Neospora then and now: Prevalence of *Neospora caninum* in Maritime Canada in 1979, 1989, and 1998

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Abstract — The seroprevalence of *Neospora caninum* was compared among New Brunswick, Nova Scotia, and Prince Edward Island in 1998, 1989, and 1979. In 1998, the seroprevalence was lowest in Prince Edward Island, where it was the same as in 1989. *Neospora caninum* was present in 1979, but at a lower prevalence.

Résumé — ***Neospora* auparavant et maintenant : prévalence de *Neospora caninum* dans le Canada maritime en 1979, 1989 et 1998.** La séroprévalence de *Neospora caninum* a été comparée entre le Nouveau-Brunswick, la Nouvelle-Écosse et l'Île-du-Prince-Édouard en 1998, 1989 et 1979. En 1998, la séroprévalence était la plus faible à l'Île-du-Prince-Édouard, où elle était la même qu'en 1989. *Neospora caninum* était présent en 1979, mais la prévalence était plus faible.

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Neospora caninum, a protozoal parasite, is a common cause of abortion in dairy cattle in North America. Diagnosis of *N. caninum* abortion in dairy cattle in Ontario increased from 1.6% of abortion submissions in 1993–94 to 5.7%, 11.4%, 12.5%, and 15.8% in 1994–95, 1995–96, 1996–97, and 1997–98, respectively (1). Since 1994, it has been the most commonly diagnosed cause of abortion in dairy herds in Ontario. In Quebec, 11.4% of all aborted bovine fetuses submitted to diagnostic laboratories in 1996 were infected with *N. caninum* (2). In California, in a nonrandom prospective study in 1991, 42.5% of aborted fetuses were found to be infected with *N. caninum* (3).

Cows that become infected with *N. caninum* appear to remain infected for life. Infection is acquired through vertical (dam to offspring in utero) or horizontal transmission (2). Domestic dogs have recently been identified as a definitive host of the organism (4). In a study in California (5), seropositive primiparous animals were 7.4 times more likely to abort than were seronegative primiparous herd mates. Seropositive first lactation cows were 1.7 times more likely to abort their first pregnancy of that lactation. In a Quebec case-control study, 22.5% of cows within herds with a previously diagnosed *N. caninum* abortion were seropositive, whereas the seroprevalence in herds without diagnosed *N. caninum* abortions was 7.5% (2).

Although the first diagnosed cases of *N. caninum* abortion occurred in New Mexico in 1989 (6), there is much speculation over whether this is an emerging disease or if recent advancements in diagnostic abilities and increased surveillance have lead to the increase in diagnosis. Retrospectively, *N. caninum* has been demonstrated in Australia in a previously undiagnosed stillborn calf, dating back to 1974 (7). In Canada, *N. caninum* abortion was first reported in 1994, in both British Columbia and Prince Edward Island (8,9).

The objective of this research was to ascertain the current seroprevalence of *N. caninum* in dairy cattle in the Maritimes and compare that value with the seroprevalence in the late 1980s and late 1970s.

For the 1998 seroprevalence information, 30 dairy herds were randomly selected from each of the 3 Maritime provinces (New Brunswick, Nova Scotia, and Prince Edward Island). Herds were selected from the approximately 200 herds participating in the milk recording program of the Atlantic Dairy Herd Improvement Corporation in each province. Within these 90 herds, serum samples were taken from 30 randomly selected lactating cows, between June 1 and August 20, 1998. In herds with less than 30 lactating cows, all milking animals were sampled. Serum samples were frozen at −20°C prior to shipment, in a single batch, to the diagnostic laboratory.

Samples from 1989 were available from a serum bank, stored frozen at −20°C, at the Atlantic Veterinary College. These samples had been collected from a random sample of dairy farms in Prince Edward Island as part of an assessment of bovine leukemia virus and *Leptospira* infection. In total, 516 samples from 28 herds were tested (18 to 19 per herd). Samples from 1979 were available from a serum bank at the Canadian Food Inspection Agency in Ottawa, Ontario. These samples had been collected randomly in the Maritime region as part of a nationwide bovine leukemia virus prevalence survey of dairy and beef cattle, and were stored in a lyophilized form. In total, 127 useable samples were available from 10 randomly selected dairy farms. Sera in this bank were from lactating and dry cows within the selected herds, and the number of available samples

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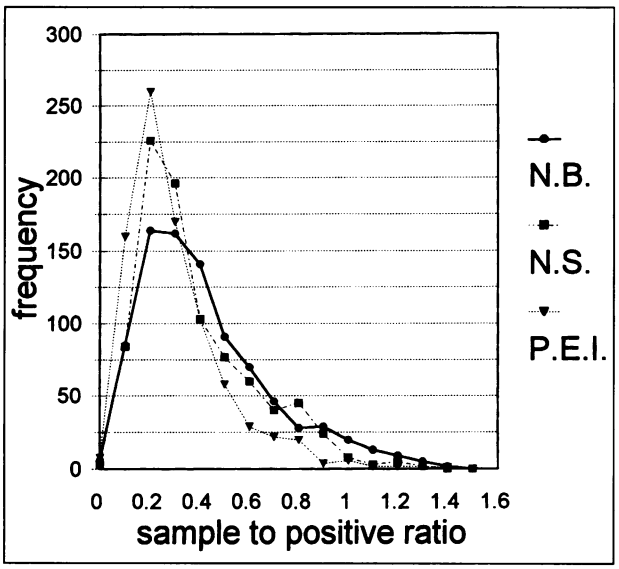

Figure 1. Frequency histogram of *Neospora caninum* sample to positive control ratios for New Brunswick (N.B) (n = 871), Nova Scotia (N.S.) (n = 876), and Prince Edward Island (P.E.I.) (n = 847) in 1998.

per herd ranged from 5 to 20. Five of these farms were in Prince Edward Island, 3 in New Brunswick, and 2 in Nova Scotia.

All sera (1979, 1989, and 1998) were tested with an enzyme-linked immunosorbent assay (ELISA). By using a sample to positive (S/P) ratio cutoff value of 0.60, the technique had a reported sensitivity and specificity of 99% and 98.4%, respectively (10).

The results were interpreted at the herd and cow level for 1998 and 1989, but only at the cow level for 1979, because the within-herd numbers were very low. For cow level interpretation, a cutoff S/P ratio for the ELISA of 0.60 was used for the 1998 and 1989 samples. When the lyophilized 1979 samples were reconstituted and assayed, there was a consistent high background ELISA score. The average of the negative sera (based on 0.60 cutoff) in 1998 and 1989 was 0.32 and 0.36, respectively. The average of the negative sera (based on 0.60 cutoff) in 1979 was 0.48. Because of this elevated background, the S/P ratio cutoff for interpretation of the 1979 samples was raised by the difference between the average of the negatives in 1989 and 1998 (0.34) and the average of the negative 1979 samples (0.48), or 0.14 of a unit, to 0.74.

The criterion for herd level analysis was also conservative. Despite the fact that the test had very good reported sensitivity and specificity, when a large number of animals within a herd were tested, there was a substantial chance of falsely calling a herd positive, if a single positive animal was used as the criterion. In an attempt to prevent over-diagnosis at the herd level, we chose a criterion of 2 cows with a S/P ratio of greater than 0.60 as the minimum threshold.

The ELISA S/P values for 1998 were available for 2594 individual animals on 90 farms, 30 from each Maritime province. In total, 497/2594 (19.2%) had S/P ratios of more than 0.60 (95% CI; 17.6% to 20.8%). The range of S/P values was 0.06 to 1.42. The prevalence of infection in New Brunswick, Nova Scotia, and Prince Edward Island was 222/871 (25.5%) cows (95% CI; 22.5% to 28.5%), 187/876 (21.3%) cows (95% CI; 18.5% to 24.1%), and 88/847 (10.4%) cows (95% CI; 8.3% to 12.5%), respectively. Figure 1 illustrates the frequency of various S/P ratios by province.

Using the criterion outlined above, namely, 2 animals with S/P ratios greater than 0.60 per herd, 71/90 (78.9%) herds were found to be infected (95% CI; 70.3% to 87.5%). In New Brunswick, 27/30 (90%) herds (95% CI; 79.0% to 100%) were found to be positive, and 28.2% of animals (95% CI 25.0% to 31.4%) within positive herds were found to be infected, an average of 8.2 infected animals per positive herd. In Nova Scotia, 25/30 (83.3%) herds (95% CI; 69.3% to 96.7%) were found to be positive, and 24.6% of animals (95% CI; 21.5% to 27.7%) within positive herds were infected, an average of 7.4 infected animals per positive herd. In Prince Edward Island, 19/30 (63.3%) herds (95% CI; 45.7% to 80.9%) were found to be positive, and 15.3% of animals (95% CI; 12.2% to 18.4%) within positive herds were infected, an average of 4.4 infected animals per positive herd.

Overall, the proportion of 1989 sera with S/P ratios of 0.60 or greater was 78/516 (15.1%) (95% CI; 11.9% to 18.3%). The range of S/P values was 0.11 to 1.83. Twenty-one of 28 (75%) herds in Prince Edward Island (95% CI; 58.6% to 91.4%) were found to be positive, if the criterion for herd diagnosis outlined above was used. Within positive herds, at that time, an average of 18.5% of animals were found to be infected (95% CI; 14.6% to 22.4%).

The range of values for the S/P ratios for the 1979 samples was 0.01 to 1.18. The seroprevalence for the 1979 samples, using the criterion outlined above (S/P ratio 0.74 or higher), was 11/127 (8.7%) (95% CI; 3.7% to 13.7%).

Evaluation of the data for the 3 provinces in 1998 indicates that Prince Edward Island had a lower overall cow level prevalence of infection than either New Brunswick or Nova Scotia. The prevalence of infection was not different between New Brunswick and Nova Scotia. The lower seroprevalence in Prince Edward Island resulted from a lower prevalence of infection within infected herds and numerically, but not significantly, fewer positive herds.

Samples from 1989 and 1998 can be compared for Prince Edward Island only. The overall prevalence of infection between the 2 decades was remarkably similar, both at the herd and cow level. Because of differences in sample storage and handling, comparison of the 1979 results with the 1998 results is challenging. The S/P ratio cutoff value for the 1979 data was adjusted to reflect the increased background readings from the ELISA with these lyophilized samples. This adjustment potentially gives a conservative estimate of the seroprevalence at that time. One sample in the 1979 data set had an S/P ratio of 1.18, which would have put it in the top 2% of S/P ratios from both 1989 and 1998. It is apparent that *N. caninum* was present in the region at that time, although probably at a lower prevalence than is currently observed.

From these data, it is apparent that *N. caninum* infection was present long before the first regionally diagnosed

cases in 1994 (9). The current prevalence is similar to 10 y ago and, although it seems certain that the disease was present 20 y ago, the prevalence may have increased to the current plateau sometime between 1979 and 1989.

More research is required to determine herd and cow level risk factors for infection. Additionally, the consequences of infection, both for reproductive performance and other measures of health and productivity, need further evaluation.

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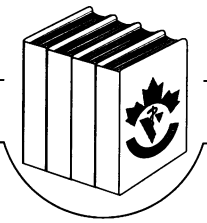
BOOK REVIEW



COMPTE RENDU DE LIVRE

Matthews J. ***Diseases of Goats.*** Blackwell Science, Oxford, 1999. 367 pp. ISBN 0-632-0167-1.

With the increasing popularity of both meat and milk goats across North America, any text covering this unique animal is a welcome addition to my library. The author presents the information in this text in a concise manner, using bullet lists, tables, text boxes, and flow charts. Each disease is broken down into its etiology, clinical signs, diagnosis, postmortem findings, treatment, and prevention. The treatment lists cover most of the options available, with the author adding cautionary notes on drugs not approved for goats or animals used for meat or milk production. The format allows the reader to quickly find information. Instead of a reference list, the author directs the reader to further reading material at the end of each chapter. The first 5 chapters follow the life-cycle of a goat, starting with reproductive evaluation and diseases of the doe and buck. The following chapters cover gestation, periparturient problems, and the causes and treatment of weak kids. Thereafter, the series of chapters cover specific diseases of body systems. The final chapters cover plant poisoning, anesthesia, disbudding, dehorning, and surgical techniques. The appendix contains information on the normal goat, including a girth measurement to body weight conversion table, growth tables, and normal clinical pathology values. A section on drug dosages, routes of administration, and responsible use of drugs follows. Also included are diagnostic reference charts which summarize the clinical and diagnostic steps required to identify causes of weak kids, chronic weight loss, nervous diseases, and diarrhea. Although this book covers problems present in the United Kingdom and drugs that may not be familiar to veterinarians in North America, there are more similarities than differences. This book is a valuable reference and I recommend it to both veterinarians and students who have an interest in small ruminants, in particular goats.

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