in uninfected young and adult deer, and no maternally derived antibody interference was observed in progeny vaccinated at approximately 3-4 months of age. In infected herds, vaccination enhanced seroprevalence and antibody titres, and reduced urine shedding by 44% and culture from urine and kidneys by 37% in the face of continued natural challenge.

Analysis of previous data combined with pooled data from the above studies, indicated that 73.0% of lines and 29.0% of individual deer at slaughterhouses had kidney lesions indicative of leptospirosis with a relative risk (RR) of 1.08 and 1.6 for the relationship between seropositivity to Hardjobovis and Pomona, respectively. The overall RR between positive serology, lesion and culture was 2.1. The kidney culture rate ranged from 2.5-33% between herds demonstrating significant risk of exposure to humans, particularly slaughterhouse workers.

This study has provided an understanding of the epidemiology in farmed deer and control options available to the industry

Acknowledgements

A number of people, family, friends, colleagues, and organizations from México and New Zealand (NZ) have contributed immensely towards the achievement of this study and my time in NZ (Aotearoa, the land of the long white cloud!!!). I have a strong belief in the importance of being able to say thank you, and recognising others in your life, in both your personal or professional accomplishments. In the Latin-American culture and particularly in my "México del alma (of my soul)" it is important to know how to say thank you! (¡Gracias!). I know that this list is long, but I value and treasure all the support and contributions, which made this study possible, and what it represents to me personally.

Professional Acknowledgement:

To my great group of supervisors and friends; Dr. Julie Collins-Emerson, Dr. Anne Midwinter, Prof. Peter Wilson, Dr. Cord Heuer (Danke!) and Dr. Colin Mackintosh; who have guided me through this research with knowledge, patience and experience, thank you. Thank-you for your support, learning opportunities, wonderful "can do" attitude whenever we faced challenges in the process of the research and surviving my dyslexia!!!

I am deeply thankful to my academic sponsor CONACyT (National Council of Science of Technology) Government of México for my scholarship funding, UNAM, FES-C (México National Autonomous University, Cuautitlán Superior Studies Faculty), and the research sponsors, DEEResearch (Deer Industry New Zealand), and Schering-Plough Animal Health Limited. To México and NZ as countries for all the opportunities they represent and the beauty in them.

The New Zealand Deer Farmers: without you there would have been no research project. I would like to particularly thank Mr. Tim Aitkens and family (my No. 1 Farmers, and great friends), Mr. Owen Cowie and Mr. Lockie Tylee for their interest, sponsorship, knowledge, hard work, trust and access to their deer herds. I would also like to acknowledge the 100 plus farms involved in this study, Massey University's Deer Research Unit, the Deer Slaughter Premises (Hastings, Fielding and Hokitika), and Dr. L. J. M. Audigé and his PhD project (1995), that provided serum samples and data that were one of the corner stones of this project.

My gratitude and thanks also goes out to the many veterinarians involved in this study. Their time, interest, ideas, experience, disposition and help to the project and to me personally is deeply appreciated; DMV. MSc. Arturo Luque, Dr. Alex Grinberg, BVSc. Nick Wheelan, Dr. Simone Magnino, BVSc. Ian Walker, BVSc. Glenn Dean, BVSc. Adrian Campbell, BVSc. Alison Quinn, and Mr. Tony Pearse from DINZ; .

Thanks also needs to be given to those who gave technical support and assistance with sample collection, key to making the research real, to my friends and colleagues; Geoff Purchas (thank you for time, knowledge and wonderful disposition!), Fernanda Castillo Alcala*, Natasha Swainson.*, Jaimie Glossop.* (*"Dear-Deer-Ladies"!!!), my dear "amigo" Martin Chesterfield, and Geoff Warren. To all the Dutch, French, and Kiwi students: Anne-Hélène Bunod, Ross Moolenar, Floorchet, Mirka, Marleen, Andrew and Daniel, and to all the Latin American friends that have marched through the "Deer farm experience" with me.

Dedicatory:

I would like to dedicate the effort and personal growth that going through the PhD represents. To my family (Ma, Pa, Pau, Luis, Sonia and Natalia), I simply would not be me, without you or without what you have taught me.

I also want to dedicate all that this research represents, to six extraordinary friends that through their courage have taught me and reinforce in me, how brave the fight for life is, how important and grand life is, and to live life fully, honestly, with faith and with an open heart. This dedicatory is small and humble in front of your courageous battles. To my dear friends; Arturo Luque (Usted es gente grande, en todos sentidos y en cualquier lugar caballero) and Family, Javi Cañumir Contreras (Corazón más valiente no he conocido, mi niña querida), Dr. Armando Shimada Miyasaka (No hay palabras para describir la fuerza de su espíritu), Mrs. Shirley Tejeda (Noble corazón en todo momento), my "Dear-Deer" Peter Wilson and Sylvia Weil.

Personal Acknowledgement:

To those in my family that are as close as friends and the friends that are as close as family you have made such a difference in my life; the Families Esquivel-Ayanegui, Alcérrecá-Martínez, Ulloa-Escobedo, and Loubet-García, Lili-Daniel & Fam., Angélica-Manuel & Fam., Francisco & Fam., mi siempre querido Dr. Jorge & Fam., Horacio & Fam., Ale V. & Fam., Fernanda C. & Nacho L., Natalia B., Victor R., Klelia S., Suemi R., Fam. Luque-Flavel, Vicky-Alex Grinberg & Fam., Fam. Jiménez, Fam. Zegbe, Fam. Cañumir-Contreras and Fam. Laca Gastaldi.

To all the great friends that NZ has given me and who have made such a difference in my time here. You have given me so much and you will be part of my heart forever; Fam. Hepp (Ch.), Lisa (Guat.), Alfredo (Mx.), David (Pr.), Florencia (Uru.), Fabio (Brs.), Alexis (Uru.) Federico (Uru-Arg-Sue!!!), Elly (Uru.), Viviana and Alejandro (Mex.), Muddy (EUA), Susan (NZ), Natasha (NZ), Jaimie (Au.), Barbara (Au.), Leanna (Au.), John and Paulina (NZ.), and Nick Wheelan & Fam (NZ). To my mentors and friends, who undertook the challenge of helping, guiding and supporting my professional development: mi maestro Dr. Jorge Tórtora Pérez, Dr. Guillermo Valdivia Anda, MVZ. René Guzmán Ramírez

To those at Massey University IVABS, The Deer Research Group and the Epicentre that made this time a special and enjoyable one; Prof. Colin Holmes, Prof. Tom Barry, Dr. Nicolás López Villalobos, Mr. Peter Wildbore, Mr. Mike Hogan, Mr. Hamish Mack, Mrs. Allain Scott, Dr. Simone Hoskins, Prof. Peter Davies & Fam. To all the lovely deer and the Deer Industry of NZ, you never cease to amaze me. Deer are magnificent creatures and every encounter with them is a new learning opportunity. It has all been worth it, even with the kicks, bruises and some close encounters of the not so nice kind!, Its been an amazing journey with a very special challenge.

¡Gracias! (Thank you!) to all of you, for the support, the belief, the tolerance, the friendship, and the love during this project and during my whole life for some of you. I know, I have had my hard and dramatic moments, even so, all of you have stood by me. I love you people.

Preface

Leptospirosis is a contagious and infectious spirochaete bacterial disease caused by various serovars of the genus *Leptospira* (OIE 2000). Leptospiral infections are an emerging health problem in human and veterinary medicine, having an important economic impact on production animal industries, and being one of the most frequent zoonoses in the human population (Plank and Dean 2000; Levet 2001).

There is limited information about leptospirosis in deer (Prescott 1993). Evidence from surveys of free-ranging and farmed deer from 1957 to 2005 indicates that *Leptospira* have been prevalent in many deer populations internationally (Ayanegui-Alcérreca et al 2003). Nineteen serovars have been reported in deer, but only serovars Hardjobovis, Pomona, Copenhageni, and Roumanica have been isolated (Ayanegui-Alcérreca et al 2004).

Leptospirosis in farmed deer in New Zealand has been reported intermittently for about 25 years (Ayanegui-Alcérreca et al 2003). Nevertheless, not much was known of its prevalence, epidemiology, subclinical effects, prevention, and human health significance (Wilson et al 1998). Bacterial cultures and serological results from New Zealand suggest that serovars Hardjobovis and Pomona are the most frequent pathogens in red deer (*Cervus elaphus*) and Copenhageni has been linked to occasional outbreaks (Flint et al 1986; Griffin 1987; Ayanegui-Alcérreca et al 2003).

The research presented in this thesis was in response to the Deer Industry's desire for robust data on the national distribution and on-farm epidemiology of leptospiral infections, as well as the effectiveness of vaccination in reducing risk to animals and humans. Data will provide guidance for the deer industry in determining the need for an industry-wide control strategy, and if so, the most appropriate course(s) of action.

Thesis format

- Chapter 1 contains an extensive literature review of the biology of leptospirosis and its role in farm animal disease in general, but with a particular reference to deer. This Chapter contains review papers entitled: "Leptospirosis in New Zealand farmed deer: A review" and "A review of international reports of leptospirosis in deer" which have been submitted to scientific journals for publication.
- Chapter 2 describes methodology common to the research presented in Chapters 3 to 8.
- Chapters 3 to 8 describe individual research projects written largely in the format for papers to be submitted to scientific journals. The methodology specific to each chapter is described in them.
- Chapter 9 is a general discussion, which brings the research into context, to allow a broad presentation of the relevant results of the different research projects.
- Appendices 1 to 4 contain the raw data for Chapters 3 to 8.

Table of Contents.

Abstract	I
Acknowledgements	II
Preface	IV
Thesis format	IV
Index	V
Chapter 1	
Literature Review An overview of <i>Leptospira</i> in general, and leptospirosis in farmed deer with particular reference to New Zealand.	1
1.1 Introduction	1
1.2 Background to New Zealand Deer Industry	1
1.3 Leptospiral nomenclature	3
1.4 History of Leptospirosis	5
1.4.1 Global Situation	5
1.4.2 Animal Medicine	6
1.5 Biology of Leptospirosis	6
1.6 Epidemiology of Leptospirosis	7
1.6.1 Environmental Factors	9
1.6.2 Animal factors	9
1.7 New Zealand Livestock	10
1.7.1 Cattle	10
1.7.2 Swine	11
1.7.3 Sheep and Goats	11
1.7.4 Other farm animals	12
1.8 Farmed Deer in New Zealand	12
1.9 A review of international reports of leptospirosis in deer	12
1.10 Leptospirosis in Humans	12
1.11 Bacterial factors and disease mechanisms of leptospirosis	13
1.11.1 Bacterial Pathogenic Factors	13
1.11.1.1 Motility	14
1.11.1.2 Attachment	14
1.11.1.3 Endotoxin LPS (Lipopolysaccharide)	14
1.11.1.4 Cytotoxins and Haemolysins	15
1.11.2 Disease Mechanisms at the Cellular Level (Pathophysiology)	17
1.11.2 Disease Mechanisms at the Cellular Level (Pathophysiology)	18
1.11.3 Pathogenesis and Clinical Disease	17
1.11.4 Pathology and Clinical Presentation	18
1.11.4.1 Acute	18
1.11.4.2 Sub-acute	18
1.11.4.3 Chronic	18
1.11.5 The Disease in Deer	19
1.11.5.1 Macroscopic Pathology	19
1.11.5.2 Microscopic Pathology of Leptospirosis with	20
References to Deer	20

	1.11.6 Clinical Pathology	20
	1.11.7 Differential diagnosis of Leptospirosis in Deer	20
1.12	Diagnosis	20
	1.12.1 Acute Case Diagnosis	21
	1.12.2 Chronic Cases	21
	1.12.3 Epidemiological Research	21
	1.12.4 Diagnostic techniques	23
	1.12.4.1 Dark-field Microscopy	23
	1.12.4.2 Silver Staining	23
	1.12.4.3 Histopathology	24
	1.12.4.4 Bacterial Culture	24
	1.12.4.5 Animal Inoculation	25
	1.12.4.6 Immunofluorescence (Fluorescent Antibody; IFA)	25
	1.12.4.7 Immunohistochemistry	25
	1.12.4.8 Polymerase Chain Reaction (PCR)	25
	1.12.4.9 DNA fingerprints, Ribosomal RNA	26
	1.12.4.10 Serological Techniques	26
	1.12.4.11 Microscopic agglutination test (MAT)	26
	1.12.4.12 Macroscopic Agglutination Test	28
	1.12.4.13 ELISA (Enzyme Linked Immunosorbent Assay)	28
	1.12.4.14 Latex Agglutination Test	29
	1.12.4.15 Sensitised Red Blood Cell Methods	29
1.13	Immunological responses to leptospirosis	29
	1.13.1 Humoral Immunity	30
	1.13.2 Cellular Immunity	30
	1.13.3 Innate Immunity	31
	1.13.4 Maternal immunity in ruminants	31
1.14	Treatment	33
1.15	Prophylaxis, Control and Management	33
	1.15.1 Leptospiral Vaccines	33
	1.15.2 Vaccination	34
	1.15.3 Control and management	35
1.16	Leptospirosis as a zoonoses in New Zealand	38
1.17	Research objectives	38
	1.17.1 General Objective	39
	1.17.2 Specific Objectives	39
	1.17.3 Research Hypotheses	39
	Attachment 1 Leptospirosis in New Zealand farmed deer: A review.	40
	Abstract	41
	Introduction	41
	Leptospiral serovars present in New Zealand	42
	Occurrence in deer	42
	Host: serovar relationship for deer	43
	Relationship between serovar and disease	44
	Epidemiology of infection in deer	44
	Clinical signs and gross pathology	45
	Histopathology	45
	Treatment and vaccination	46
	Human leptospirosis associated with deer	47

Conclusions	47
Attachment 2 A review of international reports of Leptospirosis in deer	51
Abstract	52
Introduction	52
Scope of this review	53
Taxonomy	53
Serological and bacteriological data.	54
Clinical disease and mortalities	55
Culture and serological titres	56
Habitat of deer with evidence of leptospirosis	57
Relationship between serovar and deer species host	57
Regional distribution of serovars	57
Leptospiral host definitions for deer	58
Deer leptospirosis as a zoonosis	59
Conclusion	59
Chapter 2 General Material and Methods	68
2.1 Introduction	69
2.2 Animal ethics	69
2.3 Animals and farms	69
2.4 Herd screening and survey	69
2.5 On-farm vaccine trials	70
2.5.1 Leptospiral diagnosis by herd and brief clinical history of the herd	72
2.5.2 Weaners used in farm trials.	73
2.5.3 Hinds used in vaccine trials	74
2.6 Vaccination technique	75
2.7 Deer restraint	75
2.8 Sample collection and handling	75
2.8.1 Blood (serum) sampling	75
2.8.2 Serum Bank	76
2.8.3 Urine	76
2.8.4 Urine handling	76
2.8.5 Urine Dark-field examination	77
2.9. Slaughter	77
2.9.1 Blood collection at slaughter	77
2.9.2 Kidney collection and gross pathology examination	78
2.10 Histopathology	78
2.10.1 Formalin/saline solution 10%	79
2.9 Serology	79
2.9.1 Serum master plates	79
2.9.2 Dark-field microscopy	79
2.9.3 Microscopic agglutination test (MAT)	80
2.9.3 Serotyping and identification of leptospire isolates	81
2.10 Bacteriology	81
2.10.1 Maintenance of leptospiral cell cultures for serology	81
2.10.2 Urine Culture	82
2.10.3 Kidney Cultures	82
2.10.4 Long term storage of leptospiral cultures	83

2.11	Serological interpretation	83
2.11.1	Manipulation and transformation of titre data for statistical purposes.	83
2.11.2	Titre dilution range and cut-off points for the MAT	84
Chapter 3 A longitudinal retrospective serological investigation of leptospirosis on deer farms		87
3.1	Introduction	88
3.2	Material and Methods	88
3.2.1	Farms, Animals and sampling regime	88
3.2.2	Re-sampling of farms	89
3.2.3	Blood Collection, Identification and Storage	90
3.2.4	Serology	90
3.2.5	Statistical analysis	90
3.3	Results	91
3.3.1.	Serovar Hardjobovis	91
3.3.1.1	Farm, age, season	94
3.3.1.2	Age and season cohorts by seroprevalence	94
3.3.1.3	Age and seasonal cohorts by titre.	95
3.3.2.	Serovar Pomona	96
3.3.2.1	Farm, age, year, season and sex	96
3.3.2.3	Pomona titre distribution and geometric means.	97
3.3.2.3.	Pomona “case” farm	98
3.3.3.	Serovar Copenhageni	99
3.3.4.	Re-sampling of farms	99
3.4	Discussion	100
3.4.1	Serovar Hardjobovis	101
3.4.2.	Serovar Pomona	102
3.4.3	Serovar Copenhageni	103
3.4.4	Re-sampling of Farms	104
3.5	Conclusions	104
Chapter 4 Longitudinal observations of Leptospira in naturally infected commercial farmed red deer herds		109
4.1	Introduction	110
4.2	Materials and Methods	110
4.2.1	Farm and animal selection and management	110
4.2.2.	Leptospiral history of farms	112
4.2.3	Sample collection, storage and processing	112
4.2.4	Statistical analysis	112
4.3	Results	11
4.3.1	Serology	113
4.3.1.1	Hardjobovis	113
4.3.1.1.1	Group, year, sampling month and age effects	115
4.3.1.2	Pomona	115
4.3.1.2.1	Group, Year, sampling month and age effects	116
4.3.1.3	Copenhageni	116
4.3.1.4	Dual Hardjobovis and Pomona	117

4.3.2	Urine dark field microscopy	118
4.3.4	Live <i>Leptospira</i> index	120
4.3.5	<i>Leptospiral</i> culture	121
4.3.6	Kidney gross and histopathology	122
4.3.7	Adult deer, Farm 2	123
4.4	Discussion.	123
4.4.1	Serology	124
4.4.2	Urine shedding and culture	126
4.4.3	Kidney pathology and bacteriology	126
4.4.4	Use of multiple diagnostic tests	128
4.5	Conclusions.	129
Chapter 5	Studies of a Trivalent <i>Leptospiral</i> Vaccine in Deer	130
5.1	Introduction	131
5.2	Materials and methods	131
5.2.1.	Trial Design	131
5.2.2.	Farms, animals and sampling	132
5.2.3.	Vaccination	133
5.2.4.	Sample collection and storage	134
5.2.5	Microagglutination test (MAT)	134
5.2.6	Bacteriology, gross pathology and histopathology	134
5.2.7	Data analysis	134
5.3	Results	135
5.3.1	Non-infected herd (Farm 4)	135
5.3.2	Infected herds (Farms 1-3)	136
5.3.2.1	Hardjobovis	138
5.3.2.2	Pomona	138
5.3.2.3	Copenhageni	143
5.3.2.4	Titre response	143
5.3.3	Urine shedding and culture	143
5.3.4	Kidney lesions	144
5.3.5	Kidney culture	144
5.3.6	Relationship between DFM and urine and kidney culture	145
5.3.6.1	Shedding time	146
5.3.7	Production outcomes	146
5.3.7.1	Weight gain	146
5.3.7.2	Weaning percentage	147
5.4	Discussion	147
5.4.1	Non-Infected herd	148
5.4.2	Infected farms	149
5.4.3	Urine shedding, “live <i>Leptospira</i> index” shedding time and kidney lesions	151
5.4.4	Production outcomes	152
5.5	Conclusions	154

Chapter 6 Serological responses to a Trivalent Leptospiral Vaccine in pregnant hinds and progeny	155
6.1 Introduction	156
6.2 Materials and methods	156
6.2.1. Farms, animals and management	156
6.2.2 Trial design	157
6.2.2.1. Hinds	157
6.2.2.2 Progeny	157
6.2.2. Vaccination, sampling and serology	158
6.2.4 Statistical analysis	158
6.3 Results	15
6.3.1 Seroprevalence and GMT in Hinds	159
6.3.1.1 Year 1	159
6.3.1.2 Year 2	160
6.3.2 Relationship between serology of dams and progeny	165
6.4 Discussion	168
6.5 Conclusions	170
Chapter 7 Regional seroprevalence of Leptospirosis on deer farms in New Zealand.	173
7.1 Introduction	173
7.2 Materials and methods	173
7.2.1 Study design	173
7.2.2 Farms, blood samples and serology	174
7.2.3 Questionnaire	175
7.2.4 Statistical analyses	175
7.3 Results	175
7.3.1 Seroprevalence	175
7.3.2 Questionnaire	178
7.4 Discussion	179
7.5 Conclusions	182
Chapter 8 Relationship between Leptospira serology, kidney lesions and culture	183
8.1 Introduction	184
8.2 Materials and Methods	184
8.2.1. Animals and sampling	184
8.2.2 Blood collection and handling	185
8.2.3 Serology	185
8.2.4 Kidney collection and gross lesion description	185
8.2.5 Histopathology	186
8.2.6 Culture	186
8.2.7 Statistical analysis	186
8.3 Results	187
8.3.1 Serology	187
8.3.2. Gross kidney lesions	188
8.3.2 Association between kidney lesions and serology	189

8.3.3 Association between white spots, serology, histopathology and culture.	191
8.3.4. Relationship between titre and kidney lesion and culture status	193
8.4 Discussion.	197
8.4.1 Seroprevalence	197
8.4.2 Gross pathology and serology	198
8.4.3 Pathology, culture and serology	198
8.4.4 Agreement between diagnostic techniques	199
8.4.5 Possible Risk of exposure to humans	200
8.5 Conclusions.	202
Chapter 9 General discussion	203
9.1 Introduction	204
9.2 Serovars, serology and bacteriology	204
9.3 Epidemiology	204
9.4 Host serovar relationship	206
9.5 Zoonotic risk	206
9.6 Vaccination	207
9.7 Production responses	210
9.8 Proposed industry action	210
9.9 Study limitations	210
9.10 Further research	212
Chapter 10 References	213
10. References	214
Appendix 1 raw data Chapter 3 (Serum Bank)	240
Appendix 2 raw data Chapters 4, 5 and 6 (Farm Trials)	265
Appendix 3 raw data Chapter 7 (Regional survey)	317
Appendix 4 raw data Chapter 8 (Deer Slaughter Premises)	353

Table of Figures

Chapter 1

- 1.1. Taxonomy of Spirochaetales and Leptospira (Adapted from Quin et al 2002). 4
- 1.2. Diagrammatic illustration of a typical spirochaete, indicating important structural features (A) and their relationship in cross section (B). The flagellae are attached to the cell wall at each end of the organism. (Quin et al 2002). 7
- 1.3. A schematic diagram of the progression of leptospiral disease and immunity, and the role of vaccines. Adapted from (Greene et al 1998). * Antibodies can be either the result of vaccination, passive immunity (colostral) or the result of previous infection. 36

Chapter 3

- 3.1 Overall seroprevalence s Hardjobovis ($\geq 1:24$), Pomona and Copenhageni ($\geq 1:14$), (all ages, all samplings and both sexes and years combined within each farm) with farms ranked by the seroprevalence of Hardjobovis. 91
- 3.2. Overall seroprevalence for serovar Hardjobovis (cut point of $\geq 1:24$) (Top), and Pomona (cut point 1: 14) (below), from each farm, all samples combined, at each sampling, ranked by the seroprevalence in the adult group 92
- 3.3 Seroprevalence of Hardjobovis ($\pm 95\%$ CI), all ages, all samplings, and both sexes combined, within each farm in years one and two with farm ranked by the seroprevalence in the first year. The final column presents the average seroprevalence, all farms in both years. 94
- 3.4. Seroprevalence for serovar Hardjobovis, all farms combined, for each age group at each sampling. Note, weaners in year 1 become yearlings in year 2, and yearlings in year 1 become adults in year 2. Weaners in year 2 were sampled only in that years. 95
- 3.5 Geometric mean of coded titres (the reciprocal titres are presented in brackets) for serovar Hardjobovis (and 95%CI) for each age group, all farms combined, at each sampling period in years 1 and 2. 96
- 3.6 Total and individual seroprevalences by age and sex for Pomona on Farm 15. 98
- 3.7 Comparative seroprevalence and GMT for serovars Pomona and Hardjobovis on Farm 15. 98

Chapter 4

- 4.1 Seroprevalence (95%CI) with a cut point of $\geq 1:24$ and coded geometric mean titre (95%CI) for serovars Hardjobovis, Pomona and Copenhageni from each farm all samples combined by month. 114

4.2 Proportion of animals within the overall seroprevalence (and 95% CI) at each sampling on dual Hardjobovis and Pomona infected farms that were individually or dually seropositive. 118

4.3 Number of deer (n) from which urine was collected and was DFM positive or negative at various combinations of sampling times on each farm. 119

4.4 Seroprevalence (95% CI) for serovars Hardjobovis and Pomona, and the proportion (%) “Live Leptospira index” positive (95% CI) at each sampling period, and overall. 120

4.5 Proportion of animals LLI positive that were seropositive at \geq various titre cut points for Hardjobovis and Pomona. 121

Chapter 5

5.1. Seroprevalence (left) and coded GMT (right) ($\pm 95\%$ CI) of each serovar in vaccinated and non-vaccinated control deer on the non-infected Farm (Farm 4) in Years 1 and 2. (Vaccination times represented by arrows). 137

5.2 Seroprevalence (left) and coded GMT ($\pm 95\%$ CI) (right) of serovar Hardjobovis in vaccinated and non-vaccinated control deer on each farm by sampling day and age. (Vaccination represented by arrows). 139

5.3 Seroprevalence (left) and coded GMT ($\pm 95\%$ CI) (right) of serovar Pomona in vaccinated and non-vaccinated control deer on each farm by sampling day and age. (Vaccination times represented by arrows). 140

5.4 Seroprevalence (left) and coded GMT ($\pm 95\%$ CI) (right) of serovar Copenhageni in vaccinated and non-vaccinated control deer on each farm by sampling day and age. (Vaccination times represented by arrows). 142

5.5 Mean coded GMT ($\pm 95\%$ CI) of combined titres from infected farms for each serovar from vaccinated and non-vaccinated control deer (Vaccination times represented by arrows). 143

5.6. Proportion of “live Leptospira index” positive deer in vaccinated and non-vaccinate groups on infected farms. * = Significant difference. 146

5.7 Mean weight gain (kg \pm SE) from March to September (both years pooled) in “live Leptospira index” positive and negative deer from vaccinated and control groups on Farm 2. 147

Chapter 6

6.1. Geometric mean of the coded titre (top) and seroprevalence (bottom) ($\pm 95\%$ CI) of Hardjobovis, Pomona and Copenhageni in vaccinated and control hinds on days 0 (vaccinated, October), 28 (booster, November) and 100 (February) on Farms 2 and 4 in Year 1. 159

- 6.2. Geometric mean of the coded titre (top) and seroprevalence (bottom) ($\pm 95\%$ CI) of Hardjobovis, Pomona and Copenhageni in control and vaccinated hinds given a booster on day 0 (October), and sampled day 30 (November) and 79 (February) on Farm 4 Year 2. Note, half of boosted and control hinds had received vaccination in the previous season (Figure 6.1). 161
- 6.3. Seroprevalence ($\pm 95\%$ CI) in vaccinated and control progeny of vaccinated and control hinds from 28 days before vaccination (February) and up to 284 days thereafter. (V= Vaccine in March, B= Booster in April). 163
- 6.4 Coded geometric mean titre (GMT) ($\pm 95\%$ CI) in vaccinated and control progeny of vaccinated and control hinds from 28 days before vaccination (February) and up to 284 days thereafter. (V= Vaccine in March, B= Booster in April). 164
- 6.5 Geometric mean of the coded titre (above) and seroprevalence (below) ($\pm 95\%$ CI) of vaccinated and control hinds in March and progeny in February and March. 167

Chapter 7

- 7.1. Herd and overall individual animal level seroprevalence ($\pm 95\%$ CI) of Hardjobovis and Pomona alone or in combination, and individual animal seroprevalence for Copenhageni. 176
- 7.2. Distribution of within-herd seroprevalence for Serovars Hardjobovis and Pomona alone or in combination, ranked by seroprevalence to Pomona. 177
- 7.3. Herd seroprevalence for Hardjobovis and Pomona individually or combined in each region ranked by Hardjobovis. 177
- 7.4. New Zealand regional survey: approximate distribution of leptospirosis in farmed deer, Serovar Hardjobovis 62.0% (●), Pomona 3.7% (◆), Hardjobovis and Pomona 17.6% (▲), Negative farms 16.7%. 178

Chapter 8

- 8.1. Herd and individual animal seroprevalence ($\pm 95\%$ CI), of serovars Hardjobovis, Pomona and Copenhageni, first column (Leptospira) overall serology to either serovar,*= positive titre only to serovar Hardjobovis, Pomona or Copenhageni, the dual positive titres for the different combinations of serovars, final column prevalence of kidney lesions (white spots). 187
- 8.2. Within-herd seroprevalence distribution of deer positive to serovars Hardjobovis ($\geq 1:24$), Pomona ($\geq 1:14$), and Copenhageni ($\geq 1:14$) in Periods 1 and 2 showing herds positive to a single or multiple serovar, sorted by order of seroprevalence to Pomona followed by Hardjobovis. 189
- 8.3. Prevalence of kidneys with white spots, histopathological lesions, culture positive, and overall seroprevalence ($\pm 95\%$ CI) for the three farms from which data are derived. (The total number of kidneys used for each diagnostic procedure are in brackets). 191

8.4 Reciprocal geometric mean titre (GMT) (\pm 95% CI) of titres for all serovars combined, or Hardjobovis and Pomona individually, in deer that were kidney gross lesion, histological lesion or culture positive or negative.	194
8.5 Kidneys without lesions.	194
8.6 Congested kidney, scaring on the kidney surface and cortex.	195
8.7 White spots on approximately 20% of the kidney surface.	195
8.8 White spots on approximately 6-50% of the kidney surface.	196
8.9 Focal Interstitial inflammatory cell infiltration of seropositive adult hind to Hardjobovis and with white spotted kidneys. H&E .	196
8.10 Interstitial nephritis, mononuclear cell infiltration in the cortico medular area of a white spotted kidney from a seropositive Hardjobovis and Pomona weaner. H&E.	197
8.11 A deer carcass at the Feilding DSP shortly after sticking, demonstrating voidance of urine, placing workers at risk of direct contact.	201

Tables

Chapter 1

1.1. Genus and species classifications of the *Leptospira* found in New Zealand based on sensu stricto and sensu lato classifications of the seven strains known to exist in NZ. (Committee on the taxonomy of *Leptospira* 2002). 5

1.2. Criteria for definition of host-adapted and incidental host categories for leptospiral infections (Heath and Johnson 1994; Radostits et al 1999). 8

1.3. Currently accepted host-serovar relationships for *Leptospira* serovars present in New Zealand. The serovars isolated from farmed deer in New Zealand are in bold (Brockie 1977a,b; Marshall et al 1976; Hathaway 1978, 1981a,b; Flint et al 1986; Flint et al 1988a; Mackintosh 1993; Day 1997; Wilson et al 1998; Midwinter 1999). 10

1.4. A Summary of the pathogenesis and origin of the pathophysiology of the disease at the cellular level. 16

1.5. Summary of diagnostic test and their use in the medical and epidemiological investigations 22

Attachment 1

1. Summary of clinical and research reports of leptospirosis in deer in New Zealand. MAT = Microscopic Agglutination Test, ND = Not done or not described, Weaner = 3-13 months of age, Neg = Negative; Pos = Positive. 48

2. Data summarised from quarterly veterinary diagnostic laboratory reports in various issues of Surveillance (Ministry of Agriculture and Forestry and its predecessors, Wellington, New Zealand) describing leptospirosis cases in deer since first reported in 1980. 50

3. Epidemiological definitions of leptospiral host status (Hathaway 1981b). 50

4. Relationship between leptospiral host category and clinical and/or sub-clinical expression of disease (Heath and Johnson 1994) 50

Attachment 2

1. Publication, country, deer species, sample size, diagnostic method and lesion status in global reports of leptospirosis in deer (1923-2005) by region. (Expt = experimental challenge, ND = not done or not reported, NS = not stated). (Deer species taxonomic names are presented in Table 5.2) 60

2. Deer species and number of reports of leptospirosis in the 66 used publications. 65

3. Number of reports of each serovar reported in deer in four regions from 1923 to 2005. Excluding experimental challenges. 66
4. Number of reports (and percentage of publications in which each serovar has been reported within each habitat) in naturally infected deer. 66
5. Leptospiral serovars isolated from deer, type of infection, number of reports, country, proportion of sample culture positive, and serological titres reported.* number of cultures was not stated. 67

Chapter 2

- 2.1. Description of trial farms. Hb. & Pom. = Hardjobovis and Pomona, Hb. & Pom. R = Hardjobovis and recent introduction Pomona. 71
- 2.2. Weaner trial groups by farm. 74
- 2.3. Summary of pregnant hind vaccine trails
75
- 2.4. Example of manipulation, with sample number, titre and coded titre, (above) and description of back transformation of the Geometric mean of those titres (below). 84

Chapter 3

- 3.1 Summary of a regression analysis and Relative Risk for the relationship between Copenhageni and Hardjobovis and Pomona at different cut points. (Only statistically significant comparisons are included). 99
- 3.2. Seroprevalence of each serovar, and infection status of re-sampled herds sampled in both 1992-3 (92-3), and 2004-5 (04-5). 100
- 3.3. Summary of number (n) and % of deer sampled that were Hardjobovis seropositive at a cut point of $\geq 1:24$, and reciprocal titre of the geometric mean titre (GMT) at each sampling period, by age category and sampling month. 106
- 3.4. Summary of number (n) and % of deer sampled that were Pomona seropositive at a cut point of $\geq 1:14$, and reciprocal titre of the geometric mean titre (GMT) at each sampling period, by age category and sampling month. 107
- 3.5. Summary of number (n) and % of deer sampled that were Copenhageni seropositive at a cut point of $\geq 1:14$, and reciprocal titre of the geometric mean titre (GMT) at each sampling period, by age category and sampling month. 108

Chapter 4

- 4.1. Summary of study farms and policies, leptospiral status, trial design, duration, sampling schedule and animal fate. 111

4.2. Summary of regression analysis for the relationship between the response variable seroprevalence to Hardjobovis at different titre cut points, and the effect variables group, Year, sampling month, and age in months.

115

4.3. Summary of regression analysis for the relationship between the response variable seroprevalence to Pomona at different titre cut points, and the effect variables group, Year, sampling month and age in months, and seropositive titres to serovar Copenhageni. 116

4.4. Relative risk (RR) (95%CI) for the regression analysis response variable Copenhageni titre against the effect variables Hardjobovis or Pomona titre at titre cut points $\geq 1:24$, $\geq 1:14$ and $\geq 1:96$. 117

4.5. Number of samples, proportion (%) positive and 95%CI for kidney pathology and culture, urine dark field microscopy and culture, and “live Leptospira index” positive, and serovar identification of isolates. 122

Chapter 5

5.1. Farms, location, general description, leptospiral status and experimental procedures. 133

5.2. Urine DFM and culture results for vaccinated and control deer on each farm. 144

5.3. Kidney culture results for vaccinated and control deer on each farm. 145

Chapter 6

6.1. Summary of trial design and vaccination and sampling dates for hinds. 157

6.2. Summary of trial design and vaccination and sampling dates for progeny. 158

6.3. Summary of regression analyses of seroprevalence in hinds for all serovars at different titre cut points. 160

6.4. Summary of regression analyses (χ^2 and p-value) and Relative Risk (95%CI) for the relationship between the response variable, seroprevalence in progeny at different titre cut points, and the effect variables hind (vaccinated or control), farm, and day in Year 1. 165

6.5. Summary of regression analyses (χ^2 and p-value) and Relative risk (95%CI) for the relationship between the response variable seroprevalence to serovars Hardjobovis, Pomona and Copenhageni at different titre cut points, and the effect variables hind (vaccinated or control) and day on Farm 4 Year 2. 166

Chapter 7

7.1 Summary of assumptions, and procedures, for estimating the number of herds and the number of samples per herd required to estimate herd seroprevalence for serovars

Hardjobovis and Pomona using the formula $n = Z^2 \alpha (pq) / L^2$ (see Table) for estimating proportions. 174

7.2. Number of herds calculated and actually sampled, by region, and sample source (Farm or DSP). 174

Chapter 8

8.1 Summary of regression analyses for relationships between white spot kidney lesions and serology, histopathology and culture. (95%CI in brackets) 190

8.3 Proportion of deer that were serologically positive with white spots on kidneys that were also culture positive, and a summary of the Yates corrected Chi-Square (χ^2) test for the alternative hypothesis that seroprevalence in culture positive deer with white spot lesions in the kidney (Ws(+), C(+)) is higher than in culture negative deer with white spot lesions in the kidneys (Ws(+), C(-)). The relative risk for each comparison (95% CI) is included. 192

Appendices

Appendix 1 raw data Chapter 3 (Serum Bank)	240
1. General data	241
Appendix 2 raw data Chapters 4, 5 and 6 (Farm Trials)	265
Table 2.1a List of abbreviations used for Appendix 2a.	266
Appendix 2a. Raw data for the natural infection and Vaccine efficiency trails (Chapters 4,5 and 6).	267
Appendix 2b. Weaner weights farm2, year 2004 by weighting month.	312
Appendix 3 raw data Chapter 7 (Regional survey)	317
Table 3.1a List of abbreviations and classification used in appendices 3a and 3c.	318
Appendix 3a. Regional survey individual animal serology results for each serovar, and region and farm number.	319
Appendix 3b. Questionnaire (Deer Farm Leptospirosis)	345
Appendix 3c. Questionnaire results	346
Appendix 4 raw data Chapter 8 (Deer Slaughter Premises)	353
Appendix 4.1 Complete raw data for serum and kidney samples collected at the deer slaughter premises.	354

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