Aim

The aim of this study was to determine whether there was Leptospira spp. infection or not in the Maniototo region of Central Otago. If so what was the prevalence, and, if possible, is this at a level where farmers would see profitable production responses as a result of instigating a vaccination programme.

Introduction

A recent survey throughout New Zealand showed eighty-one percent of deer herds tested were sero-positive for Leptospira spp. (Ayanegui-Alcérreca 2010). While this was an extensive serosurvey with 2016 animals sampled from 111 herds across nine regions, including Otago, there were no herds sampled from the Central Otago area.

Recently the New Zealand deer industry has shown an increasing amount of concern about the impact of leptospirosis in the New Zealand deer industry which may be associated with the promotion of the value of preventive vaccination programmes. The cost benefit of vaccination is entirely dependent on the within-herd prevalence. Wilson et al. (2009) determined the break even point for vaccination of young deer is 19% within-herd prevalence.

Materials and methods

Study design

A herd was considered sero-positive when both of the following conditions were met:

1. At least three out of twenty animals were sero-positive with a titre of ≥1/25 for Leptospira borgpetersenii serovar Hardjo-bovis and ≥1/50 for Leptospira interrogans serovar Pomona. The choice of the higher titre cut-point for Pomona was to increase herd-based specificity; this is based on the observation that deer are maintenance hosts for Hardjo-bovis, but accidental and possibly a maintenance population for Pomona (Ayanegui-Alcérreca 2010).

2. At least two of the Hardjobovis sero-positive animals had a titre of ≥1/50.
All procedures involving the use of live animals were approved by the AgResearch (Ruakura) Animal Ethics Committee (AEC 13380).

**Herds and sampling**

Twelve herds were selected based on the presence of suitable animals, suitable facilities and the owner’s willingness to participate. No herds had a confirmed history of vaccination of deer against *Leptospira* spp.

Sampling took place between 9 September 2014 and 3 December 2014.

Male and female red, red x wapiti and elk deer less than two years old were involved in the survey. The age criterion was based on preliminary data that indicated that this age group had the highest seroprevalence in deer herds, which should optimise the sensitivity of the serological result at herd level (Ayanegui-Alcérreca 2010).

Twenty deer were randomly selected from each herd for blood sampling. A random sample was achieved by dividing the number of eligible animals for sampling in the shed by 20, and using the resulting number as the interval between deer for blood sampling.

Blood samples were collected from the jugular vein whilst deer were being gently restrained by an experienced handler in a small pen or a hydraulic deer-restraining crush.

Blood samples were collected into a 10ml evacuated plastic tube without anticoagulant (Precision Glide Becton Dickinson Vacutainer Systems, Plymouth, UK), using a 20-G, 1-inch vacutainer needle for each animal. After collection blood samples were left to clot at room temperature, and then sent fresh by courier to New Zealand Veterinary Pathology, Palmerston North, where they were centrifuged at 3000 rpm for six minutes. The serum was then removed from the clot and stored in a plastic tube. Samples were frozen at -20ºC (+/-2ºC) until analysed.

**Serology**

Serology for serovars Hardjo-bovis and Pomona was performed at the serology laboratory at New Zealand Veterinary Pathology (NZVP) using MAT as described in detail by Ayanegui-Alcérreca (2006).

Cut points of 1/25 and 1/50 for serovars Hardjo-bovis and Pomona respectively were selected so the results could be compared with those of Ayanegui-Alcérreca *et al.* (2010).

Although the serovar *Leptospria interrogans* serovar Copenhageni has been included in previous seroprevalence surveys (Ayanegui-Alcérreca 2010), it was not included in the present study due to previously reported low seroprevalence at herd and animal levels, suggesting sporadic occurrence and the limited evidence of clinical significance of Copenhageni infection in deer (Ayanegui-Alcérreca 2007).
Descriptive analysis

Descriptive data are expressed as herd prevalence (percent) and within-herd prevalence (range).

Previous studies have found no differences in data in samples collected from males and females (Ayanegui-Alcérreca 2006), therefore, for the purpose of this study, both sources were considered equivalent.

Due to genetic cross-over in the deer industry it was decided not to include genotype or breed in the analysis.

Results

Data were available from 240 animals from 12 herds providing a cross-sectional study of the Central Otago region local to the Maniototo (Figure 1).

The number of herds sampled was much lower than the estimated number required for significant statistical analysis to be performed (Ayanegui-Alcérreca 2010) which meant descriptive analysis only could be used. For the purpose of a serosurvey, the number of herds sampled provided an adequate cross-section of herds.

In total four (33%) herds and 42 (17.5%) individual animals were sero-positive for Hardjo-bovis. One animal (0.4%) was sero-positive for Pomona infection, but no herds were classified as sero-positive for this serovar. No dual sero-reactivity was recorded in this survey (Table 1).

The within-herd seroprevalence for Hardjo-bovis ranged from 0 to 35% with the seropositive herds having a mean seroprevalence of 26.3%.

An indication of the activity of infection within sero-positive herds can be taken from the numbers of animals at each titre, presented in Table 1.
Leptospirosis in deer – a local survey

### Table 1. The numbers of animals represented by each titre in the herds tested

<table>
<thead>
<tr>
<th>Herd number</th>
<th>Number (%) of animals at each titre</th>
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<tbody>
<tr>
<td></td>
<td>L. hardjo</td>
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<tr>
<td>1</td>
<td>2 (10%)</td>
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<tr>
<td>2</td>
<td>5 (25%)</td>
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<tr>
<td>3</td>
<td>2 (10%)</td>
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<tr>
<td>4</td>
<td>3 (15%)</td>
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<td>5</td>
<td>2 (10%)</td>
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<td>6</td>
<td>3 (15%)</td>
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<tr>
<td>7</td>
<td>3 (15%)</td>
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<tr>
<td>8</td>
<td>4 (20%)</td>
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<tr>
<td>9</td>
<td>3 (15%)</td>
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<tr>
<td>10</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>11</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>12</td>
<td>2 (10%)</td>
</tr>
</tbody>
</table>

Four herds (2, 4, 10 and 12) were sero-positive for Hardjo-bovis. Herds 2 and 12 had a low-level exposure and Herds 4 and 10 a very low-level exposure (suspicious).

Four herds showed 15–20% individual animal sero-positivity with titres of 1/25. As only one individual had a titre of 1/50 across these four herds, it was concluded that this was not evidence of sero-positivity in these herds.

**Discussion**

Ayanegui-Alcerreca (2010) showed that leptospirosis is widespread in deer herds throughout New Zealand, but this local study suggests there may not be a uniform distribution of the disease throughout the country. A very different herd seroprevalence (33%) of *Leptospira spp.* was found in the region studied compared to the 81% found in the New Zealand serosurvey by Ayanegui-Alcerreca (2010). However, consistent with the New Zealand serosurvey, was the predominance of Hardjo-bovis, at both the herd and the individual level. No evidence was found of herd-level infection with Pomona, but the individual animal seroprevalence (0.4%) was less than the 8.4% found in the New Zealand serosurvey (Ayanegui-Alcérreca 2010).

This cross-sectional study did not demonstrate the serological status over time. Perhaps leptospirosis infection is recent to this region, resulting in the low levels of activity. Further investigation into this is needed, and in the future we may see a trend in the levels of activity indicating whether this is an acute or chronic state for the region. Herd 2 has been tested for *Leptospira* spp. in the past with no sero-positivity found so the results of this survey may indicate a recent infection.
The results of this local survey, suggesting that the prevalence of leptospirosis may vary throughout New Zealand, may have implications on the ability to make informed decisions related to the cost-benefit of a leptospirosis vaccination programme.

Wilson et al. (2009) discussed that whether vaccination is economic or not is difficult to predict as there are no reliable figures for expected response to vaccination. The economic returns from vaccination are associated with improved weight gain in young deer from weaning to twelve months and reproduction performance in breeding hinds.

To get some indication of a predicted weight gain response data from Subharat et al. (2008) has been used to show the relationship between within herd seroprevalence and weight gain (Figure 2). Note that two of the data points are not significant production responses.

The analyses presented here are based on the following assumptions:

- Cost of vaccination (inc. sensitiser, booster, labour and sundry) – $3.22/animal
- Dressing out percentage – 56%
- Schedule price – $8/kg
- Liveweight gain in young deer from March–November extrapolated from Subharat et al. (2008) (Figure 2)

**Figure 2.** Relationship between weight gain in response to vaccination in young deer between March and November and herd seroprevalence of Hardjo-bovis (Adapted from Subharat et al. (2008))

- \(R^2 = 0.9686\)

**Example: Herd 2**

Vaccination of a herd with 35% seroprevalence should provide an approximate response of 22g/day in the infected animals which is equivalent to 4.6kg liveweight or 2.6kg carcass weight worth $20.80.

If this was a herd of 100 deer, 35 would be infected, giving a potential return of $728 from a $322 investment; a 226% return on investment.
Analysing the other three sero-positive herds from this study showed that vaccinating herd 4 with a 20% seroprevalence may give a potential 117% return on investment and herd 10 with a 25% seroprevalence may give a potential 153% return on investment.

So it is possible, based on the assumptions above, that the four sero-positive herds from the twelve in this study would see a profitable return on investment from vaccinating the young deer.

Less data is available to predict expected weaning rate responses at different levels of seroprevalence. Subharat et al. (2008) reported a 4.7% increase of weaning rate in vaccinated rising two-year-old hinds compared with their unvaccinated herd-mates with a trend of increased weaning rate with increased seroprevalence of Hardjo-bovis.

Wilson et al. (2009) showed a break-even point for economic return is an improvement in weaning of 1.3%.

Conclusion

The prevalence of leptospirosis in deer herds in Central Otago is likely to be lower than in other areas of New Zealand. This highlights the need to determine a herd’s seroprevalence before making decisions to vaccinate.

Hardjo-bovis was the most prevalent serovar at herd and individual animal level, which is consistent with earlier data from farmed deer within New Zealand and there was little evidence of infection with Pomona.

Further research is needed to provide more meaningful correlations between within-herd prevalence and weight gain and weaning rate responses. However, there are other, perhaps non-economic, benefits from a leptospirosis vaccination programme, especially because leptospirosis is an important zoonosis.

Vaccination programmes could be regarded as insurance policies. In the case of leptospirosis this means taking out an insurance policy for the farming family and employees. However, if a farmer’s decision to vaccinate is based on profitable production responses alone then individual herd seroprevalence needs to be assessed. More information is required before we can predict these responses and, therefore, an accurate return on investment.

Acknowledgements

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References

For formatting purposes, all original long URLs have been condensed using the ow.ly format.


