Preventive Veterinary Medicine 125 (2016) 59–65

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

A cross-sectional study of factors associated with birth weights of Norwegian beef calves

Sindre T. Nelson*, Adam D. Martin, Ingrid H. Holmøy, Knut Karlberg, Ane Nødtvedt

Department of Production Animal Clinical Sciences, Faculty of Veterinary Medicine and Biosciences, Norwegian University of Life Sciences, Oslo, Norway

ARTICLE INFO

Article history:
Received 30 September 2015
Received in revised form 4 January 2016
Accepted 6 January 2016

Keywords:
Bovine
Cattle
Management
Recording system
Suckler cows
Offspring

ABSTRACT

A cross-sectional study was performed to evaluate factors which influence birth weights of beef suckler calves in Norway. Data were from a national beef cattle registry, and lifetime production data of cows slaughtered between January 2010 and January 2013 were included in the study population. The study population consisted of 20,541 cows and 53,819 calves. The analysis was performed on the subset of singleton calvings from which birth weights were recorded. The study sample consisted of 9903 cows with birth weights available for 29,294 calves. The mean birth weight was 43.47 kg (95% CI 43.40; 43.53). Two multilevel linear regression models were built; the first was for all calves and included parity of dam as one of the explanatory variables (with herd and cow as random effects), the second model was for calves born to primiparous dams only where age of first calving was included as an explanatory variable (with a random herd effect). The multilevel regression models estimated that female calves were 2.3 kg lighter than males (95% CI 2.2–2.4, $P < 0.001$), that calves of Norwegian Red, Charolais, Aberdeen Angus and "Other" born in the western part of Norway were lighter than from all other regions, and that calving in the autumn yielded lighter offspring than calving other parts of the year. Furthermore, calves born from primiparous cows were heavier than calves from older cows. Herd explained a large proportion of the variation in birth weights (40% and 37%, in the full and heifer models, respectively), and both the herd and cow random effects were highly significant. In conclusion, birth weights of beef calves in the Norwegian Beef Cattle Recording System were influenced by sex of the calf, breed of the dam, parity, age at first calving, calving season, cow, herd and region.

1. Introduction

There is no tradition for specialized beef production in Norway, where milk and meat for the domestic market have traditionally been produced by dual purpose Norwegian Red cattle. Over the past two decades, improvements in the breeding and management of Norwegian dairy cows have resulted in considerably higher milk yields per cow leading to a decrease in the size of the national dairy population, but still filling the nationally regulated milk quota (Kumbhakar et al., 2008). Beef is a by-product of the dairy industry and the reduction in the national dairy herd has led to a reduction in beef production in Norway. Concurrently the human population has increased and beef consumption has increased. Consequently, in 2012 more than 22% of the annual consumption of beef was imported into Norway (Animalia, 2013a). If domestically produced beef is to meet consumer demand, which is a political goal, the number of beef cattle must increase substantially over the next decade and their productivity must be improved (Ruud et al., 2013). Norwegian beef producers, as well as their veterinarians and advisors, therefore need information regarding factors affecting productivity in the national beef herd in order to increase the output in a sustainable manner.

In specialized beef production the successful rearing of calves for slaughter and replacement of breeding stock is a key factor determining herd profitability. Economic studies of the functional traits of beef production showed that fertility was the most important trait for sustainable suckler cow operations (Prince et al., 1987; Diskin and Kenny, 2014).

The optimal size of a calf will vary depending on the breed and parity of the dam, and there must be a balance between being large enough to be healthy and robust and not being so large as to cause dystocia. Birth weight is reported to be the single most important risk-factor for occurrence of dystocia (Nix et al., 1998; Bellows and Lammoglia, 2000), and dystocia can affect both the cow and calf

* Corresponding author at: Department of Production Animal Clinical Sciences, Faculty of Veterinary Medicine and Biosciences, Norwegian University of Life Sciences, P.O. Box 8146 Dep., N-0033 Oslo, Norway. Fax: +47 22597083.
E-mail address: sindre.nelson@nmbu.no (S.T. Nelson).

http://dx.doi.org/10.1016/j.prevetmed.2016.01.011
0167-5877/

Table 1
Generation of the study sample in a cross-sectional study of birth weights among Norwegian beef calves based on the Norwegian Beef Cattle Recording System (NBCRS) database.

Herds (*n*)	Cows (*n*)	Calves (*n*)	Explanation
2176	20,541	62,813	Study population, extracted animals from the NBCRS
	−55	−234	Excluded: obvious recording errors
		−1459	Excluded: twin calves
	−661	−2245	Excluded: age at first calving below 1.5 or over 3.6 years
	−1875	−5056	Excluded: first calving missing in NBCRS
	17,950	53,819	
		−24,525	Birth weight missing
1192	9903	29,294	Study sample

negatively and in severe cases lead to loss of both. Dystocia is further known to negatively impact fertility in the post-partum period leading to increased occurrence of uterine disease, delays in onset of luteal activity and extended calving intervals (Zaborski et al., 2009). Calf birth weight has also been shown to influence days open in Norwegian Hereford herds (Martin et al., 2010). The factors influencing birth weights of beef calves are not fully known, but both genetic and environmental factors are involved (Holland and Odde, 1992). Important factors influencing birth weights include: parity, fetal sex, sire and dam breed, maternal nutrition and climate during last trimester (Mee, 2008). Furthermore, differences between the geographical regions of Norway might potentially influence birth weights through differences in management, climate and/or nutrition. Understanding the variability in birth weights in Norwegian beef suckler herds, and the mechanisms behind this variability, can be a means to optimizing the production. The aim of this study was therefore to document the distribution of birth weights among beef suckler calves in Norway, and to evaluate factors associated with birth weights at the individual calf level. The factors of interest were sex of the calf, breed, region, damís age at first calving, calving season, parity, cow and herd.

2. Materials and methods

2.1. Study population

The data used in this study were extracted from the Norwegian Beef Cattle Recording System (NBCRS). Producer membership in the NBCRS is voluntary, but more than 78% ($n = 66{,}584$) of Norwegian beef suckler cows, representing 57% ($n = 2428$) of the Norwegian beef herds, were enrolled at the end of 2012 (Animalia, 2013b). In the NBCRS animals are identified by a unique 12-digit number, where 8 digits identify the location of farm of origin and 4 digits identify the individual, and all the cattle must be ear-tagged with this number in accordance to EU-legislation EF 1760/2000. The database further includes individual animal information regarding date of birth, sex, breed, herd (current and of origin), ancestry, slaughter date and slaughter quality. Producers are encouraged to record weights at certain ages, e.g., at birth and 200 days of age, calving difficulties and animal losses other than slaughter.

Data on all adult cows slaughtered between 1st of January 2010 and 23rd of January 2013 were extracted from the NBCRS (Table 1). Only cows registered with a least one progeny were kept in the initial extraction along with all data of their offspring, including those born before herd membership in the NBCRS. The data set was screened for illogical observations, obvious typing errors and duplicates, and when found these were omitted. If only one obvious error occurred in the records of a cow with many parities the single offspring was removed. However, if errors occurred more than once, all the registrations concerning the cow and her progeny were deleted. Data from cows with age at first calving below 1.5 years and cows with age at first calving over 3.6 years of age where excluded from the analyses.

2.2. Outcome and explanatory variables

The outcome variable of interest was the birth weight of each calf and the explanatory variables included were cow identity, sex of the calf, breed of the dam, region, age of dam at first calving, season of calving, parity of the cow and herd of birth. The breed of each animal was defined as purebred if the animal was registered genetically as 15/16 parts (or more) of the same breed, calculated from the breed composition of parents, grand- and great grandparents. If less than 15/16 parts purebred, animals were coded as crossbreed. The breed variable was retained for the most important breeds; Norwegian Red, Hereford, Charolais, Aberdeen Angus, Limousin and Simmental, while the less numerous breeds were merged into a pooled category; “Other”. The Other category consisted of the breeds Jersey, Sided Troender/Northland cattle, Telemark cattle, Doela cattle, Old Norwegian Red Polled, Norwegian South- and Western cattle, Norwegian Western Fjord cattle, Holstein, Danish Red, Blond d’Aquitaine, Highland Cattle, Tiroler Gray, Dexter, Piemontese, Galloway and cross-breeds. The herds’ locations were grouped into five geographical regions of Norway which are also used for the regulation of movements of cattle livestock; Costal Southeast, Inland Southeast, Western, Mid- and, Northern Norway, respectively. Age at first calving was defined by subtracting birth date from first calving date. Parity was defined by the sequence of calvings for each cow in the dataset. For twin calvings, the birth weights of both twins were excluded from the analysis but the calving still gave rise to an increase in parity. Parity was coded individually for the first 6 parities, while subsequent parities were pooled as greater than 6th due to the low number of observations in this group. Season of calving was dichotomized based on month of partum. “Spring calving” was defined as births between first of February and the end of July while the “Autumn calving” season was set to the first of August to the end of January. The unit of observation was the calving, and because several sequential offspring could be registered from each cow these observations were not independent of each other, which needed to be taken into account during analysis. Cows were further clustered within herds, which were located within regions.

2.3. Statistical methods

The generation of the initial database from the NBCRS was performed using SAS 9.2 (SAS Institute Inc., Cary, NC, USA). Further data management and statistical analysis was performed using Stata SE/12 (Stata Corp., College Station, TX, USA).