A questionnaire on the health, management, and performance of cow-calf herds in Québec

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Abstract — Questionnaires were mailed to 520 cow-calf producers in Québec in order to compare management practices and herd performance according to herd size (small: < 40 females, or large: ≥ 40 females) and in 4 geographic areas for the 1995 calving season. Owners of large herds adopted management practice and preventive measures more often than did owners of small herds. Average calving and weaning rates were 95% and 87% respectively. Average perinatal and preweaning mortality rates were between 4.9% and 5.6%. A greater percentage of owners with large herds than owners of small herds reported diarrhea and pneumonia problems. Among large herds, the number of herds experiencing pneumonia and calf mortality associated with diarrhea tended to be higher in areas of the northwest. Calf mortality due to pneumonia was higher in the northeast. No regional variation was found among small herds. Further research is needed to identify diseases risk factors.

Résumé — Questionnaire sur la santé, la gestion et le rendement de troupeaux vaches-veaux au Québec. Un questionnaire a été posté à 520 producteurs vaches-veaux du Québec. L'étude visait à comparer la santé et le rendement des élevages pour l'année de production 1995 selon la taille des troupeaux (petit : < 40 vaches, ou grand : ≥ 40 vaches) et entre les quatre régions géographiques. Les techniques de régie et les mesures préventives étaient plus souvent utilisées par les propriétaires de grands troupeaux que par ceux des petits troupeaux. Les indices de vêlage et de sevrage moyens étaient respectivement de 95 % et de 87 %. Les indices de mortalité périnatale et avant le sevrage moyens variaient entre 4,9 % et 5,6 %. Un plus fort pourcentage de propriétaires de grand troupeaux ont rapporté des problèmes de diarrhée et de pneumonie que ceux de petits troupeaux. Parmi les grands troupeaux, la proportion d'élevage avec des problèmes de pneumonie et de mortalité avant le sevrage associée à la diarrhée tendait à être plus élevée dans la région du Nord-Ouest. La mortalité associée à la pneumonie était plus élevée dans la région du Nord-Est. Aucune variation géographique n'a été observée chez les petits troupeaux. Une recherche plus poussée des facteurs de risque des maladies des élevages vaches-veaux est nécessaire.

(Traduit par les auteurs)

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Introduction

Cow-calf production in Québec represents over 220 000 breeding females and involves nearly 7000 farms (1). In the past few years, the total number of cow-calf producers has decreased, while the average size of herds has increased (2).

In 1990–1991, Ganaba et al (3) reported that the percentage of weaned calves was as low as 78.8% on average in 26 randomly selected herds from Abitibi-Ouest, in northwestern Québec (Figure 1). Most production losses were attributable to a 14.7% overall calf mortality. Couture and Major (4) had reported an overall calf mortality rate of 14.3% in the same area in 1988. No other study describing cow-calf herds in Québec has been reported. Large surveys were performed at the end of the 1980s in Ontario (5–7) and Alberta (8), and in 1996 in the United States (9,10).

The purpose of this study was to describe the health, management, and reproductive performance of cow-calf herds from different regions of Québec and to compare these results with findings previously reported in Québec and elsewhere in North America. The role of herd size and regional variation in health problems was also addressed.

Materials and methods

Questionnaire design

The questionnaire (available upon request from the corresponding author), written in French and in English, included 95 questions about the 1995 calving season. The first section gathered general information about the owner or respondent and demographic information on the cow-calf herd. Other sections emphasized reproduction, calf health and management practices, replacement heifers, cow health, management and culling practices, record keeping, animal identification, and miscellaneous information. Questions were of 3 types: (1) closed (42%), (2) open-ended (24%), and (3) semi-closed (34%) (3). The questionnaire was evaluated by 7 cow-calf producers, 3 agronomists, 5 veterinarians, and 1 representative of the Québec beef producers federation.

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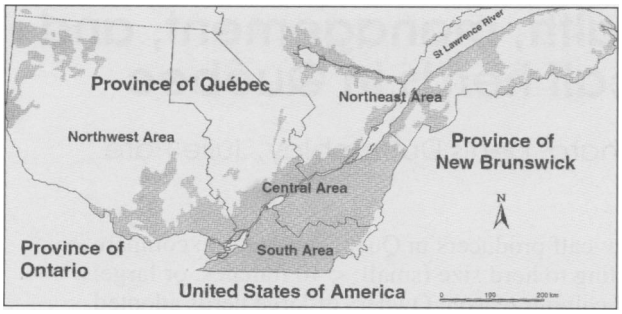

Figure 1. Regions of the province of Québec studied with the questionnaire survey. Shaded area indicates cultivated farm land.

Following their recommendations, corrections were made.

Study population and sample selection

Herds were selected from a 1995 census of cow-calf producers in Québec. Only herds with 12 or more breeding females (heifers and cows) were included. As indicated by the census data, the distribution of herd sizes was bimodal. Therefore, herds were classified in 1 of 2 categories: small herds; herds with < 40 females, and large herds; herds with ≥ 40 females. These categories had also been used in a previous publication on Québec cow-calf herds (2).

Three hundred and 200 producers, from the small and large herd categories, respectively, were randomly selected. To ensure that a sufficient number of replies were received from owners of large cow-calf production herds found mainly in the northwestern region, and because a nonresponse rate of 40% was expected, 20 additional participants were randomly drawn from the list of large herds from this area.

Data collection

A cover letter explaining the project was sent between mid-May and mid-June 1996 to each of the 520 selected participants. One to 2 wk later, a questionnaire and a stamped, preaddressed return envelope were mailed. Two weeks after mailing the questionnaire, a short letter was sent inviting producers who had failed to respond to complete and return the questionnaire. A final reminder was sent 4 wk later. Producers who had failed to respond were asked with each reminder why they had not completed the questionnaire and how many years they had been involved in the cow-calf business. A preaddressed and stamped return envelope was again provided.

Measured outcomes and definitions

Most measured outcomes were derived from Hamilton (11) and were calculated as follows. The calving percentage was defined as the number of females that calved divided by the number of females that had been exposed to the bull × 100%. The weaning percentage was the number of calves weaned divided by the number of females that had been exposed to the bull × 100%. The culling percentage was the number of cows and heifers that died or were sold in 1995 divided by the number of females that had been exposed to the bull × 100%. The adult female mortality was calculated from the number of cows and heifers that died in 1995 divided by the number of females that had been exposed to the bull. The perinatal mortality was the number of stillborn calves and calves that died during the first 24 h of life divided by the number of calvings. The preweaning mortality was the number of calves that died between 24 h from birth and weaning divided by the number of calves that were alive at 24 h. Specific preweaning mortality due to either diarrhea or pneumonia was calculated from the number of calves that died from a particular disease divided by the total number of calves that died between 24 h and weaning. The percentage of herds with pneumonia or diarrhea was calculated as the number of producers who answered "yes" when asked if calves suffered from these diseases in 1995 divided by the total number of respondents. Dystocia rates for cows and heifers were calculated from the number of cows or heifers that had a difficult calving divided by the number of cows or heifers that calved × 100%. A difficult calving was defined as any calving that required a cesarean, a fetotomy, or a hard pull on the calf by the owner or the veterinarian. The herd dystocia rate was the number of cows and heifers with a difficult calving divided by the number that calved in the herd.

Validation and statistical data analysis

Data validation was performed by using descriptive analyses, histograms, and scatter plots. Comparisons of answers to specific questions with respect to herd demography were made to validate data. Aberrant results were individually reexamined and considered as missing data when the question seemed to have been misinterpreted. Two questions (one about the total income from agriculture and one about reasons for culling) were excluded from analysis because of evidence that was misinterpreted.

In order to examine regional variations, owners of each type of herd were classified into 1 of 4 large climatic regions (northeastern, central, southern, and northwestern) (12) (Figure 1). Because the number of herds in each category was not necessarily equal in each region, the representativeness of the respondent population from each region was tested. For each type of herd, the percentage of respondents from one region (number of respondents from this region divided by the total number of respondents from all regions × 100%) was compared with the percentage of producers from the same region within the study population (the number of cow-calf producers from each region divided by the number of cow-calf producers in Québec according to the 1995 census × 100%). The one-sample Z-test was used to test the null hypothesis that the respondent percentage was similar to the overall percentage in the population (13).

The Pearson chi-squared was used to test for each type of herd, the relationship between binomial variables, and regions of origin. For all regions confounded, the same test was used to examine the association between the size of herds and 1) different characteristics of the producers, 2) specific breeding management practices, 3) management practices and preventive medicine measures, and 4) the percentage of herds that experienced

Table 1. Percentage of respondents compared with the proportion of producers within the study population by region and herd size category

Region	Herds with < 40 females		Herds of ≥ 40 females	
	Respondent[a] %	Study population %	Respondent[b] %	Study population %
Northwestern	20	22	32	28
Northeastern	14	18	16	16
Central	36	32	35	34
Southern	29	28	17	22
Total	100	100	100	100

[a]2 respondents were not included because they did not identify the region
[b]6 respondents were not included because they did not identify the region
All comparisons between respondents and the study population for each herd size category are nonsignificant

diarrhea and/or pneumonia in calves in 1995. Finally, the chi-squared test was used to evaluate the association between herd vaccination against neonatal diarrhea and the occurrence of diarrhea in the herd. Because several cell values were less than 5, Fisher's exact test was used to relate the occurrence of pneumonia across regions to herd size.

Analysis of variance, followed by the Bonferroni test for multiple comparisons, was used to compare group means among regions for the owner's age and experience in cow-calf production, adult and calf mortality, and specific calf mortality rates. For these same variables, Student's *t*-test was used to evaluate if the sample means were similar between herd size categories.

Linear regression models were used to examine for each type of herd the association between calf mortality and the herd dystocia rate, and the length of the calving period. For all tests, the null hypothesis was rejected at $P \leq 0.05$. Analyses were performed by using the Statistical Analysis System (SAS, Version 6.10, SAS Institute, Cary, North Carolina, USA)

Results

Returned and completed questionnaires

Of the 520 questionnaires sent out, 188 were not returned. Obvious reasons for failing to participate were producer not involved in cow-calf production in 1995 ($n = 52$) and death of the owner ($n = 1$). These 53 producers were not included in the study. Among the remaining 467 producers contacted, 71% (small herds $n = 182$; large herds $n = 150$) completed the questionnaire. The response rate did not statistically differ across regions for both types of herds, although owners of large herds from the southern and northwestern regions responded at a slightly lower rate (southern 58%; northwestern 60%; central 69%; northeastern 70%). The percentage of respondents from each region was similar to the percentage of producers from the same region within the study population, for each herd size category (Table 1). Therefore, data from all regions were pooled for further analyses.

Respondent characteristics (Table 2)

Most cow-calf producers in Québec are sole owners, but cow-calf production is usually not the main source of income for these producers.

Table 2. Characteristics of Québec producers and businesses according to herd size

	Percentage of producers	
	Herds with fewer than 40 females ($n = 182$)	Herds of 40 females or more ($n = 148$)
Sole owner	80	72
Percentage of total income from cow-calf production:		
< 51%	79	51[a]
≥ 51%	21	49
Experience in cow-calf production:		
1 to 5 y	24	12[b]
6 to 10 y	19	28[b]
11 to 20 y	37	35
> 20 y	20	26
Previous experience in dairy production	44	30[b]
Stocker calves also	16	34[a]
Feedlot also	10	18[b]
Plan to expand	40	35
Sources of information:		
Magazines	70	77
Veterinarians	44	56[b]
Other producers	52	45
Agronomists	15	29[b]
Conferences	10	32[a]

[a]Values on the same row differ ($P \leq 0.001$)
[b]Values on the same row differ ($P < 0.05$)

Owners of large herds were younger (44 ± 11 y, $n = 139$) than owners of small herds (50 ± 13 y) ($P < 0.001$). Large herd owners also had, on average, more experience than did small herd owners ($P = 0.03$). Twelve percent of large herd owners had fewer than 5 y of experience with the cow-calf business, while 28% had between 6 and 10 y of experience. In contrast, owners of small herds were twice as numerous within the 1 to 5 y experience category (24%) but only 19% within the 6 to 10 y category.

Owners of large herds were more frequently involved in stocker calves and feedlot productions than were small herd owners, although the 2 activities occurred infrequently. Fewer large herd owners than small herd owners had experience with dairy cows. The percentage

Table 3. Percentage of Québec cow-calf producers using specific breeding management practices according to herd size

	Percentage of producers	
	Herds of < 40 females (n = 182)	Herds of ≥ 40 females (n = 148)
Heifers bred before adult cows	22	16
Bull breeding soundness evaluation	10	11
Heat synchronization	3	10[a]
Use of artificial insemination	25	31
Pregnancy diagnosis:		
some females	46	58[a]
every female	18	16

[a]Values on the same row differ ($P < 0.05$)

of owners who planned to increase the size of their herds was similar for the 2 types of herds. Among small producers, owners with dairy experience planned to increase the size of their herds less often than did producers without dairy experience ($P = 0.02$). Producers with dairy experience were, on average, older than those without dairy experience (small herds: 54 vs 45 y; large herds: 48 vs 42 y; $P < 0.01$). In both herd size categories, owners wishing to increase the size of their herd were usually less experienced (small herd $P = 0.03$, large herd $P = 0.01$).

Producers were asked to choose 2 principal sources of information on cow-calf production among the following categories: none, magazines, agronomist, veterinarian, management union, conferences, other breeders, and other. Magazines were most frequently cited; veterinarians and other producers came second or third in importance, depending on herd size. Owners of large herds relied on veterinarians, agronomists, and attendance at conferences more often than did owners of small herds.

Breeding and management practices

Few cow-calf producers adopted breeding management practices (Table 3). Owners of large herds used heat synchronization and relied on pregnancy diagnosis to a greater extent than did owners of small herds. Rates for adoption of preventive medicine measures and management practices are shown in Table 4. Large herd owners used these practices more often.

Herd performance as a function of herd size

There was no difference with respect to herd size for calving, weaning, culling and dystocia rates. Similarly, adult, perinatal, and preweaning mortality (Table 5) was similar for the 2 types of herds. Preweaning mortality due to diarrhea tended to be more frequent in large herds (Table 5), but this difference was only statistically significant in the northwestern region (Table 6). Mortality due to pneumonia was similar in small and large herds. However, the overall percentage of owners reporting diarrhea or pneumonia in calves was greater in large herds than in small herds (diarrhea: 58% vs 34%, pneumonia: 36% vs 16%, $P \leq 0.001$). In particular, the percentage of herds with diarrhea problems was higher in large herds for all regions except the south, whereas the percentage

Table 4. Management practices and preventive medicine measures according herd size

	Percentage of producers	
	Herds with < 40 females (n = 182)	Herds of ≥ 40 females (n = 148)
Dehorning before 2 mo of age[a]	53	70[b]
Castration before 2 mo of age[a]	71	82
Vitamin E-selenium injection to calves:		
first injection	68	87[c]
second injection	22	34
Vaccination of calves against blackleg	41	71[c]
Calves treated against lice and grubs[a]	29	53[c]
Calves treated against internal worms[a]	29	49[c]
Cows vaccinated	50	58
Cows treated against lice and grubs	62	70
Cows treated against internal worms	44	57
Cow identification visible from distance	43	73[c]
Calf identification visible from distance	52	80[c]
Weigh cows with a scale	7	33[c]
Weigh calves with a scale	17	49[b]
Record keeping (weight of calves, age of cows, health events, treatments)	70	85[b]

[a]Often or most of the time
[b]Values on the same row differ ($P < 0.05$)
[c]Values on the same row differ ($P \leq 0.001$)

of herds with pneumonia problems was higher in large herds for the 2 northern regions (Table 6).

Regional variations in herd performance

Among small herds, the rates of calving, weaning, culling, dystocia, adult mortality, and calf mortality (perinatal and preweaning) were similar across regions. There was also no difference across regions for preweaning mortality rates related to pneumonia or diarrhea, or for the occurrence of pneumonia or diarrhea in herds.

Among large herds, no differences occurred across the 4 regions for the rates of calving, weaning, culling, dystocia, adult mortality, and calf mortality (perinatal and preweaning). However, there was a tendency towards a higher percentage of preweaning mortality related to diarrhea in the northwestern region compared with the other regions. Significant differences were found across regions for pneumonia in calves: more herds from the northwestern region experienced problems than did those in the southern ($P = 0.005$) and central regions ($P = 0.015$). Mortality due to pneumonia was higher in the northeastern region than in the southern region ($P = 0.006$). Finally, average herd size in the large herd size category was higher in the northwestern region than in the central region ($P = 0.03$).

Other factors associated with mortality, diarrhea, and pneumonia

For the 2 types of herd, there was a positive association between herd dystocia rates and perinatal mortality

Table 5. Herd production performances, mortality, and culling rates

	Herd percentage					
	Herds with < 40 females			Herds of ≥ 40 females		
	Mean	Median	$S_{\bar{x}}$	Mean	Median	$S_{\bar{x}}$
Calving rate (%)	95	100	0.4	96	97	0.4
Weaning rate (%)	88	89	0.9	87	89	0.9
Culling rate (%)	17	12	1.8	16	12	1.3
Dystocia rate in heifers (%)	22.0	0	2.5	21.7	0	2.0
Dystocia rate in cows (%)	4.8	0	0.6	5.8	4.2	0.6
Adult female mortality rate	3.2	0	0.3	2.7	2.1	0.2
Perinatal mortality rate	4.9	4.0	0.4	5.2	4.1	0.4
Preweaning mortality rate	5.4	3.0	0.6	5.6	3.8	0.5
Rate of the preweaning mortality related to diarrhea	18.6	0	3.9	28.5	0	3.5
Rate of the preweaning mortality related to pneumonia	12.8	0	3.2	17.5	0	2.9

$S_{\bar{x}}$ — Standard error of the mean

Table 6. Comparative results for diarrhea and pneumonia problems in 4 regions of the province of Québec

	Average herd size		% herds with specific problems				% preweaning diseases related mortality			
	n, *s*		Diarrhea		Pneumonia		Diarrhea		Pneumonia	
Area	< 40	≥ 40	< 40	≥ 40	< 40	≥ 40	< 40	≥ 40	< 40	≥ 40
Northwestern	24, s = 10	80, *s* = 31	31	65[a]	11	54[b]	8	41[a]	14	22
Northeastern	25, *s* = 10	66, *s* = 29	26	68[a]	13	35[a]	18	22	8	35
Central	24, *s* = 9	62, *s* = 23	34	54[a]	19	30	19	19	17	13
South	23, *s* = 9	68, *s* = 40	39	44	17	12	23	26	11	2.2

s — standard deviation
Comparisons between herd size categories for each variable:
[a]Values on the same row differ ($P \leq 0.05$)
[b]Values on the same row differ ($P \leq 0.001$)

($P = 0.002$). Preweaning mortality was weakly associated with dystocia in small ($P = 0.04$) and large ($P = 0.055$) herds.

Small herds in which pneumonia in calves occurred had a longer calving period (5.75 mo) than did herds without pneumonia (4.04 mo) ($P = 0.006$).

A positive association was found between the length of the calving period and both preweaning mortality ($P = 0.002$) and the percentage of calves that died from pneumonia ($P = 0.05$) during the same period. In large herds, calving period was longer in herds with diarrhea problems than in herds without diarrhea problems (6.76 months vs 5 months respectively; $P = 0.002$).

Small herds in which a vaccine against neonatal diarrhea was used reported diarrhea problems more often than did those not using vaccination (55.6% vs 30.5%; $P = 0.01$). The percentage of preweaning mortality due to diarrhea tended to be higher in herds where producers vaccinated against neonatal diarrhea than in those where no such vaccination occurred (42.9% vs 14.3%; $P = 0.047$).

Discussion

The response rate of 71% was higher than first expected and was homogenous across regions for the 2 types of herd. Questionnaire presentation, stamped and pre-addressed envelopes, cover letters, and reminders may have contributed to the high response rate (14). Despite uneven sampling, comparisons between the respondent and study populations (Table 1) showed that all regions were proportionally represented.

Respondent characteristics

The small proportion of large herd producers within the "1 to 5 y of experience" category could mean that the enrollment rate into large cow-calf businesses has declined over the past 5 y. However, the provincial statistics indicate than the average herd size of cow-calf herds has increased (1,2). Our results also show that a large percentage of the less experienced producers planned to add female animals to their herds. This may suggest that producers buy small herds initially and gradually expand after a few years of experience.

Small herd owners are usually older, probably as a result of their greater past experience as dairy farmers. This would also explain why fewer cow-calf producers with dairy experience plan to increase the size of their herds. Traditionally, dairy barns in Québec held close to 40 lactating cows. For retired dairy farmers, expanding herd size would probably have involved large expenses for a new building and a bigger lot. The fact that fewer large herd owners possess dairy experience corroborates

the association between dairy experience and limited plans to increase herd size.

Small herd owners are also less involved in stocker calves and feedlot production. Since they produce a small number of calves per year, investment required for a feedlot operation would probably be greater than the additional income. Several small herd owners are also part-time cow-calf producers, and the time they can put into their operation is probably limited.

According to our survey, veterinarians were among the 2 most important sources of information for cow-calf producers. This agrees with results from a U.S. survey of 23 different states in 1996 (9). On average, 61% of American producers rated veterinarians as a very important source of information. The fact that veterinarians, agronomists, and conferences are more popular among large herd owners may indicate that the need for professional support increases with the size of the herd (9).

Breeding management practices

The adoption level of all the breeding management practices that we examined is low (Table 3), when compared with the results from a study carried out in Ontario between 1988 and 1989, showing that a large percentage of producers from Ontario checked bull breeding soundness (29%) and cows' pregnancy (79%) (5,6) and a report that 17% of American operations were using semen testing of bulls (9).

In Québec, the dairy operation is the predominant operation. Since dairy farmers rely mainly on artificial insemination, few veterinarians have the experience or the equipment required to perform a thorough bull breeding soundness evaluation and this may partly explain the low adoption rate of this measure by cow-calf producers. Differences between producers in Ontario and Québec in checking pregnancy are more difficult to explain. In Ontario, herds enrolled in the 1988–89 survey had higher performances than did nonenrolled herds (15). Therefore, results in Ontario may not accurately reflect cow-calf businesses throughout the province (15).

Heat synchronization is rarely used in Québec or the USA: only 3% of American producers use heat synchronization with cows and only 4.3% with heifers (16). On the other hand, artificial breeding of at least one female is more frequent in Québec (Table 3) than in Ontario (6,7) or the USA (9), where it is used in 15% and 7.1% of the herds, respectively. In Québec, the predominant role of the dairy industry may incline cow-calf producers towards artificial breeding. Artificial insemination might also be more popular now in Ontario than it was back in 1988–1989, the year of the survey. Greater use of heat synchronization and pregnancy diagnosis in large herds may be related to greater awareness of these new techniques by their owners.

In general, large herd owners seem to be more progressive than do small herd owners, as shown by the greater use of management practices and preventive medicine measures (Table 4). The proportion of the annual income from cow-calf production is greater for large than for small herd owners. Large herd producers might be more eager to make investments in cow-calf production. The incentive to use markings visible from a distance also probably increases with the number of cows, as other means of distance observation (animal coat color or pattern) are more likely to induce misidentifications in large herds. The profitability of other investments, such as a scale for cows or calves, is also more obvious in large businesses.

Management practices and preventive medicine measures listed in Table 4 are generally more widely adopted than are breeding practices. Producers in Québec dehorn before 2 mo of age more often than do American producers (18%) (9). The percentage of respondents in Québec performing early dehorning is similar to that in Ontario (59% of the producers dehorn before one month of age), as is the case for percentage of producers castrating early (68% castrate before 1 mo of age) or injecting vitamin E-selenium (90% of the producers) (5,6). However, fewer producers in Québec than in Alberta (41% vs 71%) vaccinate against blackleg (8). Similarly, producers in Ontario, in contrast to producers in Québec, vaccinate cows (Ontario 84%, Québec 50% (small) and 58% (large)) and treat cows against lice and grubs (Ontario 95%, Québec 62% (small) and 70% (large)) or internal worms (Ontario 83%, Québec 44% (small) and 57% (large)) more often (5,6). In the USA, 73% of producers dewormed cows in 1996 (10), a value close to the Québec figure.

Despite the fact that large herd owners used management practices more often, performance in terms of calving or weaning rate failed to ensue. Basarab (16), in a study on cow-calf herds from north central Alberta, reported a similar relationship between management practices and production efficiency.

Breeding performance

Average calving and weaning rates for Québec cow-calf herds (Table 5) are comparable with those published in Alberta (89% and 84%, respectively) (7), Ontario (95% and 88%, respectively) (5,6), and the USA (calving rate 93%) (10). Nevertheless, half of cow-calf businesses in Québec failed to reach the minimum production level (a calving rate between 90% and 94% and a weaning rate between 85% and 90%) necessary to ensure profitability (18). Moreover, the calving and weaning rates in some herds could have been overestimated. Since mailed questionnaire data rely mostly on the recall capabilities of respondents, some producers may have forgotten to take into account an open female culled between the exposure date and the calving or weaning period, which would lower the number of females exposed.

According to our survey, calf health is a major concern for cow-calf producers in Québec, especially among those owning large herds. Perinatal and preweaning calf mortality rates are higher than those reported in the USA (3.2% and 2.3%, respectively) (10), Alberta (2.3% and 2.6%, respectively) (8), and Ontario (between 3.4% and 4.2%, respectively, depending on the study year) (5,6). The 2 rates are also higher than the 2% to 3% rates judged acceptable in the literature (17). Calf mortality results from our study could be slightly overestimated, as the number of calvings, the variable used to estimate the number of calves born, does not take into account twin births. Lower mortality rates observed in Alberta may have been the result of predation on stillborn calves under extensive raising conditions. In some cases, dead calves may have been missed, which would lower estimates of mortality rates (19). Diarrhea and

pneumonia problems account for 31% and 46% of the losses in small and large herds in Québec, respectively, whereas 31% of calf mortality is attributable to digestive and respiratory problems in the USA (10). As indicated by our data validation, this difference could be explained partly by the fact that some owners sometimes attributed the death of a calf to both pneumonia and diarrhea. This will produce higher specific mortality rates. Differences in winter housing and weather conditions between Québec and the USA may also influence mortality rates of infectious diseases.

Herd size and regional variation

In general, diarrhea and respiratory problems are more important in large than in small herds, especially in the northern parts of the province. More problems related to diarrhea and pneumonia in large herds could be related to the higher risk of introducing new pathogens through the purchase of new calves (20). Indeed, for a given mortality rate, the risk of losing at least one calf during the calving period and, consequently, the chances that a calf will be replaced, increases with the size of the herd. However, this should be true for all areas of Québec, unless the practice of replacing dead calves varies across the province. The efficient administration of individual treatments may also be more problematic in large herds where individual treatment schedules rapidly become hard to follow. Also in large herds, several people may be in charge of animal health, which may impair treatment administration and follow-up (19).

Among large herds, differences observed for pneumonia occurrence and pneumonia mortality between northern and southern parts of the province might be due to colder weather conditions in the north (12). Ganaba (20) reported that calving areas and calf housing conditions in Abitibi were often deficient: disinfection was rarely performed, bedding was absent or infrequently changed, and the relative humidity of the environment was often high. Also, calves born in December through March were at a higher risk of dying (OR = 4.1) (3) than were those born in April and May. Unfortunately, our data do not permit a thorough evaluation of these factors for each region and each herd size category. Other variables, such as the existence of calving areas, the length of time calves remain in those areas, and genetic factors (20), would also need to be examined to better understand observed differences.

Other factors associated with mortality, diarrhea, and pneumonia problems

Dystocia rates were higher than the 2% rate for cows and 10% rate for heifers reported by Radostits et al (18). Dystocia rates were expected to be higher, as any strong traction applied on the calf by the producer was included in the calculations. McDermott et al (21) also reported median dystocia rates of 2.9% for cows and 18.8% for heifers. As shown in several studies, the perinatal and preweaning mortality rates are positively associated with calving difficulties (3,16,19,22–24). Therefore, veterinarians should strongly advise their clients on measures to reduce calving difficulties. In small herds where the maintenance of more than one bull is too costly, the use of semen from bulls with good calving ease indices could help to decrease calving difficulties (25).

The association between longer calving periods and higher calf mortality rates has been reported by Rogers et al (26). Calving supervision might be less intensive when the calving season is longer.

Walter-Toews (27) also reported a negative relationship between the occurrence of diarrhea problems and vaccination. These results may be associated with vaccination failure, but also with a misuse of vaccines (as a curative rather than a preventive measure). Several diarrhea vaccines also require vaccination of the cow according to a precise gestational stage, which can be difficult to achieve in herds where no breeding data (breeding date or gestation stage through pregnancy diagnosis) are kept.

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