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Exploring cattle movements in Belgium

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ABSTRACT

Movement of animals from one farm to another is a potential risk and can lead to the spreading of livestock diseases. Therefore, in order to implement effective control measures, it is important to understand the movement network in a given area. Using the SANITEL data from 2005 to 2009, around 2 million cattle movements in Belgium were traced. Exploratory analysis revealed different spatial structures for the movement of different cattle types: fattening calves are mostly moved to the Antwerp region, adult cattle are moved to different parts in Belgium. Based on these differences, movement of cattle would more likely cause a spread of disease to a larger number of areas in Belgium as compared to the fattening calves.

A closer inspection of the spatial and temporal patterns of cattle movement using a weighted negative binomial model, revealed a significant short-distance movement of bovine which could be an important factor contributing to the local spreading of a disease. The model however revealed hot spot areas of movement in Belgium; four areas in the Walloon region (Luxembourg, Hainaut, Namur and Liege) were found as hot spot areas while East and West Flanders are important "receivers" of movement. This implies that an introduction of a disease to these Walloon regions could result in a spread toward the East and West Flanders regions, as what happened in the case of Bluetongue BTV-8 outbreak in 2006. The temporal component in the model also revealed a linear trend and short- and long-term seasonality in the cattle movement with a peak around spring and autumn. The result of this explorative analysis enabled the identification of "hot spots" in time and space which is important in enhancing any existing monitoring and surveillance system.

1. Introduction

The growing livestock industry and increased animal movement that the world is facing nowadays, makes the control of disease spread, more than ever, a major challenge for the present and the future. The world human population is expected to reach 10 billion in the 50 coming years (UN, 2011). Globalization, population growth and

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urbanization lead to an increased need of meat production. The expansion in the livestock industry resulting in more and more intensive farming and animal movement, together with climate change and economic recession, makes diseases a major threat to the livestock industry itself and directly or indirectly the human population health.

Diseases (e.g., Bluetongue and Bovine Tuberculosis (bTB)) that were mainly associated with environmental characteristics, are now shown to be highly influenced by movements. It happens that diseases that had nearly disappeared from some regions suddenly reappear (Gilbert et al., 2005). Lessons learned from the major outbreaks that occurred during the end of 20th century and beginning of the 21th century (e.g., classical swine fever, bovine spongiform encephalopathy (BSE), bTB, foot and mouth) urged the need of having national and international identification and registration systems to enable tracing on and back of epidemics sources and implement control measures to avoid further spread (Elbers et al., 2001; Scudamore and Harris, 2002; Gilbert et al., 2005; Ricketts, 2004). Within this context, national and international legislations regulate the identification of cattle and registration of all animal population and movements (Regulation (EC) No. 1760/2000; Commission Decision 2003/623/EC; European Commission, 2007).

In Belgium such a registration is done in SANITEL, a national computerized identification and registration system for all cattle, ovine, caprine, cervids and poultry. This national data base is managed by the Belgian Federal Agency for the Safety of the Food Chain (FASFC) on a daily base (FAFSC, 2012). For cattle, births, movements from one herd to another or to a slaughterhouse, imports and mortality as well as animal identification, type of animal (beef, dairy, etc.), owner, herd identification, health status for certain diseases are recorded at animal level. Holding's location, sanitary status and major holding characteristics are recorded at holding level. All movements or changes to sanitary status are automatically updated in such a way that at any time one can export data and obtain an up to date picture of the situation.

The aim of this study was to explore 5 years of animal movement data in Belgium in order to identify spatial or temporal patterns that could enable further use in epidemiological risk assessment. Indeed a good understanding of animal movement within a country helps to understand the spread and epidemiology of endemic and (re)emerging diseases as well as to provide insight on how to implement control measures in case a new disease would occur. In this respect, the relationship of the movement pattern with the spreading of Bluetongue (a non-contagious, infectious, insect-borne disease of ruminants transmitted by *Culicoides* midges) in 2006 (Méroc et al., 2008) was explored.

2. Materials and methods

2.1. Data

The data used in this study were obtained from the SANITEL database of Belgium. Data recorded with relation to birth, slaughter, local purchase within Belgium and import (from other (third) countries) of individual cattle was used for the period January 2005 until December 2009. With these records it was possible to trace the movements of cattle from one farm to another. In this article, cattle are categorized into either bovine (beef or dairy cattle) and fattening calves. To facilitate the understanding of the data exploration, a map showing the different provinces in Belgium is shown in Fig. 1.

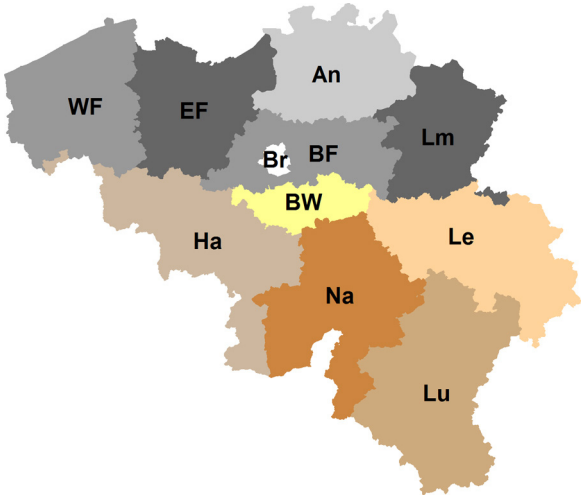

Fig. 1. Different provinces in Belgium. **An** – Antwerp; **BF** – Brabant Flanders; **Br** – Brussels; **BW** – Brabant Walloon; **EF** – East Flanders; **Ha** – Hainaut; **Le** – Liege; **Lm** – Limburg, **Lu** – Luxembourg; **Na** – Namur; **WF** – West Flanders.

A total of 4 840 523 calves (around 27% of which are reared as fattening calves) were born from 2005 to 2009 with the least amount of birth in 2008 (946,236 calves) and the largest number of births in 2006 (983,752 calves). These calves come from 30,312 herds (mostly beef herds) in which around 8.7% of these herds have less than 5 births in the 5-year period while around 4.8% have 500 births or more.

For the slaughter data, a total of 3,709,677 slaughtered cattle coming from 32,619 herds were recorded between 2005 and 2009. The majority (around 68%) of these herds have less than 50 cattle slaughtered within the 5-year period, while around 50% of the slaughtered cattle came from only 550 different herds specialized in fattening calves and located in the provinces of Antwerp and West and East Flanders. The lowest annual number of slaughtered cattle within the 5-year period is in 2009 (701,742 cattle) and the highest is in 2008 (755,174 cattle).

Around 3.22 million cattle (0.6 million per annum) were purchased locally in Belgium. With respect to the two types of cattle, within the 5-year period, around 316,000 fattening calves (ranging from 299,463 to 326,184) and around 329,000 bovine (ranging from 314,665 to 359,421) are purchased annually. Of the bovine (dairy and beef) that were purchased, around 73% were beef cattle. The age of purchased bovine was 3.21 years (SD = 2.59 years; median = 2.69 years) and 21 days (SD = 20 days; median = 17 days) for the fattening calf.

Bovine imports from different foreign countries within EU and third countries into Belgium were obtained from

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