THE RIGHT SIZED COW FOR EMERGING AND COMMERCIAL BEEF FARMERS IN SEMI-ARID SOUTH AFRICA: CONNECTING BIOLOGICAL AND ECONOMIC EFFECIENCY

by

THEO MULLER VENTER

submitted in accordance with the requirements

for the degree of

MASTER OF SCIENCE

in the subject

AGRICULTURE

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: Prof M A ANTWI

2018

Open Rubric

Table of Contents

THE RIGHT SIZED COW FOR EMERGING AND COMMERCIAL BEEF FARMERS IN SEMI-ARID SOUTH AFRICA: CONNECTING BIOLOGICAL AND ECONOMIC EFFECIENCY i

Table of Contents ii

List of tables v

List of figures vii

Abbreviations viii

Abstract ix

Key Terms xi

Declaration xii

Chapter 1 Introduction 1

1.1 Background 1

1.1.1 South African beef production 1

1.1.2 Commercial and Emerging Farmers in South Africa 1

1.1.3 Size of cattle 3

1.2 Research problem and motivation 4

1.3 Research questions 5

1.4 Research Aim 5

1.5 Objectives of the study 6

1.6 Hypotheses 6

1.7 Chapter arrangement 7

Chapter 2 Literature Review 9

2.1 Overview 9

2.2 Biological Efficiency 9

2.2.1 Introduction 9

2.2.2 Feed and energy requirements of cattle 10

2.2.3 Using energy to calculate animal numbers on a resource base 16

2.2.4 Effect of size on growth 19

2.2.5 Milk production potential 24

2.2.6 Effect of size on reproduction 25

2.2.7 Adaptation 27
2.2.8 The role of the bull 27
2.3 Micro / miniature cattle 28
2.4 Economic Efficiency 29
2.4.1 Factors influencing income 30
2.4.2 Factors influencing Expenses 32
2.4.3 Examples of case studies of economic efficiency 32
2.5 Chapter Summary 33
Chapter 3 Methodology 34
3.1 Methodology outline 34
3.2 Cattle type and sizes 34
3.3 Dry matter intake, gross energy and net energy 35
3.4 Determination of Energy for physiological functions 36
3.4.1 Energy requirements for Maintenance 36
3.4.2 Growth rates and Energy requirements for Growth 37
3.4.3 Energy requirements for Lactation 40
3.4.4 Energy requirements for foetal production 43
3.4.5 Growth and Total daily energy requirements per cow 44
3.5 Resource base 44
3.6 Production system 46
3.7 Stock flow 47
3.8 Production Budget 49
3.8.1 Income 49
3.8.2 Expenses 51
3.8.2.3 Dosing and vaccinations 52
3.9 Chapter Summary 55
Chapter 4 Results and Discussion 56
4.1 Growth and energy requirements of individual cows 56
4.1.1 Growth of individual cows 56
4.1.2 Net Energy Requirements 57
4.2 Stock flow and herd composition 63
4.3 Composition of energy requirements of the herd 68

4.4 Production Budgets 69
4.4.1 Culls and weaners sold 69
4.4.2 Meat prices 69
4.4.3 Total Income 70
4.4.4 Bull replacements 70
4.4.5 Supplementary Licks 70
4.4.6 Dosing costs 70
4.4.7 Vaccination costs 70
4.4.8 Dips costs 71
4.4.9 Processing and veterinary costs 71
4.4.10 Total allocated costs 71
4.4.11 Margin above allocated costs 71
4.5 Chapter Summary 73
Chapter 5 Discussion and Scenarios 74
5.1 Introduction 74
5.2 Limitations of the base model 74
5.3 Scenarios 75
5.3.1 Scenario 1: Reproduction rates and profitability 76
5.3.2 Scenario 2: Maturity rates and early breeding 81
5.3.3 Scenario 3: Limited feed intake 87
5.4 Further consideration related to size 98
5.4.1 Adaptation 98
5.4.2 Facilities 98
5.4.3 Selection and genetic progress 99
5.5 Chapter Summary 99
Chapter 6 Conclusion and Recommendations 101
6.1 Conclusion 101
6.2 Recommendations for Emerging and Commercial Farmers 103
6.3 Chapter Summary 104
Bibliography 106

List of tables

Table 3.1: Beef Classification in South Africa 50

Table 3.2: Supplementary feed, dosing, vaccinations and dipping schedule and expenses 53

Table 4.1: Growth and NE requirements of small cattle for important life stages 59

Table 4.2: Growth and NE requirements of medium cattle for important life stages 60

Table 4.3: Growth and NE requirements of large cattle for important life stages 61

Table 4.4: Lifetime energy requirements of small, medium and large cows 63

Table 4.5: Stock flow for the herd of small cattle 65

Table 4.6: Stock flow for the herd of medium cattle 66

Table 4.7: Stock flow for the herd of large cattle 67

Table 4.8: The energy requirements of animal classes in the herds of small, medium and large cattle 68

Table 4.9: Production budget for a herd of small, medium and large cattle 72

Table 5.1: Stock flow of the herd of medium cattle at a reproduction rate lowered to 85% of the base model 78

Table 5.2: Stock flow of the herd of large cattle at a reproduction rate lowered to 75% of the base model 79

Table 5.3: Production budget for different reproduction rates and equal profitability of small, medium and large cattle 80

Table 5.4: Stock flow of the herd of small cattle bred at 15 months 84

Table 5.5: Stock flow of the herd of medium cattle bred at 15 months 85

Table 5.6: Production budget for early bred small cattle with a FCC reproduction rate of 100%, early bred medium cattle with a FCC reproduction rate of 54% and large cattle as in the base model 86

Table 5.7: The results of limiting feed to 7,633Mcal during the growth stage of small, medium and large cattle. 89

Table 5.8: Small, medium and large cows fed 90% of calculated NEm+g during the growth cycle 90

Table 5.9: Comparison between NEm requirements as calculated as LSU and by Lofgreen & Garrett 94

Table 5.10: Comparison between LSU and calculation recommended by NRC for NEm+g 97

Table 5.11: Comparison between LSU and calculation recommended by NRC for NEm+l 97

Table 5.12: Comparison between LSU and calculation recommended by NRC for NEm+y 97

List of figures

Figure 1.1: Classification of beef farmers in South Africa 2

Figure 4.1: Growth curves of small, medium and large cows using Brody’s growth model 57

Figure 4.2: Net energy requirements of medium sized cow from birth to 1979 days 58

Figure 5.1: Net energy requirements of medium sized cow from birth to 1979 days when bred at 15 months 83

Figure 6.1: Monthly energy requirements of a herd of medium cattle 104

Abbreviations

ARC	Agricultural Research Council
BW	Body Weight
EQEBW	Equivalent Empty Body Weight
FCC	First calf cows
ICP	Inter Calving Period
LSU	Large Stock Unit
MC	Mature cows
NBRI	National Beef Recording and Improvement Scheme
NE	Net Energy
NE_g	Net energy for growth
NE_l	Net energy for lactation
NE_m	Net energy for maintenance
NE_t	Total Net Energy
NE_y	Net energy for production
NRC	National Research Council
RCC	Retained Cow Calves
RCC from MC	Retained Cow Calves from Mature Cows
RE	Retained Energy
SCC	Second calf cows
TCC	Third calf cows

Abstract

Cow size influences biological efficiency of individual animals, which influences herd composition and stock flow. This in turn influences the economic efficiency of the herd. This research followed the thread from animal size, to biological efficiency, to economic efficiency for beef cattle production under a typical production system in semi-arid South Africa. Cattle were grouped into three groups namely small, medium and large cattle, with mature weights of 300kg, 450kg and 600kg respectively. The net energy requirements of individual cattle were calculated for maintenance, growth, lactation and foetal production, for each of the three sizes. Growth rates, milk yield, reproduction rates, and management practices were assumed from existing research. Next the stock flow for a herd of small, medium and large cattle were calculated from the above. Income and expenses as commonly used in the research area were calculated from the stock flow. Gross profit above allocated costs were subsequently calculated for the three herds under the above-mentioned conditions.

When assuming similar reproduction and growth rates for small, medium and large mature cattle, the following results were obtained: more heads of small cattle could be held on a set resource base, but the total live weight of a herd of large cattle that could be held on the same resource base was greater. This was mostly due to proportionately lower maintenance energy requirements in the herd of large cattle. In the simulation in this study, maintenance energy requirements for the herd of large cattle was 71.2%, compared to 72.0% for the herd of medium cattle and 73.1% for the herd of small cattle. Income from the herd of small cattle was the lowest, as less kilograms of beef were available to sell. Allocated costs for the herd of small cattle were the highest, due to a large number of expenses being charged per head of cattle. As a result, the herd of large cattle were more economically efficient than their smaller counterparts. Income above allocated costs for the herds of large, medium and small cattle were R1,182,865, R1,085,116 and R946,012 respectively.

Larger cattle generally have a lower reproduction rate under similar conditions. No equation exists that directly links size to reproduction rates, especially considering the vast number of variables that influences reproduction rates. However, in the form of scenarios, it could be calculated that, given a reproduction rate of 80% for mature small cattle, when reproduction rates of large cattle were 24.7% lower than that of small cattle and the reproduction rates of medium cattle were 15.4% lower than that of small cattle, the large and medium herds became less profitable than the small herd.

Smaller cattle mature faster than larger cattle which provides the opportunity for early breeding. When small cattle were bred early, at 15 months, at a calving rate of only 44.5% it was more profitable than when the same cows were bred at 24 months. When medium cattle were bred at 15 months, a calving rate of 37.0% was needed to be more profitable than when they were bred at 24 months. Even when the herd of small cattle were bred at 15 months with a reproduction rate of 100%, it could still not match the profitability of the herd of large cattle bred at 24 months given the reproduction rates of all other classes of animals were similar. When the herd of medium cattle were bred at 15 months, at a calving rate of 53.7%, it matched the profit of the herd of large cattle that were bred at 24 months, when the reproduction rates of other classes were equal.

Scenarios were considered were feed intake was limited. When feed was limited to a specific amount, smaller cattle were more biologically efficient and cattle with potential for small mature sizes would grow to a larger size than cattle with potential for medium and large mature sizes. When feed was limited by a factor of the calculated energy requirements of small, medium and large cattle, large cattle were more effective. This is because large cattle use proportionately less energy for maintenance, which allows more energy to be allocated to growth, lactation and foetal production. When energy was limited to an amount per unit of metabolic weight, small cattle were more efficient than medium and larger cattle in the growth and production phases. Small, medium and large cattle were equally efficient (or inefficient) in the maintenance and lactation phases. Energy requirements of cattle in South Africa are commonly calculated using the Large Stock Unit (LSU). The LSU typically overestimates energy requirements for cattle, except in the lactation phase. When using the LSU to match small, medium or large cattle to a resource base, the LSU overestimates energy requirements of large cattle proportionately more than that of small and medium cattle. This is excluding the lactation phase, where energy requirements for all three sizes are underestimated and that of large cattle underestimated proportionately more.

There are more considerations when matching cow size to managerial practices. A smaller body size is a natural adaptation to a semi-arid environment and this adaptation can be expressed in different ways. The number of animals on a resource base has implications on management practices. Having more heads of cattle on a resource base increases genetic variation of the herd, allowing for genetic progress to be made faster than in herd of fewer cattle.

Key Terms

Cattle size, cow size, biological efficiency, economic efficiency, metabolic weight, energy requirements of cattle, energy requirements for maintenance, energy requirements for growth, energy requirements for lactation, energy requirements for foetal production.

Declaration

I declare that THE RIGHT SIZED COW FOR EMERGING AND COMMERCIAL BEEF FARMERS IN SEMI-ARID SOUTH AFRICA is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

Name: Theo Muller Venter

Student Number: 47713046

Degree: M.Sc. Agriculture

2018, September 1st

Chapter 1 Introduction

1.1 Background

1.1.1 South African beef production

South Africa had around 13.8 million heads of cattle in 2012, of which 80% were for beef production. South Africa is not self-sufficient when it comes to beef production, as consumption exceeds production (Department of Agriculture, Forestry & Fisheries, 2015). This makes South Africa a net importer of beef, meaning there is ample room to increase output and efficiency. A more efficient system can deliver higher output at similar or lower input. Improving biological efficiency of the national herd will go a long way towards increasing output and increasing profitability of individual farmers.

Most beef cattle in South Africa are managed under extensive conditions and utilises natural pasture. According to results of the National Cattle Survey undertaken in South Africa, with emphasis on beef, in 2003 around 75% of beef production systems were extensive (Scholtz *et al.*, 2008).

Production systems in South Africa are generally classified according to the age at which animals are sold. The three most common systems in South Africa are the weaner, long yearling or tolly and the two-year or ox systems (Department of Agriculture and Rural development, 2016a). According to the survey by Scholtz et al (2008), 70% of all beef cattle that were slaughtered in the formal sector had been fattened in the feedlot. This means commercial farmers produce mainly for the feedlot.

The above-mentioned reports point out the large variance in beef production systems in South Africa. However, while there are many differences in production systems, it can be concluded that commercial farmers utilize a production system where animals are raised extensively, then sold to the feedlot for fattening, one very common system being a weaner system where animals are sold to the feedlot after they are weaned.

1.1.2 Commercial and Emerging Farmers in South Africa

There is great variation among ownership and management of the national herd. Despite the differences, these sectors can all gain from being more biological and economic efficient.

More than 44% of the total South African cattle herd is owned by emerging and subsistence farmers according to further results of the national cattle survey (Scholtz *et al.*, 2008). Figure 1.1 shows the gene flow of South African beef and dual-purpose cattle

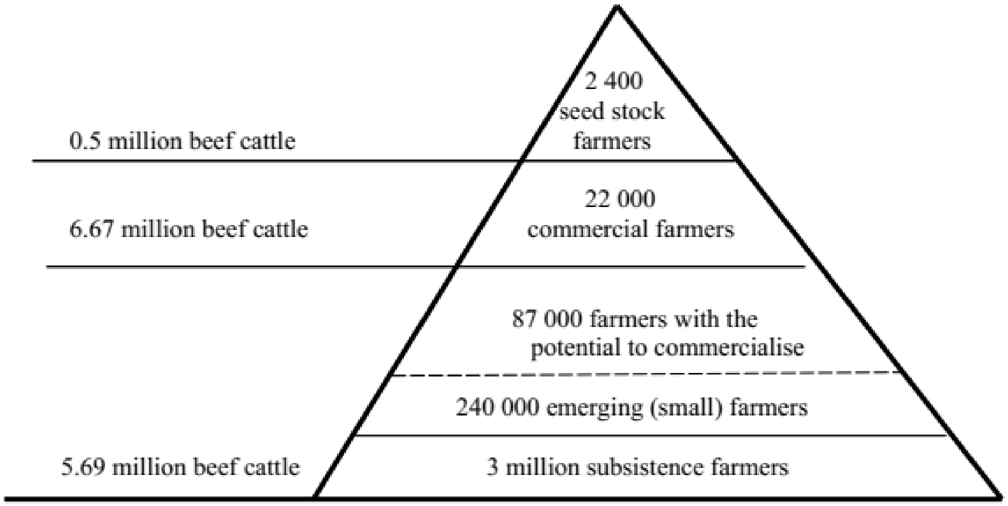

Figure 1.1: Classification of beef farmers in South Africa
(Scholtz *et al.*, 2008)

According to the South African Beef Market Value Chain report, 60% of the SA cattle herd is owned by commercial farmers and 40% by emerging and communal farmers. This report divided beef producers into 3 groups (Department of Agriculture, Forestry & Fisheries, 2015). Beef producers were classified as follows:

- Commercial farmers where production is high and comparable to developed countries.
- Emerging farmers where production is lower, but they could have the potential to commercialise.
- Communal or subsistence farmers where communal grazing is used for beef production.

Although there are slight variations in the way beef farmers are classified and grouped in previous research and reports, it is clear that the emerging sector makes up a substantial portion of the total herd. This sector has the most potential when it comes to improving efficiency, however there are many obstacles in this sector.

Herds are typically small, with an average herd size of only 19 heads of cattle in the emerging and communal sector, compared to 419 in the commercial sector. Animals are mainly kept for meat and cash (47%) and 15% was kept as an investment, one of the reasons being a lack of formal banking systems in some demographical areas. Animals were also kept for milk, cultural and ceremonial reasons, dowry and work. Uncontrolled breeding is still practiced in 63% of cases in the emerging sector (Scholtz *et al.*, 2008).

There is a lack of access to structured markets in the emerging and communal sectors (Scholtz *et al.*, 2008; Sikhweni & Hassan, 2013). Cattle from the informal sector are seldom sold to feedlots, as they do not meet the requirements set by commercial feedlots. These cattle are mostly sold privately or at auctions. Despite little access to formal markets, the above-mentioned survey by Scholtz et al. found that this industry is in fact flourishing.

The lack of information in the emerging sector is a double-edged sword in many cases. One side is that information about the industry is highly variable and not readily available. The other side being the fact that these farmers themselves have little access to managerial information. The lack of information should be seen as the biggest constraint in the emerging sector (Department of Agriculture, 2006).

1.1.3 Size of cattle

More results from the National Cattle survey show that farmers put much consideration into size when selecting a bull. The survey listed several reasons for bull selection namely: performance, conformation, temperament, size, availability, colour and horns. Commercial farmers first consider performance, conformation and temperament, but 8.8% still predominantly select a bull based on size. Emerging farmers' main consideration was performance (30.3%) followed by size (23.5%). Thirty-three percent (33%) of communal farmers considered size to be the most important factor and as the author put it, still believe "*bigger is better*" (Scholtz *et al.*, 2008).

Since mature size of cattle influences biological efficiency, it is essential to identify the right sized cow for the environment and management practices of South African beef farmers. Biological efficiency in turn influences economic efficiency and thus the right sized cow will be the most profitable cow.

1.2 Research problem and motivation

The goal of emerging and commercial farmers is to have a sustainable and profitable enterprise that supplies high quality animals and beef. These farmers are faced with making complex management decisions that could severely impact their efficiency. With rising input costs and in the face of climate change, the way forward for farmers is through becoming more efficient. One of these decisions is to select the right sized cow for their resource base. The right sized cow will be both biologically and economically efficient, allowing for sustainability and profitability. In this case biological efficiency means producing more kilograms of live animals per year, with similar or less inputs. In an extensive beef enterprise, the principal and often limiting input is the feed energy that is available from the farmer's resource base. Matching the right sized cow to the resource base will improve the biological efficiency of the herd, which in turn will improve economic efficiency of the enterprise.

Therefore, the research problem that has been identified, and that this research aims to fill, is how size influences biological efficiency of individual cows, the effect of biological efficiency of individual animals on the herd composition and stock flow on a specific resource base, the resulting income and expenditure of the herd under an extensive weaner production system in semi-arid South Africa, specifically in the North-West province, and finally the subsequent economic efficiency of a herd made up of these individual cows of different sizes.

Although the influence of cow size on efficiency is not a new topic, as more and research has been done on this topic, it calls for a complete assessment of efficiency of individual animals and the subsequent effect on the economic efficiency of a herd. Mature body size influence biological efficiency, and biological efficiency influences economic efficiency (Dickerson, 1978; DiCostanzo & Meiske, 1994; Arango & Van Vleck, 2002; Johnson *et al.*, 2010), however there is not a direct correlation between size and economic efficiency with many more variables that needs to be taken into account along the way. Even though the biological efficiency of individual cows can be measured to some extent, the interaction between cow size, biological efficiency of individual animals and the profitability of a herd as a whole, has received less attention. Research suggests that the most efficient cow size is furthermore determined by the environment and production system in use (Morris & Wilton, 1976; Dickerson, 1978; Arango & Van Vleck, 2002). Moreover, previous studies have been mostly concerned with differences among breeds, with differences in size within one breed, studied less.

When the physiological functions of an individual cow are measured, in terms of feed requirements, reproduction rates, growth rates, milk yield, and calf size among others, it relates to the biological efficiency of the cow. Biological efficiency in terms of energy requirements for maintenance, growth, lactation and reproduction can by accurately calculated with existing numeric equations, given that the other variables that form part of these equations are known. Be that as it may, biological efficiency of individual animals is still a long stretch from economic efficiency of a herd under specific conditions and management practices. Knowing the biological efficiency of individual animals allows the calculation of herd composition and stock flow on a pre-determined resource base. Only once the stock flow for the herd is known, can the income and expenses of the herd be calculated. Income and expenses that are typical for the management practices in the research area should be considered. From the income and expenses the economic efficiency can be calculated. This means that there is a definite connection between the size of individual animals and the profitability of the herd as a whole, however this connection has not been evaluated fully, even more so for the conditions set out in this thesis.

1.3 Research questions

The study set out to answer the following research questions:

1. Does size influence biological efficiency of individual cows and in what way?
2. How does biological efficiency of different sized cows influence the herd composition and number of animals of different sizes a resource base can support?
3. How does herd composition and number of animals on a resource base affect profitability?
4. If the objective is economic efficiency, should emerging and commercial beef farmers in semi-arid South Africa choose small, medium or large cows?
5. Under which situations will one sized cow be more economically efficient than another?

1.4 Research Aim

The main aim of the study was to determine the right sized cow for emerging and commercial beef farmers in semi-arid South Africa in terms of economic efficiency. Since commercial and emerging farmers aim to be profitable, the right sized cow will be the most economically efficient cow. However, the size of individual cows is not directly proportionate to the profitability of the enterprise. Therefore, the aim of this research was to connect the influence of size on biological efficiency of individual animals to the economic efficiency of a herd as a whole on a specific resource base in a semi-arid environment and under management practices as typically used in a weaner production system in South Africa.

1.5 Objectives of the study

The main aim of the study was to determine which sized cow will be the most economically efficient. Therefore, the objectives of the study were to:

- determine how cow size affects the biological efficiency of individual cows
- calculate the biological efficiency of small, medium and large cows throughout their life cycles
- establish how the biological efficiency of individual cows influences the herd composition and stock flow on a set resource base
- calculate the income and expenditure resulting from the stock flow of a herd of small, medium and large cattle under typical management practices applied in the commercial and emerging sector
- determine the economic advantages of choosing a herd of small, medium or large cattle under the conditions and management practices described in the study
- compare the biological and economic efficiency of the herd of small, medium and large cattle
- determine how biological and subsequent economic efficiency is influenced by performance traits, such as reproduction rates, maturation rates and feed restrictions among the three sizes
- make practical recommendations to commercial and emerging farmers when selecting for cattle size

without changing from one breed to another, specific to an extensive weaner production system in the North-West province of South Africa.

1.6 Hypotheses

The hypotheses that the research set out to test were**:**

- The size of individual animals will influence biological efficiency of individual animals, especially in terms of feed requirements
- The biological efficiency of individual animals will impact the herd composition if a pre-determined amount of feed energy is available

- The herd composition will determine income and expenditure of the herd, and thus the resulting profitability
- Therefore, profitability of an enterprise is affected by the size of individual animals and although animal size and profitability are not correlated, they are related. Thus, it stands to reason that one sized animal will be more profitable than another given certain set of conditions

1.7 Chapter arrangement

Chapter 1 presents an introduction to the study consisting of the background to the study in terms of South African beef production, commercial and emerging farmers in South Africa and the size of cattle. Thereafter the research motivation, research questions, aim and objectives of the study, hypotheses, and chapter arrangement are provided.

A review of previous literature in terms of biological efficiency and economic efficiency is done in Chapter 2. In the section on biological efficiency, feed and energy requirements of cattle is reviewed in depth, next the use of energy requirements to calculate cattle numbers on a resource base is discussed, followed by the effect of size on growth, milk production, reproduction and adaptation. The role of the bull is discussed next. An introduction on micro/miniature cattle is given. In the review of previous literature on economic efficiency, factors influencing income is discussed, followed by factors influencing expenses and finally examples of case studies are given. Finally, the chapter is summarized.

Chapter 3 discusses the methodology behind this research. First the methodology outline is provided, followed by a discussion of cattle types and sizes. Next the correlation between dry matter intake, gross and net energy is discussed, followed by the section on the determination of energy requirements for physiological functions. The resource base and production system used in this thesis is defined next, followed by the calculation used for the stock flow, and the resulting production budget. The chapter is closed with a summary in terms of an overview of the methodology.

Chapter 4 provides the results of the study and discusses them. The results are given in terms of growth and energy requirements of individual cows, stock flow and herd composition, composition of energy requirements of the herd. This is followed by the production budgets that resulted from the study and a discussion thereof. Lastly, a chapter summary is provided.

The discussion and scenarios in chapter 5 is concerned with the limitations of the study, where qualitative data could not be numerically expressed. This chapter starts with an introduction, followed by an explanation of the limitations of the study. Next different scenarios are given based on assumptions on biological efficiencies of different sized cattle. Further considerations that farmers need to take before selecting the most suitable sized cow to their situation is discussed next. The chapter summary ends the chapter

Chapter 6 reaches a conclusion in terms of the results of the study and the considerations when selecting one sized cow over another. Finally, recommendations are made to commercial and emerging farmers, followed by the chapter summary. Finally, the bibliography and appendix A are provided.

Chapter 2 Literature Review

2.1 Overview

Previous literature points out that the most efficient cow size will depend on the production system and environment. What works for one production system might not necessarily work for another system as far as the right sized cow is concerned. Matching cow size to the environment, and management goals of the system will increase overall biological and economic efficiency.

Finding the right sized cow for the right production system is not an easy task. It is not always possible to isolate individual factors that are influenced by size. When considering the optimal cow size, both biological and economic efficiency need to be considered. Although they are not necessarily proportionate, they are definitely related.

This chapter first takes a look at biological efficiency among different sized animals, with special attention given to feed requirements. Economic efficiency is discussed next and the complex relationship between biological efficiency and economic efficiency is demonstrated.

The effect of cow size has been a topic of debate for more than a century, however as new information becomes available, the need to rethink what is already known becomes clear. Furthermore, there are still unexplored areas concerning size, especially within breed and where the cow herd is considered as to individual animals. This literature review aims to show the progress that has been made in this field, but more importantly to review some of the equations and calculations that can be used to determine the effect of cow size on energy requirements, growth, lactation and reproduction. This will form the starting point for the simulation study to determine the most economic efficient cow size.

2.2 Biological Efficiency

2.2.1 Introduction

There have been many different definitions for biological efficiency throughout the literature cited. Most of these definitions are concerned with getting a proportionally higher output from an input. In order to give a thorough review in terms of biological efficiency; feed energy, growth, reproduction, lactation and environmental adaptation are considered. These measures of efficiency are interrelated but will be discussed separately as far as possible to show how they are affected by the mature size of cattle.

2.2.2 Feed and energy requirements of cattle

One of the most important inputs for a beef production enterprise is feed. Feed is also often the limiting factor when herd size is considered. A defined resource base can only provide a specific feed quantity (when environmental variations and management is removed from the equation). In turn, the feed quantity determines the number of animals the farm can support when little or no supplementary feed is procured. As is expected large cattle eat more than small cattle and thus, a resource base or farm can support a higher number of small cows and a lower number of large cows. Here, biological efficiency in terms of feed energy and conversion is concerned with the number of animals, of a specific weight, that a defined resource base can support.

Cattle partition feed in the following order: maintenance, growth, lactation and production (Johnson *et al.*, 2010). Thus, since cows will first use feed for maintenance, in a situation where feed is unlimited or inexpensive, cows with a proportionately lower maintenance requirement will perform better biologically and economically in the growth, lactation and reproduction phases. Larger cows generally have proportionately lower maintenance requirements than smaller cows and often perform better in these environments. However, where feed is limited, smaller cows have been proven to be more efficient. In a comprehensive study done by T. Jenkins and C. Ferrell in 1994, the effect of varying dry matter intake (DMI) on 9 different breeds was recorded over a period of 5 years. Results from this study showed that smaller breeds and breeds with a lower genetic potential for growth and milk production (Red Poll, Angus and Pinzgauer) had higher conception and reproductive rates than larger breeds when feed was limited. Larger cows and cows with high genetic potential for growth and milk production were more efficient in an environment with high feed levels than smaller cows. All breeds displayed maximum efficiency where feed intake was not limited (Ferrell & Jenkins, 1984; Jenkins & Ferrell, 1994). Nearly all previous literature suggests larger cows have a lower reproduction rate than smaller cows under similar conditions. Even more so, when feed is restricted. In this case, reproduction rates of larger cows will drop comparatively more than their smaller counterparts, than in an environment with abundant feed (Jenkins & Ferrell, 2002).

2.2.2.1 Feed energy for maintenance

The feed requirements of cattle purely for maintenance has a significant effect on the total feed requirements of the herd. A higher maintenance requirement directly translates into higher total feed requirements. Where individual cows are concerned, more than 50% of total feed energy intake by adult and market animals is used purely for maintenance (Dickerson, 1978). This leaves less than 50% for the growth, lactation and production phases. Where the total herd is considered, more than 70% of the energy requirements of the cow herd is used for maintenance and around 50% of the total energy can be allocated to cow maintenance (Ferrell & Jenkins, 1984).

Maintenance requirements are, among other factors, influenced by the breed and size of cattle. However, if the effects of breed need to be omitted from the equation, it is done by comparing smaller cows and larger cows of the same breed. In this case, where the maintenance feed requirements within a specific breed is compared, the metabolic weight comes into play. Kleiber's law states that the metabolic rate of animals is directly proportionate to the animal's weight to the factor of 0.75. This is also referred to as the animal's metabolic weight. It can be defined as $metabolic\ weight = live\ weight^{0.75}$ (Kleiber, 1932). The metabolic weight can be used to determine maintenance feed requirements, for example, if cow with a weight of 500kg needs15kg of feed energy per day for maintenance, then a 1000kg cow will need only 25kg, and not 30kg, calculated as $(1000 \div 500)^{0.75}$ x 15 kg = 25kg. The metabolic weight of animals forms the basis of nearly all other equations aimed at the prediction of maintenance feed requirements of different sized animals.

When measuring the maintenance feed requirements, different approaches have been taken. One well known method for determining maintenance energy requirements, as calculated by Lofgreen & Garrett, is commonly referred to as the California Method (Lofgreen & Garrett, 1968). This method is used to determine the retained energy or energy balance of the animal. They argued that the retained energy equals the net energy used for growth. Since growth can be measured, the retained energy can be computed. Therefore, since energy for maintenance and growth (NE_{m+g}) is equal to the sum of energy for maintenance (NE_m) and energy for growth (NE_g), then if NE_{m+g} and NE_g is known, then NE_m can be calculated. Further, the energy used for maintenance equals the energy used for heat production at zero feed intake. The results from the retained energy measurements were extrapolated to determine the heat production at zero feed intake and thus the energy requirements needed for maintenance. Results from the study showed daily Net Energy for Maintenance (NE_m) to be

$$NE_m = 0.077 / W^{0.75} \qquad \text{(Mcal)}$$

where *W* is the weight of the animal. This study was done using mostly growing steers and non-lactating, non-pregnant heifers of British breeds that were housed in a low stress environment. The National Research Council (2000) sites the work of Lofgreen & Garrett and uses it as the starting point for their calculation of maintenance requirements. The NRC further notes that, since animal activity normally decreases when they are fed below maintenance, the model of Lofgreen & Garrett already incorporates this into the calculation and adjustments for increased or decreased activity does not have to be made. However, this only applies to voluntary activity. If animals need to be herded across large areas or if animals have to walk large distances to their water source, different activity levels are not automatically compensated for.

2.2.2.2 Feed energy for growth

Growth has been defined as the deposit of tissue, mostly in the form of proteins which leads to an increase of skeletal, muscle and organ tissue in the animal. As the animal matures, total protein deposited will reach a plateau, with minor fluctuations (when animals are not grossly over- or under fed). Animal weights might thus fluctuate at maturity, mostly due to fat deposits. Often, mature weight is defined as the weight at which protein deposits level out. When the small fluctuations in mature weight is neglected, it is referred to as asymptotic weight.

As growth is defined as the deposit of tissue, it translates into the deposit of energy. When an animal is in the growth phase, the animal uses the net energy for growth and maintenance (NE_{m+g}). As mentioned in the previous section, Lofgreen & Garrett showed that the net energy for growth can be isolated into net energy for maintenance (NE_m) and net energy for growth (NE_g) and that $NE_{m+g} = NE_m + NE_g$ (Lofgreen & Garrett, 1968). This means if any two of the variables are known, the third can easily be calculated.

Since the energy deposited in the form of tissue, usually measured in weight, equals the net energy intake for gain, it means net energy for gain is a function of weight gain. Weight gain in turn is dependent on the current body weight and asymptotic weight of the animal, which means the three most important variables when calculating NE_g is body weight, asymptotic weight and weight gain.

Garret (Garrett, 1980) utilized comparative slaughter methods to determine the energy deposits for animals at different feed levels. British breeds and Charolais cattle were used and cattle were fed different diets. The energy deposits of the carcasses were measured to calculate the net energy for gain. The retained energy by bull calves were found to be 17% lower than that of heifers for the same growth rate, among British breeds. Animals that had hormonal growth implants had 4.5% lower retained energy needs for the same growth rate than those without. The results from the comparative slaughter trails led to the following equation for British steers (which had growth implants). Here retained energy (RE) equals NE_g.

$$NE_g = RE = 0.0635*EBW^{0.75} * EWG^{1.097} \text{ (Mcal)}$$

and for heifers of British breeds (with growth implants)

$$NE_g = RE = 0.0783*EBW^{0.75} * EWG^{1.119} \text{ (Mcal)}$$

where *EBW* is empty body weight and *EWG* is empty body weight gain. Even though there are variations among breeds and animal class, this is the most comprehensive study that has been done to determine the net energy requirements for gains and has been adopted by many researchers and institutions to calculate energy requirements for growth.

Therefore, net energy requirements for growth are dependent on body weight, asymptotic weight and body weight gain. Larger cattle grow faster, as is discussed in section 2.4, and thus both the body weight and body weight gain will be higher at any given day after conception for larger animals, until growth eventually stops. Simply put larger cattle grow faster but need more energy to do so, even if energy for maintenance is ignored.

2.2.2.3 Feed energy during pregnancy

It is generally accepted that the energy required during pregnancy is highly correlated to calf birth weight. This means that by assuming calf birth weight, energy requirements during pregnancy can be calculated. Ferrell et al. calculated the energy requirements of the gravid uterus in purebred Herefords (Ferrell *et al.*, 1976). He found the relationship to be

$$Ye = 69.73e^{(0.03233 - 0.0000275t)t} \text{ (kcal)}$$

Where t = time of gestation. The above equation was formulated with a birth weight of 38.5kg. From this equation, the NRC (2000) further developed a prediction of energy requirements for the gravid uterus as follows

$$Ye = birth\ weight\ (0.05855 - 0.0000996t)e^{(0.03233 - 0.0000275t)t} \qquad \text{(kcal)}$$

And building on the above equation, the NRC developed the below equation to estimate the net energy requirements during pregnancy as

$$NE_y = 0.576\ birth\ weight\ (0.4504 - 0.000766t)\ e^{(0.0233 - 0.0000275t)t}$$

Where t is the time after conception.

Some other factors that affect calf birth weight are the breed of both the cow and the bull, as well as the genotype – and logically the size of the bull and the cow, which is discussed further in section 2.3.

Interestingly, when observing from another angle, calf weight is not greatly influenced by nutritional over- or underfeeding of the dam within a wide range, for example the birth weight of calves did not vary greatly when the dam was within a condition score of 3.5 to 7, unless they were greatly over- or underfed. This means that the cow will provide the foetus with sufficient energy even if it means giving up some of her own reserves. When this happens, instances of low rebreeding rates, dystocia and other reproductive problems were found to be more common (National Research Council, 2000). This is also in contrast to previous literature which states that cows will use energy firstly for maintenance and the for other biological functions.

2.2.2.4 Feed energy for lactation

Calculating the milk yield of beef cows are complicated by the fact that calves suckle on the mother and measuring the milk yield without disturbing the natural bond between mother and calf is not that simple. Furthermore, the genetic potential of the cow, age, breed, as well as the potential of the calf to consume milk, affect milk yield. The potential of the calf to consume milk is in turn influenced by the genetics (especially in the case of cross breeding), age, size and sex among others. This section is concerned with the relationship between feed requirements and lactation. The relationship between cow size and lactation is discussed in section 2.4. Since the two topics are interrelated they cannot be completely separated and some of the information might be repeated.

As the milk production potential of cows increase, so will their maintenance feed requirements (Jenkins & Ferrell, 2002). Thus, a small cow with high milk production potential, needs more energy for maintenance than the same size cow with low milk production potential. Simply put, a cow that can produce more milk during lactation, eats more, whether it is lactating or not. This means when cows are not lactating, cows with a higher milk production potential will be less efficient in terms of NE_m requirements.

Some ways in which milk yield in beef cows has been measured is by hand milking or weighing the calf right before and right after suckling to determine the weight of the milk it consumed. This method where the calf is weighed before and after suckling is most commonly used and is known as the weigh-suckle-weigh method. Even if this method provides accurate information of the milk yield over time, it doesn't provide any information on the milk composition. The fat percentage, protein percentage, total non-fat solids and lactate are commonly used to describe the composition of milk. Even if the milk composition has been determined once, it still varies over time, even within one lactation. Milk composition is further influenced by breed, age and nutrition.

When milk yield is measured, it follows a general curve over the period of lactation. Jenkins and Farrell (Jenkins & Ferrell, 1984) gathered milk yield and composition data from crossbred cows of Angus, Hereford, Charolais, Jersey and Simmental. Although there were differences among breeds, they predicted daily milk yields as

$$Y_n = n / ae^{kn}$$

where
Y_n is the daily milk yield (kg/day)
n is the time, in weeks, postpartum
a and k are solution parameters. Where a can be solved as $a = 1/\,(peak\ milk\ yield * k * e)$ and $1/k$ is the time of peak milk yield.
This equation can further be used to determine total milk yield over lactation of n weeks as

$$Total\ milk\ yield\ for\ n\ weeks = -7/ak * (ne^{-kn} + 1/ke^{-kn} - 1/k)$$

The NRC cites previous research to show that peak milk yield occurs at around 8.5 weeks postpartum on average, which solves values for *k* in the above equation. This leaves two more variables to solve the equation, peak milk yield (from which *a* can be calculated) and time of lactation.

Now, although an equation has been formulated to calculate total milk yield, it still leaves the conversion from yield to energy. The energy content of the milk is equal to the net energy required for lactation. The energy content of milk is in turn influenced by the fat percentage, protein content, solids-not-fat (SNF) and lactate. The equation developed by Tyrrell and Reid (1964) was adopted by the NRC and states:

$$E = (0.092 * \text{fat percent}) + (0.049 * \text{SNF percent}) - 0.0569$$

Where *E* is the energy content of the milk (Mcal/kg) and thus also the net energy requirement for producing one kilogram of milk. From previous research the NRC calculated the following mean values for beef cattle among a wide range of breeds; fat content at 4.03%, protein content at 3.38%, solids not fat, 8.31%, and lactose 4.75%. When these average values are plugged into above equations the net energy requirements of beef cattle can be estimated, and although there is large variation among breeds, the variation within breeds may be less. This leaves peak milk yield and length of lactation as the two unsolved variables, for which assumptions need to be made.

Where age is considered, milk yields from lactating 2-year old heifers were found to be 26% lower, and 3- year olds 12% lower than that of mature cows (National Research Council, 2000). This translates into a 26% and 12% lower net energy requirement during lactation.

So, to outline, cows with a higher milk production potential requires more energy for maintenance as well as during lactation but produces larger calves at weaning. Milk composition varies even within one lactation, but lactation curves follow a similar pattern irrespective of size. The energy required for milk production is equal to the energy content of the milk. This is not easily measured since milk compositions changes constantly. Equations are available for estimating total milk yield, based on peak milk yield.

2.2.3 Using energy to calculate animal numbers on a resource base

Different countries have adopted different definitions, terminology and calculations to convert different animals into a standard unit, including the Large Stock Unit (South Africa), the Animal Unit (USA), Stock Unit (New Zealand) among others. Two of these definitions will be discussed, the Large Stock Unit and the Animal Unit

The most common conversion of animal size and class into a standard unit in South Africa is the Large Stock Unit. Initially the definition was broad, and the term used loosely, but in 1983 the South African Department of Agriculture gave a more concrete definition to the LSU. In a technical communication called *Classification of livestock for realistic prediction of substitution values in terms of a biologically defined Large Stock Unit,* the LSU was standardized and defined. These became more commonly known as the Meissner tables, after the author H.H. Meissner (1983). The LSU is defined as:

"the equivalent of a head of cattle with a mass of 450 kg which gains 500g/day in mass on grass pasture with a mean digestible energy % of 55.

The following specifications also apply:

- *Sufficient nitrogen for rumen fermentation and sufficient amino acids to allow for a gain of 500 g/day are supplied*
- *The temperature of the environment is in the thermoneutral zone of cattle*
- *Macro and trace minerals, water and any other nutritional elements not specified above are not limiting with respect to the life processes of the animal "*

The above definition translates into a metabolizable energy requirement of 75MJ/day. LSU is often used to describe grazing capacity per hectare and both LSU/ha and ha/LSU is used to express the energy yields of a resource.

This technical communication used the unpublished work from Alderman & Barber at the 6th Symposium on energy and metabolism, in Stuttgart, in Sept. 1973 to convert animals of different sizes and different classes into LSUs. The equations from Alderman & Barber differ from that of Loffgreen & Garrett (1968) and Garrett (1980) which were adopted the NRC. The differences are shown below:

Net energy requirements for maintenance:

Alderman & Barber, Meissner:

$FM = 5.67 + 0.061W$ (MJ)

Loffgreen and Garret, NRC:

$NE_m = 0.077 / W^{0.75}$ (Mcal)

where

FM = net energy requirements for maintenance (MJ/day)

NE_m = net energy requirements for maintenance (Mcal/day)

W = body weight

Net energy requirements for growth:

Alderman & Barber, Meissner:

$SF = LWG\ (6{,}28 + 0{,}0188\ W) / l - 0{,}30\ LWG$ (MJ)

Garrett, NRC:

$NE_g = 0.0635 * EBW^{0.75} * EWG^{1.097}$ (Mcal)

where

SF = net energy requirements for growth (MJ/day)

LWG = gain in live mass (kg/day)

W = live mass

NE_g = net energy requirements for growth (Mcal / day)

EBW = Empty body weight (kg)

EWG = Empty body weight gain (kg/day)

From the equation of Alderman & Barber it is clear that they neglect the metabolic weight of the animal and assume that energy requirements are linear among different sizes. This is in contrast with most other research, and particularly Kleiber's law. The equation for weight gain by Garrett makes distinction between bull and heifer calves and also whether the calves has received hormonal implants.

There are also differences in the calculation of energy requirements during lactation and pregnancy adopted by Meissner and the NRC. This illustrates that, despite LSU being the most commonly used way to standardize animal size and class, it might be dated and could be reviewed. This receives further attention in Chapter 5 where the calculations used in this research is compared to the calculations for a LSU.

Another common way used to convert animals of different sizes and classes into a standard unit is the Animal Unit. Although the term might be much older than the LSU, it came into being in a similar way, where the term was loosely used to describe a 1,000 lb cow with a calf. The term was more comprehensively defined in 1974 by the Society of Range Management (1998). The definition is as follows:

"*one mature cow of about 1,000 pounds (450 kg), either dry or with calf up to 6 months of age, or their equivalent, consuming about 26 pounds (12 kg) of forage/day on an oven-dry basis"*

The animal unit equivalent (AUE) sheds more light on the conversion of different animal classes to AU and is defined as follows:

"A number relating the forage dry matter intake (oven-dry basis) of a particular kind or class of animal relative to one AU. If intake is not known, it can be estimated from the ratio of the metabolic weight of the animal in question to the metabolic weight of one AU (450 kg to the .75 power)"

Although this definition is broad and can be widely applied, it leaves a lot of room for misinterpretation. For example, the quality of the feed is not defined, nor the energy content. It bases the calculation of an animal unit purely on the dry matter intake (DMI). Animals of different sizes and different classes can thus be easily converted into an AU or AUE based on their total dry matter intake, but it does not clarify energy requirements.

The above illustrates the large variation in definitions, as well as the calculation, of a standard unit. Many more attempts have been made to properly define a standard animal unit, each with their advantages and disadvantages.

2.2.4 Effect of size on growth

When a farmer is in the business of selling beef, the goal is to produce more sellable product in as little time as possible, with the least amount of inputs. Here the size of the animal at different life stages needs to be considered. Growth is not constant and changes throughout an animal's life. Growth rate refers to the gain in weight, usually measured daily. It is different from maturation which refers to the age at which animals reach certain life stages, for example age at puberty and age at maturity. This section will look at the weight at different life stages, the growth rate and maturation of animals of different sizes.

The growth rate of individual animals is influenced by, among others, genetics, the environment, sex, physiological status, maternal effects and management. Despite the variation in growth of individual animals, a similar pattern in growth curves are followed. Because of the low reproduction rate of cattle, growth is more important in cattle than most other meat animals and a faster maturing animal is a more effective animal, all other functions being equal (Arango & Van Vleck, 2002).

The growth curve of nearly all animals follows a sigmoid shape from conception, when growth is slow, then enters a phase of rapid weight increase as the animal enters puberty and finally it slows down again and eventually even stops (except for fluctuations in mature weight) at maturity. Thus, weight gain increases up to a point and then starts to decrease. This is called the inflection point.

The idea of fitting growth curves to the growth of animals has come a long way. Growth curves are useful for predicting daily gain in animals and thus also the feed requirements during the growth stage. Several mathematical models have been developed to predict growth, among others, Brody's asymptotic growth curve, Gompertz, Logistic and von Bertalanffy models which follows a sigmoid shape with a fixed inflection point and Richards model which has a variable inflection point. Brody's growth model has been found to be a good fit for beef cattle after birth, despite not having an inflection point. Brody's model is commonly used when evaluating the growth of beef cattle. (Jhony *et al.*, 2017). It is therefore discussed further.

Brody calculated growth as follows:

$$W = A - Be^{-kt}$$

where
W = Weight at time t in kg
A = growth limiting factor
B = integration constant
k = growth rate
t = time in days

The growth limiting factor (*A*), usually refers to the mature weight of the animal, unless there are some other limiting factors. The intercept of the curve where t=0 is the integration constant (*B*). Since Brody's model only fits growth after the inflection, *B* is used to correct for the fact that there is no inflection point. As mentioned before, Brody's model describes the growth of beef cattle fittingly after birth. Thus, if the model is applied for an animal from birth, *B* will be calculated as follows:

$$B = (A - birth\ weight) \div A$$

where *A* is again the mature weight of the animal. For example, if a calf is born at 30kg and expected to reach 600kg, B = (600-30)÷600 = 0.95.

The significance of the growth rate, *k*, shows that growth declines at a constant rate. Because the growth rate declines, *k* is preceded by a minus. For example, if *k* = 10%, and daily weight gain at time t_n=100g, then daily weight gain at time t_{n+1} = 100g-10% = 90g, t_{n+2} = 90g-10% = 81g, t_{n+3} = 81g-10% = 72.9g, etc.

As far back as 1976 Morris & Wilton already argued that bigger mature cattle are bigger through all life stages. In a review of biological efficiency, Morris & Wilton also concluded that the weight of calves at weaning and at one year of age tended to increase as the weight of their dams increased, showing that larger cows raise larger calves. This means that if a cow is bigger than other cattle at maturity, it was also bigger at previous life stages, for example, birth, weaning and puberty. This has been demonstrated in numerous research where heavier mature weights were positively correlated to heavier weight at puberty and weaning (Morris & Wilton, 1976; Fiss & Wilton, 1993; Arango & Van Vleck, 2002).

Growth rates are not to be confused with maturation rates. Maturation rates refers to the time for an animal to be able to perform certain physiological functions. A review of previous literature suggests that smaller animals mature faster. (Morris & Wilton, 1976; Dickerson, 1978; Fiss & Wilton, 1989; Arango & Van Vleck, 2002). This means that smaller animals can be weaned sooner, will reach sexual and reproductive maturity, as well as marketable weight sooner. This suggest a positive correlation between maturing rates and biological efficiency.

One such a study was done at the Subtropical Agricultural Research Station, Brooksville, Florida, to show the effect of size on growth and maturity. Results support the argument that smaller mature cows matured faster. When Brahman calves were grouped together as small, medium and large at puberty with weights of 679 lb, 692 lb and 756 lb. Heifers from the small, medium and large size groups reached puberty at 576 days, 623 days and 635 days respectively, confirming earlier maturity in smaller cows. In the same experiment Angus cattle were divided into two groups, one selected for large mature size and one selected for early maturity. Results showed that animals selected for large mature size reached puberty at 591 lb and 518 days, whereas the group selected for early maturity averaged 551 lb and 487 days at puberty (Warnick *et al.*, 1991)

A similar study done at the same location, the Subtropical Agricultural Research Station in Brooksville, Florida yielded different results. The growth curves of small, medium and large framed Brahman cattle were compared (Menchaca *et al.*, 1996). Animals were categorized according to hip height Animals were divided into 3 stages and separated by sex and results are discussed as such.

Stage one – birth to weaning:

Growth curves for medium and large framed animals were found to be similar but with the weight and weight gain of the large group always higher than that of the medium group. Both had inflection points at similar times (127 days for medium animals and 126 days for large animals). The weight of small framed animals was always lower than the other two groups, however the point of inflection was 5 and 6 days later than for the large and medium groups respectively. The decline in instantaneous weight gain after the point of inflection was also lower than the other two groups and it was in fact higher than the other two groups at the age of weaning. Males followed a similar growth pattern as females but were 9.4%, 6.1% and 7.6% larger respectively in each of the size groups.

Stage two – weaning to 20 months (males) and weaning to 32 months (females)

All three groups fitted a similar growth curves during stage 2, with instantaneous growth again lowest for small framed animals and highest for large frame animals. There were however large differences among the two sexes, with bulls from all groups growing at a faster rate than cows.

Stage three – 32 months to maturity (females only)

As expected cows from the large group was the heaviest and cows from the small group was the lightest at all times throughout stage 3. Instantaneous gain was higher for the large group at the start of stage three, showing a faster growth rate. Growth slowed, and weight plateaued sooner than the other groups. This in fact means larger cattle matured sooner.

The results from Menchaca is in contrast to other research that suggests smaller cows mature faster. It does however confirm that larger mature animals are larger at all life stages compared to smaller mature animals under similar conditions.

Jenkins & Ferrell showed smaller cows are more efficient when the weight of calves weaned is compared to the weight of the dam at weaning. He compared the efficiency among 9 breeds as the weight of cows weaned per weight of cow exposed per weight of dry matter consumed. Smaller breeds (Red poll, Pinzgauer, Angus) were generally more efficient than large breeds (Charolais, Simmental, Gelbvieh) (Jenkins & Ferrell, 2002)

Similar results were obtained in a 2016 experiment by Beck *et al*. (2016) the effect of mature body weight on cow and calf performance in the south-eastern United States was studied. They stocked 4ha parcels with large (571kg) and small (463kg) mature size cow-calf pairs of different, but mostly English breeds. In this experiment, for every 100kg increase in cow weight, calf weight per 100kg cow weight decreased by 6.7kg, indicating higher weaning efficiency in smaller cows. This shows that despite calves from larger cows growing faster and weighing more at weaning, smaller cows actually weans a higher proportion of their own bodyweight (Beck *et al.,* 2016).

In another case study by the University of Arkansas in 2006, Whitworth et al suggested that cow production efficiency (CPE) be used to measure efficiency, where CPE is defined as pounds of weaned calf divided by cow weight. In this study *Bos indicus* influenced females were bred with Beefmaster bulls. Cow weights and 205-day weaning weights were calculated from herd records over 5 years. Cows were divided into 3 groups according to CPE. The group averaging the highest CPE (0.4648) were also the smallest (averaging 1,223 lb), the middle CPE group (0.3986) weighed 1,292 lb on average and the group with the lowest CPE (0.3276) were the largest (averaging 1,428 lb). First-calf heifers were excluded to adjust for future growth. This study thus concluded that smaller cows had a higher weaning biological efficiency (Whitworth *et al.*, 2006).

When looking at the birth weight of cows of different ages, the calf of 2-year-old first time heifers were found to be 8% lower than that of comparable mature females. 3-year-old cows had 5% smaller calves and 4-year-old cows had 2% smaller calves than mature cows. Heifer calves were found to average 7% lighter than bull calves (National Research Council, 2000).

Morris & Wilton concluded that selecting for a high daily gain will increase mature weight, since bigger cows grow faster. This also means that selecting for faster growing calves will lead to an increase in mature size. Since an increase in mature size might not be desirable, it should be used with caution as a selection criterion (Arango & Van Vleck, 2002; Scasta *et al.*, 2015; Morris & Wilton, 1976).

To conclude, growth of all sized animals generally follows the same curve and Brody's equation has been proved a good fit. Larger mature cattle were also larger at previous life stages, where feed intake is not limited. As a result, larger cattle gain more weight at the same growth rate as smaller animals. Most research suggest that smaller cattle mature faster and it has been demonstrated in case studies, the exception being the work of Menchaca. Some research suggest smaller cows are more efficient when the size of calves weaned is compared to the size of the cow.

2.2.5 Milk production potential

As mentioned in previous sections, calves that end up being heavier at maturity, are heavier through all life stages. Since they are then also heavier from birth to weaning, they will need more energy than smaller calves during this life stage. Calves mainly get their energy requirement from their dams' milk. Thus, it only makes sense that larger cows will produce more milk during lactation.

When looking at it from another angle, cows with higher milk production produces heavier and faster growing calves. Jenkins & Ferrell, Arango &Van Vleck and Johnson sited previous literature to show that cows with higher lactation yields, wean heavier calves (Jenkins & Ferrell, 2002; Arango & Van Vleck, 2002; Johnson *et al.*, 2010). Since these cows provide more milk to their offspring, their offspring uses the higher feed energy to grow faster.

The above research papers are more concerned with the performance of the calf than the size of the cow producing the milk. Much more research is concerned with the performance of dairy cows. Few research papers, however, actually compares the effects of beef cow size to milk production potential, particularly within a specific breed. Morris & Wilton reviewed previous literature and the effect of size on milk production. Most literature cited by Morris & Wilton related to dairy cows and results were mixed, however it mostly showed a higher milk production, but lower efficiency in milk production as size increased. (Morris & Wilton, 1976).

In an experiment by Swanepoel & Hoogenboezem, 493 Bonsmara cows were divided into two groups, one group had a short calving interval of less than 400 days, the other group had a calving interval of more than 400 days. There were obvious differences in size between the two groups, the first having an average size of 482kg and the latter an average size of 513kg. More relevant is the milk production of the first group that produced an average of 5.50 L/day compared to 8.26 L/day. Thus, although the goal of the research was to compare the differences in calving intervals, it does shed light on the relationship between milk production and size within a breed (Swanepoel & Hoogenboezem, 1994).

As mentioned in section 2.2.2.4, lactation is influenced by milk production potential, age, breed, and importantly suckling potential of the calf. It can then be concluded, from available literature on the topic, that if the breed and age are similar for two cows, the one with the larger calf will produce more milk.

2.2.6 Effect of size on reproduction

One of the most important efficiency measures in both biological and economic terms is reproduction. Cows have a low rate of reproduction and high maintenance requirements. Should a cow fail to reproduce the economic effects are far worse than if a smaller calf were produced. Pregnancy rates and weaning percentage are two of the most noteworthy reproduction efficiency measures.

Larger sized animals have longer gestation and lactation periods (Dickerson, 1978; Fiss & Wilton, 1989; Arango & Van Vleck, 2002). The longer gestation periods mean animals have less time to recover after calving, before they are expected to reproduce in the next season. Failing to reproduce within a given breeding season means animals will be consuming energy for maintenance, without being productive. Another important consideration is that longer gestation and lactation periods increases the time before the calf can be weaned. This means in a weaner production system, more inputs consumed before an output is realised when the calf is sold, however a larger calf can be sold.

Longer reproduction periods for larger cows were confirmed by the study of Swanepoel & Hoogenboezem, where Bonsmara cows were grouped as having a short inter calving period (<400 days) or a long inter calving period (>400 days). The group with the short ICP were significantly smaller at 482 kg compared to 513 kg for the long ICP. They also found a negative correlation between high pre-weaning growth (as was demonstrated for large cows) and fertility. Smaller cows had a longer lifetime fertility than larger cows (Swanepoel & Hoogenboezem, 1994).

Similar results were obtained at the Subtropical Agricultural Research Station (STARS) in Brooksville, Florida when the effect of cow size on reproduction efficiency of Brahman cows was studied. Olsen presented some of the results and showed that overall reproductive efficiency was better for smaller sized cows. Animals were categorized according to hip height as small at 52 inches, medium at 54 inches and large at 55.5 inches. Heifers were bred for the first time at 2 years of age. Despite being bred at a relatively late age, there were still a notable difference in pregnancy rates, with 93.7% of small frame heifers falling pregnant, compared to 89.7% for medium frame and 86.9% for large frame heifers. Even more significant was the pregnancy rates when these heifers were re-bred at 3 years (while lactating). Only 34.5% from the large frame group fell pregnant, 51.8% from the medium frame group, where the small frame group had a pregnancy rate of 74.9%. Similar results were obtained for Angus cows at the same location (Olsen, 1993).

Stewart & Martin also studied the effect of mature size on lifetime productivity of cows. As the weight of cows increased, they produced fewer calves throughout their lifetime. The average weaning weight of calves increased with the size of their dams, but total weight weaned throughout their lifetime decreased, although not significantly. This was due to a shorter productive lifetime in the herd, based on the culling criteria applied in the study (Stewart & Martin, 1981).

Similar results were obtained by Taylor who found cows with higher lifetime fertility are smaller and calf earlier in the calving season. Mature size might be restricted by regular and early breeding, but smaller size is in fact a desirable trait for cattle under extensive conditions (Taylor, 2006). Taylor went on to show that smaller cows have lighter calves at weaning, however there were little difference between the yearling weight of small cows and larger cows. He argued that this is due to compensatory growth.

The above review mentions but a few studies that have shown that smaller cows have shorter ICP, higher reproductive rates and higher lifetime fertility. Since cows have a low rate of reproduction, a cow that fails to fall pregnant within a breeding season means a high input without realising an output. When a strict culling criterion is applied in terms of rebreeding rates, large cows will spend less time in the herd and need to be replaced often.

2.2.7 Adaptation

Larger body sizes are better adapted to cold environments and use abundant feed supply more efficiently. Larger animals have a smaller body surface to body volume ration than smaller cows, which partially explains better adaptation to cold climates. The larger surface area to body mass of smaller animals is more suited to warmer climates. Some research suggest smaller animals tend to be more efficient when feed supply is limited as in the case of dry climates (Dickerson, 1978; Arango & Van Vleck, 2002; Jenkins & Ferrell, 2002).

A study at the Matopos Research station in Zimbabwe showed that indigenous breeds (Sanga breeds) are more effective in terms of reproduction and cow efficiency than exotic breeds under a range system in semi-arid Zimbabwe. The author also noted that breeds which performed best under these conditions were also the smallest and that their size is in fact an adaptation to the environment (Moyoa *et al.*, 1994).

A 2015 study in Wyoming researched the relationship between cow size and efficiency (calf weight to cow weight at weaning) in a semi-arid high elevation environment. Research was focused on the effect of drought or dry seasons on cow efficiency of different sizes. Cows from smaller breeds were always more efficient than those from larger breeds. Small cows in a dry year were still more efficient than large cows in a wet year. The experiment went on to show that smaller cows can lower their maintenance requirements in a dry year, and thus are more adaptable to dry seasons with less feed availability (Scasta *et al.*, 2015).

Most research suggest that a smaller body size is an adaptation to semi-arid and hotter climates. This research is mostly concerned with the differences among breeds and not size differences within a specific breed. This suggests that smaller breeds could handle fluctuations in feed levels better than larger breeds, however the same might not hold true for small and large specimens of the same breed.

2.2.8 The role of the bull

Since an individual cow transfer her traits only to one calf per breeding season, the genetic contribution of an individual cow within a herd is small. Especially where cows are selected for traits with low heritability it would be much more effective to select an appropriate bull. Genetics of bulls in the herd make up 50% of the genetics of the offspring, so it is imperative to select a bull that match the selection objectives of the herd.

The lower maintenance requirements of smaller cows can to some extent be used to lower total maintenance requirements of a herd. Since a smaller female will have lower feed requirements, when she is crossbred with a large male, it will combine lower maintenance requirement with a higher growth rate in the offspring. For example, Dickerson argued that when a complementary crossbreeding program is used, the small size of females relative to the potential genetic size of their offspring will lower maintenance feed cost per kg of offspring marketed (Dickerson, 1978). However, if replacement animals are selected from the same herd, it will lead to an increase in mature size over time, since the larger size of the bull will be inherited by the offspring. There could also be a higher occurrence of dystocia.

Since mature weight is highly heritable, when mating a larger bull to the cow herd, it will lead to a gradual increase in the average size of the herd if replacement animals are held back from the same herd. Also, since larger animals have a faster growth rate as discussed in section 2.2.4, when selecting a young replacement bull based on a faster growth rate, it could also lead to an increase in animals' sizes.

2.3 Micro / miniature cattle

Micro or miniature cattle refer to very small sized cattle. Although there is no official definition for these cattle, this research will focus on the terms micro cattle and miniature cattle. These cattle are not smaller due to defects or genetic abnormalities, but are simply a smaller version of existing breeds or distinct breeds that were intentionally bred to be tiny (Boden, 2008; Gradwohl, 1997).

In 1993 the National Research Council published a report on micro livestock including micro cattle which was defined as cattle with a mature weight of about 300kg or less. The International Miniature Cattle Breeder's Society uses the term miniature cattle. Miniature cattle are defined as cattle that measures 42 inches or less from the ground to the hook bone at three years of age (Gradwohl, 1997).

Micro cattle are easier to handle, more efficient under improper management, perform better in harsh conditions and have a high tolerance to disease. They perform better in hot conditions due to a higher surface area to body mass, they are easier to handle and have fewer problems when calving (National Research Council, 1991; Gradwohl, 1997). However smaller cattle have received less attention, mainly due to them not being as prestigious as larger breeds.

Miniature cattle have become the most widely used term to describe these smaller versions or smaller breeds (Boden, 2008). This term will be used to define these small cattle for the rest of this thesis.

Although miniature cattle are merely a smaller version of cattle, the reason they are discussed here is to acknowledge the existence of these animals and demonstrate that they are a palpable option should a farmer desire to utilize very small cattle. Another advantage is that more of these animals can be held on a small area, adding to genetic diversity within the herd.

2.4 Economic Efficiency

Economic efficiency in this case will be defined as the profit or loss of an enterprise. This could be due to a proportionally higher income compared to expenses, proportionally lower expenses than income or a combination of the aforementioned. Previous research has used area specific simulation studies and experiments to calculate economic efficiency. Furthermore, linear programming, probable production curves among other methods were used to predict the most profitable cow size. Since production systems, biological efficiency, markets, among others vary widely the individual factors that make up income and expenses will be discussed separately, as to one simulation study as a whole.

When the influence of body size on economics is to be studied, there are two important considerations: the economic efficiency of an individual cow, and the economic efficiency of the enterprise as a whole.

Body size doesn't necessarily directly impact economic efficiency, but due to the biological differences, variation in incomes and expenses are observed. Body size influence biological efficiency, and biological efficiency influences economic efficiency (Dickerson, 1978; DiCostanzo & Meiske, 1994; Arango & Van Vleck, 2002; Johnson *et al.*, 2010). Although economic and biological efficiency are not directly proportionate, they are highly correlated, and a more biological efficient cow is normally also a more economically efficient cow.

Cattle has a low reproduction rate and a subsequent high maintenance cost. Since beef farmers are mainly in the business of selling kilograms of meat, actually having calves to sell every year is the most important consideration when it comes to income. The culling of cows and bulls also generate income; however, it is secondary to the income from calf sales. Variable expenses will vary with cow size and literature has proven it is lower for smaller cows when measured for individual cows. However, since a resource base can support more small cows, the variable expenses of the resource base as a whole need to be considered. Fixed costs are those costs that do not vary as production levels increase or decreases. Therefore, in this case, fixed costs are defined as costs that remain the same, whether or not the resource base supports more small cows or less large cows. As it is not influenced by cow size, it will not receive much consideration in the literature review, or the rest of this research.

Previous research aimed at measuring economic efficiency has been done mostly at the hand of simulation studies and will be discussed in section 2.4.3.

2.4.1 Factors influencing income

Income in a weaner system is mainly generated from calf sales. Cows reproduce and produce calves which are to be sold at a certain age, for example at weaning. It has been shown that smaller cows produce smaller calves, thus generating a lower income per cycle or season. However, a set resource base can maintain more small cows, which complicates the equation. For the sake of argument, when differences in reproductive efficiency are ignored, there are still a huge number of variables to be taken into consideration.

2.4.1.1 Selling price

South Africa has a relatively simple meat classification system, based on the age and fat grade of the animal. Younger animals normally fetch a premium price, and the fat grade should match the requirements of the end consumer.

The end consumer is the one who chooses what they want to buy and the price they are willing to pay for it. They are thus indirectly involved in determining the price that the farmer will receive for their products. End producers prefer a good fat covering of the carcass, without it being overly fat. They will also pay more for a higher grade of beef. Animals slaughter at a lower age receives a higher grading and the number of incisors is the determiner for the age (Brody, 2017).

In the commercial sector, 65-70% of cattle slaughtered has spent some time in a feedlot (Department of Agriculture, Forestry & Fisheries, 2015). The feedlot aims to satisfy the end customer’s requirement and has control, to some extent, over the age and fat covering at which the animals are slaughtered. In a weaner system, weaners are sold to the feedlot, meaning the farmer and the feedlot comes to an agreement and the price is usually paid on a per kilogram basis. The feedlot might pay a premium for animals that suit their goals when supplying the end consumer.

The mature size of animals influences its rate of maturity and smaller animals will reach slaughter age sooner than large animals. Even if the rate of maturity is ignored, larger or smaller animals might be penalized, mainly because of two reasons:

1. The customer might prefer a specific size when purchasing their cuts in the butchery or supermarket (Brody, 2017)
2. The equipment for handling animals from when they are received in the feedlot, until they are sold to the end consumer might not accommodate small or large extremes falling outside of a certain range (Dickerson, 1978)

2.4.1.2 Number of animals sold

First consider individual cows. A larger calf will fetch a higher price than a small calf, where price premiums are ignored. Thus, a large cow producing a large calf each year will yield a higher income than a small cow producing a small calf each year. A cow producing no calf will yield no income unless it is culled. In fact, reproductive efficiency has been shown as the single most important measure of biological and economic efficiency (Jenkins & Ferrell, 2002). Having one large cow thus generates a higher income than having one small cow. Furthermore, income is generated from cow and bull culls. The biological efficiency will largely determine which animals are culled, where reproduction might be the most important consideration once again. Again, ignoring biological efficiency and price premiums, culling a larger animal will yield a higher income than culling a smaller animal.

However, given a set resource base, more small cattle can be supported than large cattle. Furthermore, a herd consists of calves (from adult cows as well as cows that are still growing), growing cows, mature cows and bulls. Given the difference in energy requirements of the different classes of animas, combined with the differences in mature weight, maintenance requirements, growth rate, lactation yields, and sizes of calves weaned, the number of small animals as well as the composition of this herd will differ from the number of large animals and the composition the herd of large animals.

Consequently, knowing which sized individual animal generates the highest income, gives little clarity on which sized animal will generate the highest income in a herd. Therefore, the stock flow and inventory of a herd of different sized cattle must first be computed before any assumptions on income or profitability of a herd can be made.

2.4.2 Factors influencing Expenses

Johnson argued that adjusting the herd size according to metabolizable energy, or Kleiber's law, will not impact total fixed costs or total feed cost, but it will increase variable costs and lead to additional costs to increase inventory. To compensate for the higher costs, higher revenue should be generated from selling a larger number of smaller calves. She also noted that in an environment where feed availability varies, and supplementary feed may be scarce or expensive, larger cattle will have a lower reproduction rate and subsequent economic risk (Johnson *et al.*, 2010). Some expenses are dependent on the size of animals or more specifically the total kilograms that will incur the expenses, for example supplementary licks and dosing. Other expenses are normally charged on a per head basis, for example veterinary costs and vaccinations.

As with income, it has been shown that an individual small cow has fewer expenses, where biological efficiency is ignored. However as with income, the number of animals and the composition of the herd will determine the total expenses.

2.4.3 Examples of case studies of economic efficiency

Doye evaluated the economic efficiency of medium sized (1,100 lb) and large sized (1,400 lb) cows in a whole farm model. Two pasture systems (native pasture and improved pasture) were used in the model. The pasture systems had a carrying capacity of 100 breeding cows and 4 bulls of medium size or a carrying capacity of 76 breeding cows and 3 bulls of large size. Income was higher for the larger cows in both systems; however, operating costs, including feeding costs, were proportionally higher for larger cows. This led to lower returns over all costs for bigger cows. Fixed costs were also higher per breeding female of the larger sized group, as total fixed costs were allocated to fewer females (Doye & Lalman, 2011).

Bryant calculated economic efficiency of different sized cows on a resource base that can sustainably maintain 100 AU. He calculated a production revenue curve for small cows (1,000 lb) and large cows (1,200 lb) in three locations of the USA by averaging the prices for calves for the 10 years up to 2010. He assumed that cows wean 50% of their body size and have a 90% weaning rate regardless of size. According to his method 90 small calves (450-500lb) or 75 big calves (550-600lb) would be marketable per season. Even though the larger cows will produce slightly more pounds of calf for this resource base, the smaller cow-calf operation will yield higher revenue because of higher prices offered per pound to smaller cows (Bryant *et al.*, 2011).

There are a number of case studies that aimed to find the most profitable sized cow for the herd as a whole. In some cases, keeping a herd of small animals proved to be more profitable, where in others it did not, yet more case studies showed that economic efficiency might depend on the beef-to-feed price ratio (Morris & Wilton, 1975; McMorris *et al.*, 1986; Whitworth *et al.*, 2006; Bryant *et al.*, 2011; Doye & Lalman, 2011). Results vary from one research area and production system to the next.

2.5 Chapter Summary

This chapter reviewed the effect of size on biological efficiency, with special consideration to feed intake requirements. Economic efficiency is dependent on biological efficiency however they are not directly correlated. The economic efficiency of individual cows tells us little about the economic efficiency of the herd as a total. Previous case studies to determine the most profitable cow size yielded varying results.

Chapter 3 Methodology

3.1 Methodology outline

First the type of cattle and sizes to be used in the simulation study was defined. Next the energy requirements and the calculation thereof were discussed. The energy requirements for individual animals for maintenance, growth, lactation and foetal production throughout their life stages were calculated. This was done for the life cycle of a cow of each of the three sizes. Next the resource base was defined in terms of available energy. An inventory and stock flow were simulated for a typical production system in semi-arid South Africa, by assuming productivity guidelines from previous literature. Inventory and energy requirements of animals were used to determine the number of animals the resource base can maintain. Thereafter a production budget for each of the three size groups was calculated to determine income, expenditure and ultimately profitability. The calculation described here will be referred to as the base model in other sections.

3.2 Cattle type and sizes

As far as possible, data was gathered for the commercial beef sector of South Africa. Information about this sector could be obtained from existing literature, mostly in the form of government publications. In some cases, information for the whole sector was unavailable. Around 16% of cattle absorbed into South African feedlots were Bonsmaras or Bonsmara crossbreds, the most numerous of all breeds. The seedstock industry also breeds predominantly Bonsmaras (Scholtz *et al.*, 2008). In the case where there was no or little information available for a specific data set in the commercial sector, information from the Bonsmara breed was used. As mentioned in section 1.1.2, limited information is available for the emerging sector, however emerging farmers are defined as farmers that have the potential to commercialize. Therefore, the data as described above is also applicable to the emerging sector. This study looked at the differences in efficiency within a specific breed, thus comparisons were not made among different breeds. Animals were divided into 3 sizes according to mature weight,

- Small, with a mature weight of 300kg
- Medium, with a mature weight of 450kg

- Large, with a mature weight of 600kg

Although a small size of 300kg might seem extreme, refer to the discussion of miniature cattle in Chapter 2. This shows that a mature size of 300kg is not only a theoretical option, but animals of this size are actually available and can be used should the farmer desire.

3.3 Dry matter intake, gross energy and net energy

Dry matter intake (DMI) is commonly used to express the amount of feed an animal will eat. Feed is responsible for providing the animal with energy for maintenance, growth and other physiological functions.

Given a specific energy content of feed, DMI and the net energy utilized by the animal is highly correlated for animals of the same breed and physiological stage. In this study, net energy was set as the limiting factor for the number of animals to be kept on the resource base and is defined next.

Not all energy that is consumed by animals is utilized for maintenance, growth, lactation and production. The following energy values are commonly defined:

Gross Energy (E): The total energy in the feed consumed

Digestible energy (DE): E minus energy lost in faeces.

Metabolizable Energy (ME): E minus faecal energy, urinary energy and gaseous energy

ME can only be partitioned into Heat Energy (HE) and Retained Energy (RE), thus

ME = HE + RE

A common misconception is that ME = HE + NE, however, NE is actually the change in Retained Energy as a fraction of the change in Intake Energy. Net Energy and Retained Energy are very often equal and thus the misconception.

Net Energy (NE) = ΔRE /ΔIntake Energy(IE)

Total Net Energy (NE_t) is the energy available to the animal for maintenance and physiological functions (growth, milk production, foetal production). The heat production at zero feed intake is equal to the animal's maintenance requirements.

NE_t = Net Energy for maintenance (NE_m) + Net Energy for growth (NE_g) + Net Energy for lactation or milk production (NE_l) + Net Energy for foetal growth (NE_y)

Now, as NE has been well defined, the NE for each animal of different sizes and physiological stage could be calculated. The NE will determine the number of animals (in different production stages) of different size that can be supported by the resource base.

3.4 Determination of Energy for physiological functions

This research aimed to use the equations prescribed in the seventh revised edition of *Nutrient Requirements for Beef Cattle* by the NRC for NE requirements as far as possible (National Research Council, 2000). As science has progressed, these equations have been refined and even complicated as new information and ways of measuring energy has become available. There are many variables that influence energy requirements for physiological functions other than body size, however many of these variables will not be affected by the size of the animals. Since animals within the same breed is compared, the effect of breed on energy requirements can be omitted. A further example is where energy requirements are influenced by the terrain (topography of the terrain, ambient temperature, etc.). Since the environment were the same for all animals, it would make calculation cumbersome and was therefore omitted. Thus, for the sake of simplicity, where an equation contained numerous variables that were constant or uninfluenced by the size of cattle, a simple version was used.

The energy requirements and calculations for the different physiological functions are discussed in detail in the following paragraphs.

3.4.1 Energy requirements for Maintenance

For the calculation in this study, the variables that influenced Net Energy for maintenance were taken as the animal's bodyweight and more specifically metabolic weight.

The controlled slaughter study by Lofgreen and Garrett, discussed in Chapter 2, estimated daily NE_m. The results from this study were adopted by the NRC. Currently the most widely used equation to calculate NE_m is

$$daily\ NE_m = 0.077 Mcal/BW^{0.75}$$

where *BW* is the body weight of the animal. This equation was also used in this study to calculate maintenance energy requirements.

Animals partition energy for maintenance before any of the other physiological phases, therefore energy requirements for maintenance are always applicable, irrespective of its life stage. (Lofgreen & Garrett, 1968; National Research Council, 2000; Johnson *et al.*, 2010)

Since body weight increases as animals grow, the NE_m changed daily. Another complicating matter was the effect of growth on BW, as is explained in the next section.

The maintenance requirements of bulls were assumed to be 15% higher, in line with the NRC's guidelines. In this study, it was assumed that all bulls on the resource base were already mature and their only energy requirement was for maintenance.

3.4.2 Growth rates and Energy requirements for Growth

For the calculation in this thesis, net energy for growth was influenced by the animal's body weight, daily weight gain and composition of weight gain. Daily weight gain was calculated using Brody's model and in turn influenced birth weight, growth rate, mature weight and time after birth.

Growth is defined as the increase of body size, in this case measured by mass, from birth to maturity. Growth is not linear. Animal growth normally follows a sigmoid shape curve from conception to maturity. Brody's growth curve has been found to be a good fit to beef cattle from the time after birth. Brody's model was thus used to calculate the daily gain of animals (Brody, 1945).

Note that there is a difference between daily gain and average daily gain (ADG). ADG is defined as the weight gain from one point in time to another point in time, divided by the number of days between these two points. ADG however fails to recognize that growth is not linear and accelerates and decelerates throughout the animal's life. ADG could thus be useful for rough calculations when net gains are measured over short periods. In this study daily gain was calculated every day and not as an average taken over a longer period of time.

Brody's growth model states:

$$f(t) = A\ (1\text{-}B^{-kt})$$

where

$f(t)$ gives the expected weight of the animal at time = t

A = asymptotic weight or average adult weight as $t \rightarrow \infty$

B = the constant of integration, thus the inception point of the growth curve where $t=0$. In this case, $t=0$ when the calf is born

k = growth rate

t = time after t_0 in days

The following values were used to calculate growth for the 3 animal sizes.

A = 300kg, 450kg or 600kg.

It was assumed that calves would weigh 6.67…% of their dams' body weight, thus

B = 0.933...

To calculate the growth rate, it was assumed that animals would reach 97.5% of mature weight after 51 months or 1552 days, when they were then classified as mature cows.

Thus, solving for k in $f(t) = A\,(1-B^{-kt})$ yields

k = -ln(A/(A*0.975)-1)/1552 days

k= 0.2361…%

Substituting the above values in Brody's model gave the daily weight gain, for each day after birth. This could then be used to determine NE_g.

The equation formulated by Garret and refined by the NRC were used to calculate the net energy requirements for growth. The equations are

$$NE_g = RE = 0.0635 * EBW^{0.75} * EBG^{1.097} \text{ (Mcal)}$$

Where *EBW* is Empty Body Weight and *EBG* is Empty Body Gain (Garrett, 1980; National Research Council, 1984; National Research Council, 2000).

However, as animals grow, the composition of their RE differs. When energy intake is not limited animals will deposit retained energy mostly for protein while growing and proportionately more fat as the animal nears mature weight. This means if there are 3 animals all weighing 100 kg, and that will gain 1kg within the next day, but that will have mature weights of 300kg, 450kg and 600kg NE_g will differ for each of the animals and will be 2.5Mcal, 1.8Mcal and 1.5Mcal respectively. This is mainly due to the difference in composition of the gain made (fat vs protein). NE_g will thus logically also be influenced by the composition or marbling at mature weight. It was assumed that all three sizes had 28% body fat at maturity.

The above formula used to determine NE_g was formulated with an average mature weight of 478kg. To compensate for the differences in composition of daily gain for animals which will have different mature weights, the NRC uses the following calculation.

First the current body weight of the animal is converted into the equivalent shrunk body weight by

$$EQSBW = SBW * (SRW/FSBW)$$

$$EQEBW = 0.891 * EQSBW$$

$$EBG = 0.965 * SWG$$

$$NE_g = RE = 0.0635 * EQEBW^{0.75} * EBG^{1.097}$$

Where

EQSBW = equivalent shrunk body weight

SRW = Standard Reference Weight which refers to the 478kg mature weight of the comparative slaughter experiments mentioned above.

FSBW = Final Shrunk Body Weight, which in this case was taken as the mature weight of the animals, thus 300kg, 450kg and 600kg for this study

EQEBW = Equivalent Empty Body Weight

EBG = Empty body weight gain

SWG = Shrunk Body Weight Gain which in this case is the daily gain as computed using Brody's model as discussed in the previous paragraphs.

The above calculation which incorporates the standard reference weight thus caters for animals of any frame size. By using the standard reference weight, differences in composition of weight gain among different frame sizes is duly calculated. Furthermore, little difference was also found in growth rates of heifers and steers; thus, this assumption holds true if it is assumed steers are castrated shortly after birth. In this study, it was assumed that bull calves were castrated early and sold as weaners and all replacement breeding bulls were bought. Therefore, no differentiation was made between the growth of bull and cow calves.

To recap the calculation, Brody's model was used to calculate SWG for the first 1552 days for the animal after birth. SWG and the other variables were plugged into the equations of the NRC to determine NE_g for each day from $t_1, t_2, t_3,..,t_{1552}$. Animals were classified as mature at 1553 days of age and their weight set at 100% of mature weight.

From chapter 2, smaller mature animals are smaller throughout all life stages. Also, calves from 2 year heifers and 3 year cows are 8% and 5% smaller than calves from mature cows. To calculate the growth of calves from first calf cows and second calf cows, the expected mature weight was set at 92% and 95% of the expected mature weight of calves from mature cows. The same method was used to calculate gain as described above, in this case with a lower expected mature weight.

3.4.3 Energy requirements for Lactation

Total lactation yield is influenced by peak milk production and length of lactation. Peak milk production is argued to be influenced by calf size and mature size. If calves are weaned at the same time, as is often the case, length of lactation is the same, irrespective of size. Energy requirements per kg of milk produced in turn is influenced by milk composition. By calculating the milk yield and the energy content of milk, NE_l could thus be calculated.

From the energy requirements for milk yield developed by Jenkins & Ferrel (Jenkins & Ferrell, 1984):

$$Y_n = n / ae^{kn}$$

Where

n is the time, in weeks, postpartum

a = 1/ (peak milk yield * k * e)

k = 1 / week of peak milk yield

By sighting previous research, the NRC concluded that peak milk yield occurred at 8.5 weeks on average. This was calculated over a wide range of beef cow breeds. Therefore

$$k = 1 / 8.5$$

was taken for all sizes.

Research connecting the size of the cow to the peak milk yield is scarce and a direct correlation between cow size and peak milk yield has not been shown.

Maiwashe et al. measured the growth curve parameters for Bonsmara and Nguni cows (Maiwashe *et al.*, 2013). Results also showed a peak milk yield of 8.5 weeks. Peak milk yield for Bonsmaras were 10 kg / day, however there is no mention of the size of the cows. From this, the peak milk yield for medium sized cows was taken as 10kg/day. Much previous research does not directly correlate milk yield to size but stresses the suckling capability of the calf. The calf weight of small, medium and large frame cows were assumed to be 20kg, 30kg and 40 kg respectively. By assuming the metabolic weight and the net energy requirements of the calves are proportionate, the peak milk yield for small and large frame cows were calculated as follows:

$$MY_s = CW_s^{0.75} / CW_m^{0.75} * 10 \text{ kg/day}$$

$$= 20^{0.75} / 30^{0.75} * 10 \text{ kg/day}$$

$$= 7.38\ldots\text{kg/day}$$

$$MY_l = CW_l^{0.75} / CW_m^{0.75} * 10 \text{ kg/day}$$

$$= 40^{0.75} / 30^{0.75} * 10 \text{ kg/day}$$

$$= 12.41\ldots\text{kg/day}$$

where

MY_s , MY_l = Calculated peak milk yield for small and large cows respectively

CW_s, CW_m, CW_l = The weight at birth for small, medium and large calves respectively

It was assumed that calves were weaned at 205 days. Thus, the lactation time was assumed to be 205 days. Weaner calves were sold 7 days later (10 days later for calves from heifers) at 7 months of age.

Furthermore, as recommended by the NRC, 2-year-old heifers produced 26% less milk and 3-year-old cows produced 12% less milk respectively throughout the first and second lactations. The recommendation of the NRC was kept for consistency; however, it should be noted that they predict the calves of first calf cows to be merely 8%, and the calves of second calf cows to be 5% smaller than that of older cows. In this simulation study, cows were bred for the first time at 24 months and thus lactated at 3 years, therefore, milk production was set as 12% lower and calf birth weights at 8% lower for these first calf cows. For second calf cows, milk production was left unchanged from that of mature lactations, however, for consistency calves were expected to be 5% lighter.

By substituting the above peak lactations and time of peak lactations, the milk yield for week n could be calculated. To calculate the daily yield, the equation was adapted to:

$$Y_t = t / ae^{kt}$$

Where

$t = n/7$ and is thus the conversion from weeks (n) to days (t).

Now since the daily milk yield could be computed, the milk yield had to be converted into net energy requirements. The net energy requirements for lactation of the cow were taken as equal to the net energy content of the milk. The net energy content of the milk is determined by the milk composition. The NRC reviewed previous literature and recommends using a fat content of 4.0%, protein content of 3.4% and a SNF (solids non-fat) content of 8.3% for general calculations. These recommendations were also used in the calculation in this research.

From the equation developed by Tyrrell & Reid (1964), the energy content of milk can be calculated as

$$E = (0.092 * \text{fat percent}) + (0.049 * \text{SNF percent}) - 0.0569$$

From the above equation and recommendations of the NRC, the energy content of 1 kg of milk is calculated to be 0.7178Mcal/kg.

The above therefore allowed for the calculation of NE_l per day during lactation for cows from each of the three different size groups, including lower milk yield for first calf cows of all sizes.

3.4.4 Energy requirements for foetal production

This research calculated energy requirements during pregnancy using the gestation period and size of the calf at birth as variables. The size of the calf at birth was in turn influenced by the mature size.

As shown in Chapter 2, the NRC derived an equation for calculating the net energy requirements for gravid uterus from the work of Ferrel et al (1976). It is assumed that the net energy used for the gravid uterus equals the net energy of the gravid uterus. The net energy requirements during pregnancy is estimated by:

$$NE_y = 0.576 \text{ birth weight } (0.4504 - 0.000766t)\, e^{(0.03233 - 0.0000275t)t} \quad \text{kcal}$$

where *t* is the time after conception. This leaves two variables unsolved, the birth weight of the calf and the total duration of pregnancy.

The *Performance Information from Breeds Participating in the National Beef Recording and Improvement Scheme* of South Africa was used to determine the average calf weight (Scholtz, 2010). Information available for the national seed stock showed the average calf birth weight was 35kg and the average cow weight was 492 kg for the same period from 1999 to 2008. This gives an average of 6.7% of cow weight. The commercial average was 36kg for calf birth weight and 518kg cow weight for the same period, however data is only available for between 2 and 5 cows for the last 4 years, far too few to be accepted as representative of the total commercial sector. Therefore, information from the seed stock industry was used as a starting point. Calf birth weight is influenced by mature size. As discussed in Chapter 2, animals that turned out to be larger mature animals were larger at all life stages. It is thus safe to assume that larger cows gave birth to larger calves. For this simulation study, calf weight was assumed to be 6.67% of mature weight, giving approximate birth weights of 20kg, 30kg and 40kg for calves from small, medium and large cows respectively.

As recommended by the NRC, calves from 2-year first calf cows were 8% lighter, and that of 3-year old second calf cows were 5% lighter than that of mature animals. No compensation was made for 4-year old cows. From the literature review it is concluded that animals that were smaller at birth, were also smaller at other life stages. It was assumed that these calves remained 8% and 5% smaller than those from mature cow until they were all sold at 7 months of age.

The total duration of pregnancy was set at 283 for all three groups. As discussed in Chapter 2, it has been shown that smaller animals have a shorter gestation period. Results were mainly from measurements in controlled studies, and it is impossible to assume a specific day or number at which smaller cows will calf.

3.4.5 Growth and Total daily energy requirements per cow

By Using Brody's growth curve and the expected mature weight of animals, the exact weight for each animal for every single day from birth until one year after maturity was computed. Having the exact weight of each animal at each day available allowed for accurate energy requirement, inventory and income and expenditure calculations.

The total daily energy requirements (NE_t) is the sum of the net energy for maintenance (NE_m), the net energy for growth (NE_g), the net energy during lactation (NE_l) and the net energy during pregnancy (NE_y) for each day. Thus

$$NE_t = NE_m + NE_g + NE_l + NE_y$$

As mentioned before the order in which energy is prioritised for physiological functions are also important. Literature suggests animals will always use energy for maintenance first. In the case were feed is limited animals will first compensate by failing to reproduce.

From the above it was thus possible to calculate the energy requirements for each individual animal for each of the physiological functions for every day it remained in the herd. A summary of the daily energy requirements for small, medium and large cows is given in table 4.1, 4.2 and 4.3 and the full results for energy requirements for each day from birth to 1 year after maturity for each of the three sizes is given in Appendix A.

3.5 Resource base

Due to the low rainfall in the semi-arid regions of South Africa, extensive cattle farming is the dominant practice. Approximately a quarter (24.6%) of South Africa's surface is classified as semi-arid with rainfall ranging between 400-600mm. The semi-arid regions of SA consist of mainly Savannah and grassland. Grassland can be divided into "sweet" and "sour" veld which refers to the palatability of the grass. Sweet veld retains its nutrients and palatability even in winter and animals will voluntarily graze it throughout the year. Sweet veld occurs at high elevation and low rainfall as is found in the semi-arid regions (Suttie *et al.*, 2005; Mucina & Rutherford, 2006).

Grazing capacity in South Africa is usually expressed as ha/LSU. The LSU and the calculation thereof were discussed in chapter 2 and also receives more attention in Chapter 5. There is huge variation in grazing capacity in South Africa. The average grazing capacity of the grassland biome is 4-6ha/LSU and that of the Savannah biome 10-15ha/LSU (Avenant, 2016). At a lower grazing capacity, animals need to walk long distances to find grazing or water, they will need more energy over and above that needed for maintenance. However, whether the animal is big or small, the activity would be similar and therefore not influence the results of the study.

In this thesis one of the aims was to determine the number of animals of different sizes a set resource base can support. A well-defined resource base will have a specific amount of gross energy available annually. This energy is utilized by the animals and finally used for maintenance, growth, lactation and foetal production. More small animals and less large animals can be held on this resource base. It is accepted that different sizes of the same breed will be equally efficient in extracting net energy from gross energy. Net energy of the resource base is therefore used as the limiting factor in this study.

The amount of net energy of the sample resource base used in this study is solely used to find the ratio of small:medium:large animals that can be maintained on a resource base that supplies a set amount of energy. Therefore, in this case, any random amount of net energy could be chosen, since we are concerned with ratios and not specific numbers.

To add a comprehensible and easily calculatable value to the net energy available on the resource base, the net energy requirements of 500 non-pregnant non-lactating cows of 450kg live weight at maintenance was used. That is without energy requirements for growth, pregnancy or lactation. From section 4.1,

$$\text{Yearly } NE_m = 0.077 * BW^{0.75} * 365 \quad \text{(Mcal)}$$

$$= 0.077 * 450^{0.75} * 365$$

$$= 1{,}372{,}976 \quad \text{(Mcal)}$$

It was assumed that feed was available as required by the animals throughout the year. Thus, there were no periods were there was a feed shortage. This underlines the importance of grazing management. Since the semi-arid grasslands are made up of mainly sweet grass, which retains its nutrients well, feed availability can to some extent be controlled. This is done through rotational grazing and timing a breeding season to energy availability, among other management practices. As is normal in the semi-arid North West and Freestate provinces, a protein lick was fed in the winter and a phosphate lick in summer.

3.6 Production system

A commonly used definition for a production system in South Africa, is where only the age at which animals are marketed is mentioned. The most popular systems are weaner, tolly, and ox -systems which refers to the age at which animals are sold. A weaner system is also commonly referred to as a cow-calf system. The KwaZulu-Natal department of agriculture and rural development guidelines to define a production system were used, where the following is defined (Department of Agriculture and Rural development, 2016a):

- Age, mass and class at which animals are sold
- The breeding, management and feeding systems

This study simulated a production system defined as follows:

- A weaner system was followed where weaners were sold at 7 months to the feedlot. Animals were sold at different weights. Culled cows and bulls were sold as class B2/3 and C2/3 meat as further described under section 7.1
- Natural mating was assumed. It was assumed that a breeding season was used, furthermore to simplify calculations, it was assumed that all cows that fell pregnant did so on the same day. The management system was defined as extensive as is most commonly applied in South Africa and also the research area. Animals were managed on savannah or grassland and grazed year-round with no supplementary feeding, however mineral licks were fed.
- Dosing and vaccinations were calculated in line with common practices in the North-West and Freestate Provinces

The production system determined the calculation of the inventory and the production budget.

3.7 Stock flow

Next a stock flow for each of the three size groups was computed, since individual animals required different amounts of energy for different physiological functions. The stock flow was calculated monthly, starting from January.

Animals were divided into 6 classes

- Mature cows (MC): Cows were classified as MC on 1553 days. These are cows that had 2 or more calves. MC were bred and fell pregnant on 23 December. Non- pregnant MC were culled on 30 April. Pregnant MC calved on 1 October.
- Second calf cows (SCC): Cows were classified as SCC at 1188 days of age. SCC are cows that had their first calf on 1 July and were rebred for the second time on 23 December at 1179 days and will yield their second calf on 1 October at 1461 days. Non-pregnant SCC were culled on 30 April
- First calf cows (FCC): Cows were classified as FCC at 823 days of age. FCC were bred for the first time on 22 September at 722 days or approximately 24 months. The ones that fell pregnant calved on 1 July at 1779 days or approximately 33 months. Non-pregnant FCC were culled on 31 January. FCC were rebred on 23 December at 1179.
- Retained cow calves (RCC): Heifers were classified as RCC at 458 days. These were heifers retained to replace the culls from the other cow groups. These animals were bred for the first time on 22 September at 722 days. These retained animals were retained only from MC and not FCC or SCC.
- Calves from MC, RCC from MC, calves from SCC and calves from FCC. Calves from MC and calves from SCC were born on 1 October, weaned 23 April at 205 days and sold on 30 April at 212 days. Calves from FCC were born on 1 July, weaned on 21 January at 205 days and sold on 31 January at 215 days. All calves from SCC and FCC were sold. Calves held back for replacement were only from MC and were named RCC from MC from month 7 to 15 and were named RCC from month 15 as described in the point above.
- Bulls. Bulls were assumed to be mature throughout their lifetime in the herd. The number of bulls was assumed to be 1:25 of all breedable cows at the highest quantity. Bulls were replaced at 20% and they were culled and replaced on 30 November after compensating for a loss due to mortality.

The most important variables that influenced the calculation of the stock flow was the calving rate of MC, calving rate of SCC, calving rate of FCC, and subsequent culling rate, the replacement rate of bulls and the death rates for the different animal classes.

Calving rates vary greatly throughout the whole beef sector in South Africa. The seed stock industry reports a calving percentage of around 76% for breeds that take part in performance recording. Commercial animals that take part in performance recording has a calving percentage of 83% but could be skewed by the low number of animals in the performance recording scheme. Some calving rate estimates are as low as 61% for the commercial sector and a mere 48% for the emerging sector (Scholtz *et al.*, 2008; Scholtz, 2010). When it comes to the calving percentages of FCC, SCC and MC, there is little information available to differentiate among the 3 groups. The targets from the Department of Agriculture & Rural Development (2016b) suggests farmers aim for a calving percentage of 90% for heifers bred at 2 years, 75% for first calf cows and 80% for mature cows and this was taken as the reproduction rates in the base model.

From the literature review, there is evidence that suggest smaller cows have a higher reproduction rate. Unfortunately, this qualitative data cannot be expressed numerically, therefore the same fertility rate was accepted for all sizes in the base model. Reproduction rate is arguably the most important biological efficiency measure and is therefore further discussed in Chapter 5.

Replacement cows came from the same herd. The same gestation length, of 283 days, was assumed for all cows. Lactation started on the day cows calved. Lactations lasted 205 days and ended on the 23 April for MC and SCC and on 21 January for FCC. Calves were sold at 7 months of age. Calves from MC and calves from SCC were sold on 30 April. Calves from FCC were sold on 31 January. A very strict culling criterion was followed, where all animals that didn't reproduce where culled. Pregnancy tests were done on 30 April for MC and SCC and on 31 January for FCC. Non-pregnant cows were immediately sold. A mortality rate of 1% was assumed for all animals except calves. The mortality rate of calves was set at 3%. Deaths were calculated monthly.

Using the above assumptions, the stock flows were calculated for herds of each of the three sizes. Next the energy requirements were matched to the stock flow. From the energy requirements of each class of animal and the stock flow the number of animals of each class was calculated. The total energy requirements per day across all animal classes could be calculated by multiplying the number of animals of each class, with their daily energy requirements. The monthly energy requirements were the sum of the daily energy requirements for the month for each class of animal. The same calculation was used for each month for MC, SCC, FCC, RCC, Calves from MC, RCC from MC, Calves from SCC, Calves from FCC, and Bulls for a herd of small, medium and large cattle.

The energy requirements calculated for individual cows where done for cows that fell pregnant. Therefore, for MC, SCC and FCC that didn't gestate, the NE_y needed during pregnancy was subtracted from the NE_t requirements, since they would not be consuming energy for foetal production. For example:

The NE_t for a pregnant mature cow was calculated for each day from birth throughout maturity, as described in section 3.4. From 1 January to 31 January, medium sized pregnant MC needed NE_t of 412.29Mcal, (of which NE_m was 233.22Mcal, NE_g was 0, NE_l was 178.54Mcal, and NE_y was 0.53Mcal). There were 171.9 MC on the resource base from 1 January to 31 January, meaning NE_t for January for this class would be 171.9 MC * 412.29 Mcal = 70.851Mcal if all cows were pregnant. But, importantly, 34.4 of these cows did not fall pregnant and did not use NE_y. This is NEy of 34.4 * 0.53 = 18.08Mcal not used. Therefore, the NE_t of medium MC for January was 71,851Mcal. The NE_m for this class for January was also calculated as 233.22Mcal * 171.9MC = 40,088.35Mcal. NE_l was 178.54Mcal * 171.9MC = 30,690.46Mcal. NE_y was 0.53 * (171.9-34.4) = 72.31Mcal.

Using the above calculations, the number of animals in each class that the resource base could support was calculated. With the animal numbers, and the exact daily energy they need, the number of animals that could be supported by the resource base was calculated to match 1,372,976 Mcal. Animal numbers were not rounded to whole numbers, as this simulation study is concerned with accurate ratios among the different sized animals. Inventories are shown in table 4.4,4.5 and 4.6 for small, medium and large cattle respectively.

3.8 Production Budget

3.8.1 Income

Income is generated from calf sales and culls of female animals and bulls. Calves were sold at 7 months of age. FCC and SCC that failed to reproduce were culled at 28 months (on 31 January) and 43 months (on 30 April) respectively. MC were also culled after pregnancy tests, on 30 April, but they were sold at various ages when failing to reproduce, averaging around 111 months.

The South African red meat classification system is mostly concerned with the age, measured by the number of permanent incisors, and the fatness. Animals are usually classified as follows:

Table 3.1: Beef Classification in South Africa

(Brody, 2017)

	Milk teeth	**2 teeth**	**4 teeth**	**6 teeth**	**8 teeth**	**Fat grade**
Grade	A – grade	AB – grade	B – grade	B – grade	C – grade	0- No fat 1- Very lean 2- Lean 3- Medium 4- Fat 5- Slightly overfat 6- Excessively overfat
Age	0-18 months	18-24 months	24-36 months	36-48 months	48 months or older	

From the above, FCC that were culled were classified as B2/3 and SCC, MC and bulls that were culled were classified as C2/3. Prices for culls and weaners were obtained from the Red Meat Producers Association (RMPA) and ABSA. The RMPA publishes weekly prices and the average weekly price for 2017 for the above classes were taken. This gave a price of R40.48 and R39.18 per kilogram of slaughtered carcass for class B2/3 and C2/3 respectively. It was assumed that all animals of all classes yielded a carcass of 52% of body mass, which gave a live price of R21.05/kg and R20.38/kg for B2/3 and C2/3. The average weekly price published for weaners throughout 2017 was taken, giving a live price of R32.25/kg (Red Meat Producers Organization & ABSA, 2018).

From the growth curve calculation discussed in section 3.4.2 the exact weight of each animal class for every single day from birth was known. Using this and the inventory calculation, the exact live kilograms of each animal of each class for each size that were sold could be obtained. By multiplying the live kilograms sold from each class sold with the price per kilogram as discussed above, the total income was calculated for the herds of small, medium and large cattle. To illustrate, consider the following example:

SCC were culled on 31 April and 11.99 medium SCC were culled. From the growth rate calculation, medium SCC weighed exactly 430.8kg on 31 April. Therefore, a total of 5,163.31kg were sold as medium SCC culls, at a price of R20.38/kg. This gave an income of R105,206.00 for medium SCC culls. The income from other classes were calculated similarly, for the herds of small, medium and large cattle.

3.8.2 Expenses

Except for bull replacements, other expenses were adapted from the production budgets of Senwes Agricultural Services for extensive beef production in the North-West and Freestate provinces (Senwes Agricultural Services, 2017). Where expenses were incurred on a per head basis, the number of animals was obtained from the calculated stock flow. Where expenses were incurred on a live weight basis, the number of animals of each class to which it applies, were obtained from the stock flow. The exact weight of the relevant animal was known from the growth rate calculation discussed in section 3.4.2. Thus, to get the total weight to which the expense applies, the relevant number of animals from the stock flow was multiplied by the exact weight of those animal for the day on which the expense was incurred.

3.8.2.1 Bull replacements

It was assumed that replacement bulls were bought at a higher price than bulls that were culled. To maintain a high calving percentage and improve the efficiency of the herd, a good bull is essential as the genetics from bulls make up 50% of the genetics of the progeny. When buying a bull, size influenced their choice by up to 9% of commercial farmers and 24% of emerging farmers (Scholtz *et al.*, 2008). It can therefore be assumed that a larger bull will fetch a premium in terms of price. A practical rule that has been suggested is that the cost of a bull should be approximately 8 times the value of a weaner calf to be marketed to the feedlot or 5 times the price of a fattened cow (Bradfield, 2015). The price of a weaner calf was assumed to be R32.25/kg. Converting the price of eight weaners to one bull, gave a price of R112.00/kg for a bull and, R33,599, R50,398, R67,198 for a 300kg, 450kg and 600kg bull respectively. When taking the price of 5 cows, it gave a slightly lower price of R101.88/kg bull. The ratio of 8 weaners to one bull was taken for calculations in this study.

3.8.2.2 Supplementary Licks

Animals were given licks to supplement vital nutrients needed. Animals received a protein supplement in winter and a phosphate supplement in summer.

The protein lick was given for 6 months through winter starting 1 May and a phosphate lick for 6 months through summer starting 1 November. Voermol's Premix 450 and Supefos were used in this research. The supplementary requirements of animals will vary according to size and physiological function. For instance, a lactating cow will also consume more feed and thus also more licks than a non-pregnant cow. Therefore, it was assumed that lick intake was directly equivalent to NE_t requirements.

Since recommendations on licks normally provide a maximum intake per animal, this was matched to the maximum NE_t for any of the individual animals used in the aforementioned calculations. The maximum NE_t throughout the three cattle sizes throughout their lives was, as expected, from a large mature cow during peak lactation at 18.241Mcal. This was matched to the maximum recommendation for Premix450 and Superfos, which was 500g and 240g respectively. Using this as a starting point the amount of feed needed for all three production budgets could be determined. Therefore, when an animal's NE_t is 18.241 Mcal, it will require 500g of Premix450. Therefore, if the large herd's total NE_t during winter is 590,599 Mcal, they will require 590,599 / 18.241 * 500g = 16,188,803g of Premix450. Thus the calculation for winter licks were 500g / 18.241 Mcal * $NE_{t(\text{small, medium and large})}$ from 1 May to 31 October . A similar calculation was done for Superfos, where summer lick was calculated as 240g / 18.241 Mcal * $NE_{t(\text{small, medium and large})}$ from 1 November to 30 April.

3.8.2.3 Dosing and vaccinations

Dosing and vaccination programs, as prescribed by Senwes Agricultural (2017), were used and the motivation for the dosing and vaccinations are provided in table 3.2. Dosing was timed mainly according to recommendations of individual products. Products that recommended a schedule of 4-8 weeks before breeding were administered on 1 November for MC, SCC, FCC and bulls and 1 August (670 days) for RCC and when applicable to RCC from MC.

3.8.2.4 Dips

Animals were dipped to control external parasites. The dipping schedule and motivation is provided in table 3.2.

3.8.2.5 Prices of expenses

Product prices were obtained from different sources. Where products were sold in a variety of quantities, the price quoted for the largest quantity was used. Feed prices were obtained from Voermol's sales representative in the Potchefstroom/ Klerksdorp region. Prices for Vit-Aid, Bovitect III and Cattlemaster 4 were obtained from ANB Veterinary Wholesalers' online store (2018). The price for the Rift Valley Fever vaccine was obtained from ONB's sales representative. Prices for all other doses, vaccines and dips were obtained from Vet Products Online (2018). All product prices were inclusive of VAT. The information is provided in table 3.2.

Table 3.2: Supplementary feed, dosing, vaccinations and dipping schedule and expenses

(Personal collection from various sources)

Product	**Manufacturer and reference**	**Motivation**	**Relevant Animals**	**Timing**	**Dosage**	**Price**
Licks						
Voermol Premix 450	Voermol (2018)	Protein Lick for Winter	All	1 May – 31 Oct	Max: 500g / animal / day	R205.05/ 50kg
Voermol Superfos	Voermol (2018)	Phosphate Lick for summer	All	1 Nov – 30 Apr	Max: 240g / animal / day	R260.30 / 50kg
Dosing						
Tramisol Plus	Afrivet (2018)	Roundworm and Liver fluke	Bulls, MC, SCC, FCC, RCC, RCC from MC	1 Nov (All relevant animals)	15ml/50kg	R134.41 / 200ml
Ex-A-Lint	MSD (2018)	Milk Tapeworm	Calves	1 Jan, 1 Apr (Calves from MC and SCC) 1 Oct, 1 Jan (Calves from FCC)	1ml / 4kg	R1898.55 / 5l
Valbazen	Zoetis (2018)	Roundworm and Milk Tapeworm	Bulls, MC, SCC, FCC, RCC, RCC from MC	1 May, 1 Nov (Bulls, MC, SCC, FCC) 1 Feb, 1 Aug (RCC, RCC from MC)	1ml/10kg	R1999.40 / 5l
Vit-Aid	Afrivet (2018)	Vitamin A supplement	Bulls, MC, SCC, FCC, RCC, RCC from MC	1 Jul (All relevant animals)	1ml / 250kg	R208.28 / 100ml
Multimin	Virbac (2018)	Trace Mineral Supplement	Bulls, MC, SCC, FCC, RCC, RCC from MC	1 Nov (Bulls, MC, SCC) 1 Aug (FCC,RCC, RCC from	1ml / 100kg1	R1997.09 / 500ml

				MC)		
Vaccinations						
Cattle Master 4	Zoetis (2018)	Bovine Viral Diarrhea	Bulls, MC, SCC, FCC, RCC, RCC from MC	1 Nov (Bulls, MC, SCC, FCC) 1 Aug (RCC, RCC from MC)	2ml / animal	R818.28 / 25 doses
Supavax® (MSD)	MSD (2018)	Botulism, Anthrax, Blackquarter	All animals	1 Nov (Bulls, MC, SCC, FCC) 1 Aug (RCC and RCC from MC) 1 Jan,1 Apr (Calves from MC and SCC) 1 Oct, 1 Jan (Calves from FCC)	2ml / animal	R741.92 / 50 doses
Bovilis® S	MSD (2018)	Paratyphoid (Inactivated)	Pregnant animals	1 Aug (MC, SCC) 1 May (FCC)	2ml / animal	R47.00 / 10ml
RB-51	MSD (2018)	Brucella Abortus	Female animals before breeding	1 Nov (MC, SCC, FCC) 1 Aug (RCC)	2ml / animal	R1009.63 / 25 doses
Bovi-Tect III	MSD (2018)	Pasteurella	Female animals	1Aug (All relevant animals)	1ml / animal	R1839.42 / 100ml
Rift Valley Fever (OBP)	OBP (2018)	Rift Valley Fever (Incativated)	Bulls, MC, SCC, FCC, RCC, RCC from MC	1 Aug (all relevant animals)	2ml / animal	R688.42 / 100ml
Dip						
Drastic Deadline	Bayer (2018)	Ticks, Tsetse flies, Red Lice	All animals	1 Nov (All animals) 1 May (Bulls, MC, SCC, RCC, RCC from MC)	5ml / 50 kg	R3250.50 / 6l

3.8.2.6 Processing and veterinary costs

Retained cow calves were processed and given ear tags which incurred a direct cost of R70.00 per animal. Furthermore, veterinary visits and pregnancy tests was charged at R50.00 per animal. The number of animals that incurred a cost for veterinary services were calculated as

- Cows in the months they were culled (April and January)
- Calves in the months they were sold (April and January)
- Retained heifers in April
- Bulls in December

These costs per animal were taken from Senwes Agricultural Service's production budgets (2017).

3.9 Chapter Summary

This chapter detailed the research methodology that was followed to determine the research aim. The methodology is summarized as follows: NE_t requirements of individual animals of different sizes were calculated daily during all physiological life stages and physiological functions for each day from birth to maturity. Maintenance requirements for bulls of different sizes were calculated. A stock flow was calculated by assuming a production schedule and calving percentages, death rates and replacement rates. The net energy requirements were matched to the stock flow to get a total annual net energy requirement of 1,372,976 Mcal for the herd. This provided the exact number of animals and their exact weights for each day throughout the year. This stock flow was then used to calculate income and expenditure.

Chapter 4 Results and Discussion

4.1 Growth and energy requirements of individual cows

4.1.1 Growth of individual cows

Growth curves among the three sizes (small, medium and large) were shaped similar when using Brody's model and assuming a fixed date of maturity, in this case 1552 days. Although obvious, it further illustrates that larger cattle are larger throughout all life stages, as also stipulated by numerous other researchers including Morris & Wilton (1976); Fiss & Wilton (1993); and Arango & Van Vleck (2002).

This model yielded a slightly higher growth rate than that reported for cattle that took part in the National Beef Recording and Improvement scheme (NBRI) in South Africa (Scholtz, 2010). The weight of seed stock animals that participated in the recording scheme at different stages from 1999 to 2008 as a percentage of mature weight, is compared to the current study. The average mature cow weight reported in the NBRI was 492kg. Weight at birth was 7.1% (35kg), weight at 205 days was 43.7% (215kg), and at 540 days was 67.1% (330 kg) of mature weight.

From the calculations in the base model of this study, and referring to medium cows with a mature weight of 450kg, weight at birth was set at 6.67% (30kg), weight at 205 days was 42.5% (191kg) and 540 days was 73.9% (333kg) of mature weight. Although a slightly higher growth rate was obtained in this model, than reported in the NBRI, keep in mind that in this model, feed was not limited at any stage of growth or production. When feed is limited or fluctuate, it retards growth.

The literature review showed small cattle have a faster growth and maturity rate than large cattle. Maturity rates is therefore discussed further in Chapter 5, section 5.3.2, by means of comparisons to this model and special reference to figure 4.1.

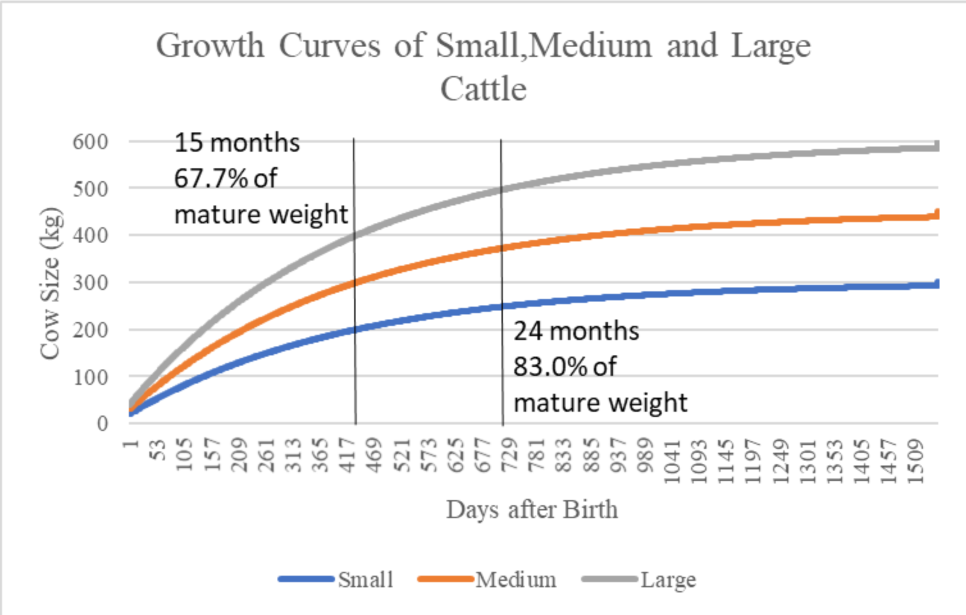

Figure 4.1: Growth curves of small, medium and large cows using Brody's growth model

4.1.2 Net Energy Requirements

The Net Energy calculation illustrated the high maintenance requirements of cattle. Figure 4.2 shows the NE requirements for a medium sized cow from birth to 1917 days, equal to one year after being classified as mature. As is obvious from the figure, more than 70% of energy requirements goes to maintenance, with much less energy spent on growth, production and lactation. Smaller cows used a slightly larger portion (71.8%) of NE_t for NE_m than medium (71.1%) and large cows (70.8%) did.

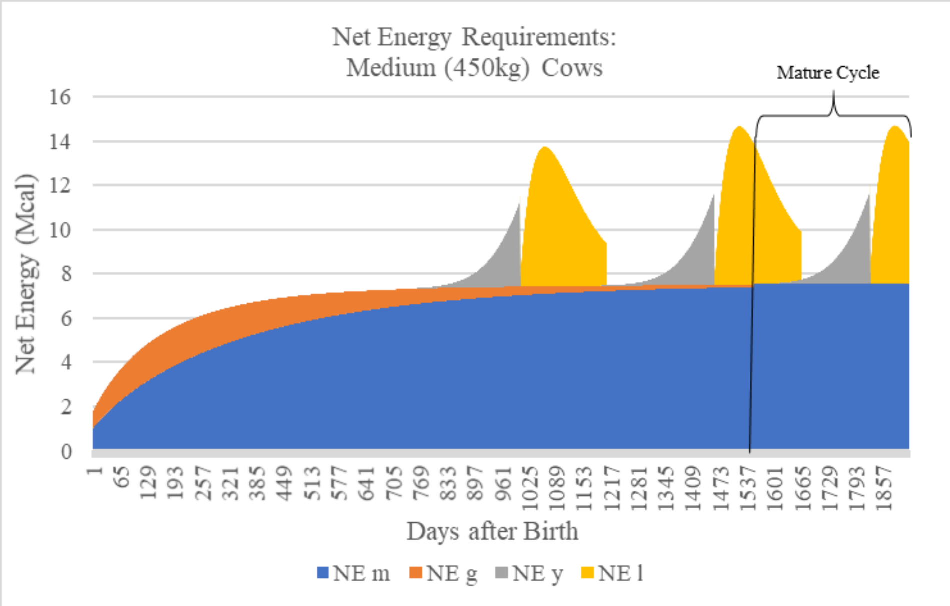

Figure 4.2: Net energy requirements of medium sized cow from birth to 1979 days

As expected, smaller cows require less energy throughout all life stages than large cows, however the energy requirement is not proportionately less. There are differences in the composition of energy for maintenance, growth, lactation and production. The full results of the calculation for daily energy requirements as discussed in Chapter 3 is given in appendix A. A summary of NE requirements is given in table 4.1, 4.2 and 4.3 for small, medium and large cattle at the most important life stages, measured from birth. As is clear from table 4.1 to 4.3 NE_t is less for smaller cows at any specific point, however two observations can be made: 1) NE_t for small cows are not proportionately less in terms of weigh and 2) the composition of NE_t differs among the 3 sizes. Since the proportion and composition of NE_t differs at each point in time for the different sized cows, it is more practical to compare the proportions and compositions of NE over longer life stages, as is discussed in the following paragraphs.

Table 4.1: Growth and NE requirements of small cattle for important life stages

		t Birth	t Gestation	t Lactation	weight	% of Mature Weight	Daily Gain	Daily milk yield	NE m	NE g	NE l	NE y	NE t
Weight at birth					20.0								
Birth	01-Oct	1			20.7	7%	0.660		0.746	0.483			1.229
Calves are weaned	23-Apr	205			127.4	42%	0.408		2.920	1.115			4.035
Calves are Sold	30-Apr	212			130.2	43%	0.401		2.969	1.113			4.081
First Breeding	22-Sep	722	1		249.1	83%	0.120		4.828	0.483		0.005	5.316
FCC are culled	31-Jan	853	132		262.6	88%	0.088		5.023	0.358		0.164	5.545
First Calving. First Lactation starts.	01-Jul	1004	283	1	273.8	91%	0.062	0.29	5.183	0.250	0.209	2.575	8.217
Second breeding	23-Dec	1179	1	176	282.7	94%	0.041	2.71	5.308	0.163	1.946	0.005	7.422
First Calves are weaned	21-Jan	1208	30	205	283.8	95%	0.038	1.94	5.325	0.151	1.392	0.012	6.880
First Calves are sold	31-Jan	1218	40		284.2	95%	0.037		5.330	0.148		0.016	5.494
SCC are Culled	30-Apr	1307	129		287.2	96%	0.030		5.372	0.118		0.158	5.648
Second Calving. Second lactation starts	01-Oct	1461	283	1	291.1	97%	0.021	0.33	5.427	0.080	0.238	2.659	8.404
Mature Breeding	23-Dec	1544	1	84	292.7	98%	0.017	6.90	5.449	0.065	4.953	0.005	10.472
Classified as mature	01-Jan	1553	10	93	300.0			6.57	5.550		4.714	0.007	10.271
2nd lactation ends	23-Apr	1665	122	205	300.0			2.20	5.550		1.582	0.141	7.273
Calves are weaned, MC are Culled	30-Apr	1672	129		300.0				5.550			0.166	5.716
Mature Calving. Mature Lactation	01-Oct	1826	283	1	300.0			0.33	5.550		0.238	2.799	8.587
Repetition of Mature Cycle Starts	31-Dec	1917	9	92	300.0			6.61	5.550		4.742	0.007	10.300

Table 4.2: Growth and NE requirements of medium cattle for important life stages

		t Birth	t Gestation	t Lactation	weight	% of Mature Weight	Daily Gain	Daily milk yield	NE m	NE g	NE l	NE y	NE t
Weight at birth					30.0								
Birth	01-Oct	1			31.0	7%	0.990		1.011	0.754			1.765
Calves are weaned	23-Apr	205			191.1	42%	0.612		3.958	1.739			5.697
Calves are Sold	30-Apr	212			195.4	43%	0.602		4.024	1.736			5.760
First Breeding	22-Sep	722	1		373.6	83%	0.181		6.543	0.754		0.007	7.304
FCC are culled	31-Jan	853	132		393.9	88%	0.133		6.808	0.559		0.245	7.612
First Calving. First Lactation starts.	01-Jul	1004	283	1	410.7	91%	0.093	0.40	7.025	0.390	0.284	3.862	11.561
Second breeding	23-Dec	1179	1	176	424.0	94%	0.061	3.67	7.195	0.254	2.637	0.008	10.094
First Calves are weaned	21-Jan	1208	30	205	425.7	95%	0.057	2.63	7.217	0.236	1.887	0.019	9.359
First Calves are sold	31-Jan	1218	40		426.3	95%	0.056		7.224	0.230		0.025	7.480
SCC are Culled	30-Apr	1307	129		430.8	96%	0.045		7.281	0.184		0.249	7.714
Second Calving. Second lactation starts	01-Oct	1461	283	1	436.7	97%	0.032	0.45	7.355	0.125	0.322	4.198	12.001
Mature Breeding	23-Dec	1544	1	84	439.0	98%	0.026	9.35	7.385	0.101	6.713	0.008	14.208
Classified as mature	01-Jan	1553	10	93	450.0			8.90	7.523		6.389	0.011	13.923
2nd lactation ends	23-Apr	1665	122	205	450.0			2.99	7.523		2.144	0.212	9.879
Calves are weaned, MC are Culled	30-Apr	1672	129		450.0				7.523			0.249	7.772
Mature Calving. Mature Lactation	01-Oct	1826	283	1	450.0			0.45	7.523		0.322	4.198	12.044
Repetition of Mature Cycle Starts	31-Dec	1917	9	92	450.0			8.95	7.523		6.428	0.010	13.961

Table 4.3: Growth and NE requirements of large cattle for important life stages

		t Birth	t Gestation	t Lactation	weight	% of Mature Weight	Daily Gain	Daily milk yield	NE m	NE g	NE l	NE y	NE t
Weight at birth					40.0								
Birth	01-Oct	1			41.3	7%	1.320		1.255	1.033			2.288
Calves are weaned	23-Apr	205			254.8	42%	0.816		4.911	2.384			7.295
Calves are Sold	30-Apr	212			260.5	43%	0.802		4.993	2.380			7.373
First Breeding	22-Sep	722	1		498.1	83%	0.241		8.119	1.033		0.010	9.162
FCC are culled	31-Jan	853	132		525.2	88%	0.177		8.448	0.766		0.327	9.541
First Calving. First Lactation starts.	01-Jul	1004	283	1	547.6	91%	0.124	0.49	8.717	0.535	0.352	5.150	14.754
Second breeding	23-Dec	1179	1	176	565.4	94%	0.082	4.56	8.928	0.348	3.272	0.011	12.559
First Calves are weaned	21-Jan	1208	30	205	567.7	95%	0.076	3.26	8.955	0.324	2.341	0.025	11.645
First Calves are sold	31-Jan	1218	40		568.4	95%	0.075		8.964	0.316		0.034	9.313
SCC are Culled	30-Apr	1307	129		574.4	96%	0.061		9.034	0.253		0.332	9.619
Second Calving. Second lactation starts	01-Oct	1461	283	1	582.2	97%	0.042	0.56	9.126	0.171	0.400	5.598	15.296
Mature Breeding	23-Dec	1544	1	84	585.4	98%	0.035	11.60	9.164	0.139	8.330	0.011	17.643
Classified as mature	01-Jan	1553	10	93	600.0			11.04	9.335		7.928	0.014	17.277
2nd lactation ends	23-Apr	1665	122	205	600.0			3.71	9.335		2.660	0.282	12.277
Calves are weaned, MC are Culled	30-Apr	1672	129		600.0				9.335			0.332	9.667
Mature Calving. Mature Lactation	01-Oct	1826	283	1	600.0			0.56	9.335		0.400	5.598	15.333
Repetition of Mature Cycle Starts	31-Dec	1917	9	92	600.0			11.11	9.335		7.976	0.014	17.324

In this model, mature cows were culled at 19% and a death rate of 1% was assumed, meaning cows stayed in the herd for an average of 5 years after being classified as mature. Cows that reproduced as FCC, as well as SCC were retained. This means if a FCC or SCC was not culled before reaching maturity, they would spend a total of 3377 days in the herd and produce a calf seven times throughout their time in the herd. The net energy requirements of cows that remained in the herd for 3377 days are shown below in table 4.4 and divided into the period where animals were growing (1-1152 days) and the period where animals were mature (1153-3377 days).

When NE_t requirements among the three sizes are compared, small cows had a proportionately higher energy requirement. Small cows were half the size (50%) of large cows but required 58% as much NE_t as large cows (23,669Mcal to 40,553Mcal). Similarly, small cows were only 67% the size of medium cows but required 73% NE_t of medium cows (32,423Mcal). This is mostly due to smaller cows having a proportionately higher energy requirement for maintenance as described by Kleiber's Law (Kleiber, 1932). In fact, NE_m of small cows (16, 999Mcal) were 59% that of large cows (23,041Mcal) and 74% of medium cows (28,590Mcal), despite being only 50% and 67% in weight of large and medium cows. This illustrates that small cows will be less efficient when cows are non-lactating and non-pregnant, however their efficiency moves closer to that of larger cows when other physiological functions come into play and NE_m makes up a smaller portion of NE_t.

When the composition of NE_t is observed, the NE_m of small cows were higher as a percentage of NE_t. From birth to 1552 days of age, small cows utilised more than three quarters of net energy solely for maintenance. Larger calves, which grew faster, used a larger proportion of total energy for growth (10.8%), than small (8.8%) and medium calves (9.9%). Similar results were reported by Carpenter (1971). As mature cows, a slightly lower proportion of NE_t is used for NE_m, with around a quarter of NE_t used for NE_l..Arango (2002) reported NE_m of adult cows as being more than 50% of NE_t. Lifetime NE_m were 71.8% for small cows, higher than that of medium (71.1%) and large cows (70.5%), consistent with previous research (National Research Council, 2000; Jenkins & Ferrell, 2002)

It can be concluded that, in the base model simulation where growth rates and reproductions rates were similar for small, medium and large cows, small cows were the least efficient in terms of NE_t requirements. Similar results were reported by Dickerson (1978), Farrell & Jenkins (1984) and Arango (Arango & Van Vleck, 2002) among others. The work of Farrell & Jenkins however compared differences among breeds and not the effects within one breed. Growth and reproduction have been shown to have significant influence on efficiency. Because similar growth and reproduction rates were assumed in the base model, which might not always be the case, it is revisited in chapter 5.

Table 4.4: Lifetime energy requirements of small, medium and large cows

		Growing animals			Mature animals			Total time in herd		
		Birth to 1552 days			1 mature cycle			birth to 3377 days		
		Small	**Medium**	**Large**	**Small**	**Medium**	**Large**	**Small**	**Medium**	**Large**
NE requirements (Mcal)	NE m	6,870	9,311	11,554	2,026	2,746	3,407	16,999	23,041	28,590
	NE g	793	1,237	1,696	-	-	-	793	1,237	1,696
	NE l	1,042	1,412	1,752	736	997	1,238	4,721	6,399	7,940
	NE y	315	484	646	168	252	336	1,155	1,746	2,328
	NE t	9,019	12,445	15,647	2,930	3,996	4,981	23,669	32,423	40,553
NE requirements (% of NE t)	NE m	76.2%	74.8%	73.8%	69.1%	68.7%	68.4%	71.8%	71.1%	70.5%
	NE g	8.8%	9.9%	10.8%	0.0%	0.0%	0.0%	3.3%	3.8%	4.2%
	NE l	11.6%	11.3%	11.2%	25.1%	25.0%	24.8%	19.9%	19.7%	19.6%
	NE y	3.5%	3.9%	4.1%	5.7%	6.3%	6.8%	4.9%	5.4%	5.7%
	NE t	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

4.2 Stock flow and herd composition

As expected, more small cows could be kept on the resource base. The net energy requirements, reproduction rates and death rates influenced the herd composition and the number of animals that could be kept on the resource base. Furthermore, as different classes of animals within the same size group used energy differently the composition of the small, medium and large herds were also different. As on January 1st, when animals were recategorized into different groups, the resource base could support 236.6 small mature cows, 171.9 medium mature cows or 136.9 large mature cows. Enough replacements were bred to replace culled and deceased mature cows and thus herd numbers were similar at the start and end of every year. The stock flow is an intermediary step between biological and economic efficiency and in fact serves to illustrate the ratios of small to medium to large cattle that can be maintained by the same resource base. From the stock flow the number of animals that were sold, either as culls or weaners could be calculated. Furthermore, the number of animals that will incur an expense could be obtained from the stock flow. Where income or expenses were incurred on a weight basis, the relevant number of animals were obtained from the stock flow, and then multiplied with the exact weight of those animals on the day of the income or expense. The weight of these animals is known from the growth rate calculation discussed in section 3.4.2 and subsequent results in section 4.1.1. The stock flows are self-explanatory, and they are provided in table 4.5 to 4.7.

Table 4.5: Stock flow for the herd of small cattle

		SMALL CATTLE												
_			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MC		236.6	236.6	236.4	236.2	236.0	188.6	188.5	188.3	188.2	188.0	187.8	187.7	187.5
Pregnant MC	Calving%	80%	189.3	189.1	188.9	188.8	188.6	188.5	188.3	188.2	188.0			150.0
Open MC			47.3	47.3	47.2	47.2								37.5
Deaths	Death%	1%	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Culls		19%				47.2								
SCC			66.2	66.1	66.1	66.0	49.5	49.4	49.4	49.4	49.3	49.3	49.2	49.2
Pregnant SCC	Calving%	75%	49.7	49.6	49.6	49.5	49.5	49.4	49.4	49.4	49.3			39.4
Open SCC			16.6	16.5	16.5	16.5								9.8
Deaths	Death%	1%	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						16.5								
FCC			74.3	66.8	66.8	66.7	66.6	66.6	66.5	66.5	66.4	66.4	66.3	66.3
Pregnant FCC	Calving%	90%	66.9	66.8	66.8	66.7	66.6	66.6						49.7
Open FCC			7.4											16.6
Deaths	Death%	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Culls			7.4											
RCC			75.0	75.0	74.9	74.9	74.8	74.7	74.7	74.6	74.5	74.5	74.4	74.4
Pregnant RCC											67.1	67.0	67.0	66.9
Open RCC											7.5	7.4	7.4	7.4
Deaths	Death%	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Calves from MC			186.6	186.1	185.7	185.2						188.0	187.5	187.1
Deaths	Death%	3%	0.5	0.5	0.5	0.5						0.5	0.5	0.5
Calves sold from MC						108.4								
RCC from MC						76.7	76.6	76.4	76.2	76.0	75.8	75.6	75.4	75.2
Deaths	Death%	3%				0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Calves from SCC			49.0	48.8	48.7	48.6						49.3	49.2	49.1
Deaths	Death%	3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from SCC						48.5								
Calves from FCC			65.6	-					66.6	66.4	66.3	66.1	65.9	65.8
Deaths	Death%	3%	0.2						0.2	0.2	0.2	0.2	0.2	0.2
Calves sold from FCC			65.4											
Bulls			15.1	15.1	15.1	15.1	15.1	15.1	15.0	15.0	15.0	15.0	15.0	15.1
Deaths	Death%	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls													2.9	
Purchased	Replace%	20%											3.0	

Table 4.6: Stock flow for the herd of medium cattle

			MEDIUM CATTLE											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MC		171.9	171.9	171.7	171.6	171.5	137.1	136.9	136.8	136.7	136.6	136.5	136.4	136.3
Pregnant MC	Calving%	80%	137.5	137.4	137.3	137.2	137.1	136.9	136.8	136.7	136.6			109.0
Open MC			34.4	34.3	34.3	34.3								27.3
Deaths	Death%	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Culls		19%				34.3								
SCC			48.1	48.1	48.0	48.0	36.0	35.9	35.9	35.9	35.8	35.8	35.8	35.7
Pregnant SCC	Calving%	75%	36.1	36.0	36.0	36.0	36.0	35.9	35.9	35.9	35.8			28.6
Open SCC			12.0	12.0	12.0	12.0								7.1
Deaths	Death%	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						12.0								
FCC			54.0	48.5	48.5	48.5	48.4	48.4	48.3	48.3	48.3	48.2	48.2	48.1
Pregnant FCC	Calving%	90%	48.6	48.5	48.5	48.5	48.4	48.4						36.1
Open FCC			5.4											12.0
Deaths	Death%	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls			5.4											
RCC			54.5	54.5	54.4	54.4	54.3	54.3	54.3	54.2	54.2	54.1	54.1	54.0
Pregnant RCC											48.7	48.7	48.7	48.6
Open RCC											5.4	5.4	5.4	5.4
Deaths	Death%	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calves from MC			135.6	135.2	134.9	134.6						136.6	136.3	135.9
Deaths	Death%	3%	0.3	0.3	0.3	0.3						0.3	0.3	0.3
Calves sold from MC						78.8								
RCC from MC						55.8	55.6	55.5	55.3	55.2	55.1	54.9	54.8	54.7
Deaths	Death%	3%				0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Calves from SCC			35.6	35.5	35.4	35.3						35.8	35.7	35.7
Deaths	Death%	3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from SCC						35.2								
Calves from FCC			47.7	-					48.4	48.3	48.1	48.0	47.9	47.8
Deaths	Death%	3%	0.1						0.1	0.1	0.1	0.1	0.1	0.1
Calves sold from FCC			47.5											
Bulls			11.0	11.0	11.0	11.0	10.9	10.9	10.9	10.9	10.9	10.9	10.9	11.0
Deaths	Death%	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls													2.1	
Purchased	Replace%	20%											2.2	

Table 4.7: Stock flow for the herd of large cattle

			LARGE CATTLE											
_			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MC		136.9	136.9	136.8	136.7	136.6	109.2	109.1	109.0	108.9	108.8	108.7	108.6	108.5
Pregnant MC	Calving %	80%	109.5	109.4	109.4	109.3	109.2	109.1	109.0	108.9	108.8			86.8
Open MC			27.4	27.4	27.3	27.3								21.7
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Culls		19%				27.3								
SCC			38.3	38.3	38.3	38.2	28.6	28.6	28.6	28.6	28.5	28.5	28.5	28.5
Pregnant SCC	Calving %	75%	28.7	28.7	28.7	28.7	28.6	28.6	28.6	28.6	28.5			22.8
Open SCC			9.6	9.6	9.6	9.6								5.7
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						9.5								
FCC			43.0	38.7	38.6	38.6	38.6	38.5	38.5	38.5	38.4	38.4	38.4	38.3
Pregnant FCC	Calving %	90%	38.7	38.7	38.6	38.6	38.6	38.5						28.8
Open FCC			4.3											9.6
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls			4.3											
RCC			43.4	43.4	43.4	43.3	43.3	43.3	43.2	43.2	43.1	43.1	43.1	43.0
Pregnant RCC											38.8	38.8	38.8	38.7
Open RCC											4.3	4.3	4.3	4.3
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calves from MC			108.0	107.7	107.5	107.2						108.8	108.5	108.3
Deaths	Death %	3%	0.3	0.3	0.3	0.3						0.3	0.3	0.3
Calves sold from MC						62.8								
RCC from MC						44.4	44.3	44.2	44.1	44.0	43.9	43.8	43.6	43.5
Deaths	Death %	3%				0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Calves from SCC			28.3	28.3	28.2	28.1						28.5	28.5	28.4
Deaths	Death %	3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from SCC						28.0								
Calves from FCC			38.0	-					38.5	38.4	38.3	38.3	38.2	38.1
Deaths	Death %	3%	0.1						0.1	0.1	0.1	0.1	0.1	0.1
Calves sold from FCC			37.9											
Bulls			8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.8
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls													1.7	
Purchased	Replace%	20%											1.8	

4.3 Composition of energy requirements of the herd

The NE_t of individual animals of each of the different classes were used to calculate the total number of small, medium and large cows that can be maintained on a resource base in terms of total net energy. The NE_t of the three herds will thus be equal and was set at 1,372,976Mcal. There were however differences in the composition of the NE_t of the herds. From section.4.1.2, small cows use a larger portion of their NE_t for maintenance. From the inventories in section 4.2, the composition of the 3 herds were also different. This meant that total energy compositions of the herds differed. Where individual cows were concerned, small, medium and large cows used 71.8%, 71.1% and 70.5% of NE_t for NE_m, these numbers are even larger for the herds as a whole, at 73.1%, 72.0% and 71.2% for the herd of small, medium and large cattle respectively. This is mainly due to the fact that growing animals use a larger proportion of NE_t for NE_m than productive mature animals, as well as the fact that bulls have to be maintained on the resource base. NE_m of the productive cow herd (MC, SCC and FCC) amounted to 70.2%, 69.6% and 69.3% for the herds of small, medium and large cattle when calculated as a portion of the total NE_t of the herds. Similar results were obtained by Ferrell & Jenkins (1984).

Table 4.8: The energy requirements of animal classes in the herds of small, medium and large cattle

Herd Energy Composition	SMALL		MEDIUM		LARGE	
Mature Cows: NE m	413,135	30.1%	406,870	29.6%	402,129	29.3%
Mature cows: NE l	154,729	11.3%	152,383	11.1%	150,607	11.0%
Mature cows: NE y	31,646	2.3%	34,491	2.5%	36,631	2.7%
Mature cows: NE t	599,510	43.7%	593,744	43.2%	589,367	42.9%
Second Calf Cows: NE m	107,864	7.9%	106,228	7.7%	104,990	7.6%
Second Calf Cows: NE g	2,157	0.2%	2,445	0.2%	2,670	0.2%
Second Calf Cows: NE l	21,591	1.6%	21,263	1.5%	21,016	1.5%
Second Calf Cows: NE y	7,887	0.6%	9,049	0.7%	9,610	0.7%
Second Calf Cows: NE t	139,499	10.2%	138,985	10.1%	138,286	10.1%
First Calf Cows: NE m	126,800	9.2%	124,877	9.1%	123,422	9.0%
First Calf Cows: NE g	6,329	0.5%	7,174	0.5%	7,835	0.6%
First Calf Cows: NE l	40,813	3.0%	40,194	2.9%	39,725	2.9%
First Calf Cows: NE y	10,127	0.7%	11,038	0.8%	11,723	0.9%
First Calf Cows: NE t	184,069	13.4%	183,283	13.3%	182,706	13.3%
Retained Cow Calves: NE m	126,442	9.2%	124,525	9.1%	123,074	9.0%
Retained Cow Calves: NE g	16,027	1.2%	18,168	1.3%	19,842	1.4%
Retained Cow Calves: NE y	188	0.0%	205	0.0%	218	0.0%
Retained Cow Calves: NE t	142,658	10.4%	142,899	10.4%	143,134	10.4%
Calves from MCs: NE m	79,982	5.8%	78,769	5.7%	77,852	5.7%
Calves from MCs: NE g	37,961	2.8%	43,034	3.1%	46,997	3.4%
RCC from MC: NE m	67,637	4.9%	66,611	4.9%	65,835	4.8%
RCC from MC: NE g	18,444	1.3%	20,909	1.5%	22,835	1.7%
Calves from SCC: NE m	20,191	1.5%	19,885	1.4%	19,653	1.4%

Calves from SCC: NE g	9,059	0.7%	10,269	0.7%	11,215	0.8%
Calves from FCC: NE m	27,165	2.0%	26,753	1.9%	26,442	1.9%
Calves from FCC: NE g	11,715	0.9%	13,280	1.0%	14,503	1.1%
All calves: NE t	272,156	19.8%	279,512	20.4%	285,333	20.8%
Bulls: NE m	35,085	2.6%	34,553	2.5%	34,151	2.5%
Bulls: NE t	35,085	2.6%	34,553	2.5%	34,151	2.5%
Total Herd: NE m	**1,004,303**	**73.1%**	**989,073**	**72.0%**	**977,548**	**71.2%**
Total Herd: NE g	**101,692**	**7.4%**	**115,280**	**8.4%**	**125,898**	**9.2%**
Total Herd: NE l	**217,133**	**15.8%**	**213,840**	**15.6%**	**211,348**	**15.4%**
Total Herd: NE y	**49,849**	**3.6%**	**54,783**	**4.0%**	**58,182**	**4.2%**
Total Herd: NE t	**1,372,976**	**100.0%**	**1,372,976**	**100.0%**	**1,372,976**	**100.0%**

4.4 Production Budgets

4.4.1 Culls and weaners sold

The herd of small cattle yielded more heads of weaners (222.34) to be sold to the feedlot, than the herd of medium (161.56) and large (128.68) cattle, however the herd of small cattle yielded less kilograms (28,034kg) than the herd of medium (30,554kg) and large (32,450kg) cattle. Cow and bull culls from the herd of small cattle yielded less kilograms (19,747kg C2/3 and 1,950kg B2/3) than the herd of medium (21,522kg C2/3 and 2,125kg B2/3) and large (22,858kg C2/3 and 28,33kg B2/3) cattle. The work of Doye & Lalman (2011) also found that a herd of large cattle will yield less weaners and culls, but more kg to be sold, when the same reproduction rate is assumed.

4.4.2 Meat prices

There were little fluctuations in meat prices throughout the year with relative standard deviation at 6.9%, 7.0% and 11% for class B2/3, C2/3 and weaners respectively. Prices did however have a declining trend over the year. This meant there would be little advantage in trying to sell animals at one time rather than another. The price per kilogram live weight for class B2/3 was R21.05/kg and for C2/3 animals it was R20.38/kg irrespective of the size of the animal. Weaners were sold at a live weight price of R32.25/kg irrespective of the size of the weaner.

Income was calculated on a per kilogram basis. There were no premiums or penalties for small or large cows. Dickerson (1978) referred to the automation of beef processing and housing and predicted price penalties for either too small or too large animals. The work of Bryant (2011) showed stockyards in the USA payed a premium for smaller cattle and the work of Doye & Lalman (2011) also assumed a higher price for smaller calves.

4.4.3 Total Income

With no premiums or penalties for cattle of different sizes, the herd of small cattle yielded the lowest income. This is as a result of fewer kilograms of marketable meat to be sold from this herd, which in turn is partly as a result of higher NE_m needs. Total income from the herd of small cattle was R1,347,373.98, compared to R1,468,502.53 and R1,571,754.71 for the herds of medium and large cattle respectively.

4.4.4 Bull replacements

The herd of small, medium and large cattle had to replace 3.0, 2.2 and 1.8 bulls annually, however when it is expressed in kg, the herd of small cattle replaced 907.7kg, the herd of medium cattle 989.32kg and the herd of large cattle 1,050.70kg. Since the replacement costs of bulls were calculated on a per kilogram basis, replacement costs were the lowest for the herd of small cattle and highest for the herd of large cattle.

4.4.5 Supplementary Licks

Licks were calculated from the NE_t of the herd and thus there were only slight variations in the amounts and resulting costs of licks. This small disparity came as a result of variations in the herd composition during the months were winter licks and summer licks were fed. The herd of small cattle required slightly less winter licks, but slightly more summer licks than the herds of medium and large cattle. The resulting variation was almost negligible with total cost of licks of R119,864.15, R119,935.24 and R119,980.22 for the herds of small, medium and large cattle.

4.4.6 Dosing costs

All dosing recommendations were administered per live kg and dosing costs were thus dependant on the total live kilograms of the animals that received the dosing, rather than the number of animals. In all instances the herd of small cattle had the fewest kilograms and the herd of large cattle had the most kilograms for which the dosing was administered. This resulted in the lowest total dosing cost for the small herd (R46,291.75) followed by the herd of medium cattle (R50,453.36) and the herd of large cattle (R53,583.93).

4.4.7 Vaccination costs

Vaccinations were done on a per head basis. As expected there were more small animals that received vaccinations than medium or large animals. This resulted in a much higher cost for vaccinations in the herd of small cattle (R73,678.45), compared to the herd of medium (R53,534.75) and large (R42,642.38) cattle.

4.4.8 Dips costs

Dips were administered on a per kilogram basis which resulted in a lower cost for the herd of small cattle (R14,213.39) than the herd of medium (R15,491.17) and large (R16,452.37) cattle.

4.4.9 Processing and veterinary costs

Processing and veterinary costs were charged on a per head basis resulting in a much higher cost of R45,654.43 for the herd of small cattle, R33,172.50 for the herd of medium cattle and R23,313.79 for the herd of large cattle.

4.4.10 Total allocated costs

Total allocated costs were in point of fact the highest for the herd of small cattle at R401,362.47, followed by the herd of medium cattle at R383,386.56. The allocated costs to the herd of large cattle was the lowest at R376,756.53. This came as a result of various costs being charged on a per head basis, as was the case in vaccinations, processing and veterinary costs. The work of Dickerson (1978) and Johnson et al. (2010) among others, also stipulated that switching from a herd of large cows to small cows will increase variable costs.

4.4.11 Margin above allocated costs

The herd of large cattle proved to be the most economically efficient in this model, exhibiting a higher income as well as lower allocated costs. The gross profit above allocated costs were 9% higher for the herd of large cattle (R1,182,864.73) than the herd of medium cattle (R1,085,115.97) and 25% higher than the herd of small cattle (R946,011.50). The full production budgets are provided in table 4.9.

Table 4.9: Production budget for a herd of small, medium and large cattle

			SMALL CATTLE		MEDUM CATTLE		LARGE CATTLE	
Income								
Cattle Sales		Price / kg	Total kg		Total kg		Total kg	
Culled Mature Cows	Class C2/3	R 20.38	14,146.99	R 288,254.91	15,418.80	R 314,168.95	16,375.52	R 333,662.74
Culled First Calf Cows	Class C2/3	R 20.38	4,737.41	R 96,528.15	5,163.31	R 105,206.00	5,483.68	R 111,733.90
Culled Replacement Heifers	Class B2/3	R 21.05	1,949.50	R 41,036.73	2,124.76	R 44,725.92	2,256.60	R 47,501.11
Live weaners sold	Weaners	R 32.25	28,034.07	R 903,979.45	30,554.32	R 985,246.95	32,450.18	R1,046,380.28
Culled Bulls	Class C2/3	R 20.38	862.53	R 17,574.74	940.08	R 19,154.71	998.41	R 20,343.23
Total income from cattle sales				R1,347,373.98		R1,468,502.53		R1,559,621.26
Expenses								
Bull Purchases		R 112.00	907.71	R 101,660.30	989.32	R 110,799.54	1,050.70	R 117,674.51
Licks		Price / kg	Total kg		Total kg		Total kg	
Winter Licks		R 4.10	16,116.34	R 66,093.13	16,160.73	R 66,275.17	16,188.80	R 66,390.28
Summer Licks		R 5.21	10,328.66	R 53,771.03	10,307.35	R 53,660.07	10,293.88	R 53,589.94
Dosing		Price / ml	Total kg		Total kg		Total kg	
Roundworm and Liver Fluke	15ml/50kg	R 0.67	126,992.38	R 25,603.57	138,408.96	R 27,905.32	146,997.06	R 29,636.81
Milk Tapeworm	1ml/4kg	R 0.38	56,633.95	R 5,376.12	61,725.33	R 5,859.43	65,555.31	R 6,223.00
Roundworm and Milk Tapeworm	1ml/10kg	R 0.40	233,462.21	R 9,335.69	254,450.39	R 10,174.96	270,238.72	R 10,806.31
Vitamin A	1ml/250kg	R 2.08	121,485.17	R 1,012.12	132,406.66	R 1,103.11	140,622.32	R 1,171.55
Trace Minerals	1ml/100kg	R 3.99	124,287.27	R 4,964.26	135,460.66	R 5,410.54	143,865.82	R 5,746.26
Vaccinations		Price / ml	Total animals		Total animals		Total animals	
BVD	2ml/animal	R 16.37	468.82	R 15,344.97	340.64	R 11,149.65	271.33	R 8,881.11
Botulism, Anthrax, Blackquarter	2ml/animal	R 7.42	1,069.83	R 15,874.57	777.34	R 11,534.46	619.18	R 9,187.62
Paratyphoid (Inactivated)	2ml/animal	R 20.34	304.16	R 12,372.08	221.00	R 8,989.55	176.04	R 7,160.50
Brucella Abortus	2ml/animal	R 20.19	377.84	R 15,259.23	274.54	R 11,087.36	218.68	R 8,831.49
Pasteurella	1ml/animal	R 18.39	454.59	R 8,361.75	330.30	R 6,075.65	263.10	R 4,839.48
Rift Valley Fever (Incativated)	2ml/animal	R 6.88	469.61	R 6,465.84	341.22	R 4,698.08	271.80	R 3,742.19
Dips		Price / ml	Total kg		Total kg		Total kg	
Ticks,Tsetse flies, Red lice	5ml/50kg	R 0.54	262,360.64	R 14,213.39	285,946.79	R 15,491.17	303,689.43	R 16,452.37
Other Costs		Price / animal	Total animals		Total animals		Total animals	
Processing		R 70.00	76.75	R 5,372.35	55.76	R 3,903.55	44.42	R 3,109.32
Veterinary Services		R 52.61	765.67	R 40,282.09	556.34	R 29,268.96	443.14	R 23,313.79
Allocated Costs				R 401,362.47		R 383,386.56		R 376,756.53
Gross Profit above allocated costs				R 946,011.50		R1,085,115.97		R1,182,864.73

4.5 Chapter Summary

Large cattle proved to be more biologically efficient in the base model. This resulted in large cattle also being more economically efficient. Large cattle yielded a higher profit above allocated costs than smaller animals, due to a combination of more sellable product as well as lower allocated costs. Lower allocated costs were because of fewer heads of cattle on the resource base. Grazing management will play an all-important role if the higher profit from large cows are to be realised. It should be kept in mind that similar reproduction rates and growth rates were assumed for the base model. Reproduction rates have been argued to be the most important efficiency measure, therefore large cattle will only be more efficient if they can maintain a comparatively high reproduction rate compared to smaller cattle.

Chapter 5 Discussion and Scenarios

5.1 Introduction

Although large cattle have been shown to be the most economically efficient in the base model, there are further considerations that need to be taken into account. This chapter will discuss situations that could not be expressed in the base model as described in chapter 3, but which are vital when the efficiency of different sized animals is concerned. Whereas it was not numerically possible to make assumptions about these situations, they can be represented by means of scenarios. This section serves as an introduction to the above-mentioned problem. Next, the limitations of the base model are illustrated, thereafter different situations are discussed and calculated.

A resounding theme from previous research is that the most efficient cow size will depend on the management system and the environment. From the literature review, larger cattle perform better where feed intake is not limited. The base model simulation used in this research showed similar results. From the calculation in this research it was possible to accurately show the differences in efficiency of cattle of different sizes throughout their productive life in the herd, given assumptions made on previous research. Being able to actually calculate efficiency in order to support previous findings was a large step towards finding the right sized cow for a prespecified environment and management system. There were however some limitations to the base model, as discussed in the next section.

5.2 Limitations of the base model

Numeric equations for feed efficiency exist and has been proved in previous research. The simulation model in this study coincided with much of the previous research on the topic. There were, nevertheless, other biological functions influenced by size which could not be expressed numerically. The most important was differences in reproduction rates of different sized animals. Previous literature showed smaller cattle will have higher reproduction rates under similar conditions. This, however, could not be expressed in a numeric equation, and even less so for the specific environment of the research area.

From the literature review, qualitative information shows differences in many biological functions between different sized animals. To illustrate the complexity of the conversion of qualitative information to quantitative data, consider the following example regarding maturity rates: Although it can be safely assumed that smaller cattle mature faster, it is not possible to numerically express this difference based on size. For example, even if it is assumed that a 450kg cow of a certain breed will take exactly 1553 days to maturity, then it has been proven that a 300kg cow will mature earlier, but it cannot, without a doubt, be calculated how many days earlier it will mature. Even though there have been case studies to determine age at maturity, they are very specific to a breed, their environment, management and other factors that might influence maturity. An even more complicated issue is the reproduction rate of different sized animals. There are countless variables that influence an animal's reproduction, and many of these are directly or indirectly related to the animal's size.

The literature review provided several factors that are influenced by size that could not be numerically expressed. Some important considerations from the literature review are:

- Larger cattle had lower reproductive rates than smaller cattle
- Smaller cattle mature faster than larger cattle
- Larger cattle are more efficient where feed is not limited. Smaller cattle are more efficient where feed is limited

Most of the above conclusions from previous literature were obtained from specific case studies or experiments and the results could not directly be transferred to this model. Since the above-mentioned biological factors will have a significant effect on herd dynamics and thus also economic efficiency it is discussed further by means of scenarios.

5.3 Scenarios

Despite the absence of quantitative numeric equations applicable to this study area, it was still possible to approach the efficiency measures from a different angle. Using the base model, where feed intake was not limited, and various physiological functions were assumed similar (for example reproduction rates), economic efficiency was calculated. In the following scenarios, the calculations that were used specifically for each scenario are explained, otherwise calculations were similar to those discussed in chapter 3.

Once more, using reproduction rates as an example, it has been proved that larger cows have lower reproduction rates than smaller cattle under similar conditions. The reproduction rate at which larger cattle become less efficient than smaller cattle could, nonetheless, be calculated. When using the base model as described in chapter 3, it was possible to measure the threshold in terms of reproduction rates where large cattle will become less profitable than small cattle, all else being equal. This is discussed next.

5.3.1 Scenario 1: Reproduction rates and profitability

Reproduction rates are an expression of many different internal and external factors, among others nutrition, fertility of the cow and bull, recovery period after calving, environmental factors, management and diseases. Previous case studies showed that if cattle are raised in similar conditions and under similar management practices, larger cows exhibited a lower reproduction rate than smaller cattle. This is largely due to biological functions being faster in smaller animals. Smaller animals mature faster, have shorter gestation periods and can be weaned earlier, as was discussed in chapter 2. This is a case where it is not possible to attach a numeric value to reproduction rates for small, medium or large cattle based on their size, but it is safe to assume it will be higher for small cows than for medium or large cows. When reproduction rates are higher, feed efficiency and profitability increases. In fact, Dickerson (Dickerson, 1978) observed the following

"Increasing N (reproduction rates) reduces female replacement, maintenance feed and fixed costs in almost direct proportions to 1/N, including the fixed cost of pregnancy and lactation status."*

*Note that fixed costs here refer to the fixed cost of keeping a female animal, not the fixed costs of the resource base as defined in chapter 3.

So, given the fact that smaller cattle have higher reproduction rates and larger cattle have lower reproduction rates, it could be determined at which rate one size will become more profitable than another. As reproduction is arguably the most important biological and economic efficiency measure, it is discussed further by means of a scenario. For this scenario the following is applicable:

- The goal of this scenario was to measure the reproduction rates at which medium and large cattle will become less profitable than small cattle
- Reproduction rates for small cattle were unchanged from the base model at 80% for MC, 75% for SCC and 90% for FCC
- Other biological measures were unchanged from the base model

- A change in reproduction rates led to a change in the stock flow and it was adjusted consequently. This is summarized in table 5.1 and 5.2
- A change in the stock flow resulted in a change to both income and expense. Expenses and their timing were adjusted accordingly. The resulting production budgets are given in table 5.3
- Reproduction rates of medium and large cattle were lowered until the subsequent production budgets yielded the same gross profit margin above allocated costs as the base model for small cattle

From the results, when reproduction rates of medium cattle were 84.59% that of small cattle, both sizes were equally profitable. Therefore, at reproduction rates of lower than 67.67% for mature cows, 63.44% for SCC and 76.13% for FCC, medium cattle will be less profitable than small cattle. When reproduction rates of large cattle were 75.35% that of small cattle, they were equally profitable. Therefore, at reproduction rates of lower than 60.28% for MC, 56.51% for SCC and 67.81% for FCC, large cattle will be less profitable than small cattle. The stock flow with the lower reproduction rates are given in table 5.1 for medium cattle and table 5.2 for large cattle.

Consistent with the base model, this model followed a very strict culling criterion, where all cows that failed to fall pregnant were culled. Consequently, at lower reproduction rates, income from cow culls where much higher, at R744,600.81 for medium cows and R968,449.96 for large cows, compared to only R425,819.79 for small cows with an unchanged reproduction rate. The budget with the change in reproduction rates is given in table 5.3.

Table 5.1: Stock flow of the herd of medium cattle at a reproduction rate lowered to 85% of the base model

			MEDIUM CATTLE -Reproduction rate of 84.59% of base model											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MCs		123.9	123.9	123.8	123.7	123.6	83.5	83.5	83.4	83.3	83.3	83.2	83.1	83.1
Pregnant MCs	Calving %	67.67%	83.8	83.8	83.7	83.6	83.5	83.5	83.4	83.3	83.3			56.2
Open MCs			40.0	40.0	40.0	39.9								26.9
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Culls		31%				39.9								
SCC			65.0	65.0	64.9	64.9	41.1	41.1	41.1	41.0	41.0	40.9	40.9	40.9
Pregnant SCC	Calving %	63.44%	41.3	41.2	41.2	41.2	41.1	41.1	41.1	41.0	41.0			27.7
Open SCC			23.8	23.8	23.7	23.7								13.2
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						23.7								
FCC			86.3	65.6	65.6	65.5	65.5	65.4	65.4	65.3	65.2	65.2	65.1	65.1
Pregnant FCC	Calving %	76.13%	65.7	65.6	65.6	65.5	65.5	65.4						41.3
Open FCC			20.6											23.8
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Culls			20.6											
RCC			87.1	87.1	87.0	86.9	86.9	86.8	86.7	86.6	86.6	86.5	86.4	86.4
Pregnant RCC											65.9	65.8	65.8	65.7
Open RCC											20.7	20.6	20.6	20.6
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Calves from MCs			82.6	82.4	82.2	82.0						83.3	83.1	82.9
Deaths	Death %	3%	0.2	0.2	0.2	0.2						0.2	0.2	0.2
Calves sold from MCs						(7.1)								
RCC from MCs						89.1	88.9	88.7	88.5	88.2	88.0	87.8	87.6	87.4
Deaths	Death %	3%				0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Calves from SCC			40.7	40.6	40.5	40.4						41.0	40.9	40.8
Deaths	Death %	3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from SCC						40.3								
Calves from FCC			64.4	-					65.4	65.2	65.1	64.9	64.8	64.6
Deaths	Death %	3%	0.2						0.2	0.2	0.2	0.2	0.2	0.2
Calves sold from FCC			64.3											
Bulls			11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.1
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls													2.1	
Purchased	Replace%	20%											2.2	

Table 5.2: Stock flow of the herd of large cattle at a reproduction rate lowered to 75% of the base model

			LARGE CATTLE - reproduction rate of 75.35% of base model											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MCs		78.7	78.7	78.6	78.6	78.5	47.3	47.2	47.2	47.2	47.1	47.1	47.0	47.0
Pregnant MCs	Calving %	60.28%	47.4	47.4	47.4	47.3	47.3	47.2	47.2	47.2	47.1			28.3
Open MCs			31.3	31.2	31.2	31.2								18.7
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls		39%				31.2								
SCC			56.7	56.6	56.6	56.5	31.9	31.9	31.9	31.8	31.8	31.8	31.8	31.7
Pregnant SCC	Calving %	56.51%	32.0	32.0	32.0	31.9	31.9	31.9	31.9	31.8	31.8			19.1
Open SCC			24.6	24.6	24.6	24.6								12.6
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						24.6								
FCC			84.4	57.2	57.1	57.1	57.0	57.0	56.9	56.9	56.9	56.8	56.8	56.7
Pregnant FCC	Calving %	67.81%	57.2	57.2	57.1	57.1	57.0	57.0						32.0
Open FCC			27.2											24.7
Deaths	Death %	1%	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls			27.1											
RCC			85.3	85.2	85.1	85.0	85.0	84.9	84.8	84.8	84.7	84.6	84.5	84.5
Pregnant RCC											57.4	57.4	57.3	57.3
Open RCC											27.3	27.2	27.2	27.2
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Calves from MCs			46.8	46.6	46.5	46.4						47.1	47.0	46.9
Deaths	Death %	3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from MCs						(40.8)								
RCC from MCs						87.2	87.0	86.8	86.5	86.3	86.1	85.9	85.7	85.5
Deaths	Death %	3%				0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Calves from SCC			31.6	31.5	31.4	31.3						31.8	31.7	31.6
Deaths	Death %	3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from SCC						31.3								
Calves from FCC			56.1	-					57.0	56.9	56.7	56.6	56.4	56.3
Deaths	Death %	3%	0.1						0.1	0.1	0.1	0.1	0.1	0.1
Calves sold from FCC			56.0											
Bulls			8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls													1.7	
Purchased	Replace%	20%											1.8	

Table 5.3: Production budget for different reproduction rates and equal profitability of small, medium and large cattle

			SMALL CATTLE - UNCHANGED REPRODUCTION RATE		MEDIUM CATTLE - REPRODUCTION RATE 85% OF SMALL CATTLE		LARGE CATTLE - REPRODUCTION RATE 75% OF SMALL CATTLE	
Income								
Cattle Sales		**Price / kg**	**Total kg**		**Total kg**		**Total kg**	
Culled Mature Cows	Class C2/3	R 20.38	14,146.99	R 288,254.91	17,960.83	R 365,964.57	18,691.83	R 380,859.15
Culled First Calf Cows	Class C2/3	R 20.38	4,737.41	R 96,528.15	10,208.11	R 207,997.38	14,108.41	R 287,468.83
Culled Replacement Heifers	Class B2/3	R 21.05	1,949.50	R 41,036.73	8,106.43	R 170,638.86	14,257.70	R 300,121.99
Live weaners sold	Weaners	R 32.25	28,034.07	R 903,979.45	17,745.60	R 572,220.07	10,658.67	R 343,696.85
Culled Bulls	Class C2/3	R 20.38	862.53	R 17,574.74	945.48	R 19,264.88	1,007.56	R 20,529.74
Total income from cattle sales				R1,347,373.98		R1,336,085.76		R1,332,676.55
Expenses								
Bull Purchases		R 112.00	907.71	R 101,660.30	995.01	R 111,436.84	1,060.33	R 118,753.36
Licks		**Price / kg**	**Total kg**		**Total kg**		**Total kg**	
Winter Licks		R 4.10	16,116.34	R 66,093.13	17,193.61	R 70,510.98	17,796.07	R 72,981.68
Summer Licks		R 5.21	10,328.66	R 53,771.03	9,811.57	R 51,079.05	9,522.39	R 49,573.57
Dosing		**Price / ml**	**Total kg**		**Total kg**		**Total kg**	
Roundworm and Liver Fluke	15ml/50kg	R 0.67	126,992.38	R 25,603.57	145,526.75	R 29,340.38	159,337.43	R 32,124.82
Milk Tapeworm	1ml/4kg	R 0.38	56,633.95	R 5,376.12	52,350.18	R 4,969.47	49,681.92	R 4,716.18
Roundworm and Milk Tapeworm	1ml/10kg	R 0.40	233,462.21	R 9,335.69	255,225.13	R 10,205.94	272,014.65	R 10,877.32
Vitamin A	1ml/250kg	R 2.08	121,485.17	R 1,012.12	133,125.04	R 1,109.09	141,054.00	R 1,175.15
Trace Minerals	1ml/100kg	R 3.99	124,287.27	R 4,964.26	140,814.52	R 5,624.39	153,191.23	R 6,118.73
Vaccinacions		**Price / ml**	**Total animals**		**Total animals**		**Total animals**	
BVD	2ml/animal	R 16.37	468.82	R 15,344.97	375.02	R 12,274.89	315.38	R 10,322.91
Botulism, Anthrax, Blackquarter	2ml/animal	R 7.42	1,069.83	R 15,874.57	750.10	R 11,130.24	584.18	R 8,668.32
Paratyphoid (Inactivated)	2ml/animal	R 20.34	304.16	R 12,372.08	189.82	R 7,721.09	136.03	R 5,533.30
Brucella Abortus	2ml/animal	R 20.19	377.84	R 15,259.23	275.82	R 11,139.19	220.31	R 8,897.15
Pasteurella	1ml/animal	R 18.39	454.59	R 8,361.75	364.54	R 6,705.42	306.97	R 5,646.43
Rift Valley Fever (Incativated)	2ml/animal	R 6.88	469.61	R 6,465.84	375.52	R 5,170.34	315.75	R 4,347.31
Dips		**Price / ml**	**Total kg**		**Total kg**		**Total kg**	
Ticks,Tsetse flies, Red lice	5ml/50kg	R 0.54	262,360.64	R 14,213.39	294,989.40	R 15,981.05	319,320.50	R 17,299.19
Other Costs		**Price / animal**	**Total animals**		**Total animals**		**Total animals**	
Processing		R 70.00	76.75	R 5,372.35	89.13	R 6,238.99	87.19	R 6,103.18
Veterinary Services		R 52.61	765.67	R 40,282.09	559.53	R 29,436.91	447.19	R 23,526.45
Allocated Costs				R 401,362.47		R 390,074.26		R 386,665.05
Gross Profit above allocated costs				R 946,011.50		R 946,011.50		R 946,011.50

5.3.2 Scenario 2: Maturity rates and early breeding

It has been proved that smaller cows mature earlier. Again, at this stage, there is no equation to determine how much earlier a smaller cow will mature, that can be computed from their size. To illustrate, take the work of Warnick *et al*. (1991) for example. In their case study, they measured the age of puberty of Brahman cows. Cows were grouped according to frame size. Small frame cows reached puberty at 576 days (and 679lb or 308kg), medium frame cows at 623 days (and 692lb or 314kg) and large frame cows at 635 days (and 756lb or 363kg). Now, despite these numbers being exact for that specific case study, it cannot be applied across the board to all breeds, environments and management practices. Even in that experiment, age at puberty differed from one year to another, within one breed and from one breed to another, and in the words of the author "*there is substantial variation in age and weight at puberty, both within and across breeds*". With the information available currently it is thus impossible to attach a numeric value to the age at which a smaller cow will reach puberty, compared to a larger cow. However, the fact that smaller animals mature faster cannot be ignored as it will have a significant effect on biological and economic efficiency. This section thus looks at a scenario where it is assumed that small and medium cows, as defined in chapter 3, can be bred earlier than large cows and the resulting effect on the economic efficiency is described.

The common rule of thumb is that when cows have reached at least 65% of their mature body weight, they can be bred for the first time. In the base model of this study, where feed was not restricted, animals reached 67.7% of their mature body weight at 15 months. However, they were bred at 722 days at 83% of mature weight. This is illustrated clearly in figure 4.1 and shows that early breeding is a definite consideration, especially when feed is well managed. As in the previous scenario, profitability is used to measure whether breeding cows early is more profitable and if so, what level of reproduction will make it so.

For this scenario, the following is applicable:

- The goal was to find the early calving percentage needed by small and medium cows that were bred early that would match the profit of large cows bred later as in the base model
- Small and medium cows were bred for the first time at 449 days (on 23 December) and those that fell pregnant calved at 731 days (on 1 October). The timing of first breeding for large cows was unchanged from the base model

- Early breeding resulted in a change in energy requirements throughout the lifetime of the cow, mostly due to an extra calf being produced earlier in the cow's life. As an illustration, the net energy requirements of a medium cow bred at 15 months is given in figure 5.1. This should be directly compared to figure 4.2 where the net energy requirements of a medium cow bred at 24 months is given
- The changes in NE requirements led to a change in stock flow. Cows were bred three times before reaching maturity and were classified as FCC, SCC and TCC. Since these changes led to a significant change in stock flows, the stock flows for small and medium cattle bred at 15 months are given in table 5.4 and 5.5
- The change in inventory led to both a higher income and expenditure. Income and expenditure were calculated as described in chapter 3, however the timing of the expenses was adapted to fit an early breeding management system. Refer to table 5.6 for the resulting production budgets
- There were no changes made to the inventory or budget of large cattle

Results from this scenario showed that even if small cows had an unrealistic calving rate of 100% for the first breeding, they were still less profitable than large cows bred later as in the base model. Nonetheless, profit was far higher (R1,101,901.45) than when bred at 24 months (946,011.50), but it could still not match the profit made by large cattle bred at 24 months of age.

When medium frame cows were able to maintain a calving rate of 53.70% for the first calving, they were able to match the profit of large cattle bred at 24 months. By assuming an early calving rate of 53.70%, it resulted in higher expenses for the herd, however income was proportionately higher. In other words, medium cattle bred at 15 months, with a calving rate of 53.70% for first calf cows, was equally profitable compared to large cattle bred at 24 months with a calving rate of 90% for first calf cow.

The gross profit above allocated cost for small cows with a 100% calving rate for early calving, medium cows with a 53.70% calving rate for early calving and large cattle with no change to the base model is given in table 5.6.

It should be noted that, when small cows were bred at 15 months, only 44.54% of cows needed to fall pregnant to be more profitable than when the same cows were bred at 24 months and 90% fell pregnant (with reproduction rates of all other classes being equal). A calving rate of merely 37.00% for cows bred at 15 months was more profitable than a calving rate of 90% for later bred cows, for the herd of medium cattle. This means that if breeding at 15 months is possible, it will be more profitable than breeding at 24 months, even if FCC have a very low reproduction rate.

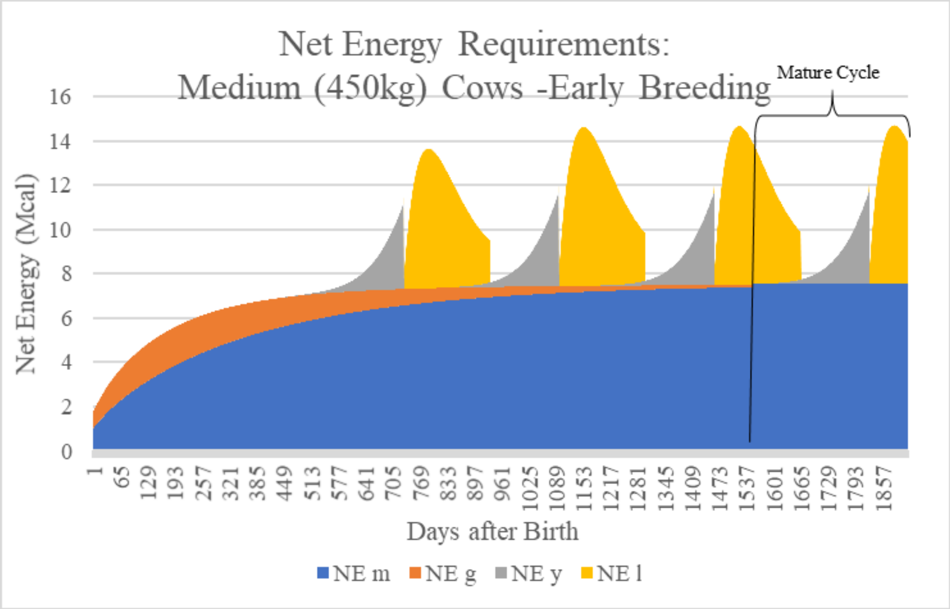

Figure 5.1: Net energy requirements of medium sized cow from birth to 1979 days when bred at 15 months

Table 5.4: Stock flow of the herd of small cattle bred at 15 months

			SMALL CATTLE (EARLY BREEDING)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MCs		212.5	212.5	212.3	212.2	212.0	169.5	169.3	169.2	169.0	168.9	168.7	168.6	168.5
Pregnant MCs	Calving %	80%	170.0	169.9	169.7	169.6	169.5	169.3	169.2	169.0	168.9			134.8
Open MCs			42.5	42.5	42.4	42.4								33.7
Deaths	Death %	1%	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Culls		19%				42.4								
TCCs			55.8	55.7	55.7	55.6	44.5	44.4	44.4	44.3	44.3	44.3	44.2	44.2
Pregnant TCCs	Calving %	80%	44.6	44.6	44.5	44.5	44.5	44.4	44.4	44.3	44.3			35.4
Open TCCs			11.2	11.1	11.1	11.1								8.8
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						11.1								
SCC's			75.1	75.0	75.0	74.9	56.1	56.1	56.0	56.0	55.9	55.9	55.8	55.8
Pregnant SCC's	Calving %	75%	56.3	56.3	56.2	56.2	56.1	56.1	56.0	56.0	55.9			44.6
Open SCC's			18.8	18.8	18.7	18.7								11.2
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						18.7								
FCCs			75.8	75.8	75.7	75.7	75.6	75.5	75.5	75.4	75.3	75.3	75.2	75.1
Pregnant FCCs	Calving %	**100%**	75.8	75.8	75.7	75.7	75.6	75.5	75.5	75.4	75.3			56.4
Open FCCs			-	-	-	-								18.8
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Culls						0.0								
Calves from MCs			167.6	167.2	166.8	166.4						168.9	168.5	168.0
Deaths	Death %	3%	0.4	0.4	0.4	0.4						0.4	0.4	0.4
Calves sold from MCs						88.8								
RCC from MCs						77.6	77.4	77.2	77.0	76.8	76.6	76.4	76.2	76.0
Pregnant RCC														76.0
Open RCCs														-
Deaths	Death %	3%				0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Calves from TCC			44.0	43.9	43.8	43.6						44.3	44.2	44.1
Deaths	Death %	3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from TCC						43.5								
Calves from SCC			55.5	55.4	55.2	55.1						55.9	55.8	55.7
Deaths		3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from SCCs						55.0								
Calves from FCCs			74.8	74.6	74.4	74.2						75.3	75.1	75.0
Deaths	Death %	3%	0.2	0.2	0.2	0.2						0.2	0.2	0.2
Calves sold from FCCs						74.0								
Bulls			16.8	16.8	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.6	16.6	16.8
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls													3.2	
Purchased	Replace%	20%											3.4	

Table 5.5: Stock flow of the herd of medium cattle bred at 15 months

			MEDIUM CATTLE (EARLY BREEDING)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MCs		146.3	146.3	146.2	146.1	145.9	116.6	116.5	116.5	116.4	116.3	116.2	116.1	116.0
Pregnant MCs	Calving %	80%	117.0	116.9	116.8	116.7	116.6	116.5	116.5	116.4	116.3			92.8
Open MCs			29.3	29.2	29.2	29.2								23.2
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Culls		19%				29.2								
TCCs			38.4	38.3	38.3	38.3	30.6	30.6	30.6	30.5	30.5	30.5	30.4	30.4
Pregnant TCCs	Calving %	80%	30.7	30.7	30.7	30.6	30.6	30.6	30.6	30.5	30.5			24.3
Open TCCs			7.7	7.7	7.7	7.7								6.1
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						7.7								
SCC's			51.7	51.6	51.6	51.6	38.6	38.6	38.6	38.5	38.5	38.5	38.4	38.4
Pregnant SCC's	Calving %	75%	38.8	38.7	38.7	38.7	38.6	38.6	38.6	38.5	38.5			30.7
Open SCC's			12.9	12.9	12.9	12.9								7.7
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						12.9								
FCCs			97.2	97.1	97.1	97.0	52.0	52.0	51.9	51.9	51.9	51.8	51.8	51.7
Pregnant FCCs		**54%**	52.2	52.2	52.1	52.1	52.0	52.0	51.9	51.9	51.9			38.8
Open FCCs			45.0	45.0	44.9	44.9								12.9
Deaths	Death %	1%	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls						44.9								
Calves from MCs			115.4	115.1	114.8	114.5						116.3	116.0	115.7
Deaths	Death %	3%	0.3	0.3	0.3	0.3						0.3	0.3	0.3
Calves sold from MCs						15.1								
RCC from MCs						99.4	99.2	98.9	98.7	98.5	98.2	98.0	97.7	97.5
Pregnant RCC														52.3
Open RCCs														45.1
Deaths	Death %	3%				0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Calves from TCC			30.3	30.2	30.1	30.0						30.5	30.4	30.3
Deaths	Death %	3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from TCC						30.0								
Calves from SCC			38.2	38.1	38.0	37.9						38.5	38.4	38.3
Deaths		3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from SCCs						37.8								
Calves from FCCs			51.5	51.3	51.2	51.1						51.9	51.7	51.6
Deaths	Death %	3%	0.1	0.1	0.1	0.1						0.1	0.1	0.1
Calves sold from FCCs						51.0								
Bulls			13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.2	13.2	13.4
Deaths	Death %	1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Culls													2.5	
Purchased	Replace%	20%											2.7	

Table 5.6: Production budget for early bred small cattle with a FCC reproduction rate of 100%, early bred medium cattle with a FCC reproduction rate of 54% and large cattle as in the base model

			SMALL CATTLE		MEDUM CATTLE		LARGE CATTLE	
Income			**100% early calving rate**		**53.7% early calving rate**		**As in base model**	
Cattle Sales		**Price / kg**	**Total kg**		**Total kg**		**Total kg**	
Culled Mature Cows	Class C2/3	R 20.38	12,708.80	R 258,950.82	13,122.79	R 267,386.12	16,375.52	R 333,662.74
Culled TCC	Class C2/3	R 20.38	3,191.86	R 65,036.30	3,295.83	R 67,154.85		
Culled SCC	Class C2/ 3	R 20.38	5,045.82	R 102,812.10	5,210.19	R 106,161.19	5,483.68	R 111,733.90
Culled FCC	Class B2/3	R 21.05	0.00	R 0.00	15,365.04	R 323,431.44	2,256.60	R 47,501.11
Live weaners sold	Weaners	R 32.25	32,983.39	R1,063,574.09	25,062.17	R 808,148.24	32,450.18	R1,046,380.28
Culled Bulls	Class C2/3	R 20.38	957.01	R 19,499.76	1,142.58	R 23,280.88	998.41	R 20,343.23
Total income from cattle sales				R1,509,873.07		R 1,595,562.73		R1,559,621.26
Expenses								
Bull Purchases		R 112.00	1,007.14	R 112,795.48	1,202.43	R 134,667.23	1,050.70	R 117,674.51
Licks		**Price / kg**	**Total kg**		**Total kg**		**Total kg**	
Winter Licks		R 4.10	14,515.27	R 59,527.14	15,389.58	R 63,112.67	16,188.80	R 66,390.28
Summer Licks		R 5.21	10,854.52	R 56,508.63	10,677.51	R 55,587.10	10,293.88	R 53,589.94
Dosing		**Price / ml**	**Total kg**		**Total kg**		**Total kg**	
Roundworm and Liver Fluke	15ml/50kg	R 0.67	117,719.50	R 23,734.02	135,275.64	R 27,273.60	146,997.06	R 29,636.81
Milk Tapeworm	1ml/4kg	R 0.38	64,247.26	R 6,098.83	66,340.11	R 6,297.50	65,555.31	R 6,223.00
Roundworm and Milk Tapeworm	1ml/10kg	R 0.40	218,747.76	R 8,747.29	235,192.35	R 9,404.87	270,238.72	R 10,806.31
Vitamin A	1ml/250kg	R 2.08	108,579.44	R 904.60	122,629.28	R 1,021.65	140,622.32	R 1,171.55
Trace Minerals	1ml/100kg	R 3.99	117,719.50	R 4,701.93	135,275.64	R 5,403.15	143,865.82	R 5,746.26
Vaccinacions		**Price / ml**	**Total animals**		**Total animals**		**Total animals**	
BVD	2ml/animal	R 16.37	436.75	R 14,295.33	347.69	R 11,380.21	271.33	R 8,881.11
Botulism, Anthrax, Blackquarter	2ml/animal	R 7.42	1,117.98	R 16,589.02	816.63	R 12,117.54	619.18	R 9,187.62
Paratyphoid (Inactivated)	2ml/animal	R 20.34	344.76	R 14,023.37	237.33	R 9,653.45	176.04	R 7,160.50
Brucella Abortus	2ml/animal	R 20.19	420.12	R 16,966.51	334.45	R 13,506.77	218.68	R 8,831.49
Pasteurella	1ml/animal	R 18.39	421.55	R 7,754.09	335.78	R 6,176.33	263.10	R 4,839.48
Rift Valley Fever (Incativated)	2ml/animal	R 6.88	438.22	R 6,033.66	349.05	R 4,805.82	271.80	R 3,742.19
Dips		**Price / ml**	**Total kg**		**Total kg**		**Total kg**	
Ticks,Tsetse flies, Red lice	5ml/50kg	R 0.54	242,372.50	R 13,130.53	273,799.04	R 14,833.06	303,689.43	R 16,452.37
Other Costs		**Price / animal**	**Total animals**		**Total animals**		**Total animals**	
Processing		R 70.00	77.56	R 5,429.47	99.44	R 6,960.69	44.42	R 3,109.32
Veterinary Services		R 52.61	774.22	R 40,731.73	579.67	R 30,496.38	443.14	R 23,313.79
Allocated Costs				R 407,971.62		R 412,698.00		R 376,756.53
Gross Profit above allocated costs				R1,101,901.45		R 1,182,864.73		R1,182,864.73

5.3.3 Scenario 3: Limited feed intake

5.3.3.1 Preface

Cattle need energy to complete physiological functions. The energy requirements of these physiological functions have been discussed and was calculated in this study. When feed is limited, the animal will lack the energy needed to complete these functions, meaning they will be negatively affected. When animals are fed below energy requirements, reproduction rates drop, growth rates are reduced and even maturity rates are slowed. Low reproduction rates as a result of underfeeding has been well documented. The NRC cites previous work by Rege et al which reported a severe case in Nigeria where White Fulani cattle were grossly underfed, resulting in such slow maturity rates that these cattle calved for the first time as late as 7 years (2000). Reduced energy intake also affects the performance of bulls. As is the case with female animals, when young bulls were fed below energy requirements stunted growth and delayed puberty were observed. Where energy availability was only moderately limited, and not for prolonged periods, it had little influence on the mating behaviour, semen production or semen quality of the bull. In more severe cases, where energy requirements of bulls were not matched over long periods, it led to a reduction in sperm production as well as sperm quality. In other reported cases, reduced nutrition even led to a reduction in scrotum size, which is commonly used as a measurement of fertility. Therefore, when the energy requirements of bulls were not met, it impacted the performance of the total herd. (National Research Council, 2000)

Cattle perform best at rates where feed is not limited (National Research Council, 2000; Jenkins & Ferrell, 2002). Feed requirements and feed availability might not always be matched perfectly, but despite the mismatch, some inherent mechanisms in cattle exists that reduces the impact. Research by the NRC showed that when cows were over or underfed while pregnant, within a wide range (a body condition score of between 3.5 to 7), it did not affect the weight of the calf significantly. Thus, cows can forgo some of their own energy requirements, and in the form of tissue loss, compensate for energy requirements for growth of the foetus. However, when they were grossly underfed, it resulted in calving problems, lower calf birth weight and growth, as well as low rebreeding rates. Another case where cattle can manage feed fluctuations is a phenomenon called compensatory growth. When cattle have lost body tissue and are at a low body condition score, they are able to increase feed intake and weight gain once feed becomes readily available. This has been observed in growing cattle which were reported to increase growth rates, as well as mature cattle (National Research Council, 2000).

Previous literature argue that energy will primarily be allocated to NE_m. The order of energy allocation is as follows, first NE_m, then NE_g, then NE_l, then NE_y. As Johnson et al (2010) described it, *"Essentially, a cow takes care of herself, then the calf on the ground, then the calf to come."*

This was assumed as the rule of thumb for the consequent paragraphs.

Previous research argued that smaller cattle do better in conditions where feed are limited. In most of these researches, feed was limited to an amount per metabolic weight of the animals, as in the highly regarded work of Jenkins and Farrell (1994). The following scenario will take a look at 4 ways in which feed can be limited:

1. feed is limited to a specific quantity per animal, regardless of animal size
2. the calculated energy requirements of small, medium and large cattle are considered and then reduced by a percentage
3. feed is limited as a proportion of metabolic weight
4. feed is made available according to LSU

The above is discussed at the hand of examples and from the calculations as described in chapter 3.

5.3.3.2 Feed is limited to a specific amount

This section looks at the scenario where feed is limited to a specific amount per animal. Although it is logical that larger animals eat more, it illustrates the effect of, for example, having 100 large cattle or 100 small cattle on the same resource base.

Since all cattle start out as small calves, the effect of feeding a calf with large expected mature size the same amount of feed as a calf with a small expected mature size is of interest. The following scenario illustrates the effect.

As a simple argument consider the growth stage as defined in chapter 3, where animals will reach 97.5% of maturity at 1552 days. To simplify, only growth and maintenance are considered here. If calves have unlimited access to feed energy, the NE_{m+g} requirements will be 7,663Mcal, 10,548Mcal and 13,249Mcal respectively for a small, medium and large calf. Now if feed were limited to a specific amount, smaller animals prove to be more efficient and actually grow to a larger size. For example, if feed is limited to 7,663Mcal for each of the three calves, the following can be argued. The small calf's growth and maintenance will be unaffected. The medium and large calves will grow up to a point, after which the remaining energy is used purely for maintenance requirements from this point onwards to 1552 days (if feed availability could be planned in such a way). If this is the case, medium calves will grow up to a weight of 257kg then stop growing and use the remaining energy to maintain this weight. Large calves will grow up to a weight of 252kg and then use the remaining energy for maintenance. This is summarized in table 5.7.

Table 5.7: The results of limiting feed to 7,633Mcal during the growth stage of small, medium and large cattle.

7,663Mcal in total available for 1552 days			
Size	**Small**	**Medium**	**Large**
Final Weight	293kg	257kg	252kg
% of mature mass	97.5%	57.1%	42.1%
NE_m	6870 Mcal	7151 Mcal	7255 Mcal
NE_m / NE_{m+g}	89.7%	93.3%	94.6%

Since medium and large cows grow faster than small cows, they will reach a heavier weight sooner and need to use more energy for maintenance over this period. In this example, feed requirements of small cattle were in fact not limited but it illustrates the result of limiting available energy to a specific amount. Even where the amount of available energy was lowered further, smaller cattle were found to be more efficient during the growth stage.

If feed were to be limited to a specific amount per animal during the lactation or reproduction phases, small cattle would again outperform their larger counterparts. Reference should be made to Table 4.4 that shows the energy requirements of small, medium and large cattle throughout their lifetime. If the net energy requirement of a mature cycle is considered, small, medium and large cows will need a total of 2,930Mcal, 3,996Mcal and 4,981Mcal per year respectively. If feed were limited to for example, 4,645Mcal per animal, large cows' reproduction rates would be negatively affected, where small and medium cows still had surplus feed available. If feed were limited to 2,930Mcal smaller cows would be able execute their physiological functions normally, but medium cows would probably not reproduce, and lactation would be hindered, whereas large cows would likely not reproduce, lactate properly or even maintain their current weight. Similarly, at lower feed amounts, small cows would be the most effective, although physiological functions would be negatively influenced.

Although the above results are to be expected, it illustrates the importance of matching cow size to the available feed resources. It also shows that understocking is far more effective than overstocking. Since cows use such a small amount of NE_t for reproduction, overstocking by only 4.9% (for small cows) to 5.7% (for large cows) could wreak havoc on reproduction, especially when available energy is limited during the breeding season.

5.3.3.3 Feed is limited as a percentage of the total required

This section takes a look at efficiency of different sizes when available energy is reduced by a percentage of their calculated energy requirements. This is comparable to a situation where feed becomes unavailable due to for example a drought, however, importantly, animals were matched to their resource base before feed became limited.

First consider the growth stage. Once more, to simplify, only maintenance and growth is considered. Limiting NE_{m+g} by even a small amount will negatively influence growth, irrelevant of the animal's size. Furthermore, NE_g were 10.3%, 11.7% and 12.8% of NE_{m+g} respectively for small, medium and large cows. The preceding percentages were calculated for the total growth cycle from 1 to 1552 days, therefore growth will still take place up to a point, if NE_{m+g} was limit over the total cycle.

For example, consider were NE_{m+g} is limited by 10% throughout the cycle. A small cow will grow to a weight of 234kg or 78.1% of its mature weight, a medium calf to 353kg or 78.5% of its mature weight and a large calf to 473kg or 78.9% of its mature weight. Results are summarized in table 5.8

Table 5.8: Small, medium and large cows fed 90% of calculated NEm+g during the growth cycle

Calves fed 90% of calculated NE_{m+g} during the growth cycle			
Size	**Small**	**Medium**	**Large**
Final Weight	234kg	353kg	473kg
% of mature mass	78.1%	78.5%	78.9%
NE_m	6337 Mcal	8613 Mcal	10712 Mcal
NE_m / (NE_{m+g} x 90%)	91.9%	90.7%	89.8%

This shows that when feed is limited by a percentage of NE_{m+g}, larger cows will have an advantage over smaller cows, this is mainly because of proportionately higher maintenance requirements by smaller cows as explained by metabolic weights.

Next consider the mature cycle. From table 4.4, small cows used a total of 2,930Mcal to go through a mature cycle unhindered and 5.7% of NE_t was used for reproduction. Medium cows used 3,996Mcal throughout a mature cycle and 6.3 % of NE_t was used for reproduction. Large cows used 4,981Mcal and 6.8% thereof was allocated to reproduction. As an example, if an individual cow was fed at 6% below their energy requirements, a small cow will most likely not reproduce in this cycle. In the case of medium and large cows, some, although very few, might still fall pregnant. The same can be argued for the lactation phase, from the assumption that mature cows will use energy for maintenance, then lactation and then reproduction. Table 4.4 illustrates the percentages used for maintenance, lactation and reproduction for each cow size in a mature cycle clearly and the threshold at which these functions will be adversely affected can be directly read from this table. The timing of the feed limitation should also be considered.

The above illustrates that larger cows will be more efficient than small cows when feed is limited as a percentage of the calculated requirements, since they use a proportionately lower percentage of NE_t for NE_m than smaller cows.

5.3.3.4 Feed is limited to an amount per metabolic weigh

This section is concerned with the efficiency of different sized animals, when feed is limited by some factor of metabolic weight. This relates to Kleiber's law as discussed in chapter 2 and the metabolic weight of animals.

When an animal's only physiological function is maintenance, as is the case in a mature non-pregnant, non-lactating cow, their energy requirements are a function of metabolic weight. The equation of Lofgreen and Garrett (1968) is commonly accepted as the calculation of NE_m and states,

$$NE_m = 0.077W^{0.75}$$

In fact, with reference to table 4.4, when energy requirements for maintenance for the 3 sizes are considered, it is clear that they are a function of metabolic weight, throughout the growth and mature stage. This means limiting NE_m according to metabolic weight will have a similar effect on the three sizes.

Next, consider energy requirements for growth throughout the first 1552 days as described in chapter 3. The equation used was

$NE_g = 0.0635 * EQEBW^{0.75} * EBG^{1.097}$

Yet, this is not a direct function of metabolic weight. From the description in section 4.2 of chapter 3, the composition of gain differs among the different sizes, therefore body weights were first converted into EQEBW. Furthermore, daily gain of large animals is higher than that of small animals and the composition of gain is also different. This translates into NE_g not being a pure function of metabolic weight. In fact, larger animals use proportionately more energy for gain as a function of metabolic weight.

As an example, were only NE_g is considered throughout the animal's lifetime; limiting energy to a portion of metabolic weight yields the following:

NE_{gsmall} = 793Mcal

NE_{gsmall} per unit of metabolic weight = $793 / 300^{0.75}$

= 11.00Mcal

$NE_{gmedium}$ = 1237Mcal

$NE_{gmeduim}$ per unit of metabolic weight = 12.66Mcal

NE_{glarge} = 1696Mcal

NE_{glarge} per unit of metabolic weight = 13.99Mcal

From the above, small cattle use less energy for growth per unit of metabolic weight, and will have the advantage when NE_g is limited to a unit of metabolic weight.

Where lactation is concerned, energy requirements are calculated from milk yield. As described in chapter 3, it was assumed that milk yield is in fact a function of the calf's suckling ability and that the calf's suckling ability is a function of its metabolic weight. Therefore, when NE_l is limited according to metabolic weight, it can be concluded that it will impact the three sizes equally.

The energy used for production is equal to the energy of the gravid uterus. From the calculations in chapter 3, this is not a function of metabolic weight. Again, with special reference to table 4.4, when the lifetime NE_y of the three sizes are compared, the following can be calculated:

NE_{ysmall} = 1155Mcal

NE_{ysmall} per unit of metabolic weight = 16.02Mcal

$NE_{ymedium}$ = 1746Mcal

$NE_{ymeduim}$ per unit of metabolic weight = 17.87Mcal

NE_{ylarge} = 2328Mcal

NE_{ylarge} per unit of metabolic weight = 19.20Mcal

Thus, small cattle use proportionately less NE_y as a unit of metabolic weight. When limiting NE_y as a unit of metabolic weight, small cows should thus be more efficient than medium or large cows.

From the above, when considering the NE_t of the three sizes, and feed is limited to an amount per unit of metabolic weight, small cattle will be more efficient, due to being more efficient in the growth and production stages. Therefore, when feed is limited to a unit of metabolic weight, large cattle will be the first to have an energy deficiency and when taking into consideration that energy will be partitioned to production lastly, will likely have lower reproduction rates. In this case, small cows will be more efficient, which will be expressed as a comparatively higher reproduction rate.

The highly cited work of Jenkins & Ferrell (1994), concluded that smaller cattle are more efficient when fed as a portion of metabolic weight. Here, the above calculation not only confirms the work of Jenkins & Ferrell, but also provides the reason for it. Although Jenkins & Farrell's research studied the difference among different breeds, the same argument is valid within a breed.

5.3.3.5 Feed is matched to LSU requirements

As discussed in Chapter 2, the LSU is the most commonly used system in South Africa to define animal feed requirements. In this section, a further comparison was made between the LSU and the calculation in this study. It also determined whether using LSU will be advantageous to one size above another.

In this section all energy requirements were converted to Mcal for consistency with the rest of the study, whereas the original technical communication about LSU used MJ.

First consider maintenance. As discussed in Chapter 2, animals' maintenance requirement is a function of metabolic weight and this was illustrated by Kleiber (1932) . The most commonly used equation, which was also adopted by the NRC, is that of Lofgreen & Garrett (1968) where NE_m is calculated as a function of metabolic weight. The LSU does however, not consider metabolic weight of animals but is only a function of weight. With reference to the so-called Meissner tables (Meissner, 1983), first consider energy requirements for maintenance, in other words, with zero daily gain. The two equations are as follows:

LSU: $NE_m = 1.354 + 0.0146W$ (converted to Mcal)

Lofgreen & Garrett: $NE_m = 0.077W^{0.75}$ (Mcal)

For each of the 3 sizes the LSU overestimates net energy requirements for maintenance, compared to the equation of Lofgreen & Garrett. Furthermore, since the LSU doesn't consider metabolic weight, maintenance requirements of small cattle are overestimated proportionately less than that of large cattle. A summary of the differences is shown in table 5.9.

Table 5.9: Comparison between NEm requirements as calculated as LSU and by Lofgreen & Garrett

Mature size	**300kg**	**450kg**	**600kg**
LSU NE_m (Mcal)	6.0	8.3	10.6
Lofgreen & Garrett NE_m (Mcal)	5.6	7.5	9.3
Difference between LSU and Lofgreen & Garrett	7.8%	9.5%	12.0%

Next consider growth. Meissner argued that when an animal is growing, it will be a function of weight gain and current body weight. Therefore, it was assumed that NEg is linear and only depends on these two variables. The equation to determine NEg as calculated for a LSU is:

$NE_g = LWG(1.500 + 0.0045W) / (0.2388 – 0.0717LWG)$ (converted to Mcal)

where LWG = Live Weight Gain

This is very different from the equation used by the NRC, where there are many more variables that influence the equation. The equation is:

$NE_g = 0.0635*EBW^{0.75} * EBG^{1.097}$ (Mcal)

This equation recognizes that NE_g has to consider mature weight and also that the composition of gain changes over time. This calculation was described fully in chapter 3. When the LSU equivalent for a growing animal is compared to the calculation in this study, results vary, mostly due to changes in composition in weight gain and thus energy requirements for weight gain.

Mostly the LSU equivalent overestimates NE_{m+g}, except for small cattle at heavier weights. This means that when using LSU for calculating NE_{m+g} for growing cattle, large cattle will once more be at an advantage. A comparison of the two equations for animals of different sizes is given in table 5.10.

When lactation is considered, Meissner referred specifically to dairy cows and not beef cows. Nevertheless, this is commonly used to determine LSU for beef cows as well. The equation given for LSU is for the combination of maintenance and lactation (NE_{m+l}). Inconsistent with maintenance and growth equations for LSU, this equation for NE_{m+l} considers metabolic weight. The equation is given as:

$$NE_{m+l} = (3054P + W^{0.75}\,(0.6*(481 + 2.1P))) / 238.846 \qquad \text{(converted to Mcal)}$$

The equation used by NRC separates NE_m and NE_l, however the combined equation will be given here for comparison:

$$NE_{m+l} = NE_m + NE_l = 0.077W0.75 + 0.7178P \qquad \text{(Mcal)}$$

where P = daily milk yield in kg

Both equations assume a fat content of 4%. When the computed results of the two equations are compared, the LSU calculation will underestimate NE_{m+l} requirements for all sizes compared to the calculation used in this study. The LSU equation will underestimate NE_{m+l} for small cows proportionately less, thus small cows will be at an advantage, or at a lesser disadvantage, when LSU is used to match lactating cows to their energy requirements. Table 5.11 gives a comparison of results from the two equations for a milk yield of 5kg, 10kg and 15kg a day.

When energy requirements according to LSU is considered during foetal production, only approximate values were expressed for pregnant cows. No mention was made of the stage of pregnancy. Three different sized mature cows in calf were provided in the Meissner tables, 500kg, 525kg and 550kg and they were called small, medium and large framed respectively. This makes a fair comparison between the values given as LSU and the equations used in this study difficult. Therefore, for this comparison, the following was assumed, to be consistent with the calculations in this study. Calf size was taken as 6.67% of mature weight. NE_{m+y} was calculated for the last day (day 283) of pregnancy, which is when NE_y is the highest. Regardless, when these calculations were compared, the LSU will overestimate the energy requirements needed for

NE_{m+y} significantly. Once more, energy requirements for large cattle were proportionately overestimated more, giving them an advantage over their smaller counterparts. A comparison of the calculations for NE_{m+y} for mature cows of 500kg, 525kg and 550kg are given in table 5.12.

From the above, for the animal sizes used in this study, the LSU will mostly overestimate the amount of energy animals require for maintenance, growth and foetal production, except for later growth stages of small cattle. The LSU overestimates the energy needed for large cattle proportionately more than for other sizes in the beforementioned physiological functions. This is mostly to metabolic weight not being included in the calculations. As a result, when different sized animals are matched to a resource base according to LSU, large cattle will have the advantages over smaller cattle. For the lactation phase, the LSU underestimates energy requirements. The LSU underestimates energy requirements of large cattle during the lactation phase proportionately more than for smaller sizes, resulting in large lactating cattle being at a disadvantage if they were matched to a resource base according to LSU.

Table 5.10: Comparison between LSU and calculation recommended by NRC for NEm+g

Current cattle weight, gaining 500g per day	**100kg current weight**	**150kg current weight**	**200kg current weight**	**250kg current weight**	**300kg current weight**	**350kg current weight**	**400kg current weight**	**450kg current weight**	**500kg current weightn**	**550kg current weight**	**600kg current weight**
LSU NEm+g, 500g daily gain (Mcal)	4.16	5.06	5.97	6.88	7.79	8.67	9.58	10.49	11.39	12.30	13.18
NRC NEm+g, 300kg mature size, 500g daily gain (Mcal)	3.60	4.88	6.05	7.15	8.20	N/A	N/A	N/A	N/A	N/A	N/A
NRC NEm+g, 450kg mature size, 500g daily gain (Mcal)	3.29	4.46	5.54	6.55	7.50	8.42	9.31	10.17	N/A	N/A	N/A
NRC NEm+g, 600kg mature size, 500g daily gain (Mcal)	3.13	4.24	5.26	6.21	7.13	8.00	8.84	9.66	10.45	11.23	11.98
Difference: LSU and NRC for 300kg mature size	13.4%	3.7%	-1.3%	-4.0%	-5.3%						
Difference: LSU and NRC for 450kg mature size	20.8%	11.9%	7.3%	4.8%	3.6%	2.8%	2.8%	3.0%			
Difference: LSU and NRC for 600kg mature size	24.8%	16.3%	12.0%	9.7%	8.5%	7.7%	7.7%	7.9%	8.3%	8.7%	9.1%

Table 5.11: Comparison between LSU and calculation recommended by NRC for NEm+l

Daily milk yield	**5 kg/day**			**10 kg/day**			**15kg/day**		
Cow weight	**300g**	**450kg**	**600kg**	**300g**	**450kg**	**600kg**	**300g**	**450kg**	**600kg**
LSU NEm+l (Mcal)	8.38	10.05	11.58	12.29	14.02	15.60	16.28	18.06	19.70
NRC NEm+l (Mcal)	9.14	11.11	12.92	12.73	14.70	16.51	16.32	18.29	20.10
Difference: LSU and NRC	-9.1%	-10.6%	-11.6%	-3.6%	-4.9%	-5.9%	-0.2%	-1.3%	-2.1%

Table 5.12: Comparison between LSU and calculation recommended by NRC for NEm+y

Cow size	**500kg**	**525kg**	**550kg**
Calf size at 6.67% of mature weight for NRC equation	**33kg**	**35kg**	**37kg**
LSU NEm+y , unspecified stage of pregnancy (Mcal)	19.64	21.62	23.61
NRC NEm+y, last day of pregnancy (Mcal)	12.81	13.35	13.88
Difference: LSU and NRC	35%	38%	41%

5.4 Further consideration related to size

5.4.1 Adaptation

A smaller body size has been proven as an adaptation to warmer climates and some associated diseases and parasites, as well as an environment where feed availability fluctuates. This was discussed in chapter 2. One such adaptation is that a smaller body size gives a larger surface area to body weight. This results in an animal being able to handle extreme heat better than larger cattle with a smaller surface area to body weight. More of these adaptations can be expressed in a number of ways, including reproduction rates, mortality rates and growth rates. Some research even suggests that smaller breeds can lower their maintenance requirements compared to larger breeds (Scasta *et al.*, 2015). Most of these adaptations are breed specific. When selecting for size within one breed, it is important to first determine if the breed is suited to the environment and then determine the most efficient size.

5.4.2 Facilities

One of the findings that echoes through previous literature is that the most efficient cow size will depend, among others, on the management practices. This includes the handling of cattle. When handling of cattle is concerned, the following should be considered.

Firstly, handling facilities might be suited to one size above another. For example, consider a pressure chute. If cattle are sufficiently small, they might be able to turn around in the pressure chute, whereas extremely large cattle might have difficulty moving through a small chute. Another example is head clamps that might only function within a size range. Therefore, infrastructure that aids in the handling of cattle, might only be effective within a size range and changing from one size to another (even unintentionally by means of selection criteria) could lead to costs for modifying handling equipment.

In the case where a minimum of handling facilities is used, small cattle are easier to handle. Although different breeds have differences in temperament, this research is concerned with differences within a specific breed. Thus, handling a small cow, is easier than handling a large cow, within a specific breed. However, a further consideration is the number of cattle that needs to be handled. Despite smaller cattle being easier to handle, from the model used in this study, 73% more small cattle (766) and 25% more medium cattle (556) than large cattle (443) requires veterinary services. Not only does this increase costs but is also more time consuming. This leads to higher labour costs and/or opportunity costs.

5.4.3 Selection and genetic progress

Having more cattle on a set resource base has the advantage of more genetic variation. In the model constructed for this research, in the case of small cattle, farmers had 185.2 (72.8% more than large cattle) calves to choose from for replacements, compared to 134.6 (25.5% more than large cattle) for medium cattle and 107.2 for large cattle. When a farmer is thus selecting for a specific trait, there will likely be more individual small cows that express this trait. The following equation is commonly used to determine genetic progress when selecting for a certain trait. It is customarily known as the breeder's equation.

$$R = S \text{ x } h^2 / L$$

R = response to selection,

S = is the genetic variation of the trait from the mean of the population

h = the heritability of the trait which is selected for

and L = the length of cycle interval

The larger the herd, the more genetic variation there is likely to be in the group. This would increase genetic variation in the herd of small cattle, and a herd of small cattle can thus make faster genetic gain than a herd of large cattle. Also, from a practical point of view, when a farmer has some flexibility in replacement rates, he will have more individual small cows to choose from, even if genetic variation among the three herds are similar.

Since it can be accepted that smaller cattle mature faster, the generation interval can be shortened for smaller cattle. In the management model as described in chapter 3, controlled breeding was applied and a cycle was typically 1 year, so similar intervals were assumed for different sized animals. However, if smaller cattle are bred earlier, the cycle interval will be shortened. When uncontrolled breeding is applied, smaller animals will naturally express shorter generation intervals, however the disadvantages of uncontrolled breeding might outweigh the advantages of shortening the generation interval.

5.5 Chapter Summary

This chapter looked at qualitative data that could not be quantified numerically but will be significantly influenced by the size of cattle. This was done by means of scenarios and examples to express the relationship between size, biological efficiency, economic efficiency and other management practices. Although the impact of animal size on some of these efficiency measures could not be calculated, they are easily measured. From previous on-farm records, a farmer will be able to use the calculations described above to determine the most efficient cattle size for their resource base.

Chapter 6 Conclusion and Recommendations

6.1 Conclusion

Cattle size influences biological efficiency, biological efficiency influences economic efficiency however there are many more variables that influence biological and economic efficiency other than size, that needs to be considered. Furthermore, the efficiency of individual animals are not directly proportionate to the efficiency of the herd, however the efficiency of individual animals determines the efficiency of the total herd.

Growth rates, lactations yield, and calf sizes were assumed by reviewing previous literature and consequently net energy requirements for individual animals of each of the three sizes were calculated for four biological functions, maintenance, growth, lactation and calf production throughout their lifetime in the herd. Cattle are in fact very inefficient when using energy for production. For breeding cows, throughout their lifetime, more than 70% of energy requirements was allocated to maintenance. When the total herd was considered, again more than 70% of total energy was allocated to maintenance. Small cows were the least efficient and used 71.8% of total energy for maintenance, compared to 71.1% for medium cattle and 70.5% for large cattle. A stock flow was created using recommended reproduction, death and cull rates, for a weaner production system. The net energy requirements of individual animals, of the three different sizes, were matched to the stock flow to determine the number of each class of animal a set resource base was able to support. The herd of small cattle proved to make the least efficient use of feed, with net energy requirements for maintenance at 73.1% of total net energy requirements, compared to 72.0% for the herd of medium cattle and 71.2% for the herd of large cattle. From the stock flow and inventory for each size, income and expenditure were calculated to determine which size would be the most profitable. The herd of large cattle yielded the highest income, mostly due to having lower maintenance requirements, and the resource base being able to support more kilograms of cattle in the large herd. Smaller cattle had the highest expenditure, due to expenses charged on a “per head” basis, as was the case for vaccinations, veterinary and processing costs. As a result, large cattle proved to be the most profitable.

The above results were made by assuming similar reproduction rates for small, medium and large cattle. Smaller cows have been proven to have a higher reproduction rate than larger cattle, although there is not a numerical equation to calculate the difference between reproduction rates of small cows and large cows under similar conditions. Therefore, the reproduction rates at which medium and large cattle would become less profitable than small cattle were calculated in a scenario. When the reproduction rate of small mature cows was 80%, medium cattle would be less profitable at reproduction rates of 68% for mature cows and large cattle would be less profitable at reproduction rates of 60% for mature cows.

Smaller cattle have been proven to mature faster than larger cattle. Again, there is no numerical equation to calculate how much faster a small cow will mature than a large cow. The possibility of early breeding of small and medium cattle were calculated in a scenario. Results showed that even at very low reproduction rates for FCC (45% for small cattle and 38% for medium cattle) early breeding is more profitable than late breeding. Profitability from the herd of small cattle, that were bred early could still not match the profitability of the herd of large cattle bred late, even if FCC reproduced at 100%. Profitability from the herd of medium cattle, that were bred early matched the profitability of the herd of large cattle that were bred late when FCC reproduced at 54%.

Further scenarios were calculated where available feed energy was not matched to cattle's energy requirements. Results varied as to the most efficient cow size were feed is limited. It did however illustrate that even slightly overstocking a resource base would negatively impact reproduction, then lactation and then growth. It is more profitable to slightly understock a resource base, than to overstock. Further results showed that using the LSU to match animals to the resource base would in most cases overestimate energy requirements, and be advantageous to larger cattle, except in the lactation phase. More current and accurate equations exist to calculate the energy requirements of cattle than the LSU.

There are more considerations the farmer needs to take into account to find the right sized cow for their situation, including adaptation, infrastructure, and selection goals. Nonetheless, biological and economic efficiency is at the heart of finding the right sized cow for their individual enterprise.

6.2 Recommendations for Emerging and Commercial Farmers

All cattle sizes are at their most efficient when feed intake is not limited. There is very little leeway where energy requirements for reproduction is concerned, with only between 4.9% to 5.7% of energy used for reproduction. Furthermore, energy for reproduction will be allocated after energy requirements of other physiological functions have been met. Consequently, even slightly overstocking a resource base could drastically reduce reproduction, and slightly understocking a resource base might be more profitable than overstocking. Grazing management is vital. Energy requirements of the herd can be accurately calculated and should be matched to a grazing plan. This is especially noteworthy to emerging and communal farmers, where there is a tendency to severely overstock a resource base.

The energy requirements of the total herd can be calculated accurately to intervals as small as a day. For more practical considerations, the monthly energy requirements of the herd can be calculated. This means, under proper grazing management, the energy requirements of the herd can largely by matched to feed availability throughout the season. As an example, the monthly energy requirements of a herd of medium cattle is given in figure 6.1. Matching energy requirements to feed availability can only be done with rotational grazing and when utilizing breeding seasons. 98% of communal and 63% of emerging farmers use uncontrolled breeding (Scholtz *et al.*, 2008). Continuous grazing is also commonly reported for communal and emerging farmers and is discouraged. When cattle are grazed continuously, fluctuations in feed availability due to natural processes becomes accentuated. For example, in the summer rainfall areas of South Africa, grass enters a stage of dormancy or very slow growth during winter times. When cattle are grazed continuously, there will be a shortage of feed and feed energy during winter months.

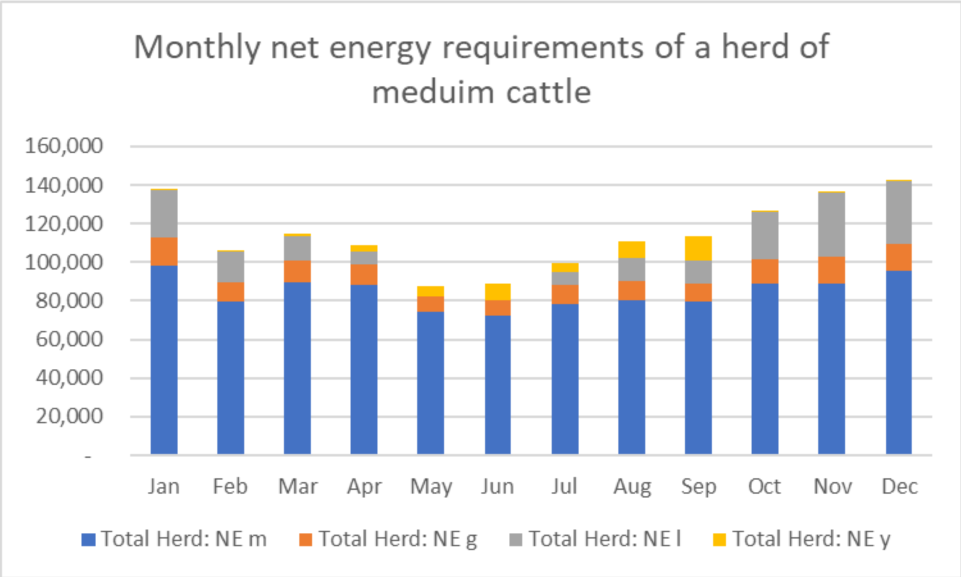

Figure 6.1: Monthly energy requirements of a herd of medium cattle

(Personal collection)

When high reproduction rates can be maintained for larger cattle, they are more biologically and economically efficient than smaller cattle, however when reproduction rates of larger cattle are significantly lower than that of smaller cattle they will become less profitable. Reproduction rates for different sized animals can easily be measured on the farm. Farmers should select the size of their cattle accordingly.

Smaller cattle mature earlier than larger cattle, and early breeding should be considered. The profitability of a herd can be increased with early breeding, even at low reproduction rates. When growing animals' energy intake is limited it will lead to stunted growth and a delay in puberty. Therefore, early breeding is only a viable option when growing cattle has sufficient access to energy.

Farmers should consider using the recommendations of the NRC (2000) to calculate the energy requirements of cattle, rather than LSU (Meissner, 1983). The equations recommended by the NRC can be used to calculate energy requirements of individual animals, as well as the herd, accurately.

6.3 Chapter Summary

The aim of this research was to determine the most efficient cow size for emerging and commercial beef farmers in semi-arid South Africa. This chapter gave a conclusion of the study. It summarized the research mythology, research results and different scenarios that were obtained from the study. Ultimately, recommendations were given for farmers who wish to become more economically efficient by utilizing the right sized cow for their individual needs. Recommendations were provided in a practical manner and should be used by farmers who wishes to increase their profitability.

Bibliography

Afrivet, Cattle Products. 2018, http://www.afrivet.co.za/QuickNav_CattleProducts.php#VitaminsMinerals_Anchor.

ANB Veterinary Wholesalers, 2018, http://shop.anbvet.co.za/Main.asp?D=%7B8E1896F9-E32E-45D8-BB92-B5A646447FC1%7D&PageType=ProductList&CategoryID=31.

Arango, J.A. & Van Vleck, L.D., 2002. Size of beef cows: early ideas, new developments. Genetics and Molecular Research. 1, 51-63.

Avenant, P., 2016. Long Term Grazing Capacity norms for South Africa. Department: Agriculture, Forestry and Fisheries Republic of South Africa.

Bayer, Drastic Deadline. 2018, https://animalhealth.bayer.co.za/scripts/pages/en/livestock/cattle/drastic_deadline.php.

Beck, P.A., Stewart, C.B., Gadberry, M.S., Haque, M. & Biermacher, J., 2016. Effect of mature body weight and stocking rate on cow and calf performance, cow herd efficiency, and economics in the south eastern United States. J.Anim.Sci. 94, 1689-1702.

Boden, D.W.R., 2008. Miniature Cattle: For Real, for Pets, for Production. Journal of Agricultural and Food Information. 9.

Bradfield, M., 2015. Hoeveel kos 'n goeie bul? Landbouweekblad. 9 Oct, 54.

Brody, S., 1945. Bioenergetics and growth; with special reference to the efficiency complex in domestic animals. Reinhold, Oxford, England. xii, 1023 pp.

Brody, S., 2017. Understanding the red meat classification system. Farmer's Weekly.

Bryant, K.J., Montgomery, T.G., Whitworth, W.A. & Stark, J.C.R., 2011. Economically Efficient Cow Size Selection Using the Product/Product Model.

Carpenter, J.A.J., 1971. An Evaluation of Mature Size in Beef Cattle and its Relationship to Production Efficiency. Ph.D. thesis, Texas A&M University, United States, Texas.

Department of Agriculture, 2006. South African Country Report on Farm Animal Genetic Resources.

Department of Agriculture and Rural development, Beef Production: The Basics. Beef Production Systems. 2017.

Department of Agriculture and Rural development, Beef Production: The Basics. Useful Statistics. 2017.

Department of Agriculture, Forestry & Fisheries, 2015. A Profile of the South African Beef Market Value Chain 2014. Department: Agriculture, Forestry and Fisheries, South Africa.

Dickerson, G.E., 1978. Animal size and efficiency: basic concepts. Anim.Prod. 27, 367-379.

DiCostanzo, A. & Meiske, J.C., 1994. Optimizing cow size and efficiency to maximize profitability, 1-14.

Doye, D. & Lalman, D., 2011. Selected Papers: SAEA 2011 Annual Meetings. Journal of Agricultural and Applied Economics. 43, 457-472.

Ferrell, C.L. & Jenkins, T.G., 1984. Energy utilization by mature, nonpregnant, nonlactating cows of different types. Journal of animal science. 58, 234-243.

Ferrell, C.L., Garrett, W.N. & Hinman, N., 1976. Growth, Development and Composition of the Udder and Gravid Uterus of Beef Heifers during Pregnancy. J.Anim.Sci. 42, 1477-1489.

Fiss, C.F. & Wilton, J.W., 1989. Effects of breeding system, cow weight and milk yield on reproductive performance in beef cattle. Journal of animal science. 67, 1714-1721.

Fiss, C.F. & Wilton, J.W., 1993. Contribution of breed, cow weight, and milk yield to the preweaning, feedlot, and carcass traits of calves in three beef breeding systems. J.Anim.Sci. 71, 2874-84.

Garrett, W.N., 1980. Energy utilization by growing cattle as determined in 72 comparative slaughter experiments. Energy metabolism. Studies in the agricultural and food sciences., 3-7.

Gradwohl, R., What are miniature cattle? 2016, http://www.minicattle.com/what.html.

Jenkins, T.G. & Ferrell, C.E., 2002. Beef cow efficiency-Revisited.

Jenkins, T.G. & Ferrell, C.L., 1994. Productivity through weaning of nine breeds of cattle under varying feed availabilities: I. Initial evaluation. J.Anim.Sci. 72, 2787-97.

Jenkins, T.G. & Ferrell, C.L., 1984. A note on lactation curves of crossbred cows. Animal Science. 39, 479-482.

Jhony, T.T., GalvÃ£o, A.C. & Weber da, S.R., 2017. Comparing non-linear mathematical models to describe growth of different animals. Acta Scientiarum.Animal Sciences. 39, 73-81.

Johnson, J.J., Radakovich, J.D. & Dunn, B.H., 2010. Producing Right Sized Cows
Cow Size and Efficiency: Solving the Puzzle. NCBA Cattlemen's College.

Kleiber, M., 1932. Body size and metabolism. Hilgardia. 6, 315-353.

Lofgreen, G.P. & Garrett, W.N., 1968. A System for Expressing Net Energy Requirements and Feed Values for Growing and Finishing Beef Cattle. J.Anim.Sci. 27, 793-806.

Maiwashe, A., Nengovhela, N.B., Nephawe, K.A., Sebei, J., Netshilema, T., Mashaba, H.D., Nesengani, L. & Norris, D., 2013. Estimates of lactation curve parameters for Bonsmara and Nguni cattle using the weigh-suckle-weigh technique. S.Afr.J.Anim.Sci. 43, s12-s16.

McMorris, M.R., Wilton, J.W. & Pfeiffer, W.C., 1986. Breeding System, Cow Weight and Milk Yield Effects on Various Economic Variables in Beef Production1,2. 63, 1373-1383.

Meissner, H.H., 1983. Classification of livestock for realistic prediction of substitution values in terms of a biologically defined Large Stock Unit. Republic of South Africa, Dept. of Agriculture. 44 pp.

Menchaca, M.A., Chase, C.C., Olson, T.A. & Hammond, A.C., 1996. Evaluation of growth curves of Brahman cattle of various frame sizes. J.Anim.Sci. 74, 2140-2151.

Morris, C.A. & Wilton, J.W., 1975. Influence of mature cow weight on economic efficiency in beef cattle production. Canadian journal of animal science., 233-250.

Morris, C.A. & Wilton, J.W., 1976. Influence of body size on the biological efficiency of cows: A review. Canadian Journal of Animal Science. 56, 613-613-647.

Moyoa, S., Swanepoel, F.J.C. & Rege, J.E.O., 1994. Evaluation of indigenous, exotic and crossbred cattle for beef production in a semi-arid environment
Australian Society of Animal Production. 21, 204-206.

MSD, Species | Cattle. 2018, http://www.msd-animal-health.co.za/species/cattle.aspx.

Mucina, L. & Rutherford, M.C., 2006. The vegetation of South Africa, Lesotho and Swaziland / Ladislav Mucina and Michael C. Rutherford (editors). South African National Biodiversity Institute. 807 pp.

National Research Council, 1984. Nutrient Requirements of Beef Cattle. The National Academies Press, Washington, DC.

National Research Council, 1991. Micro livestock: little-known small animals with a promising economic future / Board on Science and Technology for International Development. Washington, D.C: National Academy Press, 1991.xvii, 449 pp., 2-xvii, 449.

National Research Council, 2000. Nutrient Requirements of Beef Cattle: Seventh Revised Edition: Update 2000. The National Academies Press, Washington, DC.

OBP, Products. 2018, https://www.obpvaccines.co.za/products.

Olsen, T.A., 1993. Reproductive Efficiency of Cows of Different Sizes.

Red Meat Producers Organization & ABSA, ABSA Weekly Prices. 2018, http://www.rpo.co.za/information-centre/absa/weekly-prices/.

Scasta, J.D., Henderson, L. & Smith, T., 2015. Drought effect on weaning weight and efficiency relative to cow size in semiarid rangeland. J.Anim.Sci. 93, 5829-5839.

Scholtz, M.M., Bester, J., Mamabolo, J.M. & Ramsay, K.A., 2008. Results of the national cattle survey undertaken in South Africa, with emphasis on beef. Applied Animal Husbandry & Rural Development. 1.

Scholtz, M.M., 2010. Beef Breeding in South Africa. 2nd ed. Agricultural Research Council. 296 pp.

Senwes Agricultural Services, 2017. Inkomste-koste-ontleding vir: Vleisbeeste - Ekstensiewe speenkalfstelsel vir die 2017-2018 seisoen (Noordwes en Vrystaatstreek). Senwes Agricultural Services.

Sikhweni, N.P. & Hassan, R., 2013. Opportunities and challenges facing small-scale cattle farmers living adjacent to Kruger National Park, Limpopo Province.

Society of Range Management, 1998. Glossary of terms used in range management, fourth edition. Edited by the Glossary Update Task Group, Thomas E. Bedell, Chairman.

Stewart, T.S. & Martin, T.G., 1981. Mature weight, maturation rate, maternal performance and their interrelationships in purebred and crossbred cows of Angus and Milking Shorthorn parentage. Journal of animal science. 52, 51-56.

Suttie, J.M., Reynolds, S.G. & Batello, C., 2005. Grasslands of the World. Food and Agricultural Organization of the United Nations, Rome.

Swanepoel, F. & Hoogenboezem, J., 1994. Interrelationship among cow size, lifetime cow fertility, milk production and pre-weaning calf growth in sub-tropically adapted beef cattle. 20.

Taylor, G.J., 2006. Factors affecting the production and reproduction performance of tropically adapted beef cattle in southern Africa, University of Pretoria, South Africa.

Tyrrell, H.F. & Reid, J.T., 1964. Prediction of the Energy Value of Cow's Milk[1,2]. J.Dairy Sci. 48, 1215-1223.

Vet Products Online, Cattle Products. 2018, https://www.vetproductsonline.co.za/site/menu/products_species/cattle.

Virbac, Multimin. 2018, https://za.virbac.com/home/farmer/products/multimin-se-cs.html.

Voermol, Our Products. 2018, http://voermol.co.za.dedi406.flk1.host-h.net/en/products/.

Warnick, A., Olson, T., Senseman, K., Hammond, A. & Adams, E., 1991. Puberty traits in Angus, Brahman, Hereford and Senepol heifers in central Florida.

Whitworth, W., Stark Jr, C. & Montgomery, T., 2006. A case study of the cow size and production efficiency relationship. Arkansas Animal Science Research Reports RS-545.Univ.of Arkansas, Fayetteville, 178-181.

Zoetis SA, Beef and Feedlot. 2018, https://www.zoetis.co.za/products/beef-and-feedlot/index.aspx.

Appendix A: Growth and Net Energy Requirements of different sized cattle

SMALL (300kg) MATURE COW

	Date	t Birth	t Gestation	t Lactation	weight	% of Mature Weight	Daily Gain	Daily milk yield	NE m	NE g	NE l	NE y	NE t
Weight at birth					20.0								
Birth	01-Oct	1			20.7	7%	0.660		0.746	0.483			1.229
	02-Oct	2			21.3	7%	0.659		0.764	0.493			1.257
	03-Oct	3			22.0	7%	0.657		0.782	0.503			1.285
	04-Oct	4			22.6	8%	0.656		0.799	0.513			1.312
	05-Oct	5			23.3	8%	0.654		0.816	0.523			1.339
	06-Oct	6			23.9	8%	0.652		0.833	0.533			1.366
	07-Oct	7			24.6	8%	0.651		0.850	0.542			1.392
	08-Oct	8			25.2	8%	0.649		0.867	0.551			1.418
	09-Oct	9			25.9	9%	0.648		0.884	0.560			1.444
	10-Oct	10			26.5	9%	0.646		0.900	0.569			1.469
	11-Oct	11			27.2	9%	0.645		0.917	0.578			1.495
	12-Oct	12			27.8	9%	0.643		0.933	0.587			1.520
	13-Oct	13			28.5	9%	0.642		0.949	0.595			1.544
	14-Oct	14			29.1	10%	0.640		0.965	0.604			1.569
	15-Oct	15			29.7	10%	0.639		0.981	0.612			1.593
	16-Oct	16			30.4	10%	0.637		0.996	0.620			1.617
	17-Oct	17			31.0	10%	0.636		1.012	0.629			1.640
	18-Oct	18			31.6	11%	0.634		1.027	0.636			1.664
	19-Oct	19			32.3	11%	0.633		1.043	0.644			1.687
	20-Oct	20			32.9	11%	0.631		1.058	0.652			1.710
	21-Oct	21			33.5	11%	0.630		1.073	0.660			1.733
	22-Oct	22			34.2	11%	0.628		1.088	0.667			1.755
	23-Oct	23			34.8	12%	0.627		1.103	0.675			1.778
	24-Oct	24			35.4	12%	0.625		1.118	0.682			1.800
	25-Oct	25			36.0	12%	0.624		1.133	0.689			1.822
	26-Oct	26			36.7	12%	0.622		1.147	0.696			1.844
	27-Oct	27			37.3	12%	0.621		1.162	0.703			1.865
	28-Oct	28			37.9	13%	0.619		1.176	0.710			1.886
	29-Oct	29			38.5	13%	0.618		1.191	0.717			1.908
	30-Oct	30			39.1	13%	0.616		1.205	0.724			1.929
	31-Oct	31			39.8	13%	0.615		1.219	0.730			1.949
	01-Nov	32			40.4	13%	0.614		1.233	0.737			1.970
	02-Nov	33			41.0	14%	0.612		1.247	0.743			1.990
	03-Nov	34			41.6	14%	0.611		1.261	0.750			2.011
	04-Nov	35			42.2	14%	0.609		1.275	0.756			2.031
	05-Nov	36			42.8	14%	0.608		1.289	0.762			2.051
	06-Nov	37			43.4	14%	0.606		1.302	0.768			2.070
	07-Nov	38			44.0	15%	0.605		1.316	0.774			2.090
	08-Nov	39			44.6	15%	0.604		1.329	0.780			2.109
	09-Nov	40			45.2	15%	0.602		1.343	0.786			2.129
	10-Nov	41			45.8	15%	0.601		1.356	0.792			2.148
	11-Nov	42			46.4	15%	0.599		1.370	0.797			2.167
	12-Nov	43			47.0	16%	0.598		1.383	0.803			2.186
	13-Nov	44			47.6	16%	0.596		1.396	0.808			2.204
	14-Nov	45			48.2	16%	0.595		1.409	0.814			2.223
	15-Nov	46			48.8	16%	0.594		1.422	0.819			2.241
	16-Nov	47			49.4	16%	0.592		1.435	0.825			2.259
	17-Nov	48			50.0	17%	0.591		1.448	0.830			2.278
	18-Nov	49			50.6	17%	0.589		1.460	0.835			2.295
	19-Nov	50			51.2	17%	0.588		1.473	0.840			2.313
	20-Nov	51			51.8	17%	0.587		1.486	0.845			2.331
	21-Nov	52			52.3	17%	0.585		1.498	0.850			2.348
	22-Nov	53			52.9	18%	0.584		1.511	0.855			2.366
	23-Nov	54			53.5	18%	0.583		1.523	0.860			2.383
	24-Nov	55			54.1	18%	0.581		1.536	0.864			2.400
	25-Nov	56			54.7	18%	0.580		1.548	0.869			2.417
	26-Nov	57			55.2	18%	0.578		1.560	0.874			2.434
	27-Nov	58			55.8	19%	0.577		1.573	0.878			2.451
	28-Nov	59			56.4	19%	0.576		1.585	0.883			2.468

MEDIUM (450kg) MATURE COW

	Date	t Birth	weight	% of Mature Weight	Daily Gain	Daily milk yield	NE m	NE g	NE l	NE y	NE t
Weight at birth			30.0								
Birth	01-Oct	1	31.0	7%	0.990		1.011	0.754			1.765
	02-Oct	2	32.0	7%	0.988		1.035	0.770			1.805
	03-Oct	3	33.0	7%	0.986		1.059	0.785			1.845
	04-Oct	4	33.9	8%	0.983		1.083	0.801			1.884
	05-Oct	5	34.9	8%	0.981		1.106	0.816			1.922
	06-Oct	6	35.9	8%	0.979		1.129	0.831			1.960
	07-Oct	7	36.9	8%	0.976		1.152	0.846			1.998
	08-Oct	8	37.9	8%	0.974		1.175	0.860			2.035
	09-Oct	9	38.8	9%	0.972		1.198	0.874			2.072
	10-Oct	10	39.8	9%	0.969		1.220	0.888			2.108
	11-Oct	11	40.8	9%	0.967		1.242	0.902			2.144
	12-Oct	12	41.7	9%	0.965		1.264	0.916			2.180
	13-Oct	13	42.7	9%	0.963		1.286	0.929			2.215
	14-Oct	14	43.7	10%	0.960		1.308	0.942			2.250
	15-Oct	15	44.6	10%	0.958		1.329	0.955			2.284
	16-Oct	16	45.6	10%	0.956		1.350	0.968			2.318
	17-Oct	17	46.5	10%	0.954		1.372	0.981			2.352
	18-Oct	18	47.5	11%	0.951		1.393	0.993			2.386
	19-Oct	19	48.4	11%	0.949		1.413	1.005			2.419
	20-Oct	20	49.4	11%	0.947		1.434	1.017			2.451
	21-Oct	21	50.3	11%	0.945		1.455	1.029			2.484
	22-Oct	22	51.3	11%	0.942		1.475	1.041			2.516
	23-Oct	23	52.2	12%	0.940		1.495	1.052			2.548
	24-Oct	24	53.1	12%	0.938		1.515	1.064			2.579
	25-Oct	25	54.1	12%	0.936		1.535	1.075			2.610
	26-Oct	26	55.0	12%	0.934		1.555	1.086			2.641
	27-Oct	27	55.9	12%	0.931		1.575	1.097			2.672
	28-Oct	28	56.9	13%	0.929		1.594	1.108			2.702
	29-Oct	29	57.8	13%	0.927		1.614	1.119			2.732
	30-Oct	30	58.7	13%	0.925		1.633	1.129			2.762
	31-Oct	31	59.6	13%	0.923		1.652	1.139			2.792
	01-Nov	32	60.6	13%	0.920		1.672	1.149			2.821
	02-Nov	33	61.5	14%	0.918		1.691	1.160			2.850
	03-Nov	34	62.4	14%	0.916		1.709	1.169			2.879
	04-Nov	35	63.3	14%	0.914		1.728	1.179			2.907
	05-Nov	36	64.2	14%	0.912		1.747	1.189			2.936
	06-Nov	37	65.1	14%	0.910		1.765	1.198			2.964
	07-Nov	38	66.0	15%	0.907		1.784	1.208			2.991
	08-Nov	39	66.9	15%	0.905		1.802	1.217			3.019
	09-Nov	40	67.8	15%	0.903		1.820	1.226			3.046
	10-Nov	41	68.7	15%	0.901		1.838	1.235			3.073
	11-Nov	42	69.6	15%	0.899		1.856	1.244			3.100
	12-Nov	43	70.5	16%	0.897		1.874	1.253			3.127
	13-Nov	44	71.4	16%	0.895		1.892	1.261			3.153
	14-Nov	45	72.3	16%	0.893		1.910	1.270			3.179
	15-Nov	46	73.2	16%	0.890		1.927	1.278			3.205
	16-Nov	47	74.1	16%	0.888		1.945	1.286			3.231
	17-Nov	48	75.0	17%	0.886		1.962	1.295			3.257
	18-Nov	49	75.9	17%	0.884		1.980	1.303			3.282
	19-Nov	50	76.8	17%	0.882		1.997	1.311			3.307
	20-Nov	51	77.6	17%	0.880		2.014	1.318			3.332
	21-Nov	52	78.5	17%	0.878		2.031	1.326			3.357
	22-Nov	53	79.4	18%	0.876		2.048	1.334			3.382
	23-Nov	54	80.3	18%	0.874		2.065	1.341			3.406
	24-Nov	55	81.1	18%	0.872		2.082	1.349			3.430
	25-Nov	56	82.0	18%	0.870		2.098	1.356			3.454
	26-Nov	57	82.9	18%	0.868		2.115	1.363			3.478
	27-Nov	58	83.7	19%	0.866		2.132	1.370			3.502
	28-Nov	59	84.6	19%	0.864		2.148	1.377			3.525

LARGE (600kg) MATURE COW

	Date	t Birth	weight	% of Mature Weight	Daily Gain	Daily milk yield	NE m	NE g	NE l	NE y	NE t
Weight at birth			40.0								
Birth	01-Oct	1	41.3	7%	1.320		1.255	1.033			2.288
	02-Oct	2	42.6	7%	1.317		1.285	1.055			2.340
	03-Oct	3	44.0	7%	1.314		1.314	1.077			2.391
	04-Oct	4	45.3	8%	1.311		1.344	1.098			2.441
	05-Oct	5	46.6	8%	1.308		1.373	1.119			2.491
	06-Oct	6	47.9	8%	1.305		1.401	1.139			2.541
	07-Oct	7	49.2	8%	1.302		1.430	1.159			2.589
	08-Oct	8	50.5	8%	1.299		1.458	1.179			2.637
	09-Oct	9	51.8	9%	1.296		1.486	1.199			2.685
	10-Oct	10	53.1	9%	1.293		1.514	1.218			2.732
	11-Oct	11	54.4	9%	1.290		1.541	1.237			2.778
	12-Oct	12	55.6	9%	1.287		1.569	1.255			2.824
	13-Oct	13	56.9	9%	1.283		1.596	1.274			2.869
	14-Oct	14	58.2	10%	1.280		1.623	1.292			2.914
	15-Oct	15	59.5	10%	1.277		1.649	1.310			2.959
	16-Oct	16	60.8	10%	1.274		1.676	1.327			3.003
	17-Oct	17	62.0	10%	1.271		1.702	1.344			3.046
	18-Oct	18	63.3	11%	1.268		1.728	1.361			3.089
	19-Oct	19	64.6	11%	1.265		1.754	1.378			3.132
	20-Oct	20	65.8	11%	1.262		1.779	1.395			3.174
	21-Oct	21	67.1	11%	1.259		1.805	1.411			3.216
	22-Oct	22	68.3	11%	1.256		1.830	1.427			3.257
	23-Oct	23	69.6	12%	1.254		1.855	1.443			3.298
	24-Oct	24	70.8	12%	1.251		1.880	1.459			3.339
	25-Oct	25	72.1	12%	1.248		1.905	1.474			3.379
	26-Oct	26	73.3	12%	1.245		1.930	1.489			3.419
	27-Oct	27	74.6	12%	1.242		1.954	1.504			3.458
	28-Oct	28	75.8	13%	1.239		1.978	1.519			3.497
	29-Oct	29	77.1	13%	1.236		2.003	1.534			3.536
	30-Oct	30	78.3	13%	1.233		2.027	1.548			3.574
	31-Oct	31	79.5	13%	1.230		2.050	1.562			3.612
	01-Nov	32	80.7	13%	1.227		2.074	1.576			3.650
	02-Nov	33	82.0	14%	1.224		2.098	1.590			3.687
	03-Nov	34	83.2	14%	1.221		2.121	1.603			3.724
	04-Nov	35	84.4	14%	1.219		2.144	1.617			3.761
	05-Nov	36	85.6	14%	1.216		2.167	1.630			3.797
	06-Nov	37	86.8	14%	1.213		2.190	1.643			3.833
	07-Nov	38	88.0	15%	1.210		2.213	1.656			3.869
	08-Nov	39	89.3	15%	1.207		2.236	1.668			3.904
	09-Nov	40	90.5	15%	1.204		2.259	1.681			3.939
	10-Nov	41	91.7	15%	1.201		2.281	1.693			3.974
	11-Nov	42	92.9	15%	1.199		2.303	1.705			4.009
	12-Nov	43	94.1	16%	1.196		2.326	1.717			4.043
	13-Nov	44	95.2	16%	1.193		2.348	1.729			4.077
	14-Nov	45	96.4	16%	1.190		2.370	1.741			4.111
	15-Nov	46	97.6	16%	1.187		2.391	1.752			4.144
	16-Nov	47	98.8	16%	1.184		2.413	1.764			4.177
	17-Nov	48	100.0	17%	1.182		2.435	1.775			4.210
	18-Nov	49	101.2	17%	1.179		2.456	1.786			4.242
	19-Nov	50	102.3	17%	1.176		2.478	1.797			4.275
	20-Nov	51	103.5	17%	1.173		2.499	1.808			4.307
	21-Nov	52	104.7	17%	1.171		2.520	1.818			4.338
	22-Nov	53	105.9	18%	1.168		2.541	1.829			4.370
	23-Nov	54	107.0	18%	1.165		2.562	1.839			4.401
	24-Nov	55	108.2	18%	1.162		2.583	1.849			4.432
	25-Nov	56	109.3	18%	1.160		2.604	1.859			4.463
	26-Nov	57	110.5	18%	1.157		2.624	1.869			4.493
	27-Nov	58	111.7	19%	1.154		2.645	1.879			4.524
	28-Nov	59	112.8	19%	1.151		2.665	1.888			4.554

29-Nov	60	57.0	19%	0.574	1.597	0.887	2.484	85.5	19%	0.862	2.164	1.384	3.549	114.0	19%	1.149	2.686	1.898	4.584
30-Nov	61	57.5	19%	0.573	1.609	0.892	2.501	86.3	19%	0.859	2.181	1.391	3.572	115.1	19%	1.146	2.706	1.907	4.613
01-Dec	62	58.1	19%	0.572	1.621	0.896	2.517	87.2	19%	0.857	2.197	1.398	3.595	116.2	19%	1.143	2.726	1.917	4.642
02-Dec	63	58.7	20%	0.570	1.633	0.900	2.533	88.0	20%	0.855	2.213	1.404	3.618	117.4	20%	1.141	2.746	1.926	4.672
03-Dec	64	59.3	20%	0.569	1.645	0.904	2.549	88.9	20%	0.853	2.229	1.411	3.640	118.5	20%	1.138	2.766	1.935	4.701
04-Dec	65	59.8	20%	0.568	1.656	0.909	2.565	89.7	20%	0.851	2.245	1.417	3.663	119.7	20%	1.135	2.786	1.943	4.729
05-Dec	66	60.4	20%	0.566	1.668	0.913	2.581	90.6	20%	0.849	2.261	1.424	3.685	120.8	20%	1.133	2.806	1.952	4.758
06-Dec	67	61.0	20%	0.565	1.680	0.917	2.596	91.4	20%	0.847	2.277	1.430	3.707	121.9	20%	1.130	2.825	1.961	4.786
07-Dec	68	61.5	21%	0.564	1.691	0.921	2.612	92.3	21%	0.845	2.293	1.436	3.729	123.0	21%	1.127	2.845	1.969	4.814
08-Dec	69	62.1	21%	0.562	1.703	0.924	2.628	93.1	21%	0.843	2.308	1.442	3.751	124.2	21%	1.125	2.864	1.978	4.842
09-Dec	70	62.6	21%	0.561	1.715	0.928	2.643	94.0	21%	0.841	2.324	1.448	3.772	125.3	21%	1.122	2.884	1.986	4.869
10-Dec	71	63.2	21%	0.560	1.726	0.932	2.658	94.8	21%	0.839	2.340	1.454	3.794	126.4	21%	1.119	2.903	1.994	4.897
11-Dec	72	63.8	21%	0.558	1.737	0.936	2.673	95.6	21%	0.837	2.355	1.460	3.815	127.5	21%	1.117	2.922	2.002	4.924
12-Dec	73	64.3	21%	0.557	1.749	0.940	2.688	96.5	21%	0.835	2.370	1.466	3.836	128.6	21%	1.114	2.941	2.010	4.951
13-Dec	74	64.9	22%	0.556	1.760	0.943	2.703	97.3	22%	0.834	2.386	1.472	3.857	129.8	22%	1.111	2.960	2.018	4.978
14-Dec	75	65.4	22%	0.554	1.771	0.947	2.718	98.1	22%	0.832	2.401	1.477	3.878	130.9	22%	1.109	2.979	2.025	5.004
15-Dec	76	66.0	22%	0.553	1.783	0.950	2.733	99.0	22%	0.830	2.416	1.483	3.899	132.0	22%	1.106	2.998	2.033	5.031
16-Dec	77	66.5	22%	0.552	1.794	0.954	2.748	99.8	22%	0.828	2.431	1.488	3.919	133.1	22%	1.104	3.017	2.040	5.057
17-Dec	78	67.1	22%	0.550	1.805	0.957	2.762	100.6	22%	0.826	2.446	1.493	3.940	134.2	22%	1.101	3.036	2.048	5.083
18-Dec	79	67.6	23%	0.549	1.816	0.961	2.777	101.5	23%	0.824	2.461	1.499	3.960	135.3	23%	1.098	3.054	2.055	5.109
19-Dec	80	68.2	23%	0.548	1.827	0.964	2.791	102.3	23%	0.822	2.476	1.504	3.980	136.4	23%	1.096	3.073	2.062	5.135
20-Dec	81	68.7	23%	0.547	1.838	0.967	2.805	103.1	23%	0.820	2.491	1.509	4.000	137.5	23%	1.093	3.091	2.069	5.160
21-Dec	82	69.3	23%	0.545	1.849	0.970	2.819	103.9	23%	0.818	2.506	1.514	4.020	138.6	23%	1.091	3.110	2.076	5.185
22-Dec	83	69.8	23%	0.544	1.860	0.974	2.833	104.7	23%	0.816	2.521	1.519	4.040	139.6	23%	1.088	3.128	2.083	5.211
23-Dec	84	70.4	23%	0.543	1.871	0.977	2.847	105.5	23%	0.814	2.535	1.524	4.059	140.7	23%	1.085	3.146	2.089	5.235
24-Dec	85	70.9	24%	0.541	1.881	0.980	2.861	106.4	24%	0.812	2.550	1.529	4.079	141.8	24%	1.083	3.164	2.096	5.260
25-Dec	86	71.4	24%	0.540	1.892	0.983	2.875	107.2	24%	0.810	2.565	1.534	4.098	142.9	24%	1.080	3.182	2.103	5.285
26-Dec	87	72.0	24%	0.539	1.903	0.986	2.889	108.0	24%	0.808	2.579	1.538	4.117	144.0	24%	1.078	3.200	2.109	5.309
27-Dec	88	72.5	24%	0.538	1.914	0.989	2.902	108.8	24%	0.806	2.594	1.543	4.136	145.0	24%	1.075	3.218	2.115	5.333
28-Dec	89	73.1	24%	0.536	1.924	0.992	2.916	109.6	24%	0.805	2.608	1.547	4.155	146.1	24%	1.073	3.236	2.122	5.358
29-Dec	90	73.6	25%	0.535	1.935	0.995	2.929	110.4	25%	0.803	2.622	1.552	4.174	147.2	25%	1.070	3.254	2.128	5.381
30-Dec	91	74.1	25%	0.534	1.945	0.997	2.943	111.2	25%	0.801	2.637	1.556	4.193	148.3	25%	1.068	3.271	2.134	5.405
31-Dec	92	74.7	25%	0.533	1.956	1.000	2.956	112.0	25%	0.799	2.651	1.561	4.211	149.3	25%	1.065	3.289	2.140	5.429
01-Jan	93	75.2	25%	0.531	1.966	1.003	2.969	112.8	25%	0.797	2.665	1.565	4.230	150.4	25%	1.063	3.307	2.145	5.452
02-Jan	94	75.7	25%	0.530	1.976	1.006	2.982	113.6	25%	0.795	2.679	1.569	4.248	151.4	25%	1.060	3.324	2.151	5.475
03-Jan	95	76.2	25%	0.529	1.987	1.008	2.995	114.4	25%	0.793	2.693	1.573	4.266	152.5	25%	1.058	3.341	2.157	5.498
04-Jan	96	76.8	26%	0.528	1.997	1.011	3.008	115.2	26%	0.791	2.707	1.577	4.284	153.6	26%	1.055	3.359	2.162	5.521
05-Jan	97	77.3	26%	0.526	2.007	1.013	3.021	116.0	26%	0.789	2.721	1.581	4.302	154.6	26%	1.053	3.376	2.168	5.544
06-Jan	98	77.8	26%	0.525	2.018	1.016	3.034	116.7	26%	0.788	2.735	1.585	4.320	155.7	26%	1.050	3.393	2.173	5.567
07-Jan	99	78.4	26%	0.524	2.028	1.018	3.046	117.5	26%	0.786	2.748	1.589	4.338	156.7	26%	1.048	3.410	2.179	5.589
08-Jan	100	78.9	26%	0.523	2.038	1.021	3.059	118.3	26%	0.784	2.762	1.593	4.355	157.7	26%	1.045	3.427	2.184	5.611
09-Jan	101	79.4	26%	0.521	2.048	1.023	3.071	119.1	26%	0.782	2.776	1.597	4.372	158.8	26%	1.043	3.444	2.189	5.633
10-Jan	102	79.9	27%	0.520	2.058	1.026	3.084	119.9	27%	0.780	2.790	1.600	4.390	159.8	27%	1.040	3.461	2.194	5.655
11-Jan	103	80.4	27%	0.519	2.068	1.028	3.096	120.7	27%	0.778	2.803	1.604	4.407	160.9	27%	1.038	3.478	2.199	5.677
12-Jan	104	81.0	27%	0.518	2.078	1.030	3.108	121.4	27%	0.777	2.817	1.607	4.424	161.9	27%	1.035	3.495	2.204	5.699
13-Jan	105	81.5	27%	0.516	2.088	1.033	3.121	122.2	27%	0.775	2.830	1.611	4.441	162.9	27%	1.033	3.512	2.209	5.720
14-Jan	106	82.0	27%	0.515	2.098	1.035	3.133	123.0	27%	0.773	2.843	1.614	4.458	164.0	27%	1.030	3.528	2.213	5.742
15-Jan	107	82.5	27%	0.514	2.108	1.037	3.145	123.7	27%	0.771	2.857	1.618	4.475	165.0	27%	1.028	3.545	2.218	5.763
16-Jan	108	83.0	28%	0.513	2.118	1.039	3.157	124.5	28%	0.769	2.870	1.621	4.491	166.0	28%	1.026	3.561	2.223	5.784
17-Jan	109	83.5	28%	0.512	2.127	1.041	3.169	125.3	28%	0.767	2.883	1.624	4.508	167.0	28%	1.023	3.578	2.227	5.805
18-Jan	110	84.0	28%	0.510	2.137	1.043	3.180	126.0	28%	0.766	2.897	1.628	4.524	168.1	28%	1.021	3.594	2.232	5.826
19-Jan	111	84.5	28%	0.509	2.147	1.045	3.192	126.8	28%	0.764	2.910	1.631	4.541	169.1	28%	1.018	3.610	2.236	5.846
20-Jan	112	85.0	28%	0.508	2.156	1.047	3.204	127.6	28%	0.762	2.923	1.634	4.557	170.1	28%	1.016	3.627	2.240	5.867
21-Jan	113	85.6	29%	0.507	2.166	1.049	3.215	128.3	29%	0.760	2.936	1.637	4.573	171.1	29%	1.014	3.643	2.244	5.887
22-Jan	114	86.1	29%	0.506	2.176	1.051	3.227	129.1	29%	0.758	2.949	1.640	4.589	172.1	29%	1.011	3.659	2.249	5.908
23-Jan	115	86.6	29%	0.504	2.185	1.053	3.238	129.8	29%	0.757	2.962	1.643	4.605	173.1	29%	1.009	3.675	2.253	5.928
24-Jan	116	87.1	29%	0.503	2.195	1.055	3.250	130.6	29%	0.755	2.975	1.646	4.621	174.1	29%	1.006	3.691	2.257	5.948
25-Jan	117	87.6	29%	0.502	2.204	1.057	3.261	131.4	29%	0.753	2.988	1.649	4.636	175.1	29%	1.004	3.707	2.260	5.968
26-Jan	118	88.1	29%	0.501	2.214	1.058	3.272	132.1	29%	0.751	3.000	1.651	4.652	176.1	29%	1.002	3.723	2.264	5.987
27-Jan	119	88.6	30%	0.500	2.223	1.060	3.283	132.9	30%	0.750	3.013	1.654	4.667	177.1	30%	0.999	3.739	2.268	6.007
28-Jan	120	89.1	30%	0.498	2.232	1.062	3.294	133.6	30%	0.748	3.026	1.657	4.683	178.1	30%	0.997	3.755	2.272	6.026
29-Jan	121	89.6	30%	0.497	2.242	1.064	3.305	134.4	30%	0.746	3.039	1.659	4.698	179.1	30%	0.995	3.770	2.275	6.046
30-Jan	122	90.1	30%	0.496	2.251	1.065	3.316	135.1	30%	0.744	3.051	1.662	4.713	180.1	30%	0.992	3.786	2.279	6.065
31-Jan	123	90.6	30%	0.495	2.260	1.067	3.327	135.8	30%	0.742	3.064	1.665	4.728	181.1	30%	0.990	3.802	2.282	6.084
01-Feb	124	91.1	30%	0.494	2.270	1.069	3.338	136.6	30%	0.741	3.076	1.667	4.743	182.1	30%	0.988	3.817	2.286	6.103
02-Feb	125	91.5	31%	0.493	2.279	1.070	3.349	137.3	31%	0.739	3.089	1.669	4.758	183.1	31%	0.985	3.833	2.289	6.122
03-Feb	126	92.0	31%	0.491	2.288	1.072	3.360	138.1	31%	0.737	3.101	1.672	4.773	184.1	31%	0.983	3.848	2.292	6.140

04-Feb	127	92.5	31%	0.490	2.297	1.073	3.370	138.8	31%	0.735	3.114	1.674	4.788	185.1	31%	0.981	3.863	2.295	6.159
05-Feb	128	93.0	31%	0.489	2.306	1.075	3.381	139.5	31%	0.734	3.126	1.677	4.802	186.0	31%	0.978	3.879	2.299	6.177
06-Feb	129	93.5	31%	0.488	2.315	1.076	3.391	140.3	31%	0.732	3.138	1.679	4.817	187.0	31%	0.976	3.894	2.302	6.196
07-Feb	130	94.0	31%	0.487	2.324	1.077	3.402	141.0	31%	0.730	3.150	1.681	4.831	188.0	31%	0.974	3.909	2.305	6.214
08-Feb	131	94.5	31%	0.486	2.333	1.079	3.412	141.7	31%	0.729	3.163	1.683	4.846	189.0	31%	0.971	3.924	2.308	6.232
09-Feb	132	95.0	32%	0.485	2.342	1.080	3.422	142.4	32%	0.727	3.175	1.685	4.860	189.9	32%	0.969	3.939	2.310	6.250
10-Feb	133	95.4	32%	0.483	2.351	1.081	3.433	143.2	32%	0.725	3.187	1.687	4.874	190.9	32%	0.967	3.954	2.313	6.268
11-Feb	134	95.9	32%	0.482	2.360	1.083	3.443	143.9	32%	0.723	3.199	1.689	4.888	191.9	32%	0.965	3.969	2.316	6.285
12-Feb	135	96.4	32%	0.481	2.369	1.084	3.453	144.6	32%	0.722	3.211	1.691	4.902	192.8	32%	0.962	3.984	2.319	6.303
13-Feb	136	96.9	32%	0.480	2.378	1.085	3.463	145.3	32%	0.720	3.223	1.693	4.916	193.8	32%	0.960	3.999	2.321	6.321
14-Feb	137	97.4	32%	0.479	2.387	1.086	3.473	146.1	32%	0.718	3.235	1.695	4.930	194.7	32%	0.958	4.014	2.324	6.338
15-Feb	138	97.8	33%	0.478	2.395	1.088	3.483	146.8	33%	0.717	3.247	1.697	4.944	195.7	33%	0.956	4.029	2.326	6.355
16-Feb	139	98.3	33%	0.477	2.404	1.089	3.493	147.5	33%	0.715	3.259	1.699	4.957	196.6	33%	0.953	4.043	2.329	6.372
17-Feb	140	98.8	33%	0.476	2.413	1.090	3.503	148.2	33%	0.713	3.271	1.700	4.971	197.6	33%	0.951	4.058	2.331	6.389
18-Feb	141	99.3	33%	0.474	2.422	1.091	3.513	148.9	33%	0.712	3.282	1.702	4.984	198.5	33%	0.949	4.073	2.334	6.406
19-Feb	142	99.7	33%	0.473	2.430	1.092	3.522	149.6	33%	0.710	3.294	1.704	4.998	199.5	33%	0.947	4.087	2.336	6.423
20-Feb	143	100.2	33%	0.472	2.439	1.093	3.532	150.3	33%	0.708	3.306	1.705	5.011	200.4	33%	0.944	4.102	2.338	6.440
21-Feb	144	100.7	34%	0.471	2.448	1.094	3.542	151.0	34%	0.707	3.317	1.707	5.024	201.4	34%	0.942	4.116	2.340	6.457
22-Feb	145	101.2	34%	0.470	2.456	1.095	3.551	151.7	34%	0.705	3.329	1.709	5.037	202.3	34%	0.940	4.131	2.342	6.473
23-Feb	146	101.6	34%	0.469	2.465	1.096	3.561	152.4	34%	0.703	3.341	1.710	5.051	203.3	34%	0.938	4.145	2.345	6.489
24-Feb	147	102.1	34%	0.468	2.473	1.097	3.570	153.1	34%	0.702	3.352	1.711	5.064	204.2	34%	0.935	4.159	2.347	6.506
25-Feb	148	102.6	34%	0.467	2.482	1.098	3.579	153.8	34%	0.700	3.364	1.713	5.076	205.1	34%	0.933	4.173	2.348	6.522
26-Feb	149	103.0	34%	0.466	2.490	1.099	3.589	154.5	34%	0.698	3.375	1.714	5.089	206.1	34%	0.931	4.188	2.350	6.538
27-Feb	150	103.5	34%	0.464	2.498	1.100	3.598	155.2	34%	0.697	3.386	1.716	5.102	207.0	34%	0.929	4.202	2.352	6.554
28-Feb	151	104.0	35%	0.463	2.507	1.100	3.607	155.9	35%	0.695	3.398	1.717	5.115	207.9	35%	0.927	4.216	2.354	6.570
01-Mar	152	104.4	35%	0.462	2.515	1.101	3.616	156.6	35%	0.693	3.409	1.718	5.127	208.8	35%	0.924	4.230	2.356	6.586
02-Mar	153	104.9	35%	0.461	2.523	1.102	3.626	157.3	35%	0.692	3.420	1.719	5.140	209.8	35%	0.922	4.244	2.357	6.601
03-Mar	154	105.3	35%	0.460	2.532	1.103	3.635	158.0	35%	0.690	3.432	1.721	5.152	210.7	35%	0.920	4.258	2.359	6.617
04-Mar	155	105.8	35%	0.459	2.540	1.104	3.644	158.7	35%	0.688	3.443	1.722	5.165	211.6	35%	0.918	4.272	2.361	6.633
05-Mar	156	106.3	35%	0.458	2.548	1.104	3.653	159.4	35%	0.687	3.454	1.723	5.177	212.5	35%	0.916	4.286	2.362	6.648
06-Mar	157	106.7	36%	0.457	2.557	1.105	3.662	160.1	36%	0.685	3.465	1.724	5.189	213.4	36%	0.914	4.300	2.364	6.663
07-Mar	158	107.2	36%	0.456	2.565	1.106	3.670	160.8	36%	0.684	3.476	1.725	5.201	214.3	36%	0.911	4.313	2.365	6.678
08-Mar	159	107.6	36%	0.455	2.573	1.106	3.679	161.4	36%	0.682	3.487	1.726	5.213	215.2	36%	0.909	4.327	2.366	6.694
09-Mar	160	108.1	36%	0.454	2.581	1.107	3.688	162.1	36%	0.680	3.498	1.727	5.225	216.2	36%	0.907	4.341	2.368	6.709
10-Mar	161	108.5	36%	0.453	2.589	1.108	3.697	162.8	36%	0.679	3.509	1.728	5.237	217.1	36%	0.905	4.354	2.369	6.723
11-Mar	162	109.0	36%	0.451	2.597	1.108	3.705	163.5	36%	0.677	3.520	1.729	5.249	218.0	36%	0.903	4.368	2.370	6.738
12-Mar	163	109.4	36%	0.450	2.605	1.109	3.714	164.1	36%	0.676	3.531	1.730	5.261	218.9	36%	0.901	4.381	2.372	6.753
13-Mar	164	109.9	37%	0.449	2.613	1.109	3.722	164.8	37%	0.674	3.542	1.731	5.273	219.8	37%	0.899	4.395	2.373	6.768
14-Mar	165	110.3	37%	0.448	2.621	1.110	3.731	165.5	37%	0.672	3.553	1.731	5.284	220.7	37%	0.897	4.408	2.374	6.782
15-Mar	166	110.8	37%	0.447	2.629	1.110	3.739	166.2	37%	0.671	3.564	1.732	5.296	221.5	37%	0.894	4.422	2.375	6.797
16-Mar	167	111.2	37%	0.446	2.637	1.111	3.748	166.8	37%	0.669	3.574	1.733	5.307	222.4	37%	0.892	4.435	2.376	6.811
17-Mar	168	111.7	37%	0.445	2.645	1.111	3.756	167.5	37%	0.668	3.585	1.734	5.319	223.3	37%	0.890	4.448	2.377	6.825
18-Mar	169	112.1	37%	0.444	2.653	1.112	3.764	168.2	37%	0.666	3.596	1.734	5.330	224.2	37%	0.888	4.462	2.378	6.839
19-Mar	170	112.6	38%	0.443	2.661	1.112	3.773	168.8	38%	0.664	3.606	1.735	5.341	225.1	38%	0.886	4.475	2.379	6.853
20-Mar	171	113.0	38%	0.442	2.669	1.112	3.781	169.5	38%	0.663	3.617	1.735	5.353	226.0	38%	0.884	4.488	2.379	6.867
21-Mar	172	113.4	38%	0.441	2.676	1.113	3.789	170.2	38%	0.661	3.628	1.736	5.364	226.9	38%	0.882	4.501	2.380	6.881
22-Mar	173	113.9	38%	0.440	2.684	1.113	3.797	170.8	38%	0.660	3.638	1.737	5.375	227.8	38%	0.880	4.514	2.381	6.895
23-Mar	174	114.3	38%	0.439	2.692	1.113	3.805	171.5	38%	0.658	3.649	1.737	5.386	228.6	38%	0.878	4.527	2.382	6.909
24-Mar	175	114.8	38%	0.438	2.700	1.114	3.813	172.1	38%	0.657	3.659	1.738	5.397	229.5	38%	0.876	4.540	2.382	6.923
25-Mar	176	115.2	38%	0.437	2.707	1.114	3.821	172.8	38%	0.655	3.670	1.738	5.408	230.4	38%	0.874	4.553	2.383	6.936
26-Mar	177	115.6	39%	0.436	2.715	1.114	3.829	173.4	39%	0.654	3.680	1.738	5.418	231.2	39%	0.871	4.566	2.384	6.950
27-Mar	178	116.1	39%	0.435	2.723	1.115	3.837	174.1	39%	0.652	3.690	1.739	5.429	232.1	39%	0.869	4.579	2.384	6.963
28-Mar	179	116.5	39%	0.434	2.730	1.115	3.845	174.7	39%	0.651	3.701	1.739	5.440	233.0	39%	0.867	4.592	2.385	6.976
29-Mar	180	116.9	39%	0.433	2.738	1.115	3.853	175.4	39%	0.649	3.711	1.740	5.451	233.9	39%	0.865	4.605	2.385	6.990
30-Mar	181	117.4	39%	0.432	2.746	1.115	3.861	176.0	39%	0.647	3.721	1.740	5.461	234.7	39%	0.863	4.617	2.385	7.003
31-Mar	182	117.8	39%	0.431	2.753	1.115	3.868	176.7	39%	0.646	3.732	1.740	5.472	235.6	39%	0.861	4.630	2.386	7.016
01-Apr	183	118.2	39%	0.430	2.761	1.116	3.876	177.3	39%	0.644	3.742	1.740	5.482	236.4	39%	0.859	4.643	2.386	7.029
02-Apr	184	118.6	40%	0.429	2.768	1.116	3.884	178.0	40%	0.643	3.752	1.741	5.492	237.3	40%	0.857	4.655	2.386	7.042
03-Apr	185	119.1	40%	0.428	2.776	1.116	3.891	178.6	40%	0.641	3.762	1.741	5.503	238.1	40%	0.855	4.668	2.387	7.055
04-Apr	186	119.5	40%	0.427	2.783	1.116	3.899	179.3	40%	0.640	3.772	1.741	5.513	239.0	40%	0.853	4.680	2.387	7.067
05-Apr	187	119.9	40%	0.426	2.790	1.116	3.906	179.9	40%	0.638	3.782	1.741	5.523	239.9	40%	0.851	4.693	2.387	7.080
06-Apr	188	120.4	40%	0.425	2.798	1.116	3.914	180.5	40%	0.637	3.792	1.741	5.533	240.7	40%	0.849	4.705	2.387	7.093
07-Apr	189	120.8	40%	0.424	2.805	1.116	3.921	181.2	40%	0.635	3.802	1.741	5.544	241.5	40%	0.847	4.718	2.387	7.105
08-Apr	190	121.2	40%	0.423	2.813	1.116	3.929	181.8	40%	0.634	3.812	1.741	5.554	242.4	40%	0.845	4.730	2.387	7.118
09-Apr	191	121.6	41%	0.422	2.820	1.116	3.936	182.4	41%	0.632	3.822	1.741	5.563	243.2	41%	0.843	4.743	2.387	7.130
10-Apr	192	122.0	41%	0.421	2.827	1.116	3.943	183.1	41%	0.631	3.832	1.741	5.573	244.1	41%	0.841	4.755	2.387	7.142
11-Apr	193	122.5	41%	0.420	2.835	1.116	3.951	183.7	41%	0.629	3.842	1.741	5.583	244.9	41%	0.839	4.767	2.387	7.155

	12-Apr	194	122.9	41%	0.419	2.842	1.116	3.958	184.3	41%	0.628	3.852	1.741	5.593	245.8	41%	0.837	4.779	2.387	7.167
	13-Apr	195	123.3	41%	0.418	2.849	1.116	3.965	184.9	41%	0.626	3.862	1.741	5.603	246.6	41%	0.835	4.791	2.387	7.179
	14-Apr	196	123.7	41%	0.417	2.856	1.116	3.972	185.6	41%	0.625	3.871	1.741	5.612	247.4	41%	0.833	4.804	2.387	7.191
	15-Apr	197	124.1	41%	0.416	2.863	1.116	3.979	186.2	41%	0.623	3.881	1.741	5.622	248.3	41%	0.831	4.816	2.387	7.203
	16-Apr	198	124.5	42%	0.415	2.871	1.116	3.986	186.8	42%	0.622	3.891	1.741	5.632	249.1	42%	0.829	4.828	2.387	7.215
	17-Apr	199	125.0	42%	0.414	2.878	1.116	3.993	187.4	42%	0.621	3.901	1.741	5.641	249.9	42%	0.827	4.840	2.386	7.226
	18-Apr	200	125.4	42%	0.413	2.885	1.116	4.000	188.1	42%	0.619	3.910	1.740	5.651	250.7	42%	0.825	4.852	2.386	7.238
	19-Apr	201	125.8	42%	0.412	2.892	1.115	4.007	188.7	42%	0.618	3.920	1.740	5.660	251.6	42%	0.823	4.864	2.386	7.250
	20-Apr	202	126.2	42%	0.411	2.899	1.115	4.014	189.3	42%	0.616	3.929	1.740	5.669	252.4	42%	0.822	4.876	2.386	7.261
	21-Apr	203	126.6	42%	0.410	2.906	1.115	4.021	189.9	42%	0.615	3.939	1.740	5.679	253.2	42%	0.820	4.888	2.385	7.273
	22-Apr	204	127.0	42%	0.409	2.913	1.115	4.028	190.5	42%	0.613	3.949	1.739	5.688	254.0	42%	0.818	4.899	2.385	7.284
Calves are weaned	23-Apr	205	127.4	42%	0.408	2.920	1.115	4.035	191.1	42%	0.612	3.958	1.739	5.697	254.8	42%	0.816	4.911	2.384	7.295
	24-Apr	206	127.8	43%	0.407	2.927	1.114	4.042	191.7	43%	0.610	3.968	1.739	5.706	255.6	43%	0.814	4.923	2.384	7.307
	25-Apr	207	128.2	43%	0.406	2.934	1.114	4.048	192.3	43%	0.609	3.977	1.738	5.715	256.5	43%	0.812	4.935	2.383	7.318
	26-Apr	208	128.6	43%	0.405	2.941	1.114	4.055	193.0	43%	0.607	3.986	1.738	5.724	257.3	43%	0.810	4.946	2.383	7.329
	27-Apr	209	129.0	43%	0.404	2.948	1.114	4.062	193.6	43%	0.606	3.996	1.738	5.733	258.1	43%	0.808	4.958	2.382	7.340
	28-Apr	210	129.4	43%	0.403	2.955	1.113	4.068	194.2	43%	0.605	4.005	1.737	5.742	258.9	43%	0.806	4.970	2.382	7.351
	29-Apr	211	129.8	43%	0.402	2.962	1.113	4.075	194.8	43%	0.603	4.014	1.737	5.751	259.7	43%	0.804	4.981	2.381	7.362
Calves are Sold	30-Apr	212	130.2	43%	0.401	2.969	1.113	4.081	195.4	43%	0.602	4.024	1.736	5.760	260.5	43%	0.802	4.993	2.380	7.373
	01-May	213	130.6	44%	0.400	2.976	1.112	4.088	196.0	44%	0.600	4.033	1.736	5.769	261.3	44%	0.800	5.004	2.380	7.384
	02-May	214	131.0	44%	0.399	2.982	1.112	4.094	196.6	44%	0.599	4.042	1.735	5.777	262.1	44%	0.799	5.016	2.379	7.395
	03-May	215	131.4	44%	0.398	2.989	1.112	4.101	197.2	44%	0.598	4.051	1.735	5.786	262.9	44%	0.797	5.027	2.378	7.405
	04-May	216	131.8	44%	0.397	2.996	1.111	4.107	197.8	44%	0.596	4.061	1.734	5.795	263.7	44%	0.795	5.038	2.377	7.416
	05-May	217	132.2	44%	0.396	3.003	1.111	4.114	198.4	44%	0.595	4.070	1.733	5.803	264.5	44%	0.793	5.050	2.377	7.427
	06-May	218	132.6	44%	0.396	3.009	1.111	4.120	198.9	44%	0.593	4.079	1.733	5.812	265.3	44%	0.791	5.061	2.376	7.437
	07-May	219	133.0	44%	0.395	3.016	1.110	4.126	199.5	44%	0.592	4.088	1.732	5.820	266.1	44%	0.789	5.072	2.375	7.447
	08-May	220	133.4	44%	0.394	3.023	1.110	4.133	200.1	44%	0.591	4.097	1.732	5.829	266.8	44%	0.787	5.084	2.374	7.458
	09-May	221	133.8	45%	0.393	3.029	1.109	4.139	200.7	45%	0.589	4.106	1.731	5.837	267.6	45%	0.786	5.095	2.373	7.468
	10-May	222	134.2	45%	0.392	3.036	1.109	4.145	201.3	45%	0.588	4.115	1.730	5.845	268.4	45%	0.784	5.106	2.372	7.478
	11-May	223	134.6	45%	0.391	3.043	1.109	4.151	201.9	45%	0.586	4.124	1.730	5.854	269.2	45%	0.782	5.117	2.371	7.489
	12-May	224	135.0	45%	0.390	3.049	1.108	4.157	202.5	45%	0.585	4.133	1.729	5.862	270.0	45%	0.780	5.128	2.370	7.499
	13-May	225	135.4	45%	0.389	3.056	1.108	4.164	203.1	45%	0.584	4.142	1.728	5.870	270.8	45%	0.778	5.139	2.369	7.509
	14-May	226	135.8	45%	0.388	3.063	1.107	4.170	203.6	45%	0.582	4.151	1.727	5.878	271.5	45%	0.776	5.151	2.368	7.519
	15-May	227	136.2	45%	0.387	3.069	1.107	4.176	204.2	45%	0.581	4.160	1.726	5.886	272.3	45%	0.774	5.162	2.367	7.529
	16-May	228	136.5	46%	0.386	3.076	1.106	4.182	204.8	46%	0.579	4.169	1.726	5.894	273.1	46%	0.773	5.173	2.366	7.539
	17-May	229	136.9	46%	0.385	3.082	1.106	4.188	205.4	46%	0.578	4.177	1.725	5.902	273.8	46%	0.771	5.183	2.365	7.548
	18-May	230	137.3	46%	0.384	3.089	1.105	4.194	206.0	46%	0.577	4.186	1.724	5.910	274.6	46%	0.769	5.194	2.364	7.558
	19-May	231	137.7	46%	0.384	3.095	1.104	4.200	206.5	46%	0.575	4.195	1.723	5.918	275.4	46%	0.767	5.205	2.363	7.568
	20-May	232	138.1	46%	0.383	3.102	1.104	4.205	207.1	46%	0.574	4.204	1.722	5.926	276.1	46%	0.765	5.216	2.361	7.577
	21-May	233	138.5	46%	0.382	3.108	1.103	4.211	207.7	46%	0.573	4.213	1.721	5.934	276.9	46%	0.764	5.227	2.360	7.587
	22-May	234	138.8	46%	0.381	3.114	1.103	4.217	208.3	46%	0.571	4.221	1.720	5.942	277.7	46%	0.762	5.238	2.359	7.597
	23-May	235	139.2	46%	0.380	3.121	1.102	4.223	208.8	46%	0.570	4.230	1.720	5.949	278.4	46%	0.760	5.248	2.358	7.606
	24-May	236	139.6	47%	0.379	3.127	1.102	4.229	209.4	47%	0.569	4.238	1.719	5.957	279.2	47%	0.758	5.259	2.356	7.615
	25-May	237	140.0	47%	0.378	3.133	1.101	4.234	210.0	47%	0.567	4.247	1.718	5.965	279.9	47%	0.756	5.270	2.355	7.625
	26-May	238	140.4	47%	0.377	3.140	1.100	4.240	210.5	47%	0.566	4.256	1.717	5.972	280.7	47%	0.755	5.280	2.354	7.634
	27-May	239	140.7	47%	0.376	3.146	1.100	4.246	211.1	47%	0.565	4.264	1.716	5.980	281.5	47%	0.753	5.291	2.352	7.643
	28-May	240	141.1	47%	0.376	3.152	1.099	4.251	211.7	47%	0.563	4.273	1.715	5.987	282.2	47%	0.751	5.302	2.351	7.653
	29-May	241	141.5	47%	0.375	3.159	1.098	4.257	212.2	47%	0.562	4.281	1.714	5.995	283.0	47%	0.749	5.312	2.350	7.662
	30-May	242	141.9	47%	0.374	3.165	1.098	4.263	212.8	47%	0.561	4.290	1.713	6.002	283.7	47%	0.748	5.323	2.348	7.671
	31-May	243	142.2	47%	0.373	3.171	1.097	4.268	213.3	47%	0.559	4.298	1.712	6.010	284.4	47%	0.746	5.333	2.347	7.680
	01-Jun	244	142.6	48%	0.372	3.177	1.096	4.274	213.9	48%	0.558	4.307	1.710	6.017	285.2	48%	0.744	5.344	2.345	7.689
	02-Jun	245	143.0	48%	0.371	3.184	1.096	4.279	214.5	48%	0.557	4.315	1.709	6.024	285.9	48%	0.742	5.354	2.344	7.698
	03-Jun	246	143.3	48%	0.370	3.190	1.095	4.285	215.0	48%	0.555	4.323	1.708	6.032	286.7	48%	0.740	5.365	2.342	7.707
	04-Jun	247	143.7	48%	0.369	3.196	1.094	4.290	215.6	48%	0.554	4.332	1.707	6.039	287.4	48%	0.739	5.375	2.341	7.715
	05-Jun	248	144.1	48%	0.369	3.202	1.093	4.296	216.1	48%	0.553	4.340	1.706	6.046	288.2	48%	0.737	5.385	2.339	7.724
	06-Jun	249	144.4	48%	0.368	3.208	1.093	4.301	216.7	48%	0.551	4.348	1.705	6.053	288.9	48%	0.735	5.396	2.337	7.733
	07-Jun	250	144.8	48%	0.367	3.214	1.092	4.306	217.2	48%	0.550	4.357	1.704	6.060	289.6	48%	0.734	5.406	2.336	7.742
	08-Jun	251	145.2	48%	0.366	3.220	1.091	4.312	217.8	48%	0.549	4.365	1.702	6.067	290.4	48%	0.732	5.416	2.334	7.750
	09-Jun	252	145.5	49%	0.365	3.226	1.090	4.317	218.3	49%	0.548	4.373	1.701	6.074	291.1	49%	0.730	5.426	2.333	7.759
	10-Jun	253	145.9	49%	0.364	3.233	1.090	4.322	218.9	49%	0.546	4.381	1.700	6.081	291.8	49%	0.728	5.436	2.331	7.767
	11-Jun	254	146.3	49%	0.363	3.239	1.089	4.327	219.4	49%	0.545	4.390	1.699	6.088	292.5	49%	0.727	5.447	2.329	7.776
	12-Jun	255	146.6	49%	0.362	3.245	1.088	4.333	219.9	49%	0.544	4.398	1.698	6.095	293.3	49%	0.725	5.457	2.327	7.784
	13-Jun	256	147.0	49%	0.362	3.251	1.087	4.338	220.5	49%	0.542	4.406	1.696	6.102	294.0	49%	0.723	5.467	2.326	7.793
	14-Jun	257	147.4	49%	0.361	3.257	1.086	4.343	221.0	49%	0.541	4.414	1.695	6.109	294.7	49%	0.722	5.477	2.324	7.801
	15-Jun	258	147.7	49%	0.360	3.263	1.086	4.348	221.6	49%	0.540	4.422	1.694	6.116	295.4	49%	0.720	5.487	2.322	7.809
	16-Jun	259	148.1	49%	0.359	3.268	1.085	4.353	222.1	49%	0.539	4.430	1.692	6.123	296.1	49%	0.718	5.497	2.320	7.817
	17-Jun	260	148.4	49%	0.358	3.274	1.084	4.358	222.6	49%	0.537	4.438	1.691	6.129	296.9	49%	0.716	5.507	2.319	7.826

18-Jun	261	148.8	50%	0.357	3.280	1.083	4.363	223.2	50%	0.536	4.446	1.690	6.136	297.6	50%	0.715	5.517	2.317	7.834
19-Jun	262	149.1	50%	0.357	3.286	1.082	4.368	223.7	50%	0.535	4.454	1.688	6.143	298.3	50%	0.713	5.527	2.315	7.842
20-Jun	263	149.5	50%	0.356	3.292	1.081	4.373	224.2	50%	0.534	4.462	1.687	6.149	299.0	50%	0.711	5.537	2.313	7.850
21-Jun	264	149.9	50%	0.355	3.298	1.080	4.378	224.8	50%	0.532	4.470	1.686	6.156	299.7	50%	0.710	5.546	2.311	7.858
22-Jun	265	150.2	50%	0.354	3.304	1.080	4.383	225.3	50%	0.531	4.478	1.684	6.162	300.4	50%	0.708	5.556	2.309	7.866
23-Jun	266	150.6	50%	0.353	3.310	1.079	4.388	225.8	50%	0.530	4.486	1.683	6.169	301.1	50%	0.706	5.566	2.307	7.874
24-Jun	267	150.9	50%	0.352	3.315	1.078	4.393	226.4	50%	0.529	4.494	1.682	6.175	301.8	50%	0.705	5.576	2.306	7.881
25-Jun	268	151.3	50%	0.352	3.321	1.077	4.398	226.9	50%	0.527	4.502	1.680	6.182	302.5	50%	0.703	5.586	2.304	7.889
26-Jun	269	151.6	51%	0.351	3.327	1.076	4.403	227.4	51%	0.526	4.509	1.679	6.188	303.2	51%	0.701	5.595	2.302	7.897
27-Jun	270	152.0	51%	0.350	3.333	1.075	4.408	227.9	51%	0.525	4.517	1.677	6.194	303.9	51%	0.700	5.605	2.300	7.905
28-Jun	271	152.3	51%	0.349	3.338	1.074	4.413	228.5	51%	0.524	4.525	1.676	6.201	304.6	51%	0.698	5.615	2.298	7.912
29-Jun	272	152.7	51%	0.348	3.344	1.073	4.417	229.0	51%	0.522	4.533	1.674	6.207	305.3	51%	0.696	5.624	2.296	7.920
30-Jun	273	153.0	51%	0.347	3.350	1.072	4.422	229.5	51%	0.521	4.540	1.673	6.213	306.0	51%	0.695	5.634	2.294	7.927
01-Jul	274	153.4	51%	0.347	3.356	1.071	4.427	230.0	51%	0.520	4.548	1.671	6.220	306.7	51%	0.693	5.643	2.292	7.935
02-Jul	275	153.7	51%	0.346	3.361	1.070	4.432	230.6	51%	0.519	4.556	1.670	6.226	307.4	51%	0.691	5.653	2.289	7.942
03-Jul	276	154.0	51%	0.345	3.367	1.069	4.436	231.1	51%	0.517	4.564	1.668	6.232	308.1	51%	0.690	5.662	2.287	7.950
04-Jul	277	154.4	51%	0.344	3.373	1.068	4.441	231.6	51%	0.516	4.571	1.667	6.238	308.8	51%	0.688	5.672	2.285	7.957
05-Jul	278	154.7	52%	0.343	3.378	1.067	4.446	232.1	52%	0.515	4.579	1.665	6.244	309.5	52%	0.687	5.681	2.283	7.965
06-Jul	279	155.1	52%	0.342	3.384	1.066	4.450	232.6	52%	0.514	4.586	1.664	6.250	310.2	52%	0.685	5.691	2.281	7.972
07-Jul	280	155.4	52%	0.342	3.389	1.065	4.455	233.1	52%	0.513	4.594	1.662	6.256	310.8	52%	0.683	5.700	2.279	7.979
08-Jul	281	155.8	52%	0.341	3.395	1.064	4.459	233.6	52%	0.511	4.602	1.661	6.262	311.5	52%	0.682	5.710	2.277	7.986
09-Jul	282	156.1	52%	0.340	3.401	1.063	4.464	234.2	52%	0.510	4.609	1.659	6.268	312.2	52%	0.680	5.719	2.275	7.994
10-Jul	283	156.4	52%	0.339	3.406	1.062	4.468	234.7	52%	0.509	4.617	1.657	6.274	312.9	52%	0.679	5.728	2.272	8.001
11-Jul	284	156.8	52%	0.338	3.412	1.061	4.473	235.2	52%	0.508	4.624	1.656	6.280	313.6	52%	0.677	5.738	2.270	8.008
12-Jul	285	157.1	52%	0.338	3.417	1.060	4.477	235.7	52%	0.507	4.632	1.654	6.286	314.2	52%	0.675	5.747	2.268	8.015
13-Jul	286	157.5	52%	0.337	3.423	1.059	4.482	236.2	52%	0.505	4.639	1.653	6.292	314.9	52%	0.674	5.756	2.266	8.022
14-Jul	287	157.8	53%	0.336	3.428	1.058	4.486	236.7	53%	0.504	4.646	1.651	6.297	315.6	53%	0.672	5.765	2.264	8.029
15-Jul	288	158.1	53%	0.335	3.434	1.057	4.491	237.2	53%	0.503	4.654	1.649	6.303	316.2	53%	0.671	5.774	2.261	8.036
16-Jul	289	158.5	53%	0.335	3.439	1.056	4.495	237.7	53%	0.502	4.661	1.648	6.309	316.9	53%	0.669	5.784	2.259	8.043
17-Jul	290	158.8	53%	0.334	3.444	1.055	4.499	238.2	53%	0.501	4.669	1.646	6.315	317.6	53%	0.667	5.793	2.257	8.049
18-Jul	291	159.1	53%	0.333	3.450	1.054	4.504	238.7	53%	0.499	4.676	1.644	6.320	318.3	53%	0.666	5.802	2.254	8.056
19-Jul	292	159.5	53%	0.332	3.455	1.053	4.508	239.2	53%	0.498	4.683	1.643	6.326	318.9	53%	0.664	5.811	2.252	8.063
20-Jul	293	159.8	53%	0.331	3.461	1.052	4.512	239.7	53%	0.497	4.690	1.641	6.331	319.6	53%	0.663	5.820	2.250	8.070
21-Jul	294	160.1	53%	0.331	3.466	1.051	4.517	240.2	53%	0.496	4.698	1.639	6.337	320.2	53%	0.661	5.829	2.247	8.076
22-Jul	295	160.4	53%	0.330	3.471	1.050	4.521	240.7	53%	0.495	4.705	1.637	6.343	320.9	53%	0.660	5.838	2.245	8.083
23-Jul	296	160.8	54%	0.329	3.477	1.048	4.525	241.2	54%	0.494	4.712	1.636	6.348	321.6	54%	0.658	5.847	2.243	8.090
24-Jul	297	161.1	54%	0.328	3.482	1.047	4.529	241.7	54%	0.492	4.719	1.634	6.354	322.2	54%	0.657	5.856	2.240	8.096
25-Jul	298	161.4	54%	0.327	3.487	1.046	4.534	242.2	54%	0.491	4.727	1.632	6.359	322.9	54%	0.655	5.865	2.238	8.103
26-Jul	299	161.8	54%	0.327	3.493	1.045	4.538	242.6	54%	0.490	4.734	1.631	6.364	323.5	54%	0.653	5.874	2.236	8.109
27-Jul	300	162.1	54%	0.326	3.498	1.044	4.542	243.1	54%	0.489	4.741	1.629	6.370	324.2	54%	0.652	5.883	2.233	8.116
28-Jul	301	162.4	54%	0.325	3.503	1.043	4.546	243.6	54%	0.488	4.748	1.627	6.375	324.8	54%	0.650	5.892	2.231	8.122
29-Jul	302	162.7	54%	0.324	3.508	1.042	4.550	244.1	54%	0.487	4.755	1.625	6.380	325.5	54%	0.649	5.900	2.228	8.129
30-Jul	303	163.1	54%	0.324	3.514	1.041	4.554	244.6	54%	0.485	4.762	1.623	6.386	326.1	54%	0.647	5.909	2.226	8.135
31-Jul	304	163.4	54%	0.323	3.519	1.039	4.558	245.1	54%	0.484	4.769	1.622	6.391	326.8	54%	0.646	5.918	2.223	8.141
01-Aug	305	163.7	55%	0.322	3.524	1.038	4.562	245.6	55%	0.483	4.776	1.620	6.396	327.4	55%	0.644	5.927	2.221	8.148
02-Aug	306	164.0	55%	0.321	3.529	1.037	4.566	246.0	55%	0.482	4.783	1.618	6.402	328.1	55%	0.643	5.935	2.218	8.154
03-Aug	307	164.3	55%	0.321	3.534	1.036	4.570	246.5	55%	0.481	4.790	1.616	6.407	328.7	55%	0.641	5.944	2.216	8.160
04-Aug	308	164.7	55%	0.320	3.540	1.035	4.574	247.0	55%	0.480	4.797	1.614	6.412	329.3	55%	0.640	5.953	2.213	8.166
05-Aug	309	165.0	55%	0.319	3.545	1.034	4.578	247.5	55%	0.479	4.804	1.613	6.417	330.0	55%	0.638	5.961	2.211	8.172
06-Aug	310	165.3	55%	0.318	3.550	1.032	4.582	248.0	55%	0.477	4.811	1.611	6.422	330.6	55%	0.637	5.970	2.208	8.178
07-Aug	311	165.6	55%	0.318	3.555	1.031	4.586	248.4	55%	0.476	4.818	1.609	6.427	331.2	55%	0.635	5.979	2.206	8.184
08-Aug	312	165.9	55%	0.317	3.560	1.030	4.590	248.9	55%	0.475	4.825	1.607	6.432	331.9	55%	0.634	5.987	2.203	8.190
09-Aug	313	166.3	55%	0.316	3.565	1.029	4.594	249.4	55%	0.474	4.832	1.605	6.437	332.5	55%	0.632	5.996	2.201	8.196
10-Aug	314	166.6	56%	0.315	3.570	1.028	4.598	249.9	56%	0.473	4.839	1.603	6.442	333.1	56%	0.631	6.004	2.198	8.202
11-Aug	315	166.9	56%	0.315	3.575	1.026	4.602	250.3	56%	0.472	4.846	1.601	6.447	333.8	56%	0.629	6.013	2.196	8.208
12-Aug	316	167.2	56%	0.314	3.580	1.025	4.605	250.8	56%	0.471	4.853	1.599	6.452	334.4	56%	0.628	6.021	2.193	8.214
13-Aug	317	167.5	56%	0.313	3.585	1.024	4.609	251.3	56%	0.470	4.860	1.598	6.457	335.0	56%	0.626	6.030	2.190	8.220
14-Aug	318	167.8	56%	0.312	3.590	1.023	4.613	251.7	56%	0.469	4.866	1.596	6.462	335.6	56%	0.625	6.038	2.188	8.226
15-Aug	319	168.1	56%	0.312	3.595	1.022	4.617	252.2	56%	0.467	4.873	1.594	6.467	336.3	56%	0.623	6.047	2.185	8.232
16-Aug	320	168.4	56%	0.311	3.600	1.020	4.621	252.7	56%	0.466	4.880	1.592	6.472	336.9	56%	0.622	6.055	2.183	8.237
17-Aug	321	168.8	56%	0.310	3.605	1.019	4.624	253.1	56%	0.465	4.887	1.590	6.477	337.5	56%	0.620	6.063	2.180	8.243
18-Aug	322	169.1	56%	0.309	3.610	1.018	4.628	253.6	56%	0.464	4.893	1.588	6.481	338.1	56%	0.619	6.072	2.177	8.249
19-Aug	323	169.4	56%	0.309	3.615	1.017	4.632	254.1	56%	0.463	4.900	1.586	6.486	338.7	56%	0.617	6.080	2.175	8.255
20-Aug	324	169.7	57%	0.308	3.620	1.015	4.635	254.5	57%	0.462	4.907	1.584	6.491	339.4	57%	0.616	6.088	2.172	8.260
21-Aug	325	170.0	57%	0.307	3.625	1.014	4.639	255.0	57%	0.461	4.913	1.582	6.496	340.0	57%	0.615	6.096	2.169	8.266
22-Aug	326	170.3	57%	0.307	3.630	1.013	4.643	255.4	57%	0.460	4.920	1.580	6.500	340.6	57%	0.613	6.105	2.167	8.271
23-Aug	327	170.6	57%	0.306	3.635	1.012	4.646	255.9	57%	0.459	4.927	1.578	6.505	341.2	57%	0.612	6.113	2.164	8.277

24-Aug	328	170.9	57%	0.305	3.640	1.010	4.650	256.4	57%	0.458	4.933	1.576	6.509	341.8	57%	0.610	6.121	2.161	8.282
25-Aug	329	171.2	57%	0.304	3.645	1.009	4.654	256.8	57%	0.457	4.940	1.574	6.514	342.4	57%	0.609	6.129	2.158	8.288
26-Aug	330	171.5	57%	0.304	3.649	1.008	4.657	257.3	57%	0.455	4.946	1.572	6.519	343.0	57%	0.607	6.137	2.156	8.293
27-Aug	331	171.8	57%	0.303	3.654	1.007	4.661	257.7	57%	0.454	4.953	1.570	6.523	343.6	57%	0.606	6.146	2.153	8.299
28-Aug	332	172.1	57%	0.302	3.659	1.005	4.664	258.2	57%	0.453	4.959	1.568	6.528	344.2	57%	0.604	6.154	2.150	8.304
29-Aug	333	172.4	57%	0.302	3.664	1.004	4.668	258.6	57%	0.452	4.966	1.566	6.532	344.8	57%	0.603	6.162	2.148	8.309
30-Aug	334	172.7	58%	0.301	3.669	1.003	4.671	259.1	58%	0.451	4.972	1.564	6.537	345.4	58%	0.602	6.170	2.145	8.315
31-Aug	335	173.0	58%	0.300	3.673	1.001	4.675	259.5	58%	0.450	4.979	1.562	6.541	346.0	58%	0.600	6.178	2.142	8.320
01-Sep	336	173.3	58%	0.299	3.678	1.000	4.678	260.0	58%	0.449	4.985	1.560	6.546	346.6	58%	0.599	6.186	2.139	8.325
02-Sep	337	173.6	58%	0.299	3.683	0.999	4.682	260.4	58%	0.448	4.992	1.558	6.550	347.2	58%	0.597	6.194	2.136	8.330
03-Sep	338	173.9	58%	0.298	3.688	0.997	4.685	260.9	58%	0.447	4.998	1.556	6.555	347.8	58%	0.596	6.202	2.134	8.336
04-Sep	339	174.2	58%	0.297	3.692	0.996	4.689	261.3	58%	0.446	5.005	1.554	6.559	348.4	58%	0.595	6.210	2.131	8.341
05-Sep	340	174.5	58%	0.297	3.697	0.995	4.692	261.8	58%	0.445	5.011	1.552	6.563	349.0	58%	0.593	6.218	2.128	8.346
06-Sep	341	174.8	58%	0.296	3.702	0.994	4.695	262.2	58%	0.444	5.017	1.550	6.568	349.6	58%	0.592	6.226	2.125	8.351
07-Sep	342	175.1	58%	0.295	3.706	0.992	4.699	262.7	58%	0.443	5.024	1.548	6.572	350.2	58%	0.590	6.234	2.122	8.356
08-Sep	343	175.4	58%	0.294	3.711	0.991	4.702	263.1	58%	0.442	5.030	1.546	6.576	350.8	58%	0.589	6.241	2.120	8.361
09-Sep	344	175.7	59%	0.294	3.716	0.990	4.705	263.5	59%	0.441	5.036	1.544	6.580	351.4	59%	0.588	6.249	2.117	8.366
10-Sep	345	176.0	59%	0.293	3.720	0.988	4.709	264.0	59%	0.440	5.043	1.542	6.585	352.0	59%	0.586	6.257	2.114	8.371
11-Sep	346	176.3	59%	0.292	3.725	0.987	4.712	264.4	59%	0.439	5.049	1.540	6.589	352.6	59%	0.585	6.265	2.111	8.376
12-Sep	347	176.6	59%	0.292	3.730	0.986	4.715	264.9	59%	0.438	5.055	1.538	6.593	353.1	59%	0.583	6.273	2.108	8.381
13-Sep	348	176.9	59%	0.291	3.734	0.984	4.719	265.3	59%	0.437	5.062	1.536	6.597	353.7	59%	0.582	6.280	2.105	8.386
14-Sep	349	177.2	59%	0.290	3.739	0.983	4.722	265.7	59%	0.436	5.068	1.534	6.601	354.3	59%	0.581	6.288	2.103	8.391
15-Sep	350	177.4	59%	0.290	3.744	0.982	4.725	266.2	59%	0.434	5.074	1.531	6.605	354.9	59%	0.579	6.296	2.100	8.396
16-Sep	351	177.7	59%	0.289	3.748	0.980	4.728	266.6	59%	0.433	5.080	1.529	6.610	355.5	59%	0.578	6.304	2.097	8.400
17-Sep	352	178.0	59%	0.288	3.753	0.979	4.732	267.0	59%	0.432	5.086	1.527	6.614	356.0	59%	0.577	6.311	2.094	8.405
18-Sep	353	178.3	59%	0.288	3.757	0.978	4.735	267.5	59%	0.431	5.093	1.525	6.618	356.6	59%	0.575	6.319	2.091	8.410
19-Sep	354	178.6	60%	0.287	3.762	0.976	4.738	267.9	60%	0.430	5.099	1.523	6.622	357.2	60%	0.574	6.326	2.088	8.415
20-Sep	355	178.9	60%	0.286	3.766	0.975	4.741	268.3	60%	0.429	5.105	1.521	6.626	357.8	60%	0.573	6.334	2.085	8.419
21-Sep	356	179.2	60%	0.286	3.771	0.974	4.744	268.7	60%	0.428	5.111	1.519	6.630	358.3	60%	0.571	6.342	2.082	8.424
22-Sep	357	179.4	60%	0.285	3.775	0.972	4.747	269.2	60%	0.427	5.117	1.517	6.634	358.9	60%	0.570	6.349	2.080	8.429
23-Sep	358	179.7	60%	0.284	3.780	0.971	4.751	269.6	60%	0.426	5.123	1.515	6.638	359.5	60%	0.568	6.357	2.077	8.433
24-Sep	359	180.0	60%	0.284	3.784	0.969	4.754	270.0	60%	0.425	5.129	1.512	6.642	360.0	60%	0.567	6.364	2.074	8.438
25-Sep	360	180.3	60%	0.283	3.789	0.968	4.757	270.4	60%	0.424	5.135	1.510	6.645	360.6	60%	0.566	6.372	2.071	8.443
26-Sep	361	180.6	60%	0.282	3.793	0.967	4.760	270.9	60%	0.423	5.141	1.508	6.649	361.2	60%	0.564	6.379	2.068	8.447
27-Sep	362	180.9	60%	0.282	3.798	0.965	4.763	271.3	60%	0.422	5.147	1.506	6.653	361.7	60%	0.563	6.387	2.065	8.452
28-Sep	363	181.1	60%	0.281	3.802	0.964	4.766	271.7	60%	0.421	5.153	1.504	6.657	362.3	60%	0.562	6.394	2.062	8.456
29-Sep	364	181.4	60%	0.280	3.806	0.963	4.769	272.1	60%	0.420	5.159	1.502	6.661	362.8	60%	0.560	6.402	2.059	8.461
30-Sep	365	181.7	61%	0.280	3.811	0.961	4.772	272.6	61%	0.419	5.165	1.500	6.665	363.4	61%	0.559	6.409	2.056	8.465
01-Oct	366	182.0	61%	0.279	3.815	0.960	4.775	273.0	61%	0.418	5.171	1.497	6.669	364.0	61%	0.558	6.416	2.053	8.469
02-Oct	367	182.3	61%	0.278	3.820	0.958	4.778	273.4	61%	0.417	5.177	1.495	6.672	364.5	61%	0.557	6.424	2.050	8.474
03-Oct	368	182.5	61%	0.278	3.824	0.957	4.781	273.8	61%	0.416	5.183	1.493	6.676	365.1	61%	0.555	6.431	2.047	8.478
04-Oct	369	182.8	61%	0.277	3.828	0.956	4.784	274.2	61%	0.415	5.189	1.491	6.680	365.6	61%	0.554	6.438	2.044	8.483
05-Oct	370	183.1	61%	0.276	3.833	0.954	4.787	274.6	61%	0.414	5.195	1.489	6.683	366.2	61%	0.553	6.446	2.041	8.487
06-Oct	371	183.4	61%	0.276	3.837	0.953	4.790	275.1	61%	0.413	5.201	1.487	6.687	366.7	61%	0.551	6.453	2.038	8.491
07-Oct	372	183.6	61%	0.275	3.841	0.951	4.793	275.5	61%	0.412	5.206	1.484	6.691	367.3	61%	0.550	6.460	2.035	8.495
08-Oct	373	183.9	61%	0.274	3.846	0.950	4.796	275.9	61%	0.412	5.212	1.482	6.694	367.8	61%	0.549	6.467	2.032	8.500
09-Oct	374	184.2	61%	0.274	3.850	0.949	4.798	276.3	61%	0.411	5.218	1.480	6.698	368.4	61%	0.547	6.475	2.029	8.504
10-Oct	375	184.5	61%	0.273	3.854	0.947	4.801	276.7	61%	0.410	5.224	1.478	6.702	368.9	61%	0.546	6.482	2.026	8.508
11-Oct	376	184.7	62%	0.272	3.858	0.946	4.804	277.1	62%	0.409	5.230	1.476	6.705	369.5	62%	0.545	6.489	2.023	8.512
12-Oct	377	185.0	62%	0.272	3.863	0.944	4.807	277.5	62%	0.408	5.235	1.473	6.709	370.0	62%	0.544	6.496	2.020	8.516
13-Oct	378	185.3	62%	0.271	3.867	0.943	4.810	277.9	62%	0.407	5.241	1.471	6.712	370.6	62%	0.542	6.503	2.017	8.521
14-Oct	379	185.5	62%	0.270	3.871	0.942	4.813	278.3	62%	0.406	5.247	1.469	6.716	371.1	62%	0.541	6.510	2.014	8.525
15-Oct	380	185.8	62%	0.270	3.875	0.940	4.816	278.7	62%	0.405	5.253	1.467	6.720	371.6	62%	0.540	6.518	2.011	8.529
16-Oct	381	186.1	62%	0.269	3.880	0.939	4.818	279.1	62%	0.404	5.258	1.465	6.723	372.2	62%	0.538	6.525	2.008	8.533
17-Oct	382	186.4	62%	0.269	3.884	0.937	4.821	279.5	62%	0.403	5.264	1.462	6.727	372.7	62%	0.537	6.532	2.005	8.537
18-Oct	383	186.6	62%	0.268	3.888	0.936	4.824	279.9	62%	0.402	5.270	1.460	6.730	373.2	62%	0.536	6.539	2.002	8.541
19-Oct	384	186.9	62%	0.267	3.892	0.935	4.827	280.3	62%	0.401	5.275	1.458	6.733	373.8	62%	0.535	6.546	1.999	8.545
20-Oct	385	187.2	62%	0.267	3.896	0.933	4.829	280.7	62%	0.400	5.281	1.456	6.737	374.3	62%	0.533	6.553	1.996	8.549
21-Oct	386	187.4	62%	0.266	3.900	0.932	4.832	281.1	62%	0.399	5.287	1.454	6.740	374.8	62%	0.532	6.560	1.993	8.553
22-Oct	387	187.7	63%	0.265	3.905	0.930	4.835	281.5	63%	0.398	5.292	1.451	6.744	375.4	63%	0.531	6.567	1.990	8.557
23-Oct	388	188.0	63%	0.265	3.909	0.929	4.838	281.9	63%	0.397	5.298	1.449	6.747	375.9	63%	0.530	6.574	1.987	8.561
24-Oct	389	188.2	63%	0.264	3.913	0.927	4.840	282.3	63%	0.396	5.303	1.447	6.750	376.4	63%	0.528	6.581	1.984	8.564
25-Oct	390	188.5	63%	0.264	3.917	0.926	4.843	282.7	63%	0.395	5.309	1.445	6.754	377.0	63%	0.527	6.587	1.981	8.568
26-Oct	391	188.7	63%	0.263	3.921	0.925	4.846	283.1	63%	0.394	5.315	1.443	6.757	377.5	63%	0.526	6.594	1.978	8.572
27-Oct	392	189.0	63%	0.262	3.925	0.923	4.848	283.5	63%	0.393	5.320	1.440	6.760	378.0	63%	0.525	6.601	1.975	8.576
28-Oct	393	189.3	63%	0.262	3.929	0.922	4.851	283.9	63%	0.393	5.326	1.438	6.764	378.5	63%	0.523	6.608	1.972	8.580
29-Oct	394	189.5	63%	0.261	3.933	0.920	4.854	284.3	63%	0.392	5.331	1.436	6.767	379.1	63%	0.522	6.615	1.969	8.583

30-Oct	395	189.8	63%	0.260	3.937	0.919	4.856	284.7	63%	0.391	5.337	1.434	6.770	379.6	63%	0.521	6.622	1.966	8.587
31-Oct	396	190.1	63%	0.260	3.941	0.917	4.859	285.1	63%	0.390	5.342	1.431	6.773	380.1	63%	0.520	6.629	1.962	8.591
01-Nov	397	190.3	63%	0.259	3.945	0.916	4.861	285.5	63%	0.389	5.348	1.429	6.777	380.6	63%	0.518	6.635	1.959	8.595
02-Nov	398	190.6	64%	0.259	3.949	0.915	4.864	285.9	64%	0.388	5.353	1.427	6.780	381.1	64%	0.517	6.642	1.956	8.598
03-Nov	399	190.8	64%	0.258	3.953	0.913	4.867	286.2	64%	0.387	5.358	1.425	6.783	381.7	64%	0.516	6.649	1.953	8.602
04-Nov	400	191.1	64%	0.257	3.957	0.912	4.869	286.6	64%	0.386	5.364	1.422	6.786	382.2	64%	0.515	6.656	1.950	8.606
05-Nov	401	191.3	64%	0.257	3.961	0.910	4.872	287.0	64%	0.385	5.369	1.420	6.789	382.7	64%	0.514	6.662	1.947	8.609
06-Nov	402	191.6	64%	0.256	3.965	0.909	4.874	287.4	64%	0.384	5.375	1.418	6.793	383.2	64%	0.512	6.669	1.944	8.613
07-Nov	403	191.9	64%	0.256	3.969	0.907	4.877	287.8	64%	0.383	5.380	1.416	6.796	383.7	64%	0.511	6.676	1.941	8.616
08-Nov	404	192.1	64%	0.255	3.973	0.906	4.879	288.2	64%	0.382	5.385	1.413	6.799	384.2	64%	0.510	6.682	1.938	8.620
09-Nov	405	192.4	64%	0.254	3.977	0.904	4.882	288.5	64%	0.382	5.391	1.411	6.802	384.7	64%	0.509	6.689	1.935	8.624
10-Nov	406	192.6	64%	0.254	3.981	0.903	4.884	288.9	64%	0.381	5.396	1.409	6.805	385.2	64%	0.508	6.695	1.932	8.627
11-Nov	407	192.9	64%	0.253	3.985	0.902	4.887	289.3	64%	0.380	5.401	1.407	6.808	385.7	64%	0.506	6.702	1.929	8.631
12-Nov	408	193.1	64%	0.253	3.989	0.900	4.889	289.7	64%	0.379	5.407	1.404	6.811	386.2	64%	0.505	6.709	1.925	8.634
13-Nov	409	193.4	64%	0.252	3.993	0.899	4.892	290.1	64%	0.378	5.412	1.402	6.814	386.7	64%	0.504	6.715	1.922	8.638
14-Nov	410	193.6	65%	0.251	3.997	0.897	4.894	290.4	65%	0.377	5.417	1.400	6.817	387.3	65%	0.503	6.722	1.919	8.641
15-Nov	411	193.9	65%	0.251	4.001	0.896	4.896	290.8	65%	0.376	5.423	1.398	6.820	387.8	65%	0.502	6.728	1.916	8.644
16-Nov	412	194.1	65%	0.250	4.005	0.894	4.899	291.2	65%	0.375	5.428	1.395	6.823	388.3	65%	0.500	6.735	1.913	8.648
17-Nov	413	194.4	65%	0.250	4.008	0.893	4.901	291.6	65%	0.374	5.433	1.393	6.826	388.8	65%	0.499	6.741	1.910	8.651
18-Nov	414	194.6	65%	0.249	4.012	0.891	4.904	291.9	65%	0.374	5.438	1.391	6.829	389.3	65%	0.498	6.748	1.907	8.655
19-Nov	415	194.9	65%	0.248	4.016	0.890	4.906	292.3	65%	0.373	5.443	1.388	6.832	389.7	65%	0.497	6.754	1.904	8.658
20-Nov	416	195.1	65%	0.248	4.020	0.888	4.908	292.7	65%	0.372	5.449	1.386	6.835	390.2	65%	0.496	6.761	1.901	8.661
21-Nov	417	195.4	65%	0.247	4.024	0.887	4.911	293.1	65%	0.371	5.454	1.384	6.838	390.7	65%	0.495	6.767	1.897	8.665
22-Nov	418	195.6	65%	0.247	4.028	0.886	4.913	293.4	65%	0.370	5.459	1.382	6.841	391.2	65%	0.493	6.774	1.894	8.668
23-Nov	419	195.9	65%	0.246	4.031	0.884	4.915	293.8	65%	0.369	5.464	1.379	6.844	391.7	65%	0.492	6.780	1.891	8.671
24-Nov	420	196.1	65%	0.246	4.035	0.883	4.918	294.2	65%	0.368	5.469	1.377	6.846	392.2	65%	0.491	6.786	1.888	8.674
25-Nov	421	196.4	65%	0.245	4.039	0.881	4.920	294.5	65%	0.367	5.474	1.375	6.849	392.7	65%	0.490	6.793	1.885	8.678
26-Nov	422	196.6	66%	0.244	4.043	0.880	4.922	294.9	66%	0.367	5.479	1.373	6.852	393.2	66%	0.489	6.799	1.882	8.681
27-Nov	423	196.8	66%	0.244	4.046	0.878	4.925	295.3	66%	0.366	5.485	1.370	6.855	393.7	66%	0.488	6.805	1.879	8.684
28-Nov	424	197.1	66%	0.243	4.050	0.877	4.927	295.6	66%	0.365	5.490	1.368	6.858	394.2	66%	0.486	6.812	1.876	8.687
29-Nov	425	197.3	66%	0.243	4.054	0.875	4.929	296.0	66%	0.364	5.495	1.366	6.860	394.7	66%	0.485	6.818	1.872	8.690
30-Nov	426	197.6	66%	0.242	4.058	0.874	4.932	296.4	66%	0.363	5.500	1.363	6.863	395.1	66%	0.484	6.824	1.869	8.694
01-Dec	427	197.8	66%	0.242	4.061	0.872	4.934	296.7	66%	0.362	5.505	1.361	6.866	395.6	66%	0.483	6.830	1.866	8.697
02-Dec	428	198.1	66%	0.241	4.065	0.871	4.936	297.1	66%	0.361	5.510	1.359	6.869	396.1	66%	0.482	6.837	1.863	8.700
03-Dec	429	198.3	66%	0.240	4.069	0.870	4.938	297.4	66%	0.361	5.515	1.357	6.871	396.6	66%	0.481	6.843	1.860	8.703
04-Dec	430	198.5	66%	0.240	4.073	0.868	4.941	297.8	66%	0.360	5.520	1.354	6.874	397.1	66%	0.480	6.849	1.857	8.706
05-Dec	431	198.8	66%	0.239	4.076	0.867	4.943	298.2	66%	0.359	5.525	1.352	6.877	397.5	66%	0.478	6.855	1.854	8.709
06-Dec	432	199.0	66%	0.239	4.080	0.865	4.945	298.5	66%	0.358	5.530	1.350	6.880	398.0	66%	0.477	6.861	1.851	8.712
07-Dec	433	199.2	66%	0.238	4.084	0.864	4.947	298.9	66%	0.357	5.535	1.347	6.882	398.5	66%	0.476	6.868	1.847	8.715
08-Dec	434	199.5	66%	0.238	4.087	0.862	4.949	299.2	66%	0.356	5.540	1.345	6.885	399.0	66%	0.475	6.874	1.844	8.718
09-Dec	435	199.7	67%	0.237	4.091	0.861	4.952	299.6	67%	0.355	5.545	1.343	6.888	399.4	67%	0.474	6.880	1.841	8.721
10-Dec	436	200.0	67%	0.236	4.094	0.859	4.954	299.9	67%	0.355	5.550	1.341	6.890	399.9	67%	0.473	6.886	1.838	8.724
11-Dec	437	200.2	67%	0.236	4.098	0.858	4.956	300.3	67%	0.354	5.555	1.338	6.893	400.4	67%	0.472	6.892	1.835	8.727
12-Dec	438	200.4	67%	0.235	4.102	0.856	4.958	300.6	67%	0.353	5.559	1.336	6.895	400.9	67%	0.471	6.898	1.832	8.730
13-Dec	439	200.7	67%	0.235	4.105	0.855	4.960	301.0	67%	0.352	5.564	1.334	6.898	401.3	67%	0.470	6.904	1.829	8.733
14-Dec	440	200.9	67%	0.234	4.109	0.853	4.962	301.3	67%	0.351	5.569	1.331	6.901	401.8	67%	0.468	6.910	1.826	8.736
15-Dec	441	201.1	67%	0.234	4.112	0.852	4.964	301.7	67%	0.350	5.574	1.329	6.903	402.3	67%	0.467	6.916	1.822	8.739
16-Dec	442	201.4	67%	0.233	4.116	0.850	4.967	302.0	67%	0.350	5.579	1.327	6.906	402.7	67%	0.466	6.922	1.819	8.742
17-Dec	443	201.6	67%	0.233	4.120	0.849	4.969	302.4	67%	0.349	5.584	1.325	6.908	403.2	67%	0.465	6.928	1.816	8.744
18-Dec	444	201.8	67%	0.232	4.123	0.848	4.971	302.7	67%	0.348	5.589	1.322	6.911	403.7	67%	0.464	6.934	1.813	8.747
19-Dec	445	202.1	67%	0.231	4.127	0.846	4.973	303.1	67%	0.347	5.593	1.320	6.913	404.1	67%	0.463	6.940	1.810	8.750
20-Dec	446	202.3	67%	0.231	4.130	0.845	4.975	303.4	67%	0.346	5.598	1.318	6.916	404.6	67%	0.462	6.946	1.807	8.753
21-Dec	447	202.5	68%	0.230	4.134	0.843	4.977	303.8	68%	0.346	5.603	1.315	6.918	405.0	68%	0.461	6.952	1.804	8.756
22-Dec	448	202.8	68%	0.230	4.137	0.842	4.979	304.1	68%	0.345	5.608	1.313	6.921	405.5	68%	0.460	6.958	1.800	8.759
23-Dec	449	203.0	68%	0.229	4.141	0.840	4.981	304.5	68%	0.344	5.612	1.311	6.923	406.0	68%	0.459	6.964	1.797	8.761
24-Dec	450	203.2	68%	0.229	4.144	0.839	4.983	304.8	68%	0.343	5.617	1.309	6.926	406.4	68%	0.457	6.970	1.794	8.764
25-Dec	451	203.4	68%	0.228	4.148	0.837	4.985	305.2	68%	0.342	5.622	1.306	6.928	406.9	68%	0.456	6.976	1.791	8.767
26-Dec	452	203.7	68%	0.228	4.151	0.836	4.987	305.5	68%	0.342	5.627	1.304	6.931	407.3	68%	0.455	6.982	1.788	8.770
27-Dec	453	203.9	68%	0.227	4.155	0.834	4.989	305.8	68%	0.341	5.631	1.302	6.933	407.8	68%	0.454	6.987	1.785	8.772
28-Dec	454	204.1	68%	0.227	4.158	0.833	4.991	306.2	68%	0.340	5.636	1.299	6.936	408.2	68%	0.453	6.993	1.782	8.775
29-Dec	455	204.3	68%	0.226	4.162	0.831	4.993	306.5	68%	0.339	5.641	1.297	6.938	408.7	68%	0.452	6.999	1.779	8.778
30-Dec	456	204.6	68%	0.226	4.165	0.830	4.995	306.9	68%	0.338	5.645	1.295	6.940	409.1	68%	0.451	7.005	1.775	8.780
31-Dec	457	204.8	68%	0.225	4.169	0.829	4.997	307.2	68%	0.337	5.650	1.293	6.943	409.6	68%	0.450	7.011	1.772	8.783
01-Jan	458	205.0	68%	0.224	4.172	0.827	4.999	307.5	68%	0.337	5.655	1.290	6.945	410.0	68%	0.449	7.016	1.769	8.786
02-Jan	459	205.2	68%	0.224	4.175	0.826	5.001	307.9	68%	0.336	5.659	1.288	6.947	410.5	68%	0.448	7.022	1.766	8.788
03-Jan	460	205.5	68%	0.223	4.179	0.824	5.003	308.2	68%	0.335	5.664	1.286	6.950	410.9	68%	0.447	7.028	1.763	8.791
04-Jan	461	205.7	69%	0.223	4.182	0.823	5.005	308.5	69%	0.334	5.669	1.284	6.952	411.4	69%	0.446	7.034	1.760	8.793

05-Jan	462	205.9	69%	0.222	4.186	0.821	5.007	308.9	69%	0.334	5.673	1.281	6.954	411.8	69%	0.445	7.039	1.757	8.796
06-Jan	463	206.1	69%	0.222	4.189	0.820	5.009	309.2	69%	0.333	5.678	1.279	6.957	412.3	69%	0.444	7.045	1.754	8.798
07-Jan	464	206.4	69%	0.221	4.192	0.818	5.011	309.5	69%	0.332	5.682	1.277	6.959	412.7	69%	0.443	7.051	1.750	8.801
08-Jan	465	206.6	69%	0.221	4.196	0.817	5.013	309.9	69%	0.331	5.687	1.274	6.961	413.2	69%	0.442	7.056	1.747	8.804
09-Jan	466	206.8	69%	0.220	4.199	0.815	5.014	310.2	69%	0.330	5.691	1.272	6.963	413.6	69%	0.441	7.062	1.744	8.806
10-Jan	467	207.0	69%	0.220	4.202	0.814	5.016	310.5	69%	0.330	5.696	1.270	6.966	414.0	69%	0.439	7.068	1.741	8.809
11-Jan	468	207.2	69%	0.219	4.206	0.812	5.018	310.9	69%	0.329	5.700	1.268	6.968	414.5	69%	0.438	7.073	1.738	8.811
12-Jan	469	207.5	69%	0.219	4.209	0.811	5.020	311.2	69%	0.328	5.705	1.265	6.970	414.9	69%	0.437	7.079	1.735	8.814
13-Jan	470	207.7	69%	0.218	4.212	0.810	5.022	311.5	69%	0.327	5.709	1.263	6.972	415.3	69%	0.436	7.084	1.732	8.816
14-Jan	471	207.9	69%	0.218	4.216	0.808	5.024	311.8	69%	0.327	5.714	1.261	6.975	415.8	69%	0.435	7.090	1.729	8.818
15-Jan	472	208.1	69%	0.217	4.219	0.807	5.026	312.2	69%	0.326	5.718	1.258	6.977	416.2	69%	0.434	7.095	1.725	8.821
16-Jan	473	208.3	69%	0.217	4.222	0.805	5.027	312.5	69%	0.325	5.723	1.256	6.979	416.6	69%	0.433	7.101	1.722	8.823
17-Jan	474	208.5	70%	0.216	4.226	0.804	5.029	312.8	70%	0.324	5.727	1.254	6.981	417.1	70%	0.432	7.107	1.719	8.826
18-Jan	475	208.8	70%	0.216	4.229	0.802	5.031	313.1	70%	0.323	5.732	1.252	6.983	417.5	70%	0.431	7.112	1.716	8.828
19-Jan	476	209.0	70%	0.215	4.232	0.801	5.033	313.5	70%	0.323	5.736	1.249	6.986	417.9	70%	0.430	7.118	1.713	8.830
20-Jan	477	209.2	70%	0.215	4.235	0.799	5.035	313.8	70%	0.322	5.741	1.247	6.988	418.4	70%	0.429	7.123	1.710	8.833
21-Jan	478	209.4	70%	0.214	4.239	0.798	5.036	314.1	70%	0.321	5.745	1.245	6.990	418.8	70%	0.428	7.128	1.707	8.835
22-Jan	479	209.6	70%	0.214	4.242	0.796	5.038	314.4	70%	0.320	5.749	1.243	6.992	419.2	70%	0.427	7.134	1.704	8.838
23-Jan	480	209.8	70%	0.213	4.245	0.795	5.040	314.7	70%	0.320	5.754	1.240	6.994	419.7	70%	0.426	7.139	1.700	8.840
24-Jan	481	210.0	70%	0.213	4.248	0.794	5.042	315.1	70%	0.319	5.758	1.238	6.996	420.1	70%	0.425	7.145	1.697	8.842
25-Jan	482	210.3	70%	0.212	4.252	0.792	5.044	315.4	70%	0.318	5.763	1.236	6.998	420.5	70%	0.424	7.150	1.694	8.844
26-Jan	483	210.5	70%	0.212	4.255	0.791	5.045	315.7	70%	0.317	5.767	1.233	7.000	420.9	70%	0.423	7.156	1.691	8.847
27-Jan	484	210.7	70%	0.211	4.258	0.789	5.047	316.0	70%	0.317	5.771	1.231	7.002	421.3	70%	0.422	7.161	1.688	8.849
28-Jan	485	210.9	70%	0.211	4.261	0.788	5.049	316.3	70%	0.316	5.776	1.229	7.004	421.8	70%	0.421	7.166	1.685	8.851
29-Jan	486	211.1	70%	0.210	4.264	0.786	5.051	316.6	70%	0.315	5.780	1.227	7.007	422.2	70%	0.420	7.172	1.682	8.854
30-Jan	487	211.3	70%	0.210	4.267	0.785	5.052	317.0	70%	0.314	5.784	1.224	7.009	422.6	70%	0.419	7.177	1.679	8.856
31-Jan	488	211.5	71%	0.209	4.271	0.783	5.054	317.3	71%	0.314	5.788	1.222	7.011	423.0	71%	0.418	7.182	1.676	8.858
01-Feb	489	211.7	71%	0.209	4.274	0.782	5.056	317.6	71%	0.313	5.793	1.220	7.013	423.4	71%	0.417	7.188	1.673	8.860
02-Feb	490	211.9	71%	0.208	4.277	0.780	5.057	317.9	71%	0.312	5.797	1.218	7.015	423.9	71%	0.416	7.193	1.669	8.862
03-Feb	491	212.1	71%	0.208	4.280	0.779	5.059	318.2	71%	0.311	5.801	1.215	7.017	424.3	71%	0.415	7.198	1.666	8.865
04-Feb	492	212.3	71%	0.207	4.283	0.778	5.061	318.5	71%	0.311	5.806	1.213	7.019	424.7	71%	0.414	7.204	1.663	8.867
05-Feb	493	212.6	71%	0.207	4.286	0.776	5.062	318.8	71%	0.310	5.810	1.211	7.021	425.1	71%	0.413	7.209	1.660	8.869
06-Feb	494	212.8	71%	0.206	4.289	0.775	5.064	319.1	71%	0.309	5.814	1.209	7.023	425.5	71%	0.412	7.214	1.657	8.871
07-Feb	495	213.0	71%	0.206	4.293	0.773	5.066	319.4	71%	0.309	5.818	1.206	7.025	425.9	71%	0.411	7.219	1.654	8.873
08-Feb	496	213.2	71%	0.205	4.296	0.772	5.067	319.8	71%	0.308	5.822	1.204	7.027	426.3	71%	0.410	7.224	1.651	8.875
09-Feb	497	213.4	71%	0.205	4.299	0.770	5.069	320.1	71%	0.307	5.827	1.202	7.028	426.7	71%	0.409	7.230	1.648	8.878
10-Feb	498	213.6	71%	0.204	4.302	0.769	5.071	320.4	71%	0.306	5.831	1.200	7.030	427.2	71%	0.408	7.235	1.645	8.880
11-Feb	499	213.8	71%	0.204	4.305	0.767	5.072	320.7	71%	0.306	5.835	1.197	7.032	427.6	71%	0.408	7.240	1.642	8.882
12-Feb	500	214.0	71%	0.203	4.308	0.766	5.074	321.0	71%	0.305	5.839	1.195	7.034	428.0	71%	0.407	7.245	1.639	8.884
13-Feb	501	214.2	71%	0.203	4.311	0.765	5.076	321.3	71%	0.304	5.843	1.193	7.036	428.4	71%	0.406	7.250	1.636	8.886
14-Feb	502	214.4	71%	0.202	4.314	0.763	5.077	321.6	71%	0.303	5.847	1.191	7.038	428.8	71%	0.405	7.255	1.632	8.888
15-Feb	503	214.6	72%	0.202	4.317	0.762	5.079	321.9	72%	0.303	5.852	1.188	7.040	429.2	72%	0.404	7.261	1.629	8.890
16-Feb	504	214.8	72%	0.201	4.320	0.760	5.081	322.2	72%	0.302	5.856	1.186	7.042	429.6	72%	0.403	7.266	1.626	8.892
17-Feb	505	215.0	72%	0.201	4.323	0.759	5.082	322.5	72%	0.301	5.860	1.184	7.044	430.0	72%	0.402	7.271	1.623	8.894
18-Feb	506	215.2	72%	0.200	4.326	0.757	5.084	322.8	72%	0.301	5.864	1.182	7.046	430.4	72%	0.401	7.276	1.620	8.896
19-Feb	507	215.4	72%	0.200	4.329	0.756	5.085	323.1	72%	0.300	5.868	1.179	7.047	430.8	72%	0.400	7.281	1.617	8.898
20-Feb	508	215.6	72%	0.199	4.332	0.755	5.087	323.4	72%	0.299	5.872	1.177	7.049	431.2	72%	0.399	7.286	1.614	8.900
21-Feb	509	215.8	72%	0.199	4.335	0.753	5.088	323.7	72%	0.299	5.876	1.175	7.051	431.6	72%	0.398	7.291	1.611	8.902
22-Feb	510	216.0	72%	0.199	4.338	0.752	5.090	324.0	72%	0.298	5.880	1.173	7.053	432.0	72%	0.397	7.296	1.608	8.904
23-Feb	511	216.2	72%	0.198	4.341	0.750	5.092	324.3	72%	0.297	5.884	1.171	7.055	432.4	72%	0.396	7.301	1.605	8.906
24-Feb	512	216.4	72%	0.198	4.344	0.749	5.093	324.6	72%	0.296	5.888	1.168	7.057	432.8	72%	0.395	7.306	1.602	8.908
25-Feb	513	216.6	72%	0.197	4.347	0.747	5.095	324.9	72%	0.296	5.892	1.166	7.058	433.2	72%	0.394	7.311	1.599	8.910
26-Feb	514	216.8	72%	0.197	4.350	0.746	5.096	325.2	72%	0.295	5.896	1.164	7.060	433.6	72%	0.393	7.316	1.596	8.912
27-Feb	515	217.0	72%	0.196	4.353	0.745	5.098	325.5	72%	0.294	5.900	1.162	7.062	434.0	72%	0.392	7.321	1.593	8.914
28-Feb	516	217.2	72%	0.196	4.356	0.743	5.099	325.8	72%	0.294	5.904	1.159	7.064	434.3	72%	0.391	7.326	1.590	8.916
01-Mar	517	217.4	72%	0.195	4.359	0.742	5.101	326.1	72%	0.293	5.908	1.157	7.065	434.7	72%	0.391	7.331	1.587	8.918
02-Mar	518	217.6	73%	0.195	4.362	0.740	5.102	326.3	73%	0.292	5.912	1.155	7.067	435.1	73%	0.390	7.336	1.584	8.919
03-Mar	519	217.8	73%	0.194	4.365	0.739	5.104	326.6	73%	0.292	5.916	1.153	7.069	435.5	73%	0.389	7.341	1.581	8.921
04-Mar	520	218.0	73%	0.194	4.368	0.737	5.105	326.9	73%	0.291	5.920	1.151	7.071	435.9	73%	0.388	7.346	1.577	8.923
05-Mar	521	218.1	73%	0.193	4.371	0.736	5.107	327.2	73%	0.290	5.924	1.148	7.072	436.3	73%	0.387	7.351	1.574	8.925
06-Mar	522	218.3	73%	0.193	4.374	0.735	5.108	327.5	73%	0.289	5.928	1.146	7.074	436.7	73%	0.386	7.355	1.571	8.927
07-Mar	523	218.5	73%	0.193	4.376	0.733	5.110	327.8	73%	0.289	5.932	1.144	7.076	437.1	73%	0.385	7.360	1.568	8.929
08-Mar	524	218.7	73%	0.192	4.379	0.732	5.111	328.1	73%	0.288	5.936	1.142	7.078	437.4	73%	0.384	7.365	1.565	8.931
09-Mar	525	218.9	73%	0.192	4.382	0.730	5.113	328.4	73%	0.287	5.940	1.140	7.079	437.8	73%	0.383	7.370	1.562	8.932
10-Mar	526	219.1	73%	0.191	4.385	0.729	5.114	328.7	73%	0.287	5.944	1.137	7.081	438.2	73%	0.382	7.375	1.559	8.934
11-Mar	527	219.3	73%	0.191	4.388	0.728	5.116	328.9	73%	0.286	5.947	1.135	7.083	438.6	73%	0.381	7.380	1.556	8.936
12-Mar	528	219.5	73%	0.190	4.391	0.726	5.117	329.2	73%	0.285	5.951	1.133	7.084	439.0	73%	0.381	7.384	1.553	8.938

13-Mar	529	219.7	73%	0.190	4.394	0.725	5.118	329.5	73%	0.285	5.955	1.131	7.086	439.4	73%	0.380	7.389	1.550	8.940
14-Mar	530	219.9	73%	0.189	4.397	0.723	5.120	329.8	73%	0.284	5.959	1.129	7.088	439.7	73%	0.379	7.394	1.547	8.941
15-Mar	531	220.1	73%	0.189	4.399	0.722	5.121	330.1	73%	0.283	5.963	1.126	7.089	440.1	73%	0.378	7.399	1.544	8.943
16-Mar	532	220.2	73%	0.188	4.402	0.721	5.123	330.4	73%	0.283	5.967	1.124	7.091	440.5	73%	0.377	7.404	1.541	8.945
17-Mar	533	220.4	73%	0.188	4.405	0.719	5.124	330.6	73%	0.282	5.971	1.122	7.092	440.9	73%	0.376	7.408	1.538	8.947
18-Mar	534	220.6	74%	0.188	4.408	0.718	5.126	330.9	74%	0.281	5.974	1.120	7.094	441.2	74%	0.375	7.413	1.535	8.948
19-Mar	535	220.8	74%	0.187	4.411	0.716	5.127	331.2	74%	0.281	5.978	1.118	7.096	441.6	74%	0.374	7.418	1.532	8.950
20-Mar	536	221.0	74%	0.187	4.413	0.715	5.128	331.5	74%	0.280	5.982	1.115	7.097	442.0	74%	0.373	7.422	1.529	8.952
21-Mar	537	221.2	74%	0.186	4.416	0.714	5.130	331.8	74%	0.279	5.986	1.113	7.099	442.4	74%	0.373	7.427	1.526	8.953
22-Mar	538	221.4	74%	0.186	4.419	0.712	5.131	332.0	74%	0.279	5.990	1.111	7.101	442.7	74%	0.372	7.432	1.523	8.955
23-Mar	539	221.6	74%	0.185	4.422	0.711	5.132	332.3	74%	0.278	5.993	1.109	7.102	443.1	74%	0.371	7.436	1.520	8.957
24-Mar	540	221.7	74%	0.185	4.425	0.709	5.134	332.6	74%	0.277	5.997	1.107	7.104	443.5	74%	0.370	7.441	1.517	8.958
25-Mar	541	221.9	74%	0.185	4.427	0.708	5.135	332.9	74%	0.277	6.001	1.105	7.105	443.8	74%	0.369	7.446	1.514	8.960
26-Mar	542	222.1	74%	0.184	4.430	0.707	5.137	333.2	74%	0.276	6.004	1.102	7.107	444.2	74%	0.368	7.450	1.511	8.962
27-Mar	543	222.3	74%	0.184	4.433	0.705	5.138	333.4	74%	0.275	6.008	1.100	7.108	444.6	74%	0.367	7.455	1.508	8.963
28-Mar	544	222.5	74%	0.183	4.436	0.704	5.139	333.7	74%	0.275	6.012	1.098	7.110	444.9	74%	0.366	7.460	1.505	8.965
29-Mar	545	222.7	74%	0.183	4.438	0.702	5.141	334.0	74%	0.274	6.016	1.096	7.111	445.3	74%	0.366	7.464	1.502	8.967
30-Mar	546	222.8	74%	0.182	4.441	0.701	5.142	334.3	74%	0.274	6.019	1.094	7.113	445.7	74%	0.365	7.469	1.499	8.968
31-Mar	547	223.0	74%	0.182	4.444	0.700	5.143	334.5	74%	0.273	6.023	1.092	7.115	446.0	74%	0.364	7.473	1.497	8.970
01-Apr	548	223.2	74%	0.182	4.446	0.698	5.145	334.8	74%	0.272	6.027	1.089	7.116	446.4	74%	0.363	7.478	1.494	8.972
02-Apr	549	223.4	74%	0.181	4.449	0.697	5.146	335.1	74%	0.272	6.030	1.087	7.118	446.8	74%	0.362	7.483	1.491	8.973
03-Apr	550	223.6	75%	0.181	4.452	0.695	5.147	335.3	75%	0.271	6.034	1.085	7.119	447.1	75%	0.361	7.487	1.488	8.975
04-Apr	551	223.7	75%	0.180	4.455	0.694	5.149	335.6	75%	0.270	6.038	1.083	7.121	447.5	75%	0.360	7.492	1.485	8.976
05-Apr	552	223.9	75%	0.180	4.457	0.693	5.150	335.9	75%	0.270	6.041	1.081	7.122	447.8	75%	0.360	7.496	1.482	8.978
06-Apr	553	224.1	75%	0.179	4.460	0.691	5.151	336.2	75%	0.269	6.045	1.079	7.124	448.2	75%	0.359	7.501	1.479	8.979
07-Apr	554	224.3	75%	0.179	4.463	0.690	5.153	336.4	75%	0.268	6.049	1.076	7.125	448.6	75%	0.358	7.505	1.476	8.981
08-Apr	555	224.5	75%	0.179	4.465	0.689	5.154	336.7	75%	0.268	6.052	1.074	7.126	448.9	75%	0.357	7.510	1.473	8.982
09-Apr	556	224.6	75%	0.178	4.468	0.687	5.155	337.0	75%	0.267	6.056	1.072	7.128	449.3	75%	0.356	7.514	1.470	8.984
10-Apr	557	224.8	75%	0.178	4.471	0.686	5.156	337.2	75%	0.267	6.059	1.070	7.129	449.6	75%	0.355	7.518	1.467	8.986
11-Apr	558	225.0	75%	0.177	4.473	0.684	5.158	337.5	75%	0.266	6.063	1.068	7.131	450.0	75%	0.355	7.523	1.464	8.987
12-Apr	559	225.2	75%	0.177	4.476	0.683	5.159	337.8	75%	0.265	6.067	1.066	7.132	450.3	75%	0.354	7.527	1.461	8.989
13-Apr	560	225.3	75%	0.176	4.478	0.682	5.160	338.0	75%	0.265	6.070	1.064	7.134	450.7	75%	0.353	7.532	1.458	8.990
14-Apr	561	225.5	75%	0.176	4.481	0.680	5.161	338.3	75%	0.264	6.074	1.061	7.135	451.0	75%	0.352	7.536	1.455	8.992
15-Apr	562	225.7	75%	0.176	4.484	0.679	5.163	338.5	75%	0.263	6.077	1.059	7.137	451.4	75%	0.351	7.541	1.452	8.993
16-Apr	563	225.9	75%	0.175	4.486	0.678	5.164	338.8	75%	0.263	6.081	1.057	7.138	451.7	75%	0.350	7.545	1.450	8.995
17-Apr	564	226.0	75%	0.175	4.489	0.676	5.165	339.1	75%	0.262	6.084	1.055	7.139	452.1	75%	0.350	7.549	1.447	8.996
18-Apr	565	226.2	75%	0.174	4.491	0.675	5.166	339.3	75%	0.262	6.088	1.053	7.141	452.4	75%	0.349	7.554	1.444	8.997
19-Apr	566	226.4	75%	0.174	4.494	0.674	5.168	339.6	75%	0.261	6.091	1.051	7.142	452.8	75%	0.348	7.558	1.441	8.999
20-Apr	567	226.6	76%	0.174	4.497	0.672	5.169	339.9	76%	0.260	6.095	1.049	7.144	453.1	76%	0.347	7.562	1.438	9.000
21-Apr	568	226.7	76%	0.173	4.499	0.671	5.170	340.1	76%	0.260	6.098	1.047	7.145	453.5	76%	0.346	7.567	1.435	9.002
22-Apr	569	226.9	76%	0.173	4.502	0.670	5.171	340.4	76%	0.259	6.102	1.045	7.146	453.8	76%	0.345	7.571	1.432	9.003
23-Apr	570	227.1	76%	0.172	4.504	0.668	5.173	340.6	76%	0.258	6.105	1.042	7.148	454.2	76%	0.345	7.575	1.429	9.005
24-Apr	571	227.3	76%	0.172	4.507	0.667	5.174	340.9	76%	0.258	6.109	1.040	7.149	454.5	76%	0.344	7.580	1.426	9.006
25-Apr	572	227.4	76%	0.172	4.509	0.665	5.175	341.1	76%	0.257	6.112	1.038	7.150	454.9	76%	0.343	7.584	1.423	9.007
26-Apr	573	227.6	76%	0.171	4.512	0.664	5.176	341.4	76%	0.257	6.116	1.036	7.152	455.2	76%	0.342	7.588	1.421	9.009
27-Apr	574	227.8	76%	0.171	4.515	0.663	5.177	341.7	76%	0.256	6.119	1.034	7.153	455.5	76%	0.341	7.593	1.418	9.010
28-Apr	575	227.9	76%	0.170	4.517	0.661	5.179	341.9	76%	0.255	6.122	1.032	7.154	455.9	76%	0.341	7.597	1.415	9.012
29-Apr	576	228.1	76%	0.170	4.520	0.660	5.180	342.2	76%	0.255	6.126	1.030	7.156	456.2	76%	0.340	7.601	1.412	9.013
30-Apr	577	228.3	76%	0.169	4.522	0.659	5.181	342.4	76%	0.254	6.129	1.028	7.157	456.6	76%	0.339	7.605	1.409	9.014
01-May	578	228.5	76%	0.169	4.525	0.657	5.182	342.7	76%	0.254	6.133	1.026	7.158	456.9	76%	0.338	7.610	1.406	9.016
02-May	579	228.6	76%	0.169	4.527	0.656	5.183	342.9	76%	0.253	6.136	1.024	7.160	457.2	76%	0.337	7.614	1.403	9.017
03-May	580	228.8	76%	0.168	4.530	0.655	5.184	343.2	76%	0.252	6.139	1.021	7.161	457.6	76%	0.337	7.618	1.401	9.018
04-May	581	229.0	76%	0.168	4.532	0.653	5.186	343.4	76%	0.252	6.143	1.019	7.162	457.9	76%	0.336	7.622	1.398	9.020
05-May	582	229.1	76%	0.168	4.535	0.652	5.187	343.7	76%	0.251	6.146	1.017	7.164	458.2	76%	0.335	7.626	1.395	9.021
06-May	583	229.3	76%	0.167	4.537	0.651	5.188	343.9	76%	0.251	6.150	1.015	7.165	458.6	76%	0.334	7.630	1.392	9.022
07-May	584	229.5	76%	0.167	4.540	0.649	5.189	344.2	76%	0.250	6.153	1.013	7.166	458.9	76%	0.333	7.635	1.389	9.024
08-May	585	229.6	77%	0.166	4.542	0.648	5.190	344.4	77%	0.249	6.156	1.011	7.167	459.2	77%	0.333	7.639	1.386	9.025
09-May	586	229.8	77%	0.166	4.545	0.647	5.191	344.7	77%	0.249	6.160	1.009	7.169	459.6	77%	0.332	7.643	1.383	9.026
10-May	587	230.0	77%	0.166	4.547	0.645	5.192	344.9	77%	0.248	6.163	1.007	7.170	459.9	77%	0.331	7.647	1.381	9.028
11-May	588	230.1	77%	0.165	4.549	0.644	5.194	345.2	77%	0.248	6.166	1.005	7.171	460.2	77%	0.330	7.651	1.378	9.029
12-May	589	230.3	77%	0.165	4.552	0.643	5.195	345.4	77%	0.247	6.170	1.003	7.172	460.6	77%	0.330	7.655	1.375	9.030
13-May	590	230.4	77%	0.164	4.554	0.641	5.196	345.7	77%	0.247	6.173	1.001	7.174	460.9	77%	0.329	7.659	1.372	9.032
14-May	591	230.6	77%	0.164	4.557	0.640	5.197	345.9	77%	0.246	6.176	0.999	7.175	461.2	77%	0.328	7.663	1.369	9.033
15-May	592	230.8	77%	0.164	4.559	0.639	5.198	346.2	77%	0.245	6.179	0.997	7.176	461.6	77%	0.327	7.668	1.367	9.034
16-May	593	230.9	77%	0.163	4.562	0.638	5.199	346.4	77%	0.245	6.183	0.995	7.177	461.9	77%	0.326	7.672	1.364	9.035
17-May	594	231.1	77%	0.163	4.564	0.636	5.200	346.7	77%	0.244	6.186	0.993	7.179	462.2	77%	0.326	7.676	1.361	9.037
18-May	595	231.3	77%	0.162	4.566	0.635	5.201	346.9	77%	0.244	6.189	0.991	7.180	462.5	77%	0.325	7.680	1.358	9.038

19-May	596	231.4	77%	0.162	4.569	0.634	5.202	347.1	77%	0.243	6.193	0.988	7.181	462.9	77%	0.324	7.684	1.355	9.039
20-May	597	231.6	77%	0.162	4.571	0.632	5.203	347.4	77%	0.243	6.196	0.986	7.182	463.2	77%	0.323	7.688	1.352	9.040
21-May	598	231.7	77%	0.161	4.574	0.631	5.205	347.6	77%	0.242	6.199	0.984	7.183	463.5	77%	0.323	7.692	1.350	9.041
22-May	599	231.9	77%	0.161	4.576	0.630	5.206	347.9	77%	0.241	6.202	0.982	7.185	463.8	77%	0.322	7.696	1.347	9.043
23-May	600	232.1	77%	0.161	4.578	0.628	5.207	348.1	77%	0.241	6.205	0.980	7.186	464.1	77%	0.321	7.700	1.344	9.044
24-May	601	232.2	77%	0.160	4.581	0.627	5.208	348.3	77%	0.240	6.209	0.978	7.187	464.5	77%	0.320	7.704	1.341	9.045
25-May	602	232.4	77%	0.160	4.583	0.626	5.209	348.6	77%	0.240	6.212	0.976	7.188	464.8	77%	0.320	7.708	1.339	9.046
26-May	603	232.6	78%	0.159	4.585	0.624	5.210	348.8	78%	0.239	6.215	0.974	7.189	465.1	78%	0.319	7.712	1.336	9.048
27-May	604	232.7	78%	0.159	4.588	0.623	5.211	349.1	78%	0.239	6.218	0.972	7.191	465.4	78%	0.318	7.716	1.333	9.049
28-May	605	232.9	78%	0.159	4.590	0.622	5.212	349.3	78%	0.238	6.221	0.970	7.192	465.7	78%	0.317	7.720	1.330	9.050
29-May	606	233.0	78%	0.158	4.592	0.621	5.213	349.5	78%	0.237	6.225	0.968	7.193	466.1	78%	0.317	7.724	1.327	9.051
30-May	607	233.2	78%	0.158	4.595	0.619	5.214	349.8	78%	0.237	6.228	0.966	7.194	466.4	78%	0.316	7.727	1.325	9.052
31-May	608	233.3	78%	0.158	4.597	0.618	5.215	350.0	78%	0.236	6.231	0.964	7.195	466.7	78%	0.315	7.731	1.322	9.053
01-Jun	609	233.5	78%	0.157	4.599	0.617	5.216	350.2	78%	0.236	6.234	0.962	7.196	467.0	78%	0.314	7.735	1.319	9.055
02-Jun	610	233.7	78%	0.157	4.602	0.615	5.217	350.5	78%	0.235	6.237	0.960	7.197	467.3	78%	0.314	7.739	1.316	9.056
03-Jun	611	233.8	78%	0.156	4.604	0.614	5.218	350.7	78%	0.235	6.240	0.958	7.199	467.6	78%	0.313	7.743	1.314	9.057
04-Jun	612	234.0	78%	0.156	4.606	0.613	5.219	351.0	78%	0.234	6.243	0.956	7.200	467.9	78%	0.312	7.747	1.311	9.058
05-Jun	613	234.1	78%	0.156	4.609	0.612	5.220	351.2	78%	0.234	6.247	0.954	7.201	468.2	78%	0.311	7.751	1.308	9.059
06-Jun	614	234.3	78%	0.155	4.611	0.610	5.221	351.4	78%	0.233	6.250	0.952	7.202	468.6	78%	0.311	7.755	1.306	9.060
07-Jun	615	234.4	78%	0.155	4.613	0.609	5.222	351.7	78%	0.232	6.253	0.950	7.203	468.9	78%	0.310	7.759	1.303	9.061
08-Jun	616	234.6	78%	0.155	4.616	0.608	5.223	351.9	78%	0.232	6.256	0.948	7.204	469.2	78%	0.309	7.762	1.300	9.062
09-Jun	617	234.7	78%	0.154	4.618	0.606	5.224	352.1	78%	0.231	6.259	0.946	7.205	469.5	78%	0.308	7.766	1.297	9.064
10-Jun	618	234.9	78%	0.154	4.620	0.605	5.225	352.3	78%	0.231	6.262	0.944	7.206	469.8	78%	0.308	7.770	1.295	9.065
11-Jun	619	235.1	78%	0.153	4.622	0.604	5.226	352.6	78%	0.230	6.265	0.942	7.207	470.1	78%	0.307	7.774	1.292	9.066
12-Jun	620	235.2	78%	0.153	4.625	0.603	5.227	352.8	78%	0.230	6.268	0.940	7.208	470.4	78%	0.306	7.778	1.289	9.067
13-Jun	621	235.4	78%	0.153	4.627	0.601	5.228	353.0	78%	0.229	6.271	0.938	7.210	470.7	78%	0.306	7.781	1.286	9.068
14-Jun	622	235.5	79%	0.152	4.629	0.600	5.229	353.3	79%	0.229	6.274	0.936	7.211	471.0	79%	0.305	7.785	1.284	9.069
15-Jun	623	235.7	79%	0.152	4.631	0.599	5.230	353.5	79%	0.228	6.277	0.934	7.212	471.3	79%	0.304	7.789	1.281	9.070
16-Jun	624	235.8	79%	0.152	4.634	0.598	5.231	353.7	79%	0.228	6.280	0.932	7.213	471.6	79%	0.303	7.793	1.278	9.071
17-Jun	625	236.0	79%	0.151	4.636	0.596	5.232	353.9	79%	0.227	6.283	0.930	7.214	471.9	79%	0.303	7.796	1.276	9.072
18-Jun	626	236.1	79%	0.151	4.638	0.595	5.233	354.2	79%	0.226	6.286	0.928	7.215	472.2	79%	0.302	7.800	1.273	9.073
19-Jun	627	236.3	79%	0.151	4.640	0.594	5.234	354.4	79%	0.226	6.289	0.927	7.216	472.5	79%	0.301	7.804	1.270	9.074
20-Jun	628	236.4	79%	0.150	4.642	0.593	5.235	354.6	79%	0.225	6.292	0.925	7.217	472.8	79%	0.301	7.808	1.268	9.075
21-Jun	629	236.6	79%	0.150	4.645	0.591	5.236	354.8	79%	0.225	6.295	0.923	7.218	473.1	79%	0.300	7.811	1.265	9.076
22-Jun	630	236.7	79%	0.150	4.647	0.590	5.237	355.1	79%	0.224	6.298	0.921	7.219	473.4	79%	0.299	7.815	1.262	9.077
23-Jun	631	236.9	79%	0.149	4.649	0.589	5.238	355.3	79%	0.224	6.301	0.919	7.220	473.7	79%	0.298	7.819	1.260	9.078
24-Jun	632	237.0	79%	0.149	4.651	0.588	5.239	355.5	79%	0.223	6.304	0.917	7.221	474.0	79%	0.298	7.822	1.257	9.079
25-Jun	633	237.2	79%	0.149	4.653	0.586	5.240	355.7	79%	0.223	6.307	0.915	7.222	474.3	79%	0.297	7.826	1.254	9.080
26-Jun	634	237.3	79%	0.148	4.656	0.585	5.241	356.0	79%	0.222	6.310	0.913	7.223	474.6	79%	0.296	7.830	1.252	9.081
27-Jun	635	237.5	79%	0.148	4.658	0.584	5.242	356.2	79%	0.222	6.313	0.911	7.224	474.9	79%	0.296	7.833	1.249	9.082
28-Jun	636	237.6	79%	0.147	4.660	0.583	5.243	356.4	79%	0.221	6.316	0.909	7.225	475.2	79%	0.295	7.837	1.246	9.083
29-Jun	637	237.8	79%	0.147	4.662	0.581	5.244	356.6	79%	0.221	6.319	0.907	7.226	475.5	79%	0.294	7.841	1.244	9.084
30-Jun	638	237.9	79%	0.147	4.664	0.580	5.244	356.8	79%	0.220	6.322	0.905	7.227	475.8	79%	0.294	7.844	1.241	9.085
01-Jul	639	238.0	79%	0.146	4.666	0.579	5.245	357.1	79%	0.220	6.325	0.903	7.228	476.1	79%	0.293	7.848	1.238	9.086
02-Jul	640	238.2	79%	0.146	4.669	0.578	5.246	357.3	79%	0.219	6.328	0.901	7.229	476.4	79%	0.292	7.852	1.236	9.087
03-Jul	641	238.3	79%	0.146	4.671	0.576	5.247	357.5	79%	0.219	6.331	0.899	7.230	476.7	79%	0.291	7.855	1.233	9.088
04-Jul	642	238.5	79%	0.145	4.673	0.575	5.248	357.7	79%	0.218	6.334	0.897	7.231	477.0	79%	0.291	7.859	1.231	9.089
05-Jul	643	238.6	80%	0.145	4.675	0.574	5.249	357.9	80%	0.218	6.337	0.896	7.232	477.3	80%	0.290	7.862	1.228	9.090
06-Jul	644	238.8	80%	0.145	4.677	0.573	5.250	358.2	80%	0.217	6.339	0.894	7.233	477.5	80%	0.289	7.866	1.225	9.091
07-Jul	645	238.9	80%	0.144	4.679	0.572	5.251	358.4	80%	0.217	6.342	0.892	7.234	477.8	80%	0.289	7.870	1.223	9.092
08-Jul	646	239.1	80%	0.144	4.681	0.570	5.252	358.6	80%	0.216	6.345	0.890	7.235	478.1	80%	0.288	7.873	1.220	9.093
09-Jul	647	239.2	80%	0.144	4.683	0.569	5.253	358.8	80%	0.216	6.348	0.888	7.236	478.4	80%	0.287	7.877	1.217	9.094
10-Jul	648	239.3	80%	0.143	4.686	0.568	5.253	359.0	80%	0.215	6.351	0.886	7.237	478.7	80%	0.287	7.880	1.215	9.095
11-Jul	649	239.5	80%	0.143	4.688	0.567	5.254	359.2	80%	0.215	6.354	0.884	7.238	479.0	80%	0.286	7.884	1.212	9.096
12-Jul	650	239.6	80%	0.143	4.690	0.565	5.255	359.4	80%	0.214	6.357	0.882	7.239	479.3	80%	0.285	7.887	1.210	9.097
13-Jul	651	239.8	80%	0.142	4.692	0.564	5.256	359.7	80%	0.213	6.359	0.880	7.240	479.6	80%	0.285	7.891	1.207	9.098
14-Jul	652	239.9	80%	0.142	4.694	0.563	5.257	359.9	80%	0.213	6.362	0.878	7.241	479.8	80%	0.284	7.894	1.204	9.099
15-Jul	653	240.1	80%	0.142	4.696	0.562	5.258	360.1	80%	0.212	6.365	0.877	7.242	480.1	80%	0.283	7.898	1.202	9.100
16-Jul	654	240.2	80%	0.141	4.698	0.561	5.259	360.3	80%	0.212	6.368	0.875	7.243	480.4	80%	0.283	7.901	1.199	9.101
17-Jul	655	240.3	80%	0.141	4.700	0.559	5.260	360.5	80%	0.211	6.371	0.873	7.243	480.7	80%	0.282	7.905	1.197	9.101
18-Jul	656	240.5	80%	0.141	4.702	0.558	5.260	360.7	80%	0.211	6.373	0.871	7.244	481.0	80%	0.281	7.908	1.194	9.102
19-Jul	657	240.6	80%	0.140	4.704	0.557	5.261	360.9	80%	0.210	6.376	0.869	7.245	481.2	80%	0.281	7.912	1.192	9.103
20-Jul	658	240.8	80%	0.140	4.706	0.556	5.262	361.1	80%	0.210	6.379	0.867	7.246	481.5	80%	0.280	7.915	1.189	9.104
21-Jul	659	240.9	80%	0.140	4.708	0.555	5.263	361.4	80%	0.210	6.382	0.865	7.247	481.8	80%	0.279	7.919	1.186	9.105
22-Jul	660	241.0	80%	0.139	4.710	0.553	5.264	361.6	80%	0.209	6.385	0.863	7.248	482.1	80%	0.279	7.922	1.184	9.106
23-Jul	661	241.2	80%	0.139	4.712	0.552	5.265	361.8	80%	0.209	6.387	0.862	7.249	482.4	80%	0.278	7.925	1.181	9.107
24-Jul	662	241.3	80%	0.139	4.714	0.551	5.266	362.0	80%	0.208	6.390	0.860	7.250	482.6	80%	0.277	7.929	1.179	9.108

	25-Jul	663		241.5	80%	0.138	4.717	0.550		5.266	362.2	80%	0.208	6.393	0.858		7.251	482.9	80%	0.277	7.932	1.176		9.108
	26-Jul	664		241.6	81%	0.138	4.719	0.549		5.267	362.4	81%	0.207	6.396	0.856		7.252	483.2	81%	0.276	7.936	1.174		9.109
	27-Jul	665		241.7	81%	0.138	4.721	0.548		5.268	362.6	81%	0.207	6.398	0.854		7.252	483.5	81%	0.275	7.939	1.171		9.110
	28-Jul	666		241.9	81%	0.137	4.723	0.546		5.269	362.8	81%	0.206	6.401	0.852		7.253	483.7	81%	0.275	7.942	1.169		9.111
	29-Jul	667		242.0	81%	0.137	4.725	0.545		5.270	363.0	81%	0.206	6.404	0.851		7.254	484.0	81%	0.274	7.946	1.166		9.112
	30-Jul	668		242.1	81%	0.137	4.727	0.544		5.271	363.2	81%	0.205	6.406	0.849		7.255	484.3	81%	0.273	7.949	1.164		9.113
	31-Jul	669		242.3	81%	0.136	4.729	0.543		5.271	363.4	81%	0.205	6.409	0.847		7.256	484.6	81%	0.273	7.952	1.161		9.114
	01-Aug	670		242.4	81%	0.136	4.731	0.542		5.272	363.6	81%	0.204	6.412	0.845		7.257	484.8	81%	0.272	7.956	1.159		9.114
	02-Aug	671		242.6	81%	0.136	4.733	0.540		5.273	363.8	81%	0.204	6.415	0.843		7.258	485.1	81%	0.272	7.959	1.156		9.115
	03-Aug	672		242.7	81%	0.135	4.735	0.539		5.274	364.0	81%	0.203	6.417	0.841		7.259	485.4	81%	0.271	7.963	1.154		9.116
	04-Aug	673		242.8	81%	0.135	4.737	0.538		5.275	364.2	81%	0.203	6.420	0.840		7.259	485.6	81%	0.270	7.966	1.151		9.117
	05-Aug	674		243.0	81%	0.135	4.738	0.537		5.275	364.4	81%	0.202	6.423	0.838		7.260	485.9	81%	0.270	7.969	1.149		9.118
	06-Aug	675		243.1	81%	0.134	4.740	0.536		5.276	364.6	81%	0.202	6.425	0.836		7.261	486.2	81%	0.269	7.972	1.146		9.119
	07-Aug	676		243.2	81%	0.134	4.742	0.535		5.277	364.8	81%	0.201	6.428	0.834		7.262	486.5	81%	0.268	7.976	1.144		9.119
	08-Aug	677		243.4	81%	0.134	4.744	0.533		5.278	365.0	81%	0.201	6.431	0.832		7.263	486.7	81%	0.268	7.979	1.141		9.120
	09-Aug	678		243.5	81%	0.134	4.746	0.532		5.279	365.2	81%	0.200	6.433	0.830		7.264	487.0	81%	0.267	7.982	1.139		9.121
	10-Aug	679		243.6	81%	0.133	4.748	0.531		5.279	365.4	81%	0.200	6.436	0.829		7.264	487.3	81%	0.266	7.986	1.136		9.122
	11-Aug	680		243.8	81%	0.133	4.750	0.530		5.280	365.6	81%	0.199	6.438	0.827		7.265	487.5	81%	0.266	7.989	1.134		9.123
	12-Aug	681		243.9	81%	0.133	4.752	0.529		5.281	365.8	81%	0.199	6.441	0.825		7.266	487.8	81%	0.265	7.992	1.131		9.123
	13-Aug	682		244.0	81%	0.132	4.754	0.528		5.282	366.0	81%	0.198	6.444	0.823		7.267	488.1	81%	0.265	7.995	1.129		9.124
	14-Aug	683		244.2	81%	0.132	4.756	0.527		5.283	366.2	81%	0.198	6.446	0.821		7.268	488.3	81%	0.264	7.999	1.126		9.125
	15-Aug	684		244.3	81%	0.132	4.758	0.525		5.283	366.4	81%	0.197	6.449	0.820		7.269	488.6	81%	0.263	8.002	1.124		9.126
	16-Aug	685		244.4	81%	0.131	4.760	0.524		5.284	366.6	81%	0.197	6.452	0.818		7.269	488.8	81%	0.263	8.005	1.121		9.126
	17-Aug	686		244.6	82%	0.131	4.762	0.523		5.285	366.8	82%	0.197	6.454	0.816		7.270	489.1	82%	0.262	8.008	1.119		9.127
	18-Aug	687		244.7	82%	0.131	4.764	0.522		5.286	367.0	82%	0.196	6.457	0.814		7.271	489.4	82%	0.261	8.012	1.116		9.128
	19-Aug	688		244.8	82%	0.130	4.766	0.521		5.286	367.2	82%	0.196	6.459	0.813		7.272	489.6	82%	0.261	8.015	1.114		9.129
	20-Aug	689		244.9	82%	0.130	4.767	0.520		5.287	367.4	82%	0.195	6.462	0.811		7.273	489.9	82%	0.260	8.018	1.112		9.129
	21-Aug	690		245.1	82%	0.130	4.769	0.519		5.288	367.6	82%	0.195	6.464	0.809		7.273	490.1	82%	0.260	8.021	1.109		9.130
	22-Aug	691		245.2	82%	0.130	4.771	0.517		5.289	367.8	82%	0.194	6.467	0.807		7.274	490.4	82%	0.259	8.024	1.107		9.131
	23-Aug	692		245.3	82%	0.129	4.773	0.516		5.289	368.0	82%	0.194	6.470	0.805		7.275	490.7	82%	0.258	8.027	1.104		9.132
	24-Aug	693		245.5	82%	0.129	4.775	0.515		5.290	368.2	82%	0.193	6.472	0.804		7.276	490.9	82%	0.258	8.031	1.102		9.132
	25-Aug	694		245.6	82%	0.129	4.777	0.514		5.291	368.4	82%	0.193	6.475	0.802		7.277	491.2	82%	0.257	8.034	1.099		9.133
	26-Aug	695		245.7	82%	0.128	4.779	0.513		5.292	368.6	82%	0.192	6.477	0.800		7.277	491.4	82%	0.257	8.037	1.097		9.134
	27-Aug	696		245.8	82%	0.128	4.781	0.512		5.292	368.8	82%	0.192	6.480	0.798		7.278	491.7	82%	0.256	8.040	1.095		9.135
	28-Aug	697		246.0	82%	0.128	4.783	0.511		5.293	369.0	82%	0.192	6.482	0.797		7.279	491.9	82%	0.255	8.043	1.092		9.135
	29-Aug	698		246.1	82%	0.127	4.784	0.509		5.294	369.1	82%	0.191	6.485	0.795		7.280	492.2	82%	0.255	8.046	1.090		9.136
	30-Aug	699		246.2	82%	0.127	4.786	0.508		5.295	369.3	82%	0.191	6.487	0.793		7.280	492.5	82%	0.254	8.049	1.087		9.137
	31-Aug	700		246.4	82%	0.127	4.788	0.507		5.295	369.5	82%	0.190	6.490	0.791		7.281	492.7	82%	0.254	8.053	1.085		9.138
	01-Sep	701		246.5	82%	0.126	4.790	0.506		5.296	369.7	82%	0.190	6.492	0.790		7.282	493.0	82%	0.253	8.056	1.083		9.138
	02-Sep	702		246.6	82%	0.126	4.792	0.505		5.297	369.9	82%	0.189	6.495	0.788		7.283	493.2	82%	0.252	8.059	1.080		9.139
	03-Sep	703		246.7	82%	0.126	4.794	0.504		5.297	370.1	82%	0.189	6.497	0.786		7.283	493.5	82%	0.252	8.062	1.078		9.140
	04-Sep	704		246.9	82%	0.126	4.795	0.503		5.298	370.3	82%	0.188	6.500	0.784		7.284	493.7	82%	0.251	8.065	1.075		9.140
	05-Sep	705		247.0	82%	0.125	4.797	0.502		5.299	370.5	82%	0.188	6.502	0.783		7.285	494.0	82%	0.251	8.068	1.073		9.141
	06-Sep	706		247.1	82%	0.125	4.799	0.501		5.300	370.7	82%	0.188	6.505	0.781		7.286	494.2	82%	0.250	8.071	1.071		9.142
	07-Sep	707		247.2	82%	0.125	4.801	0.499		5.300	370.8	82%	0.187	6.507	0.779		7.286	494.5	82%	0.249	8.074	1.068		9.142
	08-Sep	708		247.4	82%	0.124	4.803	0.498		5.301	371.0	82%	0.187	6.510	0.778		7.287	494.7	82%	0.249	8.077	1.066		9.143
	09-Sep	709		247.5	82%	0.124	4.804	0.497		5.302	371.2	82%	0.186	6.512	0.776		7.288	495.0	82%	0.248	8.080	1.064		9.144
	10-Sep	710		247.6	83%	0.124	4.806	0.496		5.302	371.4	83%	0.186	6.514	0.774		7.289	495.2	83%	0.248	8.083	1.061		9.144
	11-Sep	711		247.7	83%	0.124	4.808	0.495		5.303	371.6	83%	0.185	6.517	0.772		7.289	495.5	83%	0.247	8.086	1.059		9.145
	12-Sep	712		247.9	83%	0.123	4.810	0.494		5.304	371.8	83%	0.185	6.519	0.771		7.290	495.7	83%	0.246	8.089	1.057		9.146
	13-Sep	713		248.0	83%	0.123	4.812	0.493		5.305	372.0	83%	0.184	6.522	0.769		7.291	496.0	83%	0.246	8.092	1.054		9.147
	14-Sep	714		248.1	83%	0.123	4.813	0.492		5.305	372.1	83%	0.184	6.524	0.767		7.291	496.2	83%	0.245	8.095	1.052		9.147
	15-Sep	715		248.2	83%	0.122	4.815	0.491		5.306	372.3	83%	0.184	6.527	0.766		7.292	496.4	83%	0.245	8.098	1.050		9.148
	16-Sep	716		248.3	83%	0.122	4.817	0.490		5.307	372.5	83%	0.183	6.529	0.764		7.293	496.7	83%	0.244	8.101	1.047		9.149
	17-Sep	717		248.5	83%	0.122	4.819	0.488		5.307	372.7	83%	0.183	6.531	0.762		7.294	496.9	83%	0.244	8.104	1.045		9.149
	18-Sep	718		248.6	83%	0.122	4.821	0.487		5.308	372.9	83%	0.182	6.534	0.760		7.294	497.2	83%	0.243	8.107	1.043		9.150
	19-Sep	719		248.7	83%	0.121	4.822	0.486		5.309	373.1	83%	0.182	6.536	0.759		7.295	497.4	83%	0.242	8.110	1.040		9.150
	20-Sep	720		248.8	83%	0.121	4.824	0.485		5.309	373.2	83%	0.181	6.539	0.757		7.296	497.7	83%	0.242	8.113	1.038		9.151
	21-Sep	721		248.9	83%	0.121	4.826	0.484		5.310	373.4	83%	0.181	6.541	0.755		7.296	497.9	83%	0.241	8.116	1.036		9.152
First Breeding	22-Sep	722	1	249.1	83%	0.120	4.828	0.483	0.005	5.316	373.6	83%	0.181	6.543	0.754	0.007	7.304	498.1	83%	0.241	8.119	1.033	0.010	9.162
	23-Sep	723	2	249.2	83%	0.120	4.829	0.482	0.005	5.316	373.8	83%	0.180	6.546	0.752	0.008	7.305	498.4	83%	0.240	8.122	1.031	0.010	9.163
	24-Sep	724	3	249.3	83%	0.120	4.831	0.481	0.005	5.317	374.0	83%	0.180	6.548	0.750	0.008	7.306	498.6	83%	0.240	8.125	1.029	0.010	9.164
	25-Sep	725	4	249.4	83%	0.120	4.833	0.480	0.005	5.318	374.1	83%	0.179	6.550	0.749	0.008	7.307	498.9	83%	0.239	8.128	1.026	0.011	9.165
	26-Sep	726	5	249.5	83%	0.119	4.835	0.479	0.006	5.319	374.3	83%	0.179	6.553	0.747	0.008	7.308	499.1	83%	0.238	8.131	1.024	0.011	9.166
	27-Sep	727	6	249.7	83%	0.119	4.836	0.478	0.006	5.320	374.5	83%	0.178	6.555	0.745	0.009	7.309	499.3	83%	0.238	8.134	1.022	0.011	9.167
	28-Sep	728	7	249.8	83%	0.119	4.838	0.477	0.006	5.321	374.7	83%	0.178	6.557	0.744	0.009	7.310	499.6	83%	0.237	8.137	1.020	0.012	9.168
	29-Sep	729	8	249.9	83%	0.118	4.840	0.476	0.006	5.321	374.9	83%	0.178	6.560	0.742	0.009	7.311	499.8	83%	0.237	8.139	1.017	0.012	9.169

30-Sep	730	9	250.0	83%	0.118	4.841	0.475	0.006	5.322	375.0	83%	0.177	6.562	0.740	0.009	7.312	500.0	83%	0.236	8.142	1.015	0.013	9.170
01-Oct	731	10	250.1	83%	0.118	4.843	0.473	0.006	5.323	375.2	83%	0.177	6.564	0.739	0.010	7.313	500.3	83%	0.236	8.145	1.013	0.013	9.171
02-Oct	732	11	250.3	83%	0.118	4.845	0.472	0.007	5.324	375.4	83%	0.176	6.567	0.737	0.010	7.314	500.5	83%	0.235	8.148	1.011	0.013	9.172
03-Oct	733	12	250.4	83%	0.117	4.847	0.471	0.007	5.325	375.6	83%	0.176	6.569	0.735	0.010	7.315	500.7	83%	0.235	8.151	1.008	0.014	9.173
04-Oct	734	13	250.5	83%	0.117	4.848	0.470	0.007	5.326	375.7	83%	0.176	6.571	0.734	0.011	7.316	501.0	83%	0.234	8.154	1.006	0.014	9.174
05-Oct	735	14	250.6	84%	0.117	4.850	0.469	0.007	5.326	375.9	84%	0.175	6.574	0.732	0.011	7.317	501.2	84%	0.233	8.157	1.004	0.015	9.175
06-Oct	736	15	250.7	84%	0.116	4.852	0.468	0.008	5.327	376.1	84%	0.175	6.576	0.730	0.011	7.318	501.4	84%	0.233	8.159	1.002	0.015	9.176
07-Oct	737	16	250.8	84%	0.116	4.853	0.467	0.008	5.328	376.3	84%	0.174	6.578	0.729	0.012	7.319	501.7	84%	0.232	8.162	0.999	0.015	9.177
08-Oct	738	17	251.0	84%	0.116	4.855	0.466	0.008	5.329	376.4	84%	0.174	6.580	0.727	0.012	7.320	501.9	84%	0.232	8.165	0.997	0.016	9.178
09-Oct	739	18	251.1	84%	0.116	4.857	0.465	0.008	5.330	376.6	84%	0.173	6.583	0.726	0.012	7.321	502.1	84%	0.231	8.168	0.995	0.016	9.179
10-Oct	740	19	251.2	84%	0.115	4.858	0.464	0.008	5.331	376.8	84%	0.173	6.585	0.724	0.013	7.322	502.4	84%	0.231	8.171	0.993	0.017	9.180
11-Oct	741	20	251.3	84%	0.115	4.860	0.463	0.009	5.332	377.0	84%	0.173	6.587	0.722	0.013	7.323	502.6	84%	0.230	8.174	0.990	0.017	9.181
12-Oct	742	21	251.4	84%	0.115	4.862	0.462	0.009	5.333	377.1	84%	0.172	6.590	0.721	0.013	7.324	502.8	84%	0.230	8.176	0.988	0.018	9.182
13-Oct	743	22	251.5	84%	0.115	4.863	0.461	0.009	5.333	377.3	84%	0.172	6.592	0.719	0.014	7.325	503.1	84%	0.229	8.179	0.986	0.018	9.184
14-Oct	744	23	251.6	84%	0.114	4.865	0.460	0.010	5.334	377.5	84%	0.171	6.594	0.717	0.014	7.326	503.3	84%	0.229	8.182	0.984	0.019	9.185
15-Oct	745	24	251.8	84%	0.114	4.867	0.459	0.010	5.335	377.6	84%	0.171	6.596	0.716	0.015	7.327	503.5	84%	0.228	8.185	0.982	0.020	9.186
16-Oct	746	25	251.9	84%	0.114	4.868	0.458	0.010	5.336	377.8	84%	0.171	6.599	0.714	0.015	7.328	503.7	84%	0.227	8.187	0.979	0.020	9.187
17-Oct	747	26	252.0	84%	0.113	4.870	0.457	0.010	5.337	378.0	84%	0.170	6.601	0.713	0.016	7.329	504.0	84%	0.227	8.190	0.977	0.021	9.188
18-Oct	748	27	252.1	84%	0.113	4.872	0.456	0.011	5.338	378.2	84%	0.170	6.603	0.711	0.016	7.330	504.2	84%	0.226	8.193	0.975	0.021	9.189
19-Oct	749	28	252.2	84%	0.113	4.873	0.455	0.011	5.339	378.3	84%	0.169	6.605	0.709	0.017	7.331	504.4	84%	0.226	8.196	0.973	0.022	9.190
20-Oct	750	29	252.3	84%	0.113	4.875	0.454	0.011	5.340	378.5	84%	0.169	6.607	0.708	0.017	7.332	504.7	84%	0.225	8.199	0.971	0.023	9.192
21-Oct	751	30	252.4	84%	0.112	4.876	0.453	0.012	5.341	378.7	84%	0.169	6.610	0.706	0.017	7.333	504.9	84%	0.225	8.201	0.968	0.023	9.193
22-Oct	752	31	252.6	84%	0.112	4.878	0.452	0.012	5.342	378.8	84%	0.168	6.612	0.705	0.018	7.334	505.1	84%	0.224	8.204	0.966	0.024	9.194
23-Oct	753	32	252.7	84%	0.112	4.880	0.451	0.012	5.343	379.0	84%	0.168	6.614	0.703	0.019	7.336	505.3	84%	0.224	8.207	0.964	0.025	9.195
24-Oct	754	33	252.8	84%	0.112	4.881	0.450	0.013	5.344	379.2	84%	0.167	6.616	0.701	0.019	7.337	505.5	84%	0.223	8.209	0.962	0.025	9.197
25-Oct	755	34	252.9	84%	0.111	4.883	0.449	0.013	5.345	379.3	84%	0.167	6.618	0.700	0.020	7.338	505.8	84%	0.223	8.212	0.960	0.026	9.198
26-Oct	756	35	253.0	84%	0.111	4.885	0.448	0.013	5.346	379.5	84%	0.167	6.621	0.698	0.020	7.339	506.0	84%	0.222	8.215	0.957	0.027	9.199
27-Oct	757	36	253.1	84%	0.111	4.886	0.447	0.014	5.347	379.7	84%	0.166	6.623	0.697	0.021	7.340	506.2	84%	0.222	8.218	0.955	0.028	9.201
28-Oct	758	37	253.2	84%	0.111	4.888	0.446	0.014	5.348	379.8	84%	0.166	6.625	0.695	0.021	7.341	506.4	84%	0.221	8.220	0.953	0.028	9.202
29-Oct	759	38	253.3	84%	0.110	4.889	0.445	0.015	5.349	380.0	84%	0.165	6.627	0.694	0.022	7.343	506.7	84%	0.221	8.223	0.951	0.029	9.203
30-Oct	760	39	253.4	84%	0.110	4.891	0.444	0.015	5.350	380.2	84%	0.165	6.629	0.692	0.023	7.344	506.9	84%	0.220	8.226	0.949	0.030	9.205
31-Oct	761	40	253.5	85%	0.110	4.893	0.443	0.016	5.351	380.3	85%	0.165	6.631	0.690	0.023	7.345	507.1	85%	0.220	8.228	0.947	0.031	9.206
01-Nov	762	41	253.7	85%	0.110	4.894	0.442	0.016	5.352	380.5	85%	0.164	6.634	0.689	0.024	7.346	507.3	85%	0.219	8.231	0.945	0.032	9.207
02-Nov	763	42	253.8	85%	0.109	4.896	0.441	0.016	5.353	380.7	85%	0.164	6.636	0.687	0.025	7.348	507.5	85%	0.219	8.234	0.942	0.033	9.209
03-Nov	764	43	253.9	85%	0.109	4.897	0.440	0.017	5.354	380.8	85%	0.164	6.638	0.686	0.025	7.349	507.8	85%	0.218	8.236	0.940	0.034	9.210
04-Nov	765	44	254.0	85%	0.109	4.899	0.439	0.017	5.355	381.0	85%	0.163	6.640	0.684	0.026	7.350	508.0	85%	0.217	8.239	0.938	0.035	9.212
05-Nov	766	45	254.1	85%	0.108	4.900	0.438	0.018	5.356	381.1	85%	0.163	6.642	0.683	0.027	7.352	508.2	85%	0.217	8.242	0.936	0.036	9.213
06-Nov	767	46	254.2	85%	0.108	4.902	0.437	0.018	5.357	381.3	85%	0.162	6.644	0.681	0.028	7.353	508.4	85%	0.216	8.244	0.934	0.037	9.215
07-Nov	768	47	254.3	85%	0.108	4.904	0.436	0.019	5.358	381.5	85%	0.162	6.646	0.680	0.028	7.354	508.6	85%	0.216	8.247	0.932	0.038	9.216
08-Nov	769	48	254.4	85%	0.108	4.905	0.435	0.019	5.359	381.6	85%	0.162	6.648	0.678	0.029	7.356	508.8	85%	0.215	8.249	0.930	0.039	9.218
09-Nov	770	49	254.5	85%	0.107	4.907	0.434	0.020	5.360	381.8	85%	0.161	6.651	0.677	0.030	7.357	509.0	85%	0.215	8.252	0.928	0.040	9.220
10-Nov	771	50	254.6	85%	0.107	4.908	0.433	0.021	5.361	381.9	85%	0.161	6.653	0.675	0.031	7.358	509.3	85%	0.214	8.255	0.925	0.041	9.221
11-Nov	772	51	254.7	85%	0.107	4.910	0.432	0.021	5.363	382.1	85%	0.160	6.655	0.673	0.032	7.360	509.5	85%	0.214	8.257	0.923	0.042	9.223
12-Nov	773	52	254.8	85%	0.107	4.911	0.431	0.022	5.364	382.3	85%	0.160	6.657	0.672	0.033	7.361	509.7	85%	0.213	8.260	0.921	0.043	9.224
13-Nov	774	53	255.0	85%	0.106	4.913	0.430	0.022	5.365	382.4	85%	0.160	6.659	0.670	0.033	7.363	509.9	85%	0.213	8.262	0.919	0.045	9.226
14-Nov	775	54	255.1	85%	0.106	4.914	0.429	0.023	5.366	382.6	85%	0.159	6.661	0.669	0.034	7.364	510.1	85%	0.212	8.265	0.917	0.046	9.228
15-Nov	776	55	255.2	85%	0.106	4.916	0.428	0.024	5.367	382.7	85%	0.159	6.663	0.667	0.035	7.366	510.3	85%	0.212	8.268	0.915	0.047	9.230
16-Nov	777	56	255.3	85%	0.106	4.917	0.427	0.024	5.368	382.9	85%	0.159	6.665	0.666	0.036	7.367	510.5	85%	0.211	8.270	0.913	0.048	9.231
17-Nov	778	57	255.4	85%	0.105	4.919	0.426	0.025	5.370	383.1	85%	0.158	6.667	0.664	0.037	7.369	510.8	85%	0.211	8.273	0.911	0.050	9.233
18-Nov	779	58	255.5	85%	0.105	4.920	0.425	0.026	5.371	383.2	85%	0.158	6.669	0.663	0.038	7.370	511.0	85%	0.210	8.275	0.909	0.051	9.235
19-Nov	780	59	255.6	85%	0.105	4.922	0.424	0.026	5.372	383.4	85%	0.157	6.671	0.661	0.039	7.372	511.2	85%	0.210	8.278	0.907	0.053	9.237
20-Nov	781	60	255.7	85%	0.105	4.924	0.423	0.027	5.373	383.5	85%	0.157	6.673	0.660	0.041	7.374	511.4	85%	0.209	8.280	0.905	0.054	9.239
21-Nov	782	61	255.8	85%	0.104	4.925	0.422	0.028	5.375	383.7	85%	0.157	6.675	0.658	0.042	7.375	511.6	85%	0.209	8.283	0.903	0.056	9.241
22-Nov	783	62	255.9	85%	0.104	4.927	0.421	0.029	5.376	383.8	85%	0.156	6.677	0.657	0.043	7.377	511.8	85%	0.208	8.285	0.900	0.057	9.243
23-Nov	784	63	256.0	85%	0.104	4.928	0.420	0.029	5.377	384.0	85%	0.156	6.679	0.655	0.044	7.379	512.0	85%	0.208	8.288	0.898	0.059	9.245
24-Nov	785	64	256.1	85%	0.104	4.930	0.419	0.030	5.379	384.2	85%	0.156	6.682	0.654	0.045	7.380	512.2	85%	0.207	8.290	0.896	0.060	9.247
25-Nov	786	65	256.2	85%	0.103	4.931	0.418	0.031	5.380	384.3	85%	0.155	6.684	0.652	0.046	7.382	512.4	85%	0.207	8.293	0.894	0.062	9.249
26-Nov	787	66	256.3	85%	0.103	4.933	0.417	0.032	5.381	384.5	85%	0.155	6.686	0.651	0.048	7.384	512.6	85%	0.206	8.295	0.892	0.064	9.251
27-Nov	788	67	256.4	85%	0.103	4.934	0.416	0.033	5.383	384.6	85%	0.155	6.688	0.649	0.049	7.386	512.8	85%	0.206	8.298	0.890	0.065	9.253
28-Nov	789	68	256.5	86%	0.103	4.935	0.415	0.033	5.384	384.8	86%	0.154	6.690	0.648	0.050	7.388	513.0	86%	0.206	8.300	0.888	0.067	9.256
29-Nov	790	69	256.6	86%	0.103	4.937	0.414	0.034	5.386	384.9	86%	0.154	6.692	0.646	0.052	7.390	513.2	86%	0.205	8.303	0.886	0.069	9.258
30-Nov	791	70	256.7	86%	0.102	4.938	0.413	0.035	5.387	385.1	86%	0.153	6.694	0.645	0.053	7.391	513.4	86%	0.205	8.305	0.884	0.071	9.260
01-Dec	792	71	256.8	86%	0.102	4.940	0.412	0.036	5.389	385.2	86%	0.153	6.696	0.643	0.054	7.393	513.7	86%	0.204	8.308	0.882	0.073	9.263
02-Dec	793	72	256.9	86%	0.102	4.941	0.411	0.037	5.390	385.4	86%	0.153	6.698	0.642	0.056	7.395	513.9	86%	0.204	8.310	0.880	0.075	9.265
03-Dec	794	73	257.0	86%	0.102	4.943	0.410	0.038	5.392	385.5	86%	0.152	6.700	0.640	0.057	7.397	514.1	86%	0.203	8.313	0.878	0.076	9.267
04-Dec	795	74	257.1	86%	0.101	4.944	0.410	0.039	5.393	385.7	86%	0.152	6.702	0.639	0.059	7.399	514.3	86%	0.203	8.315	0.876	0.079	9.270
05-Dec	796	75	257.2	86%	0.101	4.946	0.409	0.040	5.395	385.8	86%	0.152	6.704	0.638	0.060	7.401	514.5	86%	0.202	8.318	0.874	0.081	9.272

	06-Dec	797	76	257.3	86%	0.101	4.947	0.408	0.041	5.396	386.0	86%	0.151	6.705	0.636	0.062	7.404	514.7	86%	0.202	8.320	0.872	0.083	9.275
	07-Dec	798	77	257.4	86%	0.101	4.949	0.407	0.042	5.398	386.1	86%	0.151	6.707	0.635	0.064	7.406	514.9	86%	0.201	8.323	0.870	0.085	9.278
	08-Dec	799	78	257.5	86%	0.100	4.950	0.406	0.044	5.400	386.3	86%	0.151	6.709	0.633	0.065	7.408	515.1	86%	0.201	8.325	0.868	0.087	9.280
	09-Dec	800	79	257.6	86%	0.100	4.952	0.405	0.045	5.401	386.5	86%	0.150	6.711	0.632	0.067	7.410	515.3	86%	0.200	8.328	0.866	0.090	9.283
	10-Dec	801	80	257.7	86%	0.100	4.953	0.404	0.046	5.403	386.6	86%	0.150	6.713	0.630	0.069	7.412	515.5	86%	0.200	8.330	0.864	0.092	9.286
	11-Dec	802	81	257.8	86%	0.100	4.954	0.403	0.047	5.405	386.7	86%	0.149	6.715	0.629	0.071	7.415	515.7	86%	0.199	8.332	0.862	0.094	9.289
	12-Dec	803	82	257.9	86%	0.099	4.956	0.402	0.048	5.406	386.9	86%	0.149	6.717	0.627	0.073	7.417	515.9	86%	0.199	8.335	0.860	0.097	9.292
	13-Dec	804	83	258.0	86%	0.099	4.957	0.401	0.050	5.408	387.0	86%	0.149	6.719	0.626	0.074	7.420	516.1	86%	0.198	8.337	0.858	0.099	9.295
	14-Dec	805	84	258.1	86%	0.099	4.959	0.400	0.051	5.410	387.2	86%	0.148	6.721	0.624	0.076	7.422	516.3	86%	0.198	8.340	0.856	0.102	9.298
	15-Dec	806	85	258.2	86%	0.099	4.960	0.399	0.052	5.412	387.3	86%	0.148	6.723	0.623	0.078	7.424	516.5	86%	0.197	8.342	0.854	0.105	9.301
	16-Dec	807	86	258.3	86%	0.098	4.962	0.398	0.054	5.414	387.5	86%	0.148	6.725	0.622	0.080	7.427	516.7	86%	0.197	8.344	0.852	0.107	9.304
	17-Dec	808	87	258.4	86%	0.098	4.963	0.397	0.055	5.415	387.6	86%	0.147	6.727	0.620	0.083	7.430	516.9	86%	0.197	8.347	0.850	0.110	9.307
	18-Dec	809	88	258.5	86%	0.098	4.964	0.397	0.056	5.417	387.8	86%	0.147	6.729	0.619	0.085	7.432	517.0	86%	0.196	8.349	0.848	0.113	9.310
	19-Dec	810	89	258.6	86%	0.098	4.966	0.396	0.058	5.419	387.9	86%	0.147	6.731	0.617	0.087	7.435	517.2	86%	0.196	8.351	0.846	0.116	9.314
	20-Dec	811	90	258.7	86%	0.098	4.967	0.395	0.059	5.421	388.1	86%	0.146	6.733	0.616	0.089	7.438	517.4	86%	0.195	8.354	0.844	0.119	9.317
	21-Dec	812	91	258.8	86%	0.097	4.969	0.394	0.061	5.423	388.2	86%	0.146	6.734	0.614	0.091	7.440	517.6	86%	0.195	8.356	0.842	0.122	9.320
	22-Dec	813	92	258.9	86%	0.097	4.970	0.393	0.062	5.425	388.4	86%	0.146	6.736	0.613	0.094	7.443	517.8	86%	0.194	8.359	0.841	0.125	9.324
	23-Dec	814	93	259.0	86%	0.097	4.971	0.392	0.064	5.427	388.5	86%	0.145	6.738	0.612	0.096	7.446	518.0	86%	0.194	8.361	0.839	0.128	9.328
	24-Dec	815	94	259.1	86%	0.097	4.973	0.391	0.066	5.430	388.7	86%	0.145	6.740	0.610	0.099	7.449	518.2	86%	0.193	8.363	0.837	0.131	9.331
	25-Dec	816	95	259.2	86%	0.096	4.974	0.390	0.067	5.432	388.8	86%	0.145	6.742	0.609	0.101	7.452	518.4	86%	0.193	8.366	0.835	0.135	9.335
	26-Dec	817	96	259.3	86%	0.096	4.976	0.389	0.069	5.434	389.0	86%	0.144	6.744	0.607	0.104	7.455	518.6	86%	0.192	8.368	0.833	0.138	9.339
	27-Dec	818	97	259.4	86%	0.096	4.977	0.388	0.071	5.436	389.1	86%	0.144	6.746	0.606	0.106	7.458	518.8	86%	0.192	8.370	0.831	0.142	9.343
	28-Dec	819	98	259.5	86%	0.096	4.978	0.388	0.073	5.438	389.2	86%	0.144	6.748	0.605	0.109	7.461	519.0	86%	0.191	8.373	0.829	0.145	9.347
	29-Dec	820	99	259.6	87%	0.096	4.980	0.387	0.074	5.441	389.4	87%	0.143	6.750	0.603	0.112	7.464	519.2	87%	0.191	8.375	0.827	0.149	9.351
	30-Dec	821	100	259.7	87%	0.095	4.981	0.386	0.076	5.443	389.5	87%	0.143	6.751	0.602	0.114	7.468	519.4	87%	0.191	8.377	0.825	0.153	9.355
	31-Dec	822	101	259.8	87%	0.095	4.982	0.385	0.078	5.445	389.7	87%	0.143	6.753	0.600	0.117	7.471	519.6	87%	0.190	8.379	0.823	0.156	9.359
	01-Jan	823	102	259.9	87%	0.095	4.984	0.384	0.080	5.448	389.8	87%	0.142	6.755	0.599	0.120	7.474	519.7	87%	0.190	8.382	0.821	0.160	9.363
	02-Jan	824	103	260.0	87%	0.095	4.985	0.383	0.082	5.450	390.0	87%	0.142	6.757	0.598	0.123	7.478	519.9	87%	0.189	8.384	0.819	0.164	9.368
	03-Jan	825	104	260.1	87%	0.094	4.987	0.382	0.084	5.453	390.1	87%	0.142	6.759	0.596	0.126	7.481	520.1	87%	0.189	8.386	0.818	0.168	9.372
	04-Jan	826	105	260.2	87%	0.094	4.988	0.381	0.086	5.455	390.2	87%	0.141	6.761	0.595	0.129	7.485	520.3	87%	0.188	8.389	0.816	0.173	9.377
	05-Jan	827	106	260.2	87%	0.094	4.989	0.380	0.088	5.458	390.4	87%	0.141	6.762	0.594	0.133	7.489	520.5	87%	0.188	8.391	0.814	0.177	9.381
	06-Jan	828	107	260.3	87%	0.094	4.991	0.380	0.091	5.461	390.5	87%	0.141	6.764	0.592	0.136	7.492	520.7	87%	0.187	8.393	0.812	0.181	9.386
	07-Jan	829	108	260.4	87%	0.094	4.992	0.379	0.093	5.463	390.7	87%	0.140	6.766	0.591	0.139	7.496	520.9	87%	0.187	8.395	0.810	0.186	9.391
	08-Jan	830	109	260.5	87%	0.093	4.993	0.378	0.095	5.466	390.8	87%	0.140	6.768	0.589	0.143	7.500	521.1	87%	0.187	8.398	0.808	0.190	9.396
	09-Jan	831	110	260.6	87%	0.093	4.995	0.377	0.097	5.469	390.9	87%	0.140	6.770	0.588	0.146	7.504	521.2	87%	0.186	8.400	0.806	0.195	9.401
	10-Jan	832	111	260.7	87%	0.093	4.996	0.376	0.100	5.472	391.1	87%	0.139	6.771	0.587	0.150	7.508	521.4	87%	0.186	8.402	0.804	0.200	9.406
	11-Jan	833	112	260.8	87%	0.093	4.997	0.375	0.102	5.475	391.2	87%	0.139	6.773	0.585	0.153	7.512	521.6	87%	0.185	8.404	0.802	0.205	9.411
	12-Jan	834	113	260.9	87%	0.092	4.999	0.374	0.105	5.478	391.4	87%	0.139	6.775	0.584	0.157	7.516	521.8	87%	0.185	8.407	0.801	0.210	9.417
	13-Jan	835	114	261.0	87%	0.092	5.000	0.373	0.107	5.481	391.5	87%	0.138	6.777	0.583	0.161	7.520	522.0	87%	0.184	8.409	0.799	0.215	9.422
	14-Jan	836	115	261.1	87%	0.092	5.001	0.373	0.110	5.484	391.6	87%	0.138	6.779	0.581	0.165	7.525	522.2	87%	0.184	8.411	0.797	0.220	9.428
	15-Jan	837	116	261.2	87%	0.092	5.003	0.372	0.113	5.487	391.8	87%	0.138	6.780	0.580	0.169	7.529	522.4	87%	0.184	8.413	0.795	0.225	9.433
	16-Jan	838	117	261.3	87%	0.092	5.004	0.371	0.115	5.490	391.9	87%	0.137	6.782	0.579	0.173	7.534	522.5	87%	0.183	8.415	0.793	0.231	9.439
	17-Jan	839	118	261.4	87%	0.091	5.005	0.370	0.118	5.493	392.0	87%	0.137	6.784	0.577	0.177	7.538	522.7	87%	0.183	8.418	0.791	0.236	9.445
	18-Jan	840	119	261.5	87%	0.091	5.006	0.369	0.121	5.496	392.2	87%	0.137	6.786	0.576	0.181	7.543	522.9	87%	0.182	8.420	0.790	0.242	9.451
	19-Jan	841	120	261.5	87%	0.091	5.008	0.368	0.124	5.500	392.3	87%	0.136	6.788	0.575	0.186	7.548	523.1	87%	0.182	8.422	0.788	0.248	9.457
	20-Jan	842	121	261.6	87%	0.091	5.009	0.367	0.127	5.503	392.4	87%	0.136	6.789	0.573	0.190	7.553	523.3	87%	0.181	8.424	0.786	0.253	9.464
	21-Jan	843	122	261.7	87%	0.090	5.010	0.367	0.130	5.507	392.6	87%	0.136	6.791	0.572	0.195	7.558	523.4	87%	0.181	8.426	0.784	0.259	9.470
	22-Jan	844	123	261.8	87%	0.090	5.012	0.366	0.133	5.510	392.7	87%	0.135	6.793	0.571	0.199	7.563	523.6	87%	0.180	8.429	0.782	0.266	9.476
	23-Jan	845	124	261.9	87%	0.090	5.013	0.365	0.136	5.514	392.9	87%	0.135	6.795	0.569	0.204	7.568	523.8	87%	0.180	8.431	0.780	0.272	9.483
	24-Jan	846	125	262.0	87%	0.090	5.014	0.364	0.139	5.517	393.0	87%	0.135	6.796	0.568	0.209	7.573	524.0	87%	0.180	8.433	0.779	0.278	9.490
	25-Jan	847	126	262.1	87%	0.090	5.016	0.363	0.142	5.521	393.1	87%	0.134	6.798	0.567	0.214	7.578	524.2	87%	0.179	8.435	0.777	0.285	9.497
	26-Jan	848	127	262.2	87%	0.089	5.017	0.362	0.146	5.525	393.3	87%	0.134	6.800	0.565	0.219	7.584	524.3	87%	0.179	8.437	0.775	0.292	9.504
	27-Jan	849	128	262.3	87%	0.089	5.018	0.361	0.149	5.529	393.4	87%	0.134	6.802	0.564	0.224	7.589	524.5	87%	0.178	8.439	0.773	0.298	9.511
	28-Jan	850	129	262.4	87%	0.089	5.019	0.361	0.153	5.533	393.5	87%	0.133	6.803	0.563	0.229	7.595	524.7	87%	0.178	8.442	0.771	0.305	9.518
	29-Jan	851	130	262.4	87%	0.089	5.021	0.360	0.156	5.537	393.7	87%	0.133	6.805	0.561	0.234	7.601	524.9	87%	0.178	8.444	0.770	0.312	9.526
	30-Jan	852	131	262.5	88%	0.089	5.022	0.359	0.160	5.541	393.8	88%	0.133	6.807	0.560	0.240	7.607	525.1	88%	0.177	8.446	0.768	0.320	9.533
Heifers are culled	31-Jan	853	132	262.6	88%	0.088	5.023	0.358	0.164	5.545	393.9	88%	0.133	6.808	0.559	0.245	7.612	525.2	88%	0.177	8.448	0.766	0.327	9.541
	01-Feb	854	133	262.7	88%	0.088	5.024	0.357	0.167	5.549	394.1	88%	0.132	6.810	0.557	0.251	7.619	525.4	88%	0.176	8.450	0.764	0.335	9.549
	02-Feb	855	134	262.8	88%	0.088	5.026	0.356	0.171	5.553	394.2	88%	0.132	6.812	0.556	0.257	7.625	525.6	88%	0.176	8.452	0.762	0.342	9.557
	03-Feb	856	135	262.9	88%	0.088	5.027	0.356	0.175	5.558	394.3	88%	0.132	6.814	0.555	0.263	7.631	525.8	88%	0.175	8.454	0.761	0.350	9.565
	04-Feb	857	136	263.0	88%	0.088	5.028	0.355	0.179	5.562	394.5	88%	0.131	6.815	0.553	0.269	7.637	525.9	88%	0.175	8.456	0.759	0.358	9.574
	05-Feb	858	137	263.1	88%	0.087	5.030	0.354	0.183	5.567	394.6	88%	0.131	6.817	0.552	0.275	7.644	526.1	88%	0.175	8.459	0.757	0.367	9.582
	06-Feb	859	138	263.1	88%	0.087	5.031	0.353	0.187	5.571	394.7	88%	0.131	6.819	0.551	0.281	7.651	526.3	88%	0.174	8.461	0.755	0.375	9.591
	07-Feb	860	139	263.2	88%	0.087	5.032	0.352	0.192	5.576	394.8	88%	0.130	6.820	0.550	0.288	7.657	526.5	88%	0.174	8.463	0.753	0.383	9.600
	08-Feb	861	140	263.3	88%	0.087	5.033	0.351	0.196	5.581	395.0	88%	0.130	6.822	0.548	0.294	7.664	526.6	88%	0.173	8.465	0.752	0.392	9.609
	09-Feb	862	141	263.4	88%	0.086	5.034	0.351	0.200	5.586	395.1	88%	0.130	6.824	0.547	0.301	7.671	526.8	88%	0.173	8.467	0.750	0.401	9.618
	10-Feb	863	142	263.5	88%	0.086	5.036	0.350	0.205	5.590	395.2	88%	0.129	6.825	0.546	0.308	7.679	527.0	88%	0.173	8.469	0.748	0.410	9.627

11-Feb	864	143	263.6	88%	0.086	5.037	0.349	0.210	5.596	395.4	88%	0.129	6.827	0.544	0.314	7.686	527.1	88%	0.172	8.471	0.746	0.419	9.637
12-Feb	865	144	263.7	88%	0.086	5.038	0.348	0.214	5.601	395.5	88%	0.129	6.829	0.543	0.321	7.693	527.3	88%	0.172	8.473	0.745	0.429	9.647
13-Feb	866	145	263.7	88%	0.086	5.039	0.347	0.219	5.606	395.6	88%	0.129	6.830	0.542	0.329	7.701	527.5	88%	0.171	8.475	0.743	0.438	9.656
14-Feb	867	146	263.8	88%	0.085	5.041	0.347	0.224	5.611	395.7	88%	0.128	6.832	0.541	0.336	7.709	527.7	88%	0.171	8.477	0.741	0.448	9.667
15-Feb	868	147	263.9	88%	0.085	5.042	0.346	0.229	5.617	395.9	88%	0.128	6.834	0.539	0.343	7.717	527.8	88%	0.171	8.479	0.739	0.458	9.677
16-Feb	869	148	264.0	88%	0.085	5.043	0.345	0.234	5.622	396.0	88%	0.128	6.835	0.538	0.351	7.725	528.0	88%	0.170	8.481	0.738	0.468	9.687
17-Feb	870	149	264.1	88%	0.085	5.044	0.344	0.239	5.628	396.1	88%	0.127	6.837	0.537	0.359	7.733	528.2	88%	0.170	8.483	0.736	0.478	9.698
18-Feb	871	150	264.2	88%	0.085	5.046	0.343	0.245	5.633	396.3	88%	0.127	6.839	0.536	0.367	7.741	528.3	88%	0.169	8.485	0.734	0.489	9.709
19-Feb	872	151	264.3	88%	0.084	5.047	0.342	0.250	5.639	396.4	88%	0.127	6.840	0.534	0.375	7.749	528.5	88%	0.169	8.488	0.733	0.500	9.720
20-Feb	873	152	264.3	88%	0.084	5.048	0.342	0.255	5.645	396.5	88%	0.126	6.842	0.533	0.383	7.758	528.7	88%	0.169	8.490	0.731	0.511	9.731
21-Feb	874	153	264.4	88%	0.084	5.049	0.341	0.261	5.651	396.6	88%	0.126	6.844	0.532	0.391	7.767	528.8	88%	0.168	8.492	0.729	0.522	9.743
22-Feb	875	154	264.5	88%	0.084	5.050	0.340	0.267	5.657	396.8	88%	0.126	6.845	0.531	0.400	7.776	529.0	88%	0.168	8.494	0.727	0.533	9.754
23-Feb	876	155	264.6	88%	0.084	5.052	0.339	0.272	5.663	396.9	88%	0.126	6.847	0.529	0.409	7.785	529.2	88%	0.167	8.496	0.726	0.545	9.766
24-Feb	877	156	264.7	88%	0.083	5.053	0.338	0.278	5.670	397.0	88%	0.125	6.848	0.528	0.418	7.794	529.3	88%	0.167	8.498	0.724	0.557	9.778
25-Feb	878	157	264.8	88%	0.083	5.054	0.338	0.284	5.676	397.1	88%	0.125	6.850	0.527	0.427	7.804	529.5	88%	0.167	8.500	0.722	0.569	9.791
26-Feb	879	158	264.8	88%	0.083	5.055	0.337	0.291	5.683	397.3	88%	0.125	6.852	0.526	0.436	7.813	529.7	88%	0.166	8.502	0.721	0.581	9.803
27-Feb	880	159	264.9	88%	0.083	5.056	0.336	0.297	5.689	397.4	88%	0.124	6.853	0.524	0.445	7.823	529.8	88%	0.166	8.504	0.719	0.594	9.816
28-Feb	881	160	265.0	88%	0.083	5.057	0.335	0.303	5.696	397.5	88%	0.124	6.855	0.523	0.455	7.833	530.0	88%	0.165	8.506	0.717	0.606	9.829
01-Mar	882	161	265.1	88%	0.083	5.059	0.335	0.310	5.703	397.6	88%	0.124	6.857	0.522	0.464	7.843	530.2	88%	0.165	8.508	0.716	0.619	9.842
02-Mar	883	162	265.2	88%	0.082	5.060	0.334	0.316	5.710	397.8	88%	0.123	6.858	0.521	0.474	7.853	530.3	88%	0.165	8.510	0.714	0.633	9.856
03-Mar	884	163	265.3	88%	0.082	5.061	0.333	0.323	5.717	397.9	88%	0.123	6.860	0.519	0.484	7.864	530.5	88%	0.164	8.512	0.712	0.646	9.870
04-Mar	885	164	265.3	88%	0.082	5.062	0.332	0.330	5.724	398.0	88%	0.123	6.861	0.518	0.495	7.874	530.7	88%	0.164	8.514	0.710	0.660	9.884
05-Mar	886	165	265.4	88%	0.082	5.063	0.331	0.337	5.732	398.1	88%	0.123	6.863	0.517	0.505	7.885	530.8	88%	0.163	8.516	0.709	0.674	9.898
06-Mar	887	166	265.5	88%	0.082	5.065	0.331	0.344	5.739	398.2	88%	0.122	6.864	0.516	0.516	7.896	531.0	88%	0.163	8.517	0.707	0.688	9.912
07-Mar	888	167	265.6	89%	0.081	5.066	0.330	0.351	5.747	398.4	89%	0.122	6.866	0.515	0.527	7.907	531.2	89%	0.163	8.519	0.705	0.702	9.927
08-Mar	889	168	265.7	89%	0.081	5.067	0.329	0.358	5.754	398.5	89%	0.122	6.868	0.513	0.538	7.919	531.3	89%	0.162	8.521	0.704	0.717	9.942
09-Mar	890	169	265.7	89%	0.081	5.068	0.328	0.366	5.762	398.6	89%	0.121	6.869	0.512	0.549	7.930	531.5	89%	0.162	8.523	0.702	0.732	9.957
10-Mar	891	170	265.8	89%	0.081	5.069	0.327	0.374	5.770	398.7	89%	0.121	6.871	0.511	0.560	7.942	531.6	89%	0.162	8.525	0.701	0.747	9.973
11-Mar	892	171	265.9	89%	0.081	5.070	0.327	0.381	5.778	398.9	89%	0.121	6.872	0.510	0.572	7.954	531.8	89%	0.161	8.527	0.699	0.763	9.989
12-Mar	893	172	266.0	89%	0.080	5.071	0.326	0.389	5.787	399.0	89%	0.121	6.874	0.509	0.584	7.966	532.0	89%	0.161	8.529	0.697	0.779	10.005
13-Mar	894	173	266.1	89%	0.080	5.073	0.325	0.397	5.795	399.1	89%	0.120	6.875	0.507	0.596	7.979	532.1	89%	0.160	8.531	0.696	0.795	10.021
14-Mar	895	174	266.1	89%	0.080	5.074	0.324	0.405	5.804	399.2	89%	0.120	6.877	0.506	0.608	7.991	532.3	89%	0.160	8.533	0.694	0.811	10.038
15-Mar	896	175	266.2	89%	0.080	5.075	0.324	0.414	5.812	399.3	89%	0.120	6.879	0.505	0.621	8.004	532.4	89%	0.160	8.535	0.692	0.828	10.055
16-Mar	897	176	266.3	89%	0.080	5.076	0.323	0.422	5.821	399.5	89%	0.119	6.880	0.504	0.633	8.017	532.6	89%	0.159	8.537	0.691	0.845	10.072
17-Mar	898	177	266.4	89%	0.079	5.077	0.322	0.431	5.830	399.6	89%	0.119	6.882	0.503	0.646	8.030	532.8	89%	0.159	8.539	0.689	0.862	10.089
18-Mar	899	178	266.5	89%	0.079	5.078	0.321	0.440	5.839	399.7	89%	0.119	6.883	0.501	0.659	8.044	532.9	89%	0.159	8.541	0.687	0.879	10.107
19-Mar	900	179	266.5	89%	0.079	5.079	0.321	0.449	5.849	399.8	89%	0.119	6.885	0.500	0.673	8.058	533.1	89%	0.158	8.543	0.686	0.897	10.125
20-Mar	901	180	266.6	89%	0.079	5.081	0.320	0.458	5.858	399.9	89%	0.118	6.886	0.499	0.686	8.072	533.2	89%	0.158	8.544	0.684	0.915	10.144
21-Mar	902	181	266.7	89%	0.079	5.082	0.319	0.467	5.868	400.0	89%	0.118	6.888	0.498	0.700	8.086	533.4	89%	0.157	8.546	0.683	0.934	10.162
22-Mar	903	182	266.8	89%	0.079	5.083	0.318	0.476	5.877	400.2	89%	0.118	6.889	0.497	0.714	8.100	533.6	89%	0.157	8.548	0.681	0.952	10.182
23-Mar	904	183	266.9	89%	0.078	5.084	0.318	0.486	5.887	400.3	89%	0.117	6.891	0.495	0.729	8.115	533.7	89%	0.157	8.550	0.679	0.971	10.201
24-Mar	905	184	266.9	89%	0.078	5.085	0.317	0.495	5.897	400.4	89%	0.117	6.892	0.494	0.743	8.130	533.9	89%	0.156	8.552	0.678	0.991	10.221
25-Mar	906	185	267.0	89%	0.078	5.086	0.316	0.505	5.908	400.5	89%	0.117	6.894	0.493	0.758	8.145	534.0	89%	0.156	8.554	0.676	1.011	10.241
26-Mar	907	186	267.1	89%	0.078	5.087	0.315	0.515	5.918	400.6	89%	0.117	6.895	0.492	0.773	8.160	534.2	89%	0.156	8.556	0.674	1.031	10.261
27-Mar	908	187	267.2	89%	0.078	5.088	0.315	0.526	5.928	400.8	89%	0.116	6.897	0.491	0.788	8.176	534.3	89%	0.155	8.558	0.673	1.051	10.281
28-Mar	909	188	267.2	89%	0.077	5.089	0.314	0.536	5.939	400.9	89%	0.116	6.898	0.490	0.804	8.192	534.5	89%	0.155	8.559	0.671	1.072	10.302
29-Mar	910	189	267.3	89%	0.077	5.091	0.313	0.546	5.950	401.0	89%	0.116	6.900	0.488	0.820	8.208	534.6	89%	0.154	8.561	0.670	1.093	10.324
30-Mar	911	190	267.4	89%	0.077	5.092	0.312	0.557	5.961	401.1	89%	0.116	6.901	0.487	0.836	8.224	534.8	89%	0.154	8.563	0.668	1.114	10.345
31-Mar	912	191	267.5	89%	0.077	5.093	0.312	0.568	5.972	401.2	89%	0.115	6.903	0.486	0.852	8.241	535.0	89%	0.154	8.565	0.667	1.136	10.367
01-Apr	913	192	267.6	89%	0.077	5.094	0.311	0.579	5.984	401.3	89%	0.115	6.904	0.485	0.869	8.258	535.1	89%	0.153	8.567	0.665	1.158	10.390
02-Apr	914	193	267.6	89%	0.077	5.095	0.310	0.590	5.995	401.4	89%	0.115	6.906	0.484	0.885	8.275	535.3	89%	0.153	8.569	0.663	1.181	10.413
03-Apr	915	194	267.7	89%	0.076	5.096	0.309	0.602	6.007	401.6	89%	0.114	6.907	0.483	0.903	8.292	535.4	89%	0.153	8.571	0.662	1.203	10.436
04-Apr	916	195	267.8	89%	0.076	5.097	0.309	0.613	6.019	401.7	89%	0.114	6.909	0.482	0.920	8.310	535.6	89%	0.152	8.572	0.660	1.227	10.459
05-Apr	917	196	267.9	89%	0.076	5.098	0.308	0.625	6.031	401.8	89%	0.114	6.910	0.480	0.938	8.328	535.7	89%	0.152	8.574	0.659	1.250	10.483
06-Apr	918	197	267.9	89%	0.076	5.099	0.307	0.637	6.044	401.9	89%	0.114	6.912	0.479	0.956	8.346	535.9	89%	0.152	8.576	0.657	1.274	10.507
07-Apr	919	198	268.0	89%	0.076	5.100	0.306	0.649	6.056	402.0	89%	0.113	6.913	0.478	0.974	8.365	536.0	89%	0.151	8.578	0.656	1.298	10.532
08-Apr	920	199	268.1	89%	0.075	5.101	0.306	0.662	6.069	402.1	89%	0.113	6.915	0.477	0.992	8.384	536.2	89%	0.151	8.580	0.654	1.323	10.557
09-Apr	921	200	268.2	89%	0.075	5.103	0.305	0.674	6.082	402.2	89%	0.113	6.916	0.476	1.011	8.403	536.3	89%	0.150	8.581	0.652	1.348	10.582
10-Apr	922	201	268.2	89%	0.075	5.104	0.304	0.687	6.095	402.4	89%	0.113	6.917	0.475	1.030	8.422	536.5	89%	0.150	8.583	0.651	1.374	10.608
11-Apr	923	202	268.3	89%	0.075	5.105	0.304	0.700	6.108	402.5	89%	0.112	6.919	0.474	1.050	8.442	536.6	89%	0.150	8.585	0.649	1.400	10.634
12-Apr	924	203	268.4	89%	0.075	5.106	0.303	0.713	6.121	402.6	89%	0.112	6.920	0.472	1.069	8.462	536.8	89%	0.149	8.587	0.648	1.426	10.660
13-Apr	925	204	268.5	89%	0.075	5.107	0.302	0.726	6.135	402.8	89%	0.112	6.922	0.471	1.089	8.482	536.9	89%	0.149	8.589	0.646	1.452	10.687
14-Apr	926	205	268.5	90%	0.074	5.108	0.301	0.740	6.149	402.8	90%	0.112	6.923	0.470	1.110	8.503	537.1	90%	0.149	8.590	0.645	1.480	10.715
15-Apr	927	206	268.6	90%	0.074	5.109	0.301	0.754	6.163	402.9	90%	0.111	6.925	0.469	1.130	8.524	537.2	90%	0.148	8.592	0.643	1.507	10.742
16-Apr	928	207	268.7	90%	0.074	5.110	0.300	0.767	6.177	403.0	90%	0.111	6.926	0.468	1.151	8.545	537.4	90%	0.148	8.594	0.642	1.535	10.771
17-Apr	929	208	268.8	90%	0.074	5.111	0.299	0.782	6.192	403.1	90%	0.111	6.928	0.467	1.172	8.567	537.5	90%	0.148	8.596	0.640	1.563	10.799
18-Apr	930	209	268.8	90%	0.074	5.112	0.299	0.796	6.207	403.2	90%	0.111	6.929	0.466	1.194	8.589	537.7	90%	0.147	8.597	0.639	1.592	10.828

19-Apr	931	210	268.9	90%	0.073	5.113	0.298	0.811	6.222	403.4	90%	0.110	6.930	0.465	1.216	8.611	537.8	90%	0.147	8.599	0.637	1.621 10.858
20-Apr	932	211	269.0	90%	0.073	5.114	0.297	0.825	6.237	403.5	90%	0.110	6.932	0.464	1.238	8.633	538.0	90%	0.147	8.601	0.636	1.651 10.887
21-Apr	933	212	269.0	90%	0.073	5.115	0.296	0.840	6.252	403.6	90%	0.110	6.933	0.462	1.261	8.656	538.1	90%	0.146	8.603	0.634	1.681 10.918
22-Apr	934	213	269.1	90%	0.073	5.116	0.296	0.856	6.268	403.7	90%	0.109	6.935	0.461	1.284	8.679	538.2	90%	0.146	8.604	0.633	1.711 10.948
23-Apr	935	214	269.2	90%	0.073	5.117	0.295	0.871	6.283	403.8	90%	0.109	6.936	0.460	1.307	8.703	538.4	90%	0.146	8.606	0.631	1.742 10.980
24-Apr	936	215	269.3	90%	0.073	5.118	0.294	0.887	6.299	403.9	90%	0.109	6.937	0.459	1.330	8.727	538.5	90%	0.145	8.608	0.629	1.774 11.011
25-Apr	937	216	269.3	90%	0.072	5.119	0.294	0.903	6.316	404.0	90%	0.109	6.939	0.458	1.354	8.751	538.7	90%	0.145	8.610	0.628	1.806 11.043
26-Apr	938	217	269.4	90%	0.072	5.120	0.293	0.919	6.332	404.1	90%	0.108	6.940	0.457	1.378	8.776	538.8	90%	0.145	8.611	0.626	1.838 11.076
27-Apr	939	218	269.5	90%	0.072	5.121	0.292	0.935	6.349	404.2	90%	0.108	6.942	0.456	1.403	8.800	539.0	90%	0.144	8.613	0.625	1.871 11.109
28-Apr	940	219	269.6	90%	0.072	5.122	0.291	0.952	6.366	404.3	90%	0.108	6.943	0.455	1.428	8.826	539.1	90%	0.144	8.615	0.624	1.904 11.142
29-Apr	941	220	269.6	90%	0.072	5.123	0.291	0.969	6.383	404.4	90%	0.108	6.944	0.454	1.453	8.851	539.3	90%	0.144	8.617	0.622	1.938 11.176
30-Apr	942	221	269.7	90%	0.072	5.124	0.290	0.986	6.400	404.5	90%	0.107	6.946	0.453	1.479	8.877	539.4	90%	0.143	8.618	0.621	1.972 11.211
01-May	943	222	269.8	90%	0.071	5.126	0.289	1.003	6.418	404.7	90%	0.107	6.947	0.452	1.505	8.903	539.5	90%	0.143	8.620	0.619	2.006 11.245
02-May	944	223	269.8	90%	0.071	5.127	0.289	1.021	6.436	404.8	90%	0.107	6.949	0.450	1.531	8.930	539.7	90%	0.143	8.622	0.618	2.041 11.281
03-May	945	224	269.9	90%	0.071	5.128	0.288	1.039	6.454	404.9	90%	0.107	6.950	0.449	1.558	8.957	539.8	90%	0.142	8.623	0.616	2.077 11.317
04-May	946	225	270.0	90%	0.071	5.129	0.287	1.057	6.472	405.0	90%	0.106	6.951	0.448	1.585	8.984	540.0	90%	0.142	8.625	0.615	2.113 11.353
05-May	947	226	270.1	90%	0.071	5.130	0.287	1.075	6.491	405.1	90%	0.106	6.953	0.447	1.612	9.012	540.1	90%	0.142	8.627	0.613	2.150 11.390
06-May	948	227	270.1	90%	0.071	5.131	0.286	1.093	6.510	405.2	90%	0.106	6.954	0.446	1.640	9.040	540.3	90%	0.141	8.629	0.612	2.187 11.427
07-May	949	228	270.2	90%	0.070	5.132	0.285	1.112	6.529	405.3	90%	0.106	6.955	0.445	1.668	9.069	540.4	90%	0.141	8.630	0.610	2.224 11.465
08-May	950	229	270.3	90%	0.070	5.133	0.285	1.131	6.548	405.4	90%	0.105	6.957	0.444	1.697	9.098	540.5	90%	0.141	8.632	0.609	2.263 11.503
09-May	951	230	270.3	90%	0.070	5.134	0.284	1.151	6.568	405.5	90%	0.105	6.958	0.443	1.726	9.127	540.7	90%	0.140	8.634	0.607	2.301 11.542
10-May	952	231	270.4	90%	0.070	5.135	0.283	1.170	6.588	405.6	90%	0.105	6.959	0.442	1.755	9.157	540.8	90%	0.140	8.635	0.606	2.340 11.581
11-May	953	232	270.5	90%	0.070	5.136	0.283	1.190	6.608	405.7	90%	0.105	6.961	0.441	1.785	9.187	541.0	90%	0.140	8.637	0.604	2.380 11.621
12-May	954	233	270.5	90%	0.070	5.137	0.282	1.210	6.628	405.8	90%	0.104	6.962	0.440	1.815	9.217	541.1	90%	0.139	8.639	0.603	2.420 11.662
13-May	955	234	270.6	90%	0.069	5.138	0.281	1.230	6.649	405.9	90%	0.104	6.963	0.439	1.846	9.248	541.2	90%	0.139	8.640	0.602	2.461 11.703
14-May	956	235	270.7	90%	0.069	5.139	0.281	1.251	6.670	406.0	90%	0.104	6.965	0.438	1.876	9.279	541.4	90%	0.139	8.642	0.600	2.502 11.744
15-May	957	236	270.8	90%	0.069	5.140	0.280	1.272	6.691	406.1	90%	0.104	6.966	0.437	1.908	9.310	541.5	90%	0.138	8.644	0.599	2.544 11.786
16-May	958	237	270.8	90%	0.069	5.140	0.279	1.293	6.713	406.2	90%	0.103	6.967	0.436	1.939	9.342	541.6	90%	0.138	8.645	0.597	2.586 11.828
17-May	959	238	270.9	90%	0.069	5.141	0.279	1.314	6.734	406.3	90%	0.103	6.969	0.435	1.972	9.375	541.8	90%	0.138	8.647	0.596	2.629 11.871
18-May	960	239	271.0	90%	0.069	5.142	0.278	1.336	6.756	406.4	90%	0.103	6.970	0.433	2.004	9.408	541.9	90%	0.137	8.649	0.594	2.672 11.915
19-May	961	240	271.0	90%	0.068	5.143	0.277	1.358	6.779	406.5	90%	0.103	6.971	0.432	2.037	9.441	542.1	90%	0.137	8.650	0.593	2.716 11.959
20-May	962	241	271.1	90%	0.068	5.144	0.277	1.380	6.801	406.6	90%	0.102	6.973	0.431	2.070	9.474	542.2	90%	0.137	8.652	0.592	2.760 12.004
21-May	963	242	271.2	90%	0.068	5.145	0.276	1.403	6.824	406.7	90%	0.102	6.974	0.430	2.104	9.508	542.3	90%	0.136	8.653	0.590	2.805 12.049
22-May	964	243	271.2	90%	0.068	5.146	0.275	1.425	6.847	406.8	90%	0.102	6.975	0.429	2.138	9.543	542.5	90%	0.136	8.655	0.589	2.851 12.095
23-May	965	244	271.3	90%	0.068	5.147	0.275	1.448	6.870	407.0	90%	0.102	6.977	0.428	2.173	9.578	542.6	90%	0.136	8.657	0.587	2.897 12.141
24-May	966	245	271.4	90%	0.068	5.148	0.274	1.472	6.894	407.1	90%	0.101	6.978	0.427	2.208	9.613	542.7	90%	0.135	8.658	0.586	2.944 12.188
25-May	967	246	271.4	90%	0.068	5.149	0.273	1.495	6.918	407.2	90%	0.101	6.979	0.426	2.243	9.649	542.9	90%	0.135	8.660	0.584	2.991 12.235
26-May	968	247	271.5	91%	0.067	5.150	0.273	1.519	6.942	407.3	91%	0.101	6.981	0.425	2.279	9.685	543.0	91%	0.135	8.662	0.583	3.039 12.283
27-May	969	248	271.6	91%	0.067	5.151	0.272	1.543	6.966	407.4	91%	0.101	6.982	0.424	2.315	9.721	543.1	91%	0.134	8.663	0.582	3.087 12.332
28-May	970	249	271.6	91%	0.067	5.152	0.271	1.568	6.991	407.5	91%	0.101	6.983	0.423	2.352	9.758	543.3	91%	0.134	8.665	0.580	3.136 12.381
29-May	971	250	271.7	91%	0.067	5.153	0.271	1.593	7.016	407.6	91%	0.100	6.984	0.422	2.389	9.796	543.4	91%	0.134	8.666	0.579	3.185 12.430
30-May	972	251	271.8	91%	0.067	5.154	0.270	1.618	7.042	407.7	91%	0.100	6.986	0.421	2.426	9.833	543.5	91%	0.133	8.668	0.577	3.235 12.481
31-May	973	252	271.8	91%	0.067	5.155	0.269	1.643	7.067	407.8	91%	0.100	6.987	0.420	2.464	9.872	543.7	91%	0.133	8.670	0.576	3.286 12.532
01-Jun	974	253	271.9	91%	0.066	5.156	0.269	1.669	7.093	407.9	91%	0.100	6.988	0.419	2.503	9.910	543.8	91%	0.133	8.671	0.575	3.337 12.583
02-Jun	975	254	272.0	91%	0.066	5.157	0.268	1.694	7.119	408.0	91%	0.099	6.990	0.418	2.542	9.949	543.9	91%	0.132	8.673	0.573	3.389 12.635
03-Jun	976	255	272.0	91%	0.066	5.158	0.267	1.721	7.146	408.1	91%	0.099	6.991	0.417	2.581	9.989	544.1	91%	0.132	8.674	0.572	3.441 12.687
04-Jun	977	256	272.1	91%	0.066	5.159	0.267	1.747	7.173	408.2	91%	0.099	6.992	0.416	2.621	10.029	544.2	91%	0.132	8.676	0.571	3.494 12.741
05-Jun	978	257	272.2	91%	0.066	5.160	0.266	1.774	7.200	408.3	91%	0.099	6.993	0.415	2.661	10.069	544.3	91%	0.132	8.677	0.569	3.548 12.794
06-Jun	979	258	272.2	91%	0.066	5.161	0.265	1.801	7.227	408.4	91%	0.098	6.995	0.414	2.701	10.110	544.5	91%	0.131	8.679	0.568	3.602 12.849
07-Jun	980	259	272.3	91%	0.065	5.161	0.265	1.828	7.255	408.4	91%	0.098	6.996	0.413	2.742	10.152	544.6	91%	0.131	8.681	0.566	3.657 12.904
08-Jun	981	260	272.4	91%	0.065	5.162	0.264	1.856	7.283	408.5	91%	0.098	6.997	0.412	2.784	10.193	544.7	91%	0.131	8.682	0.565	3.712 12.959
09-Jun	982	261	272.4	91%	0.065	5.163	0.264	1.884	7.311	408.6	91%	0.098	6.998	0.411	2.826	10.235	544.9	91%	0.130	8.684	0.564	3.768 13.015
10-Jun	983	262	272.5	91%	0.065	5.164	0.263	1.912	7.339	408.7	91%	0.098	7.000	0.410	2.868	10.278	545.0	91%	0.130	8.685	0.562	3.824 13.072
11-Jun	984	263	272.6	91%	0.065	5.165	0.262	1.941	7.368	408.8	91%	0.097	7.001	0.409	2.911	10.321	545.1	91%	0.130	8.687	0.561	3.881 13.129
12-Jun	985	264	272.6	91%	0.065	5.166	0.262	1.970	7.397	408.9	91%	0.097	7.002	0.408	2.954	10.365	545.2	91%	0.129	8.688	0.560	3.939 13.187
13-Jun	986	265	272.7	91%	0.065	5.167	0.261	1.999	7.427	409.0	91%	0.097	7.003	0.407	2.998	10.409	545.4	91%	0.129	8.690	0.558	3.997 13.246
14-Jun	987	266	272.8	91%	0.064	5.168	0.260	2.028	7.456	409.1	91%	0.097	7.005	0.406	3.042	10.453	545.5	91%	0.129	8.691	0.557	4.056 13.305
15-Jun	988	267	272.8	91%	0.064	5.169	0.260	2.058	7.487	409.2	91%	0.096	7.006	0.405	3.087	10.498	545.6	91%	0.128	8.693	0.556	4.116 13.364
16-Jun	989	268	272.9	91%	0.064	5.170	0.259	2.088	7.517	409.3	91%	0.096	7.007	0.404	3.132	10.543	545.8	91%	0.128	8.694	0.554	4.176 13.425
17-Jun	990	269	272.9	91%	0.064	5.171	0.258	2.118	7.547	409.4	91%	0.096	7.008	0.403	3.177	10.589	545.9	91%	0.128	8.696	0.553	4.237 13.486
18-Jun	991	270	273.0	91%	0.064	5.172	0.258	2.149	7.578	409.5	91%	0.096	7.010	0.402	3.223	10.635	546.0	91%	0.128	8.698	0.552	4.298 13.547
19-Jun	992	271	273.1	91%	0.064	5.172	0.257	2.180	7.610	409.6	91%	0.095	7.011	0.401	3.270	10.682	546.1	91%	0.127	8.699	0.550	4.360 13.609
20-Jun	993	272	273.1	91%	0.063	5.173	0.257	2.211	7.641	409.7	91%	0.095	7.012	0.400	3.317	10.729	546.3	91%	0.127	8.701	0.549	4.422 13.672
21-Jun	994	273	273.2	91%	0.063	5.174	0.256	2.243	7.673	409.8	91%	0.095	7.013	0.399	3.364	10.777	546.4	91%	0.127	8.702	0.548	4.485 13.735
22-Jun	995	274	273.3	91%	0.063	5.175	0.255	2.275	7.705	409.9	91%	0.095	7.014	0.398	3.412	10.825	546.5	91%	0.126	8.704	0.546	4.549 13.799
23-Jun	996	275	273.3	91%	0.063	5.176	0.255	2.307	7.738	410.0	91%	0.095	7.016	0.397	3.460	10.873	546.7	91%	0.126	8.705	0.545	4.614 13.864
24-Jun	997	276	273.4	91%	0.063	5.177	0.254	2.339	7.770	410.1	91%	0.094	7.017	0.397	3.509	10.922	546.8	91%	0.126	8.707	0.544	4.678 13.929

	25-Jun	998	277		273.5	91%	0.063		5.178	0.254		2.372	7.803	410.2	91%	0.094		7.018	0.396		3.558	10.972	546.9	91%	0.125		8.708	0.542		4.744	13.995
	26-Jun	999	278		273.5	91%	0.063		5.179	0.253		2.405	7.837	410.3	91%	0.094		7.019	0.395		3.608	11.022	547.0	91%	0.125		8.710	0.541		4.810	14.061
	27-Jun	1000	279		273.6	91%	0.062		5.180	0.252		2.438	7.870	410.4	91%	0.094		7.021	0.394		3.658	11.072	547.2	91%	0.125		8.711	0.540		4.877	14.128
	28-Jun	1001	280		273.6	91%	0.062		5.181	0.252		2.472	7.904	410.5	91%	0.093		7.022	0.393		3.708	11.123	547.3	91%	0.125		8.713	0.538		4.944	14.195
	29-Jun	1002	281		273.7	91%	0.062		5.181	0.251		2.506	7.939	410.6	91%	0.093		7.023	0.392		3.759	11.174	547.4	91%	0.124		8.714	0.537		5.012	14.263
	30-Jun	1003	282		273.8	91%	0.062		5.182	0.251		2.540	7.973	410.6	91%	0.093		7.024	0.391		3.811	11.226	547.5	91%	0.124		8.716	0.536		5.081	14.332
First Calving. First Lactation starts.	01-Jul	1004	283	1	273.8	91%	0.062	0.29	5.183	0.250	0.209	2.575	8.217	410.7	91%	0.093	0.40	7.025	0.390	0.284	3.862	11.561	547.6	91%	0.124	0.49	8.717	0.535	0.352	5.150	14.754
	02-Jul	1005		2	273.9	91%	0.062	0.57	5.184	0.249	0.412		5.845	410.8	91%	0.093	0.78	7.026	0.389	0.558		7.973	547.8	91%	0.123	0.96	8.718	0.533	0.692		9.944
	03-Jul	1006		3	273.9	91%	0.062	0.85	5.185	0.249	0.607		6.041	410.9	91%	0.092	1.15	7.028	0.388	0.823		8.239	547.9	91%	0.123	1.42	8.720	0.532	1.021		10.273
	04-Jul	1007		4	274.0	91%	0.061	1.11	5.186	0.248	0.796		6.230	411.0	91%	0.092	1.50	7.029	0.387	1.079		8.495	548.0	91%	0.123	1.87	8.721	0.531	1.339		10.591
	05-Jul	1008		5	274.1	91%	0.061	1.36	5.187	0.247	0.979		6.413	411.1	91%	0.092	1.85	7.030	0.386	1.327		8.743	548.1	91%	0.123	2.29	8.723	0.529	1.646		10.898
	06-Jul	1009		6	274.1	91%	0.061	1.61	5.188	0.247	1.155		6.589	411.2	91%	0.092	2.18	7.031	0.385	1.565		8.982	548.3	91%	0.122	2.71	8.724	0.528	1.942		11.195
	07-Jul	1010		7	274.2	91%	0.061	1.85	5.188	0.246	1.325		6.760	411.3	91%	0.091	2.50	7.032	0.384	1.796		9.212	548.4	91%	0.122	3.10	8.726	0.527	2.228		11.481
	08-Jul	1011		8	274.3	91%	0.061	2.07	5.189	0.246	1.489		6.924	411.4	91%	0.091	2.81	7.034	0.383	2.018		9.435	548.5	91%	0.122	3.49	8.727	0.526	2.504		11.757
	09-Jul	1012		9	274.3	91%	0.061	2.29	5.190	0.245	1.647		7.082	411.5	91%	0.091	3.11	7.035	0.382	2.233		9.650	548.6	91%	0.121	3.86	8.729	0.524	2.770		12.023
	10-Jul	1013		10	274.4	91%	0.061	2.51	5.191	0.245	1.800		7.235	411.6	91%	0.091	3.40	7.036	0.381	2.439		9.857	548.8	91%	0.121	4.22	8.730	0.523	3.027		12.280
	11-Jul	1014		11	274.4	91%	0.060	2.71	5.192	0.244	1.947		7.382	411.7	91%	0.091	3.68	7.037	0.381	2.639		10.056	548.9	91%	0.121	4.56	8.732	0.522	3.274		12.527
	12-Jul	1015		12	274.5	91%	0.060	2.91	5.193	0.243	2.088		7.524	411.7	91%	0.090	3.94	7.038	0.380	2.830		10.248	549.0	91%	0.121	4.89	8.733	0.520	3.512		12.766
	13-Jul	1016		13	274.6	92%	0.060	3.10	5.194	0.243	2.225		7.661	411.8	92%	0.090	4.20	7.039	0.379	3.015		10.433	549.1	92%	0.120	5.21	8.734	0.519	3.741		12.995
	14-Jul	1017		14	274.6	92%	0.060	3.28	5.194	0.242	2.356		7.792	411.9	92%	0.090	4.45	7.041	0.378	3.193		10.611	549.2	92%	0.120	5.52	8.736	0.518	3.962		13.216
	15-Jul	1018		15	274.7	92%	0.060	3.46	5.195	0.242	2.482		7.919	412.0	92%	0.090	4.69	7.042	0.377	3.364		10.783	549.4	92%	0.120	5.82	8.737	0.517	4.174		13.428
	16-Jul	1019		16	274.7	92%	0.060	3.63	5.196	0.241	2.603		8.040	412.1	92%	0.090	4.92	7.043	0.376	3.529		10.947	549.5	92%	0.119	6.10	8.739	0.515	4.378		13.632
	17-Jul	1020		17	274.8	92%	0.060	3.79	5.197	0.240	2.720		8.157	412.2	92%	0.089	5.14	7.044	0.375	3.687		11.106	549.6	92%	0.119	6.37	8.740	0.514	4.574		13.829
	18-Jul	1021		18	274.9	92%	0.059	3.95	5.198	0.240	2.832		8.270	412.3	92%	0.089	5.35	7.045	0.374	3.838		11.258	549.7	92%	0.119	6.64	8.742	0.513	4.763		14.017
	19-Jul	1022		19	274.9	92%	0.059	4.10	5.199	0.239	2.939		8.377	412.4	92%	0.089	5.55	7.046	0.373	3.984		11.404	549.8	92%	0.119	6.89	8.743	0.512	4.944		14.198
	20-Jul	1023		20	275.0	92%	0.059	4.24	5.199	0.239	3.043		8.481	412.5	92%	0.089	5.75	7.047	0.372	4.124		11.544	549.9	92%	0.118	7.13	8.744	0.510	5.117		14.372
	21-Jul	1024		21	275.0	92%	0.059	4.38	5.200	0.238	3.141		8.580	412.5	92%	0.089	5.93	7.048	0.371	4.258		11.678	550.1	92%	0.118	7.36	8.746	0.509	5.283		14.538
	22-Jul	1025		22	275.1	92%	0.059	4.51	5.201	0.237	3.236		8.675	412.6	92%	0.088	6.11	7.050	0.371	4.386		11.807	550.2	92%	0.118	7.58	8.747	0.508	5.443		14.698
	23-Jul	1026		23	275.1	92%	0.059	4.63	5.202	0.237	3.327		8.766	412.7	92%	0.088	6.28	7.051	0.370	4.509		11.930	550.3	92%	0.117	7.79	8.749	0.507	5.595		14.851
	24-Jul	1027		24	275.2	92%	0.059	4.76	5.203	0.236	3.414		8.853	412.8	92%	0.088	6.45	7.052	0.369	4.627		12.048	550.4	92%	0.117	8.00	8.750	0.506	5.741		14.997
	25-Jul	1028		25	275.3	92%	0.058	4.87	5.204	0.236	3.497		8.936	412.9	92%	0.088	6.60	7.053	0.368	4.739		12.160	550.5	92%	0.117	8.19	8.751	0.504	5.881		15.136
	26-Jul	1029		26	275.3	92%	0.058	4.98	5.204	0.235	3.576		9.016	413.0	92%	0.087	6.75	7.054	0.367	4.847		12.268	550.6	92%	0.117	8.38	8.753	0.503	6.014		15.270
	27-Jul	1030		27	275.4	92%	0.058	5.09	5.205	0.235	3.652		9.092	413.1	92%	0.087	6.90	7.055	0.366	4.949		12.371	550.8	92%	0.116	8.56	8.754	0.502	6.141		15.397
	28-Jul	1031		28	275.4	92%	0.058	5.19	5.206	0.234	3.724		9.164	413.2	92%	0.087	7.03	7.056	0.365	5.047		12.469	550.9	92%	0.116	8.72	8.756	0.501	6.263		15.519
	29-Jul	1032		29	275.5	92%	0.058	5.28	5.207	0.233	3.792		9.233	413.2	92%	0.087	7.16	7.057	0.364	5.140		12.562	551.0	92%	0.116	8.89	8.757	0.499	6.378		15.635
	30-Jul	1033		30	275.6	92%	0.058	5.37	5.208	0.233	3.858		9.298	413.3	92%	0.087	7.28	7.059	0.363	5.229		12.651	551.1	92%	0.116	9.04	8.758	0.498	6.488		15.745
	31-Jul	1034		31	275.6	92%	0.058	5.46	5.209	0.232	3.920		9.361	413.4	92%	0.086	7.40	7.060	0.363	5.313		12.735	551.2	92%	0.115	9.18	8.760	0.497	6.593		15.849
	01-Aug	1035		32	275.7	92%	0.057	5.54	5.209	0.232	3.979		9.420	413.5	92%	0.086	7.51	7.061	0.362	5.393		12.816	551.3	92%	0.115	9.32	8.761	0.496	6.692		15.949
	02-Aug	1036		33	275.7	92%	0.057	5.62	5.210	0.231	4.035		9.476	413.6	92%	0.086	7.62	7.062	0.361	5.469		12.892	551.5	92%	0.115	9.45	8.762	0.495	6.786		16.043
	03-Aug	1037		34	275.8	92%	0.057	5.70	5.211	0.231	4.088		9.530	413.7	92%	0.086	7.72	7.063	0.360	5.541		12.964	551.6	92%	0.114	9.58	8.764	0.493	6.875		16.132
	04-Aug	1038		35	275.8	92%	0.057	5.76	5.212	0.230	4.138		9.580	413.8	92%	0.086	7.81	7.064	0.359	5.609		13.032	551.7	92%	0.114	9.70	8.765	0.492	6.959		16.217
	05-Aug	1039		36	275.9	92%	0.057	5.83	5.213	0.230	4.185		9.627	413.9	92%	0.085	7.90	7.065	0.358	5.673		13.096	551.8	92%	0.114	9.81	8.767	0.491	7.039		16.296
	06-Aug	1040		37	276.0	92%	0.057	5.89	5.213	0.229	4.230		9.672	413.9	92%	0.085	7.99	7.066	0.357	5.733		13.157	551.9	92%	0.114	9.91	8.768	0.490	7.114		16.372
	07-Aug	1041		38	276.0	92%	0.057	5.95	5.214	0.228	4.272		9.714	414.0	92%	0.085	8.07	7.067	0.356	5.790		13.214	552.0	92%	0.113	10.01	8.769	0.489	7.184		16.442
	08-Aug	1042		39	276.1	92%	0.057	6.01	5.215	0.228	4.311		9.754	414.1	92%	0.085	8.14	7.068	0.356	5.843		13.267	552.1	92%	0.113	10.10	8.771	0.487	7.251		16.509
	09-Aug	1043		40	276.1	92%	0.056	6.06	5.216	0.227	4.348		9.791	414.2	92%	0.085	8.21	7.070	0.355	5.893		13.318	552.3	92%	0.113	10.19	8.772	0.486	7.312		16.571
	10-Aug	1044		41	276.2	92%	0.056	6.11	5.217	0.227	4.382		9.826	414.3	92%	0.084	8.28	7.071	0.354	5.940		13.364	552.4	92%	0.113	10.27	8.773	0.485	7.370		16.629
	11-Aug	1045		42	276.2	92%	0.056	6.15	5.217	0.226	4.415		9.858	414.4	92%	0.084	8.34	7.072	0.353	5.983		13.408	552.5	92%	0.112	10.34	8.775	0.484	7.424		16.683
	12-Aug	1046		43	276.3	92%	0.056	6.19	5.218	0.226	4.444		9.888	414.4	92%	0.084	8.39	7.073	0.352	6.024		13.449	552.6	92%	0.112	10.41	8.776	0.483	7.474		16.733
	13-Aug	1047		44	276.4	92%	0.056	6.23	5.219	0.225	4.472		9.916	414.5	92%	0.084	8.44	7.074	0.351	6.061		13.486	552.7	92%	0.112	10.48	8.777	0.482	7.521		16.780
	14-Aug	1048		45	276.4	92%	0.056	6.27	5.220	0.225	4.497		9.942	414.6	92%	0.084	8.49	7.075	0.350	6.096		13.521	552.8	92%	0.112	10.54	8.779	0.480	7.563		16.822
	15-Aug	1049		46	276.5	92%	0.056	6.30	5.221	0.224	4.521		9.965	414.7	92%	0.083	8.54	7.076	0.349	6.127		13.553	552.9	92%	0.111	10.59	8.780	0.479	7.603		16.862
	16-Aug	1050		47	276.5	92%	0.055	6.33	5.221	0.223	4.542		9.987	414.8	92%	0.083	8.58	7.077	0.349	6.156		13.582	553.0	92%	0.111	10.64	8.781	0.478	7.639		16.898
	17-Aug	1051		48	276.6	92%	0.055	6.35	5.222	0.223	4.561		10.006	414.9	92%	0.083	8.61	7.078	0.348	6.182		13.608	553.1	92%	0.111	10.69	8.783	0.477	7.671		16.930
	18-Aug	1052		49	276.6	92%	0.055	6.38	5.223	0.222	4.579		10.024	414.9	92%	0.083	8.65	7.079	0.347	6.206		13.632	553.3	92%	0.110	10.73	8.784	0.476	7.700		16.960
	19-Aug	1053		50	276.7	92%	0.055	6.40	5.224	0.222	4.594		10.040	415.0	92%	0.083	8.68	7.080	0.346	6.227		13.653	553.4	92%	0.110	10.76	8.785	0.475	7.727		16.986
	20-Aug	1054		51	276.7	92%	0.055	6.42	5.224	0.221	4.608		10.054	415.1	92%	0.082	8.70	7.081	0.345	6.246		13.672	553.5	92%	0.110	10.80	8.787	0.473	7.750		17.010
	21-Aug	1055		52	276.8	92%	0.055	6.44	5.225	0.221	4.620		10.066	415.2	92%	0.082	8.72	7.082	0.344	6.262		13.689	553.6	92%	0.110	10.82	8.788	0.472	7.770		17.030
	22-Aug	1056		53	276.8	92%	0.055	6.45	5.226	0.220	4.630		10.077	415.3	92%	0.082	8.74	7.083	0.344	6.276		13.703	553.7	92%	0.109	10.85	8.789	0.471	7.787		17.048
	23-Aug	1057		54	276.9	92%	0.055	6.46	5.227	0.220	4.639		10.086	415.4	92%	0.082	8.76	7.084	0.343	6.288		13.715	553.8	92%	0.109	10.87	8.790	0.470	7.802		17.062
	24-Aug	1058		55	277.0	92%	0.054	6.47	5.228	0.219	4.646		10.093	415.4	92%	0.082	8.77	7.085	0.342	6.298		13.725	553.9	92%	0.109	10.89	8.792	0.469	7.814		17.075
	25-Aug	1059		56	277.0	92%	0.054	6.48	5.228	0.219	4.652		10.099	415.5	92%	0.081	8.78	7.087	0.341	6.305		13.733	554.0	92%	0.109	10.90	8.793	0.468	7.824		17.084
	26-Aug	1060		57	277.1	92%	0.054	6.49	5.229	0.218	4.656		10.103	415.6	92%	0.081	8.79	7.088	0.340	6.311		13.739	554.1	92%	0.108	10.91	8.794	0.466	7.831		17.091
	27-Aug	1061		58	277.1	92%	0.054	6.49	5.230	0.218	4.659		10.106	415.7	92%	0.081	8.80	7.089	0.339	6.315		13.743	554.2	92%	0.108	10.92	8.796	0.465	7.835		17.096
	28-Aug	1062		59	277.2	92%	0.054	6.49	5.231	0.217	4.660		10.108	415.8	92%	0.081	8.80	7.090	0.339	6.316		13.745	554.3	92%	0.108	10.92	8.797	0.464	7.837		17.099
	29-Aug	1063		60	277.2	92%	0.054	6.49	5.231	0.216	4.660		10.108	415.8	92%	0.081	8.80	7.091	0.338	6.316		13.745	554.5	92%	0.108	10.92	8.798	0.463	7.837		17.099
	30-Aug	1064		61	277.3	92%	0.054	6.49	5.232	0.216	4.659		10.107	415.9	92%	0.081	8.80	7.092	0.337	6.315		13.743	554.6	92%	0.107	10.92	8.799	0.462	7.835		17.097

31-Aug	1065	62	277.3	92%	0.054	6.49	5.233	0.215	4.656	10.105	416.0	92%	0.080	8.79	7.093	0.336	6.311	13.740	554.7	92%	0.107	10.91	8.801	0.461	7.831	17.093
01-Sep	1066	63	277.4	92%	0.053	6.48	5.234	0.215	4.653	10.101	416.1	92%	0.080	8.79	7.094	0.335	6.306	13.735	554.8	92%	0.107	10.90	8.802	0.460	7.825	17.086
02-Sep	1067	64	277.4	92%	0.053	6.47	5.234	0.214	4.648	10.096	416.2	92%	0.080	8.78	7.095	0.334	6.299	13.729	554.9	92%	0.107	10.89	8.803	0.459	7.816	17.078
03-Sep	1068	65	277.5	92%	0.053	6.47	5.235	0.214	4.642	10.091	416.2	92%	0.080	8.76	7.096	0.334	6.291	13.721	555.0	92%	0.106	10.88	8.805	0.457	7.806	17.068
04-Sep	1069	66	277.5	93%	0.053	6.46	5.236	0.213	4.634	10.084	416.3	93%	0.080	8.75	7.097	0.333	6.282	13.711	555.1	93%	0.106	10.86	8.806	0.456	7.794	17.056
05-Sep	1070	67	277.6	93%	0.053	6.45	5.237	0.213	4.626	10.076	416.4	93%	0.079	8.74	7.098	0.332	6.270	13.700	555.2	93%	0.106	10.84	8.807	0.455	7.780	17.043
06-Sep	1071	68	277.7	93%	0.053	6.43	5.237	0.212	4.617	10.067	416.5	93%	0.079	8.72	7.099	0.331	6.258	13.688	555.3	93%	0.106	10.82	8.808	0.454	7.765	17.027
07-Sep	1072	69	277.7	93%	0.053	6.42	5.238	0.212	4.607	10.057	416.6	93%	0.079	8.70	7.100	0.330	6.244	13.674	555.4	93%	0.105	10.79	8.810	0.453	7.748	17.010
08-Sep	1073	70	277.8	93%	0.053	6.40	5.239	0.211	4.596	10.046	416.6	93%	0.079	8.68	7.101	0.330	6.229	13.660	555.5	93%	0.105	10.77	8.811	0.452	7.729	16.992
09-Sep	1074	71	277.8	93%	0.052	6.39	5.240	0.211	4.584	10.034	416.7	93%	0.079	8.66	7.102	0.329	6.213	13.643	555.6	93%	0.105	10.74	8.812	0.451	7.709	16.972
10-Sep	1075	72	277.9	93%	0.052	6.37	5.240	0.210	4.571	10.021	416.8	93%	0.078	8.63	7.103	0.328	6.195	13.626	555.7	93%	0.105	10.71	8.813	0.450	7.687	16.950
11-Sep	1076	73	277.9	93%	0.052	6.35	5.241	0.210	4.557	10.008	416.9	93%	0.078	8.61	7.104	0.327	6.177	13.608	555.8	93%	0.104	10.68	8.815	0.449	7.664	16.927
12-Sep	1077	74	278.0	93%	0.052	6.33	5.242	0.209	4.543	9.994	417.0	93%	0.078	8.58	7.105	0.326	6.157	13.588	555.9	93%	0.104	10.64	8.816	0.447	7.640	16.903
13-Sep	1078	75	278.0	93%	0.052	6.31	5.243	0.209	4.527	9.978	417.0	93%	0.078	8.55	7.106	0.326	6.136	13.568	556.0	93%	0.104	10.61	8.817	0.446	7.614	16.877
14-Sep	1079	76	278.1	93%	0.052	6.28	5.243	0.208	4.511	9.963	417.1	93%	0.078	8.52	7.107	0.325	6.114	13.546	556.1	93%	0.104	10.57	8.818	0.445	7.587	16.850
15-Sep	1080	77	278.1	93%	0.052	6.26	5.244	0.208	4.494	9.946	417.2	93%	0.078	8.49	7.108	0.324	6.092	13.523	556.2	93%	0.103	10.53	8.819	0.444	7.558	16.822
16-Sep	1081	78	278.2	93%	0.052	6.24	5.245	0.207	4.477	9.929	417.3	93%	0.077	8.45	7.109	0.323	6.068	13.500	556.4	93%	0.103	10.49	8.821	0.443	7.529	16.793
17-Sep	1082	79	278.2	93%	0.051	6.21	5.246	0.207	4.459	9.911	417.3	93%	0.077	8.42	7.110	0.322	6.043	13.475	556.5	93%	0.103	10.45	8.822	0.442	7.498	16.762
18-Sep	1083	80	278.3	93%	0.051	6.19	5.246	0.206	4.440	9.892	417.4	93%	0.077	8.38	7.111	0.322	6.018	13.450	556.6	93%	0.103	10.40	8.823	0.441	7.467	16.731
19-Sep	1084	81	278.3	93%	0.051	6.16	5.247	0.206	4.420	9.873	417.5	93%	0.077	8.35	7.112	0.321	5.991	13.424	556.7	93%	0.102	10.36	8.824	0.440	7.434	16.698
20-Sep	1085	82	278.4	93%	0.051	6.13	5.248	0.205	4.400	9.853	417.6	93%	0.077	8.31	7.113	0.320	5.964	13.397	556.8	93%	0.102	10.31	8.826	0.439	7.400	16.665
21-Sep	1086	83	278.4	93%	0.051	6.10	5.248	0.205	4.380	9.833	417.6	93%	0.076	8.27	7.114	0.319	5.936	13.369	556.9	93%	0.102	10.26	8.827	0.438	7.366	16.630
22-Sep	1087	84	278.5	93%	0.051	6.07	5.249	0.204	4.359	9.812	417.7	93%	0.076	8.23	7.115	0.318	5.908	13.341	557.0	93%	0.102	10.21	8.828	0.437	7.330	16.595
23-Sep	1088	85	278.5	93%	0.051	6.04	5.250	0.204	4.337	9.791	417.8	93%	0.076	8.19	7.116	0.318	5.878	13.312	557.1	93%	0.101	10.16	8.829	0.436	7.294	16.559
24-Sep	1089	86	278.6	93%	0.051	6.01	5.251	0.203	4.315	9.769	417.9	93%	0.076	8.15	7.117	0.317	5.848	13.282	557.2	93%	0.101	10.11	8.830	0.435	7.257	16.522
25-Sep	1090	87	278.6	93%	0.050	5.98	5.251	0.203	4.292	9.746	418.0	93%	0.076	8.11	7.118	0.316	5.818	13.252	557.3	93%	0.101	10.06	8.832	0.433	7.219	16.484
26-Sep	1091	88	278.7	93%	0.050	5.95	5.252	0.202	4.269	9.723	418.0	93%	0.076	8.06	7.119	0.315	5.787	13.221	557.4	93%	0.101	10.00	8.833	0.432	7.180	16.445
27-Sep	1092	89	278.7	93%	0.050	5.92	5.253	0.202	4.246	9.700	418.1	93%	0.075	8.02	7.120	0.315	5.755	13.189	557.5	93%	0.101	9.95	8.834	0.431	7.141	16.406
28-Sep	1093	90	278.8	93%	0.050	5.88	5.253	0.201	4.222	9.677	418.2	93%	0.075	7.97	7.121	0.314	5.723	13.157	557.6	93%	0.100	9.89	8.835	0.430	7.101	16.366
29-Sep	1094	91	278.8	93%	0.050	5.85	5.254	0.201	4.198	9.653	418.3	93%	0.075	7.93	7.121	0.313	5.690	13.124	557.7	93%	0.100	9.84	8.836	0.429	7.060	16.325
30-Sep	1095	92	278.9	93%	0.050	5.81	5.255	0.200	4.173	9.628	418.3	93%	0.075	7.88	7.122	0.312	5.656	13.091	557.8	93%	0.100	9.78	8.838	0.428	7.018	16.284
01-Oct	1096	93	278.9	93%	0.050	5.78	5.256	0.200	4.148	9.603	418.4	93%	0.075	7.83	7.123	0.312	5.623	13.057	557.9	93%	0.100	9.72	8.839	0.427	6.976	16.242
02-Oct	1097	94	279.0	93%	0.050	5.74	5.256	0.199	4.123	9.578	418.5	93%	0.075	7.79	7.124	0.311	5.588	13.023	558.0	93%	0.099	9.66	8.840	0.426	6.934	16.200
03-Oct	1098	95	279.0	93%	0.050	5.71	5.257	0.199	4.097	9.553	418.6	93%	0.074	7.74	7.125	0.310	5.554	12.989	558.1	93%	0.099	9.60	8.841	0.425	6.891	16.157
04-Oct	1099	96	279.1	93%	0.049	5.67	5.258	0.198	4.072	9.527	418.6	93%	0.074	7.69	7.126	0.309	5.519	12.954	558.2	93%	0.099	9.54	8.842	0.424	6.847	16.114
05-Oct	1100	97	279.1	93%	0.049	5.64	5.258	0.198	4.045	9.501	418.7	93%	0.074	7.64	7.127	0.308	5.483	12.919	558.3	93%	0.099	9.48	8.843	0.423	6.803	16.070
06-Oct	1101	98	279.2	93%	0.049	5.60	5.259	0.197	4.019	9.475	418.8	93%	0.074	7.59	7.128	0.308	5.447	12.883	558.4	93%	0.098	9.42	8.845	0.422	6.759	16.026
07-Oct	1102	99	279.2	93%	0.049	5.56	5.260	0.197	3.992	9.449	418.8	93%	0.074	7.54	7.129	0.307	5.411	12.847	558.5	93%	0.098	9.35	8.846	0.421	6.714	15.981
08-Oct	1103	100	279.3	93%	0.049	5.52	5.260	0.196	3.965	9.422	418.9	93%	0.073	7.49	7.130	0.306	5.375	12.811	558.6	93%	0.098	9.29	8.847	0.420	6.669	15.936
09-Oct	1104	101	279.3	93%	0.049	5.49	5.261	0.196	3.938	9.395	419.0	93%	0.073	7.44	7.131	0.305	5.338	12.774	558.7	93%	0.098	9.23	8.848	0.419	6.623	15.890
10-Oct	1105	102	279.4	93%	0.049	5.45	5.262	0.195	3.911	9.368	419.1	93%	0.073	7.39	7.132	0.305	5.301	12.738	558.8	93%	0.097	9.16	8.849	0.418	6.578	15.845
11-Oct	1106	103	279.4	93%	0.049	5.41	5.262	0.195	3.884	9.341	419.1	93%	0.073	7.33	7.133	0.304	5.264	12.701	558.9	93%	0.097	9.10	8.850	0.417	6.531	15.798
12-Oct	1107	104	279.5	93%	0.049	5.37	5.263	0.194	3.856	9.313	419.2	93%	0.073	7.28	7.134	0.303	5.226	12.663	558.9	93%	0.097	9.03	8.852	0.416	6.485	15.752
13-Oct	1108	105	279.5	93%	0.048	5.33	5.264	0.194	3.828	9.286	419.3	93%	0.073	7.23	7.135	0.302	5.189	12.626	559.0	93%	0.097	8.97	8.853	0.415	6.438	15.705
14-Oct	1109	106	279.6	93%	0.048	5.29	5.265	0.193	3.800	9.258	419.4	93%	0.072	7.18	7.136	0.302	5.151	12.588	559.1	93%	0.097	8.90	8.854	0.414	6.391	15.659
15-Oct	1110	107	279.6	93%	0.048	5.26	5.265	0.193	3.772	9.230	419.4	93%	0.072	7.12	7.136	0.301	5.113	12.550	559.2	93%	0.096	8.84	8.855	0.413	6.344	15.611
16-Oct	1111	108	279.7	93%	0.048	5.22	5.266	0.192	3.744	9.202	419.5	93%	0.072	7.07	7.137	0.300	5.074	12.512	559.3	93%	0.096	8.77	8.856	0.412	6.296	15.564
17-Oct	1112	109	279.7	93%	0.048	5.18	5.267	0.192	3.716	9.174	419.6	93%	0.072	7.02	7.138	0.300	5.036	12.474	559.4	93%	0.096	8.71	8.857	0.411	6.249	15.517
18-Oct	1113	110	279.8	93%	0.048	5.14	5.267	0.191	3.687	9.146	419.6	93%	0.072	6.96	7.139	0.299	4.998	12.436	559.5	93%	0.096	8.64	8.858	0.410	6.201	15.469
19-Oct	1114	111	279.8	93%	0.048	5.10	5.268	0.191	3.659	9.118	419.7	93%	0.072	6.91	7.140	0.298	4.959	12.397	559.6	93%	0.095	8.57	8.860	0.409	6.153	15.421
20-Oct	1115	112	279.9	93%	0.048	5.06	5.269	0.191	3.630	9.089	419.8	93%	0.071	6.85	7.141	0.297	4.920	12.359	559.7	93%	0.095	8.51	8.861	0.408	6.105	15.373
21-Oct	1116	113	279.9	93%	0.047	5.02	5.269	0.190	3.601	9.061	419.9	93%	0.071	6.80	7.142	0.297	4.881	12.320	559.8	93%	0.095	8.44	8.862	0.407	6.057	15.325
22-Oct	1117	114	280.0	93%	0.047	4.98	5.270	0.190	3.573	9.032	419.9	93%	0.071	6.75	7.143	0.296	4.843	12.281	559.9	93%	0.095	8.37	8.863	0.406	6.009	15.277
23-Oct	1118	115	280.0	93%	0.047	4.94	5.271	0.189	3.544	9.004	420.0	93%	0.071	6.69	7.144	0.295	4.804	12.243	560.0	93%	0.095	8.30	8.864	0.405	5.960	15.229
24-Oct	1119	116	280.0	93%	0.047	4.90	5.271	0.189	3.515	8.975	420.1	93%	0.071	6.64	7.145	0.294	4.765	12.204	560.1	93%	0.094	8.24	8.865	0.404	5.912	15.181
25-Oct	1120	117	280.1	93%	0.047	4.86	5.272	0.188	3.487	8.947	420.1	93%	0.071	6.58	7.146	0.294	4.726	12.165	560.2	93%	0.094	8.17	8.866	0.403	5.864	15.132
26-Oct	1121	118	280.1	93%	0.047	4.82	5.273	0.188	3.458	8.918	420.2	93%	0.070	6.53	7.146	0.293	4.687	12.126	560.3	93%	0.094	8.10	8.867	0.402	5.815	15.084
27-Oct	1122	119	280.2	93%	0.047	4.78	5.273	0.187	3.429	8.889	420.3	93%	0.070	6.47	7.147	0.292	4.648	12.087	560.4	93%	0.094	8.03	8.869	0.401	5.767	15.036
28-Oct	1123	120	280.2	93%	0.047	4.74	5.274	0.187	3.400	8.861	420.4	93%	0.070	6.42	7.148	0.291	4.608	12.048	560.5	93%	0.093	7.97	8.870	0.400	5.718	14.988
29-Oct	1124	121	280.3	93%	0.047	4.70	5.275	0.186	3.371	8.832	420.4	93%	0.070	6.37	7.149	0.291	4.569	12.009	560.6	93%	0.093	7.90	8.871	0.399	5.670	14.939
30-Oct	1125	122	280.3	93%	0.046	4.66	5.275	0.186	3.342	8.804	420.5	93%	0.070	6.31	7.150	0.290	4.530	11.971	560.7	93%	0.093	7.83	8.872	0.398	5.621	14.891
31-Oct	1126	123	280.4	93%	0.046	4.62	5.276	0.185	3.314	8.775	420.6	93%	0.070	6.26	7.151	0.289	4.491	11.932	560.7	93%	0.093	7.76	8.873	0.397	5.573	14.843
01-Nov	1127	124	280.4	93%	0.046	4.58	5.277	0.185	3.285	8.747	420.6	93%	0.069	6.20	7.152	0.289	4.452	11.893	560.8	93%	0.093	7.70	8.874	0.396	5.525	14.794
02-Nov	1128	125	280.5	93%	0.046	4.54	5.277	0.185	3.256	8.718	420.7	93%	0.069	6.15	7.153	0.288	4.414	11.854	560.9	93%	0.092	7.63	8.875	0.395	5.476	14.746
03-Nov	1129	126	280.5	94%	0.046	4.50	5.278	0.184	3.228	8.690	420.8	94%	0.069	6.09	7.154	0.287	4.375	11.816	561.0	94%	0.092	7.56	8.876	0.394	5.428	14.698
04-Nov	1130	127	280.6	94%	0.046	4.46	5.278	0.184	3.199	8.661	420.8	94%	0.069	6.04	7.154	0.287	4.336	11.777	561.1	94%	0.092	7.50	8.877	0.393	5.380	14.650
05-Nov	1131	128	280.6	94%	0.046	4.42	5.279	0.183	3.170	8.633	420.9	94%	0.069	5.99	7.155	0.286	4.297	11.738	561.2	94%	0.092	7.43	8.878	0.392	5.332	14.602

	06-Nov	1132		129	280.7	94%	0.046	4.38	5.280	0.183	3.142		8.605	421.0	94%	0.069	5.93	7.156	0.285	4.259		11.700	561.3	94%	0.091	7.36	8.879	0.391	5.284		14.555
	07-Nov	1133		130	280.7	94%	0.046	4.34	5.280	0.182	3.114		8.576	421.0	94%	0.068	5.88	7.157	0.284	4.220		11.662	561.4	94%	0.091	7.30	8.881	0.390	5.236		14.507
	08-Nov	1134		131	280.7	94%	0.046	4.30	5.281	0.182	3.085		8.548	421.1	94%	0.068	5.83	7.158	0.284	4.182		11.623	561.5	94%	0.091	7.23	8.882	0.389	5.189		14.459
	09-Nov	1135		132	280.8	94%	0.045	4.26	5.282	0.181	3.057		8.520	421.2	94%	0.068	5.77	7.159	0.283	4.143		11.585	561.6	94%	0.091	7.16	8.883	0.388	5.141		14.412
	10-Nov	1136		133	280.8	94%	0.045	4.22	5.282	0.181	3.029		8.492	421.2	94%	0.068	5.72	7.160	0.282	4.105		11.547	561.7	94%	0.091	7.10	8.884	0.387	5.094		14.365
	11-Nov	1137		134	280.9	94%	0.045	4.18	5.283	0.180	3.001		8.464	421.3	94%	0.068	5.67	7.161	0.282	4.067		11.509	561.8	94%	0.090	7.03	8.885	0.386	5.047		14.318
	12-Nov	1138		135	280.9	94%	0.045	4.14	5.284	0.180	2.973		8.436	421.4	94%	0.068	5.61	7.161	0.281	4.029		11.472	561.8	94%	0.090	6.97	8.886	0.385	5.000		14.271
	13-Nov	1139		136	281.0	94%	0.045	4.10	5.284	0.180	2.945		8.409	421.5	94%	0.067	5.56	7.162	0.280	3.991		11.434	561.9	94%	0.090	6.90	8.887	0.384	4.953		14.224
	14-Nov	1140		137	281.0	94%	0.045	4.06	5.285	0.179	2.917		8.381	421.5	94%	0.067	5.51	7.163	0.280	3.954		11.396	562.0	94%	0.090	6.83	8.888	0.383	4.906		14.177
	15-Nov	1141		138	281.1	94%	0.045	4.03	5.286	0.179	2.889		8.354	421.6	94%	0.067	5.46	7.164	0.279	3.916		11.359	562.1	94%	0.090	6.77	8.889	0.382	4.859		14.131
	16-Nov	1142		139	281.1	94%	0.045	3.99	5.286	0.178	2.862		8.326	421.7	94%	0.067	5.40	7.165	0.278	3.879		11.322	562.2	94%	0.089	6.71	8.890	0.381	4.813		14.085
	17-Nov	1143		140	281.1	94%	0.045	3.95	5.287	0.178	2.834		8.299	421.7	94%	0.067	5.35	7.166	0.277	3.842		11.285	562.3	94%	0.089	6.64	8.891	0.380	4.767		14.038
	18-Nov	1144		141	281.2	94%	0.044	3.91	5.287	0.177	2.807		8.272	421.8	94%	0.067	5.30	7.167	0.277	3.805		11.248	562.4	94%	0.089	6.58	8.892	0.379	4.721		13.993
	19-Nov	1145		142	281.2	94%	0.044	3.87	5.288	0.177	2.780		8.245	421.9	94%	0.067	5.25	7.167	0.276	3.768		11.211	562.5	94%	0.089	6.51	8.893	0.379	4.675		13.947
	20-Nov	1146		143	281.3	94%	0.044	3.83	5.289	0.177	2.753		8.218	421.9	94%	0.066	5.20	7.168	0.275	3.731		11.175	562.6	94%	0.088	6.45	8.894	0.378	4.630		13.902
	21-Nov	1147		144	281.3	94%	0.044	3.80	5.289	0.176	2.726		8.191	422.0	94%	0.066	5.15	7.169	0.275	3.695		11.138	562.6	94%	0.088	6.39	8.895	0.377	4.584		13.856
	22-Nov	1148		145	281.4	94%	0.044	3.76	5.290	0.176	2.699		8.165	422.1	94%	0.066	5.10	7.170	0.274	3.658		11.102	562.7	94%	0.088	6.32	8.896	0.376	4.539		13.811
	23-Nov	1149		146	281.4	94%	0.044	3.72	5.291	0.175	2.672		8.138	422.1	94%	0.066	5.05	7.171	0.273	3.622		11.066	562.8	94%	0.088	6.26	8.898	0.375	4.494		13.767
	24-Nov	1150		147	281.5	94%	0.044	3.69	5.291	0.175	2.646		8.112	422.2	94%	0.066	5.00	7.172	0.273	3.586		11.030	562.9	94%	0.088	6.20	8.899	0.374	4.450		13.722
	25-Nov	1151		148	281.5	94%	0.044	3.65	5.292	0.174	2.619		8.085	422.2	94%	0.066	4.95	7.172	0.272	3.550		10.995	563.0	94%	0.087	6.14	8.900	0.373	4.405		13.678
	26-Nov	1152		149	281.5	94%	0.044	3.61	5.292	0.174	2.593		8.059	422.3	94%	0.065	4.90	7.173	0.271	3.515		10.959	563.1	94%	0.087	6.08	8.901	0.372	4.361		13.634
	27-Nov	1153		150	281.6	94%	0.044	3.58	5.293	0.173	2.567		8.033	422.4	94%	0.065	4.85	7.174	0.271	3.479		10.924	563.2	94%	0.087	6.01	8.902	0.371	4.317		13.590
	28-Nov	1154		151	281.6	94%	0.043	3.54	5.294	0.173	2.541		8.008	422.4	94%	0.065	4.80	7.175	0.270	3.444		10.889	563.3	94%	0.087	5.95	8.903	0.370	4.274		13.546
	29-Nov	1155		152	281.7	94%	0.043	3.50	5.294	0.173	2.515		7.982	422.5	94%	0.065	4.75	7.176	0.269	3.409		10.854	563.3	94%	0.087	5.89	8.904	0.369	4.230		13.503
	30-Nov	1156		153	281.7	94%	0.043	3.47	5.295	0.172	2.490		7.957	422.6	94%	0.065	4.70	7.177	0.269	3.374		10.820	563.4	94%	0.086	5.83	8.905	0.368	4.187		13.460
	01-Dec	1157		154	281.8	94%	0.043	3.43	5.295	0.172	2.464		7.931	422.6	94%	0.065	4.65	7.177	0.268	3.340		10.785	563.5	94%	0.086	5.77	8.906	0.367	4.144		13.417
	02-Dec	1158		155	281.8	94%	0.043	3.40	5.296	0.171	2.439		7.906	422.7	94%	0.065	4.61	7.178	0.267	3.306		10.751	563.6	94%	0.086	5.71	8.907	0.367	4.102		13.375
	03-Dec	1159		156	281.8	94%	0.043	3.36	5.297	0.171	2.414		7.881	422.8	94%	0.064	4.56	7.179	0.267	3.271		10.717	563.7	94%	0.086	5.66	8.908	0.366	4.059		13.333
	04-Dec	1160		157	281.9	94%	0.043	3.33	5.297	0.171	2.389		7.856	422.8	94%	0.064	4.51	7.180	0.266	3.238		10.683	563.8	94%	0.086	5.60	8.909	0.365	4.017		13.291
	05-Dec	1161		158	281.9	94%	0.043	3.29	5.298	0.170	2.364		7.832	422.9	94%	0.064	4.46	7.181	0.265	3.204		10.650	563.9	94%	0.085	5.54	8.910	0.364	3.975		13.249
	06-Dec	1162		159	282.0	94%	0.043	3.26	5.298	0.170	2.339		7.807	423.0	94%	0.064	4.42	7.182	0.265	3.170		10.617	563.9	94%	0.085	5.48	8.911	0.363	3.934		13.208
	07-Dec	1163		160	282.0	94%	0.043	3.22	5.299	0.169	2.315		7.783	423.0	94%	0.064	4.37	7.182	0.264	3.137		10.584	564.0	94%	0.085	5.42	8.912	0.362	3.893		13.166
	08-Dec	1164		161	282.1	94%	0.042	3.19	5.300	0.169	2.290		7.759	423.1	94%	0.064	4.32	7.183	0.263	3.104		10.551	564.1	94%	0.085	5.37	8.913	0.361	3.852		13.126
	09-Dec	1165		162	282.1	94%	0.042	3.16	5.300	0.168	2.266		7.735	423.2	94%	0.063	4.28	7.184	0.263	3.071		10.518	564.2	94%	0.085	5.31	8.914	0.360	3.811		13.085
	10-Dec	1166		163	282.1	94%	0.042	3.12	5.301	0.168	2.242		7.711	423.2	94%	0.063	4.23	7.185	0.262	3.039		10.486	564.3	94%	0.084	5.25	8.915	0.359	3.771		13.045
	11-Dec	1167		164	282.2	94%	0.042	3.09	5.301	0.168	2.218		7.687	423.3	94%	0.063	4.19	7.186	0.261	3.006		10.454	564.4	94%	0.084	5.20	8.916	0.358	3.730		13.005
	12-Dec	1168		165	282.2	94%	0.042	3.06	5.302	0.167	2.194		7.664	423.3	94%	0.063	4.14	7.186	0.261	2.974		10.422	564.5	94%	0.084	5.14	8.917	0.358	3.691		12.965
	13-Dec	1169		166	282.3	94%	0.042	3.02	5.303	0.167	2.171		7.640	423.4	94%	0.063	4.10	7.187	0.260	2.943		10.390	564.5	94%	0.084	5.09	8.918	0.357	3.651		12.926
	14-Dec	1170		167	282.3	94%	0.042	2.99	5.303	0.166	2.148		7.617	423.5	94%	0.063	4.06	7.188	0.260	2.911		10.358	564.6	94%	0.084	5.03	8.919	0.356	3.612		12.887
	15-Dec	1171		168	282.4	94%	0.042	2.96	5.304	0.166	2.125		7.594	423.5	94%	0.063	4.01	7.189	0.259	2.880		10.327	564.7	94%	0.083	4.98	8.920	0.355	3.573		12.848
	16-Dec	1172		169	282.4	94%	0.042	2.93	5.304	0.166	2.102		7.571	423.6	94%	0.062	3.97	7.190	0.258	2.848		10.296	564.8	94%	0.083	4.92	8.921	0.354	3.534		12.809
	17-Dec	1173		170	282.4	94%	0.042	2.90	5.305	0.165	2.079		7.549	423.7	94%	0.062	3.93	7.190	0.258	2.818		10.265	564.9	94%	0.083	4.87	8.922	0.353	3.496		12.771
	18-Dec	1174		171	282.5	94%	0.041	2.86	5.306	0.165	2.056		7.526	423.7	94%	0.062	3.88	7.191	0.257	2.787		10.235	565.0	94%	0.083	4.82	8.923	0.352	3.458		12.733
	19-Dec	1175		172	282.5	94%	0.041	2.83	5.306	0.164	2.034		7.504	423.8	94%	0.062	3.84	7.192	0.256	2.756		10.205	565.0	94%	0.083	4.76	8.924	0.351	3.420		12.695
	20-Dec	1176		173	282.6	94%	0.041	2.80	5.307	0.164	2.011		7.482	423.8	94%	0.062	3.80	7.193	0.256	2.726		10.175	565.1	94%	0.082	4.71	8.925	0.351	3.383		12.658
	21-Dec	1177		174	282.6	94%	0.041	2.77	5.307	0.163	1.989		7.460	423.9	94%	0.062	3.76	7.193	0.255	2.696		10.145	565.2	94%	0.082	4.66	8.926	0.350	3.346		12.621
	22-Dec	1178		175	282.6	94%	0.041	2.74	5.308	0.163	1.967		7.438	424.0	94%	0.062	3.72	7.194	0.254	2.667		10.115	565.3	94%	0.082	4.61	8.927	0.349	3.309		12.584
Second breeding	23-Dec	1179	1	176	282.7	94%	0.041	2.71	5.308	0.163	1.946	0.005	7.422	424.0	94%	0.061	3.67	7.195	0.254	2.637	0.008	10.094	565.4	94%	0.082	4.56	8.928	0.348	3.272	0.011	12.559
	24-Dec	1180	2	177	282.7	94%	0.041	2.68	5.309	0.162	1.924	0.005	7.401	424.1	94%	0.061	3.63	7.196	0.253	2.608	0.008	10.065	565.4	94%	0.082	4.51	8.929	0.347	3.236	0.011	12.523
	25-Dec	1181	3	178	282.8	94%	0.041	2.65	5.310	0.162	1.903	0.005	7.380	424.1	94%	0.061	3.59	7.197	0.253	2.579	0.009	10.037	565.5	94%	0.081	4.46	8.930	0.346	3.200	0.011	12.487
	26-Dec	1182	4	179	282.8	94%	0.041	2.62	5.310	0.161	1.882	0.006	7.359	424.2	94%	0.061	3.55	7.197	0.252	2.550	0.009	10.008	565.6	94%	0.081	4.41	8.931	0.345	3.164	0.012	12.452
	27-Dec	1183	5	180	282.8	94%	0.041	2.59	5.311	0.161	1.861	0.006	7.338	424.3	94%	0.061	3.51	7.198	0.251	2.522	0.009	9.980	565.7	94%	0.081	4.36	8.932	0.345	3.129	0.012	12.417
	28-Dec	1184	6	181	282.9	94%	0.040	2.56	5.311	0.161	1.840	0.006	7.318	424.3	94%	0.061	3.47	7.199	0.251	2.494	0.009	9.952	565.8	94%	0.081	4.31	8.932	0.344	3.094	0.012	12.383
	29-Dec	1185	7	182	282.9	94%	0.040	2.53	5.312	0.160	1.819	0.006	7.297	424.4	94%	0.061	3.43	7.200	0.250	2.465	0.010	9.925	565.9	94%	0.081	4.26	8.933	0.343	3.059	0.013	12.348
	30-Dec	1186	8	183	283.0	94%	0.040	2.51	5.312	0.160	1.799	0.006	7.277	424.4	94%	0.060	3.40	7.200	0.249	2.438	0.010	9.898	565.9	94%	0.081	4.21	8.934	0.342	3.025	0.013	12.314
	31-Dec	1187	9	184	283.0	94%	0.040	2.48	5.313	0.159	1.778	0.006	7.257	424.5	94%	0.060	3.36	7.201	0.249	2.410	0.010	9.870	566.0	94%	0.080	4.17	8.935	0.341	2.991	0.014	12.281
	01-Jan	1188	10	185	283.0	94%	0.040	2.45	5.314	0.159	1.758	0.007	7.237	424.6	94%	0.060	3.32	7.202	0.248	2.383	0.011	9.844	566.1	94%	0.080	4.12	8.936	0.340	2.957	0.014	12.247
	02-Jan	1189	11	186	283.1	94%	0.040	2.42	5.314	0.159	1.738	0.007	7.218	424.6	94%	0.060	3.28	7.203	0.248	2.356	0.011	9.817	566.2	94%	0.080	4.07	8.937	0.339	2.923	0.014	12.214
	03-Jan	1190	12	187	283.1	94%	0.040	2.39	5.315	0.158	1.718	0.007	7.198	424.7	94%	0.060	3.24	7.204	0.247	2.329	0.011	9.791	566.3	94%	0.080	4.03	8.938	0.339	2.890	0.015	12.182
	04-Jan	1191	13	188	283.2	94%	0.040	2.37	5.315	0.158	1.699	0.007	7.179	424.7	94%	0.060	3.21	7.204	0.246	2.302	0.012	9.765	566.3	94%	0.080	3.98	8.939	0.338	2.857	0.015	12.149
	05-Jan	1192	14	189	283.2	94%	0.040	2.34	5.316	0.158	1.679	0.008	7.160	424.8	94%	0.060	3.17	7.205	0.246	2.276	0.012	9.739	566.4	94%	0.079	3.93	8.940	0.337	2.824	0.016	12.117
	06-Jan	1193	15	190	283.2	94%	0.040	2.31	5.316	0.157	1.660	0.008	7.141	424.9	94%	0.059	3.13	7.206	0.245	2.250	0.012	9.713	566.5	94%	0.079	3.89	8.941	0.336	2.792	0.016	12.085
	07-Jan	1194	16	191	283.3	94%	0.040	2.29	5.317	0.157	1.641	0.008	7.123	424.9	94%	0.059	3.10	7.207	0.245	2.224	0.013	9.688	566.6	94%	0.079	3.84	8.942	0.335	2.760	0.017	12.054
	08-Jan	1195	17	192	283.3	94%	0.039	2.26	5.317	0.156	1.622	0.008	7.104	425.0	94%	0.059	3.06	7.207	0.244	2.199	0.013	9.663	566.6	94%	0.079	3.80	8.943	0.334	2.728	0.017	12.023
	09-Jan	1196	18	193	283.4	94%	0.039	2.23	5.318	0.156	1.603	0.008	7.086	425.0	94%	0.059	3.03	7.208	0.243	2.173	0.013	9.638	566.7	94%	0.079	3.76	8.944	0.334	2.697	0.018	11.992
	10-Jan	1197	19	194	283.4	94%	0.039	2.21	5.319	0.156	1.585	0.009	7.068	425.1	94%	0.059	2.99	7.209	0.243	2.148	0.014	9.613	566.8	94%	0.078	3.71	8.945	0.333	2.665	0.018	11.961
	11-Jan	1198	20	195	283.4	94%	0.039	2.18	5.319	0.155	1.566	0.009	7.050	425.2	94%	0.059	2.96	7.210	0.242	2.123	0.014	9.589	566.9	94%	0.078	3.67	8.946	0.332	2.634	0.019	11.931

	12-Jan	1199	21	196	283.5	94%	0.039	2.16	5.320	0.155	1.548	0.009	7.032	425.2	94%	0.059	2.92	7.210	0.242	2.098	0.015	9.565	567.0	94%	0.078	3.63	8.947	0.331	2.604	0.019	11.901
	13-Jan	1200	22	197	283.5	95%	0.039	2.13	5.320	0.154	1.530	0.010	7.014	425.3	95%	0.058	2.89	7.211	0.241	2.074	0.015	9.541	567.0	95%	0.078	3.59	8.947	0.330	2.573	0.020	11.871
	14-Jan	1201	23	198	283.6	95%	0.039	2.11	5.321	0.154	1.512	0.010	6.997	425.3	95%	0.058	2.86	7.212	0.240	2.050	0.016	9.517	567.1	95%	0.078	3.54	8.948	0.329	2.543	0.021	11.842
	15-Jan	1202	24	199	283.6	95%	0.039	2.08	5.321	0.154	1.495	0.010	6.980	425.4	95%	0.058	2.82	7.213	0.240	2.026	0.016	9.494	567.2	95%	0.078	3.50	8.949	0.329	2.514	0.021	11.813
	16-Jan	1203	25	200	283.6	95%	0.039	2.06	5.322	0.153	1.477	0.010	6.963	425.5	95%	0.058	2.79	7.213	0.239	2.002	0.016	9.471	567.3	95%	0.077	3.46	8.950	0.328	2.484	0.022	11.784
	17-Jan	1204	26	201	283.7	95%	0.039	2.03	5.322	0.153	1.460	0.011	6.946	425.5	95%	0.058	2.76	7.214	0.239	1.979	0.017	9.448	567.4	95%	0.077	3.42	8.951	0.327	2.455	0.023	11.756
	18-Jan	1205	27	202	283.7	95%	0.038	2.01	5.323	0.152	1.443	0.011	6.929	425.6	95%	0.058	2.72	7.215	0.238	1.955	0.017	9.425	567.4	95%	0.077	3.38	8.952	0.326	2.426	0.023	11.728
	19-Jan	1206	28	203	283.8	95%	0.038	1.99	5.323	0.152	1.426	0.011	6.912	425.6	95%	0.058	2.69	7.215	0.237	1.932	0.018	9.403	567.5	95%	0.077	3.34	8.953	0.325	2.397	0.024	11.700
	20-Jan	1207	29	204	283.8	95%	0.038	1.96	5.324	0.152	1.409	0.012	6.896	425.7	95%	0.057	2.66	7.216	0.237	1.909	0.018	9.381	567.6	95%	0.077	3.30	8.954	0.325	2.369	0.025	11.672
First Calves are weaned	21-Jan	1208	30	205	283.8	95%	0.038	1.94	5.325	0.151	1.392	0.012	6.880	425.7	95%	0.057	2.63	7.217	0.236	1.887	0.019	9.359	567.7	95%	0.076	3.26	8.955	0.324	2.341	0.025	11.645
	22-Jan	1209	31		283.9	95%	0.038		5.325	0.151		0.012	5.488	425.8	95%	0.057		7.218	0.236		0.020	7.473	567.7	95%	0.076		8.956	0.323		0.026	9.305
	23-Jan	1210	32		283.9	95%	0.038		5.326	0.151		0.013	5.489	425.9	95%	0.057		7.218	0.235		0.020	7.473	567.8	95%	0.076		8.957	0.322		0.027	9.306
	24-Jan	1211	33		283.9	95%	0.038		5.326	0.150		0.013	5.490	425.9	95%	0.057		7.219	0.234		0.021	7.474	567.9	95%	0.076		8.957	0.321		0.028	9.306
	25-Jan	1212	34		284.0	95%	0.038		5.327	0.150		0.014	5.490	426.0	95%	0.057		7.220	0.234		0.021	7.475	568.0	95%	0.076		8.958	0.321		0.028	9.307
	26-Jan	1213	35		284.0	95%	0.038		5.327	0.149		0.014	5.491	426.0	95%	0.057		7.221	0.233		0.022	7.476	568.0	95%	0.076		8.959	0.320		0.029	9.308
	27-Jan	1214	36		284.1	95%	0.038		5.328	0.149		0.014	5.491	426.1	95%	0.057		7.221	0.233		0.023	7.476	568.1	95%	0.075		8.960	0.319		0.030	9.309
	28-Jan	1215	37		284.1	95%	0.038		5.328	0.149		0.015	5.492	426.1	95%	0.056		7.222	0.232		0.023	7.477	568.2	95%	0.075		8.961	0.318		0.031	9.310
	29-Jan	1216	38		284.1	95%	0.038		5.329	0.148		0.015	5.492	426.2	95%	0.056		7.223	0.231		0.024	7.478	568.3	95%	0.075		8.962	0.317		0.032	9.311
	30-Jan	1217	39		284.2	95%	0.037		5.329	0.148		0.016	5.493	426.3	95%	0.056		7.223	0.231		0.025	7.479	568.3	95%	0.075		8.963	0.317		0.033	9.312
First Calves are sold	31-Jan	1218	40		284.2	95%	0.037		5.330	0.148		0.016	5.494	426.3	95%	0.056		7.224	0.230		0.025	7.480	568.4	95%	0.075		8.964	0.316		0.034	9.313
	01-Feb	1219	41		284.2	95%	0.037		5.330	0.147		0.016	5.494	426.4	95%	0.056		7.225	0.230		0.026	7.481	568.5	95%	0.074		8.965	0.315		0.035	9.314
	02-Feb	1220	42		284.3	95%	0.037		5.331	0.147		0.017	5.495	426.4	95%	0.056		7.226	0.229		0.027	7.481	568.6	95%	0.074		8.965	0.314		0.036	9.315
	03-Feb	1221	43		284.3	95%	0.037		5.331	0.147		0.017	5.495	426.5	95%	0.056		7.226	0.229		0.028	7.482	568.6	95%	0.074		8.966	0.313		0.037	9.317
	04-Feb	1222	44		284.4	95%	0.037		5.332	0.146		0.018	5.496	426.5	95%	0.055		7.227	0.228		0.028	7.483	568.7	95%	0.074		8.967	0.313		0.038	9.318
	05-Feb	1223	45		284.4	95%	0.037		5.332	0.146		0.018	5.497	426.6	95%	0.055		7.228	0.227		0.029	7.484	568.8	95%	0.074		8.968	0.312		0.039	9.319
	06-Feb	1224	46		284.4	95%	0.037		5.333	0.145		0.019	5.497	426.6	95%	0.055		7.228	0.227		0.030	7.485	568.9	95%	0.074		8.969	0.311		0.040	9.320
	07-Feb	1225	47		284.5	95%	0.037		5.333	0.145		0.020	5.498	426.7	95%	0.055		7.229	0.226		0.031	7.486	568.9	95%	0.073		8.970	0.310		0.041	9.321
	08-Feb	1226	48		284.5	95%	0.037		5.334	0.145		0.020	5.499	426.8	95%	0.055		7.230	0.226		0.032	7.487	569.0	95%	0.073		8.971	0.310		0.042	9.323
	09-Feb	1227	49		284.5	95%	0.037		5.335	0.144		0.021	5.500	426.8	95%	0.055		7.230	0.225		0.033	7.488	569.1	95%	0.073		8.972	0.309		0.043	9.324
	10-Feb	1228	50		284.6	95%	0.036		5.335	0.144		0.021	5.500	426.9	95%	0.055		7.231	0.225		0.033	7.489	569.1	95%	0.073		8.972	0.308		0.045	9.325
	11-Feb	1229	51		284.6	95%	0.036		5.336	0.144		0.022	5.501	426.9	95%	0.055		7.232	0.224		0.034	7.490	569.2	95%	0.073		8.973	0.307		0.046	9.326
	12-Feb	1230	52		284.6	95%	0.036		5.336	0.143		0.022	5.502	427.0	95%	0.054		7.233	0.224		0.035	7.491	569.3	95%	0.073		8.974	0.307		0.047	9.328
	13-Feb	1231	53		284.7	95%	0.036		5.337	0.143		0.023	5.503	427.0	95%	0.054		7.233	0.223		0.036	7.493	569.4	95%	0.072		8.975	0.306		0.048	9.329
	14-Feb	1232	54		284.7	95%	0.036		5.337	0.143		0.024	5.503	427.1	95%	0.054		7.234	0.222		0.037	7.494	569.4	95%	0.072		8.976	0.305		0.050	9.331
	15-Feb	1233	55		284.8	95%	0.036		5.338	0.142		0.024	5.504	427.1	95%	0.054		7.235	0.222		0.038	7.495	569.5	95%	0.072		8.977	0.304		0.051	9.332
	16-Feb	1234	56		284.8	95%	0.036		5.338	0.142		0.025	5.505	427.2	95%	0.054		7.235	0.221		0.039	7.496	569.6	95%	0.072		8.978	0.303		0.053	9.334
	17-Feb	1235	57		284.8	95%	0.036		5.339	0.142		0.026	5.506	427.2	95%	0.054		7.236	0.221		0.041	7.497	569.7	95%	0.072		8.978	0.303		0.054	9.335
	18-Feb	1236	58		284.9	95%	0.036		5.339	0.141		0.026	5.507	427.3	95%	0.054		7.237	0.220		0.042	7.499	569.7	95%	0.072		8.979	0.302		0.056	9.337
	19-Feb	1237	59		284.9	95%	0.036		5.340	0.141		0.027	5.508	427.3	95%	0.054		7.237	0.220		0.043	7.500	569.8	95%	0.071		8.980	0.301		0.057	9.338
	20-Feb	1238	60		284.9	95%	0.036		5.340	0.140		0.028	5.508	427.4	95%	0.053		7.238	0.219		0.044	7.501	569.9	95%	0.071		8.981	0.300		0.059	9.340
	21-Feb	1239	61		285.0	95%	0.036		5.341	0.140		0.029	5.509	427.5	95%	0.053		7.239	0.219		0.045	7.503	569.9	95%	0.071		8.982	0.300		0.060	9.342
	22-Feb	1240	62		285.0	95%	0.035		5.341	0.140		0.029	5.510	427.5	95%	0.053		7.239	0.218		0.046	7.504	570.0	95%	0.071		8.983	0.299		0.062	9.344
	23-Feb	1241	63		285.0	95%	0.035		5.342	0.139		0.030	5.511	427.6	95%	0.053		7.240	0.218		0.048	7.505	570.1	95%	0.071		8.983	0.298		0.064	9.345
	24-Feb	1242	64		285.1	95%	0.035		5.342	0.139		0.031	5.512	427.6	95%	0.053		7.241	0.217		0.049	7.507	570.2	95%	0.071		8.984	0.297		0.065	9.347
	25-Feb	1243	65		285.1	95%	0.035		5.343	0.139		0.032	5.513	427.7	95%	0.053		7.241	0.216		0.050	7.508	570.2	95%	0.070		8.985	0.297		0.067	9.349
	26-Feb	1244	66		285.1	95%	0.035		5.343	0.138		0.033	5.514	427.7	95%	0.053		7.242	0.216		0.052	7.510	570.3	95%	0.070		8.986	0.296		0.069	9.351
	27-Feb	1245	67		285.2	95%	0.035		5.344	0.138		0.034	5.515	427.8	95%	0.053		7.243	0.215		0.053	7.511	570.4	95%	0.070		8.987	0.295		0.071	9.353
	28-Feb	1246	68		285.2	95%	0.035		5.344	0.138		0.035	5.516	427.8	95%	0.052		7.243	0.215		0.055	7.513	570.4	95%	0.070		8.988	0.295		0.073	9.355
	01-Mar	1247	69		285.3	95%	0.035		5.345	0.137		0.036	5.517	427.9	95%	0.052		7.244	0.214		0.056	7.514	570.5	95%	0.070		8.988	0.294		0.075	9.357
	02-Mar	1248	70		285.3	95%	0.035		5.345	0.137		0.036	5.519	427.9	95%	0.052		7.245	0.214		0.058	7.516	570.6	95%	0.070		8.989	0.293		0.077	9.359
	03-Mar	1249	71		285.3	95%	0.035		5.346	0.137		0.037	5.520	428.0	95%	0.052		7.245	0.213		0.059	7.518	570.6	95%	0.069		8.990	0.292		0.079	9.361
	04-Mar	1250	72		285.4	95%	0.035		5.346	0.136		0.038	5.521	428.0	95%	0.052		7.246	0.213		0.061	7.519	570.7	95%	0.069		8.991	0.292		0.081	9.363
	05-Mar	1251	73		285.4	95%	0.035		5.346	0.136		0.039	5.522	428.1	95%	0.052		7.247	0.212		0.062	7.521	570.8	95%	0.069		8.992	0.291		0.083	9.366
	06-Mar	1252	74		285.4	95%	0.034		5.347	0.136		0.041	5.523	428.1	95%	0.052		7.247	0.212		0.064	7.523	570.8	95%	0.069		8.993	0.290		0.085	9.368
	07-Mar	1253	75		285.5	95%	0.034		5.347	0.135		0.042	5.524	428.2	95%	0.052		7.248	0.211		0.066	7.525	570.9	95%	0.069		8.993	0.289		0.088	9.370
	08-Mar	1254	76		285.5	95%	0.034		5.348	0.135		0.043	5.526	428.2	95%	0.051		7.249	0.211		0.067	7.527	571.0	95%	0.069		8.994	0.289		0.090	9.373
	09-Mar	1255	77		285.5	95%	0.034		5.348	0.135		0.044	5.527	428.3	95%	0.051		7.249	0.210		0.069	7.529	571.1	95%	0.068		8.995	0.288		0.092	9.375
	10-Mar	1256	78		285.6	95%	0.034		5.349	0.134		0.045	5.528	428.3	95%	0.051		7.250	0.210		0.071	7.531	571.1	95%	0.068		8.996	0.287		0.095	9.378
	11-Mar	1257	79		285.6	95%	0.034		5.349	0.134		0.046	5.530	428.4	95%	0.051		7.251	0.209		0.073	7.533	571.2	95%	0.068		8.997	0.287		0.097	9.380
	12-Mar	1258	80		285.6	95%	0.034		5.350	0.134		0.047	5.531	428.4	95%	0.051		7.251	0.208		0.075	7.535	571.3	95%	0.068		8.997	0.286		0.100	9.383
	13-Mar	1259	81		285.7	95%	0.034		5.350	0.133		0.049	5.532	428.5	95%	0.051		7.252	0.208		0.077	7.537	571.3	95%	0.068		8.998	0.285		0.102	9.386
	14-Mar	1260	82		285.7	95%	0.034		5.351	0.133		0.050	5.534	428.5	95%	0.051		7.253	0.207		0.079	7.539	571.4	95%	0.068		8.999	0.284		0.105	9.389
	15-Mar	1261	83		285.7	95%	0.034		5.351	0.133		0.051	5.535	428.6	95%	0.051		7.253	0.207		0.081	7.541	571.5	95%	0.067		9.000	0.284		0.108	9.391
	16-Mar	1262	84		285.8	95%	0.034		5.352	0.132		0.053	5.537	428.6	95%	0.050		7.254	0.206		0.083	7.543	571.5	95%	0.067		9.001	0.283		0.111	9.394
	17-Mar	1263	85		285.8	95%	0.034		5.352	0.132		0.054	5.538	428.7	95%	0.050		7.254	0.206		0.085	7.546	571.6	95%	0.067		9.001	0.282		0.114	9.397
	18-Mar	1264	86		285.8	95%	0.033		5.353	0.132		0.055	5.540	428.7	95%	0.050		7.255	0.205		0.087	7.548	571.7	95%	0.067		9.002	0.282		0.117	9.400
	19-Mar	1265	87		285.9	95%	0.033		5.353	0.131		0.057	5.541	428.8	95%	0.050		7.256	0.205		0.090	7.550	571.7	95%	0.067		9.003	0.281		0.120	9.403

	20-Mar	1266	88	285.9	95%	0.033	5.354	0.131	0.058	5.543	428.8	95%	0.050	7.256	0.204	0.092	7.553	571.8	95%	0.067	9.004	0.280	0.123	9.407
	21-Mar	1267	89	285.9	95%	0.033	5.354	0.131	0.060	5.545	428.9	95%	0.050	7.257	0.204	0.094	7.555	571.9	95%	0.066	9.004	0.279	0.126	9.410
	22-Mar	1268	90	286.0	95%	0.033	5.355	0.130	0.061	5.546	428.9	95%	0.050	7.258	0.203	0.097	7.558	571.9	95%	0.066	9.005	0.279	0.129	9.413
	23-Mar	1269	91	286.0	95%	0.033	5.355	0.130	0.063	5.548	429.0	95%	0.050	7.258	0.203	0.099	7.560	572.0	95%	0.066	9.006	0.278	0.132	9.417
	24-Mar	1270	92	286.0	95%	0.033	5.355	0.130	0.064	5.550	429.0	95%	0.050	7.259	0.202	0.102	7.563	572.1	95%	0.066	9.007	0.277	0.136	9.420
	25-Mar	1271	93	286.1	95%	0.033	5.356	0.129	0.066	5.551	429.1	95%	0.049	7.259	0.202	0.104	7.566	572.1	95%	0.066	9.008	0.277	0.139	9.424
	26-Mar	1272	94	286.1	95%	0.033	5.356	0.129	0.068	5.553	429.1	95%	0.049	7.260	0.201	0.107	7.568	572.2	95%	0.066	9.008	0.276	0.143	9.427
	27-Mar	1273	95	286.1	95%	0.033	5.357	0.129	0.070	5.555	429.2	95%	0.049	7.261	0.201	0.110	7.571	572.3	95%	0.066	9.009	0.275	0.146	9.431
	28-Mar	1274	96	286.2	95%	0.033	5.357	0.128	0.071	5.557	429.2	95%	0.049	7.261	0.200	0.113	7.574	572.3	95%	0.065	9.010	0.275	0.150	9.435
	29-Mar	1275	97	286.2	95%	0.033	5.358	0.128	0.073	5.559	429.3	95%	0.049	7.262	0.200	0.115	7.577	572.4	95%	0.065	9.011	0.274	0.154	9.439
	30-Mar	1276	98	286.2	95%	0.033	5.358	0.128	0.075	5.561	429.3	95%	0.049	7.263	0.199	0.118	7.580	572.5	95%	0.065	9.011	0.273	0.158	9.443
	31-Mar	1277	99	286.3	95%	0.032	5.359	0.127	0.077	5.563	429.4	95%	0.049	7.263	0.199	0.121	7.583	572.5	95%	0.065	9.012	0.273	0.162	9.447
	01-Apr	1278	100	286.3	95%	0.032	5.359	0.127	0.079	5.565	429.4	95%	0.049	7.264	0.198	0.124	7.587	572.6	95%	0.065	9.013	0.272	0.166	9.451
	02-Apr	1279	101	286.3	95%	0.032	5.360	0.127	0.081	5.567	429.5	95%	0.048	7.264	0.198	0.128	7.590	572.6	95%	0.065	9.014	0.271	0.170	9.455
	03-Apr	1280	102	286.4	95%	0.032	5.360	0.126	0.083	5.569	429.5	95%	0.048	7.265	0.197	0.131	7.593	572.7	95%	0.064	9.015	0.271	0.174	9.459
	04-Apr	1281	103	286.4	95%	0.032	5.361	0.126	0.085	5.572	429.6	95%	0.048	7.266	0.197	0.134	7.596	572.8	95%	0.064	9.015	0.270	0.179	9.464
	05-Apr	1282	104	286.4	95%	0.032	5.361	0.126	0.087	5.574	429.6	95%	0.048	7.266	0.196	0.137	7.600	572.8	95%	0.064	9.016	0.269	0.183	9.468
	06-Apr	1283	105	286.5	95%	0.032	5.361	0.126	0.089	5.576	429.7	95%	0.048	7.267	0.196	0.141	7.603	572.9	95%	0.064	9.017	0.268	0.188	9.473
	07-Apr	1284	106	286.5	95%	0.032	5.362	0.125	0.091	5.578	429.7	95%	0.048	7.267	0.195	0.144	7.607	573.0	95%	0.064	9.018	0.268	0.192	9.478
	08-Apr	1285	107	286.5	96%	0.032	5.362	0.125	0.094	5.581	429.8	96%	0.048	7.268	0.195	0.148	7.611	573.0	96%	0.064	9.018	0.267	0.197	9.482
	09-Apr	1286	108	286.5	96%	0.032	5.363	0.125	0.096	5.583	429.8	96%	0.048	7.269	0.194	0.151	7.614	573.1	96%	0.064	9.019	0.266	0.202	9.487
	10-Apr	1287	109	286.6	96%	0.032	5.363	0.124	0.098	5.586	429.9	96%	0.048	7.269	0.194	0.155	7.618	573.2	96%	0.063	9.020	0.266	0.207	9.492
	11-Apr	1288	110	286.6	96%	0.032	5.364	0.124	0.101	5.588	429.9	96%	0.047	7.270	0.193	0.159	7.622	573.2	96%	0.063	9.021	0.265	0.212	9.498
	12-Apr	1289	111	286.6	96%	0.032	5.364	0.124	0.103	5.591	430.0	96%	0.047	7.271	0.193	0.163	7.626	573.3	96%	0.063	9.021	0.264	0.217	9.503
	13-Apr	1290	112	286.7	96%	0.031	5.365	0.123	0.106	5.593	430.0	96%	0.047	7.271	0.192	0.167	7.630	573.3	96%	0.063	9.022	0.264	0.222	9.508
	14-Apr	1291	113	286.7	96%	0.031	5.365	0.123	0.108	5.596	430.1	96%	0.047	7.272	0.192	0.171	7.634	573.4	96%	0.063	9.023	0.263	0.228	9.514
	15-Apr	1292	114	286.7	96%	0.031	5.365	0.123	0.111	5.599	430.1	96%	0.047	7.272	0.191	0.175	7.639	573.5	96%	0.063	9.024	0.262	0.233	9.519
	16-Apr	1293	115	286.8	96%	0.031	5.366	0.122	0.113	5.602	430.2	96%	0.047	7.273	0.191	0.179	7.643	573.5	96%	0.063	9.024	0.262	0.239	9.525
	17-Apr	1294	116	286.8	96%	0.031	5.366	0.122	0.116	5.605	430.2	96%	0.047	7.273	0.190	0.184	7.648	573.6	96%	0.062	9.025	0.261	0.245	9.531
	18-Apr	1295	117	286.8	96%	0.031	5.367	0.122	0.119	5.608	430.2	96%	0.047	7.274	0.190	0.188	7.652	573.7	96%	0.062	9.026	0.261	0.251	9.537
	19-Apr	1296	118	286.9	96%	0.031	5.367	0.121	0.122	5.611	430.3	96%	0.047	7.275	0.190	0.192	7.657	573.7	96%	0.062	9.026	0.260	0.257	9.543
	20-Apr	1297	119	286.9	96%	0.031	5.368	0.121	0.125	5.614	430.3	96%	0.046	7.275	0.189	0.197	7.661	573.8	96%	0.062	9.027	0.259	0.263	9.549
	21-Apr	1298	120	286.9	96%	0.031	5.368	0.121	0.128	5.617	430.4	96%	0.046	7.276	0.189	0.202	7.666	573.8	96%	0.062	9.028	0.259	0.269	9.556
	22-Apr	1299	121	287.0	96%	0.031	5.368	0.121	0.131	5.620	430.4	96%	0.046	7.276	0.188	0.207	7.671	573.9	96%	0.062	9.029	0.258	0.275	9.562
	23-Apr	1300	122	287.0	96%	0.031	5.369	0.120	0.134	5.623	430.5	96%	0.046	7.277	0.188	0.212	7.676	574.0	96%	0.062	9.029	0.257	0.282	9.569
	24-Apr	1301	123	287.0	96%	0.031	5.369	0.120	0.137	5.626	430.5	96%	0.046	7.278	0.187	0.217	7.681	574.0	96%	0.061	9.030	0.257	0.289	9.575
	25-Apr	1302	124	287.0	96%	0.031	5.370	0.120	0.140	5.630	430.6	96%	0.046	7.278	0.187	0.222	7.687	574.1	96%	0.061	9.031	0.256	0.296	9.582
	26-Apr	1303	125	287.1	96%	0.031	5.370	0.119	0.144	5.633	430.6	96%	0.046	7.279	0.186	0.227	7.692	574.2	96%	0.061	9.032	0.255	0.303	9.589
	27-Apr	1304	126	287.1	96%	0.030	5.371	0.119	0.147	5.637	430.7	96%	0.046	7.279	0.186	0.232	7.697	574.2	96%	0.061	9.032	0.255	0.310	9.597
	28-Apr	1305	127	287.1	96%	0.030	5.371	0.119	0.151	5.640	430.7	96%	0.046	7.280	0.185	0.238	7.703	574.3	96%	0.061	9.033	0.254	0.317	9.604
	29-Apr	1306	128	287.2	96%	0.030	5.371	0.118	0.154	5.644	430.8	96%	0.045	7.281	0.185	0.243	7.709	574.3	96%	0.061	9.034	0.253	0.324	9.611
First Calf Cows are Culled	30-Apr	1307	129	287.2	96%	0.030	5.372	0.118	0.158	5.648	430.8	96%	0.045	7.281	0.184	0.249	7.714	574.4	96%	0.061	9.034	0.253	0.332	9.619
	01-May	1308	130	287.2	96%	0.030	5.372	0.118	0.161	5.652	430.8	96%	0.045	7.282	0.184	0.255	7.720	574.5	96%	0.060	9.035	0.252	0.340	9.627
	02-May	1309	131	287.3	96%	0.030	5.373	0.118	0.165	5.655	430.9	96%	0.045	7.282	0.183	0.261	7.726	574.5	96%	0.060	9.036	0.252	0.348	9.635
	03-May	1310	132	287.3	96%	0.030	5.373	0.117	0.169	5.659	430.9	96%	0.045	7.283	0.183	0.267	7.732	574.6	96%	0.060	9.037	0.251	0.356	9.643
	04-May	1311	133	287.3	96%	0.030	5.374	0.117	0.173	5.663	431.0	96%	0.045	7.283	0.183	0.273	7.739	574.6	96%	0.060	9.037	0.250	0.364	9.651
	05-May	1312	134	287.3	96%	0.030	5.374	0.117	0.177	5.667	431.0	96%	0.045	7.284	0.182	0.279	7.745	574.7	96%	0.060	9.038	0.250	0.372	9.660
	06-May	1313	135	287.4	96%	0.030	5.374	0.116	0.181	5.672	431.1	96%	0.045	7.285	0.182	0.286	7.752	574.8	96%	0.060	9.039	0.249	0.381	9.668
	07-May	1314	136	287.4	96%	0.030	5.375	0.116	0.185	5.676	431.1	96%	0.045	7.285	0.181	0.292	7.758	574.8	96%	0.060	9.039	0.248	0.389	9.677
	08-May	1315	137	287.4	96%	0.030	5.375	0.116	0.189	5.680	431.2	96%	0.045	7.286	0.181	0.299	7.765	574.9	96%	0.059	9.040	0.248	0.398	9.686
	09-May	1316	138	287.5	96%	0.030	5.376	0.116	0.194	5.685	431.2	96%	0.044	7.286	0.180	0.306	7.772	574.9	96%	0.059	9.041	0.247	0.407	9.695
	10-May	1317	139	287.5	96%	0.030	5.376	0.115	0.198	5.689	431.2	96%	0.044	7.287	0.180	0.313	7.779	575.0	96%	0.059	9.041	0.247	0.417	9.705
	11-May	1318	140	287.5	96%	0.029	5.376	0.115	0.202	5.694	431.3	96%	0.044	7.287	0.179	0.320	7.786	575.1	96%	0.059	9.042	0.246	0.426	9.714
	12-May	1319	141	287.6	96%	0.029	5.377	0.115	0.207	5.699	431.3	96%	0.044	7.288	0.179	0.327	7.794	575.1	96%	0.059	9.043	0.245	0.436	9.724
	13-May	1320	142	287.6	96%	0.029	5.377	0.114	0.212	5.703	431.4	96%	0.044	7.288	0.178	0.334	7.801	575.2	96%	0.059	9.044	0.245	0.446	9.734
	14-May	1321	143	287.6	96%	0.029	5.378	0.114	0.216	5.708	431.4	96%	0.044	7.289	0.178	0.342	7.809	575.2	96%	0.059	9.044	0.244	0.456	9.744
	15-May	1322	144	287.6	96%	0.029	5.378	0.114	0.221	5.713	431.5	96%	0.044	7.290	0.178	0.349	7.817	575.3	96%	0.058	9.045	0.243	0.466	9.754
	16-May	1323	145	287.7	96%	0.029	5.379	0.114	0.226	5.718	431.5	96%	0.044	7.290	0.177	0.357	7.824	575.3	96%	0.058	9.046	0.243	0.476	9.765
	17-May	1324	146	287.7	96%	0.029	5.379	0.113	0.231	5.723	431.6	96%	0.044	7.291	0.177	0.365	7.833	575.4	96%	0.058	9.046	0.242	0.487	9.775
	18-May	1325	147	287.7	96%	0.029	5.379	0.113	0.236	5.729	431.6	96%	0.043	7.291	0.176	0.373	7.841	575.5	96%	0.058	9.047	0.242	0.498	9.786
	19-May	1326	148	287.8	96%	0.029	5.380	0.113	0.242	5.734	431.6	96%	0.043	7.292	0.176	0.382	7.849	575.5	96%	0.058	9.048	0.241	0.509	9.798
	20-May	1327	149	287.8	96%	0.029	5.380	0.112	0.247	5.740	431.7	96%	0.043	7.292	0.175	0.390	7.858	575.6	96%	0.058	9.048	0.240	0.520	9.809
	21-May	1328	150	287.8	96%	0.029	5.381	0.112	0.252	5.745	431.7	96%	0.043	7.293	0.175	0.399	7.866	575.6	96%	0.058	9.049	0.240	0.532	9.820
	22-May	1329	151	287.8	96%	0.029	5.381	0.112	0.258	5.751	431.8	96%	0.043	7.293	0.174	0.407	7.875	575.7	96%	0.057	9.050	0.239	0.543	9.832
	23-May	1330	152	287.9	96%	0.029	5.381	0.112	0.264	5.757	431.8	96%	0.043	7.294	0.174	0.416	7.884	575.8	96%	0.057	9.050	0.239	0.555	9.844
	24-May	1331	153	287.9	96%	0.029	5.382	0.111	0.269	5.763	431.9	96%	0.043	7.294	0.174	0.426	7.894	575.8	96%	0.057	9.051	0.238	0.567	9.856
	25-May	1332	154	287.9	96%	0.029	5.382	0.111	0.275	5.769	431.9	96%	0.043	7.295	0.173	0.435	7.903	575.9	96%	0.057	9.052	0.237	0.580	9.869

26-May	1333	155	288.0	96%	0.028	5.383	0.111	0.281	5.775	431.9	96%	0.043	7.296	0.173	0.444	7.913	575.9	96%	0.057	9.052	0.237	0.592	9.882
27-May	1334	156	288.0	96%	0.028	5.383	0.110	0.287	5.781	432.0	96%	0.043	7.296	0.172	0.454	7.922	576.0	96%	0.057	9.053	0.236	0.605	9.894
28-May	1335	157	288.0	96%	0.028	5.383	0.110	0.294	5.787	432.0	96%	0.042	7.297	0.172	0.464	7.932	576.0	96%	0.057	9.054	0.236	0.618	9.908
29-May	1336	158	288.0	96%	0.028	5.384	0.110	0.300	5.794	432.1	96%	0.042	7.297	0.171	0.474	7.942	576.1	96%	0.057	9.054	0.235	0.632	9.921
30-May	1337	159	288.1	96%	0.028	5.384	0.110	0.306	5.800	432.1	96%	0.042	7.298	0.171	0.484	7.953	576.1	96%	0.056	9.055	0.234	0.645	9.935
31-May	1338	160	288.1	96%	0.028	5.385	0.109	0.313	5.807	432.2	96%	0.042	7.298	0.171	0.494	7.963	576.2	96%	0.056	9.056	0.234	0.659	9.949
01-Jun	1339	161	288.1	96%	0.028	5.385	0.109	0.320	5.814	432.2	96%	0.042	7.299	0.170	0.505	7.974	576.3	96%	0.056	9.056	0.233	0.673	9.963
02-Jun	1340	162	288.2	96%	0.028	5.385	0.109	0.327	5.821	432.2	96%	0.042	7.299	0.170	0.516	7.985	576.3	96%	0.056	9.057	0.233	0.688	9.977
03-Jun	1341	163	288.2	96%	0.028	5.386	0.108	0.334	5.828	432.3	96%	0.042	7.300	0.169	0.527	7.996	576.4	96%	0.056	9.058	0.232	0.702	9.992
04-Jun	1342	164	288.2	96%	0.028	5.386	0.108	0.341	5.835	432.3	96%	0.042	7.300	0.169	0.538	8.007	576.4	96%	0.056	9.058	0.231	0.717	10.007
05-Jun	1343	165	288.2	96%	0.028	5.387	0.108	0.348	5.842	432.4	96%	0.042	7.301	0.168	0.549	8.018	576.5	96%	0.056	9.059	0.231	0.732	10.022
06-Jun	1344	166	288.3	96%	0.028	5.387	0.108	0.355	5.850	432.4	96%	0.042	7.301	0.168	0.561	8.030	576.5	96%	0.055	9.060	0.230	0.748	10.038
07-Jun	1345	167	288.3	96%	0.028	5.387	0.107	0.363	5.857	432.4	96%	0.041	7.302	0.168	0.572	8.042	576.6	96%	0.055	9.060	0.230	0.763	10.053
08-Jun	1346	168	288.3	96%	0.028	5.388	0.107	0.370	5.865	432.5	96%	0.041	7.302	0.167	0.584	8.054	576.6	96%	0.055	9.061	0.229	0.779	10.069
09-Jun	1347	169	288.4	96%	0.028	5.388	0.107	0.378	5.873	432.5	96%	0.041	7.303	0.167	0.597	8.066	576.7	96%	0.055	9.062	0.229	0.796	10.086
10-Jun	1348	170	288.4	96%	0.027	5.388	0.107	0.386	5.881	432.6	96%	0.041	7.304	0.166	0.609	8.079	576.8	96%	0.055	9.062	0.228	0.812	10.102
11-Jun	1349	171	288.4	96%	0.027	5.389	0.106	0.394	5.889	432.6	96%	0.041	7.304	0.166	0.622	8.092	576.8	96%	0.055	9.063	0.227	0.829	10.119
12-Jun	1350	172	288.4	96%	0.027	5.389	0.106	0.402	5.897	432.7	96%	0.041	7.305	0.165	0.635	8.105	576.9	96%	0.055	9.064	0.227	0.846	10.137
13-Jun	1351	173	288.5	96%	0.027	5.390	0.106	0.410	5.906	432.7	96%	0.041	7.305	0.165	0.648	8.118	576.9	96%	0.055	9.064	0.226	0.864	10.154
14-Jun	1352	174	288.5	96%	0.027	5.390	0.106	0.419	5.914	432.7	96%	0.041	7.306	0.165	0.661	8.131	577.0	96%	0.054	9.065	0.226	0.881	10.172
15-Jun	1353	175	288.5	96%	0.027	5.390	0.105	0.427	5.923	432.8	96%	0.041	7.306	0.164	0.675	8.145	577.0	96%	0.054	9.065	0.225	0.900	10.190
16-Jun	1354	176	288.5	96%	0.027	5.391	0.105	0.436	5.932	432.8	96%	0.041	7.307	0.164	0.688	8.159	577.1	96%	0.054	9.066	0.225	0.918	10.209
17-Jun	1355	177	288.6	96%	0.027	5.391	0.105	0.445	5.941	432.9	96%	0.041	7.307	0.163	0.703	8.173	577.1	96%	0.054	9.067	0.224	0.937	10.227
18-Jun	1356	178	288.6	96%	0.027	5.391	0.104	0.454	5.950	432.9	96%	0.040	7.308	0.163	0.717	8.187	577.2	96%	0.054	9.067	0.223	0.956	10.247
19-Jun	1357	179	288.6	96%	0.027	5.392	0.104	0.463	5.959	432.9	96%	0.040	7.308	0.163	0.731	8.202	577.2	96%	0.054	9.068	0.223	0.975	10.266
20-Jun	1358	180	288.7	96%	0.027	5.392	0.104	0.473	5.969	433.0	96%	0.040	7.309	0.162	0.746	8.217	577.3	96%	0.054	9.069	0.222	0.995	10.286
21-Jun	1359	181	288.7	96%	0.027	5.393	0.104	0.482	5.978	433.0	96%	0.040	7.309	0.162	0.761	8.232	577.4	96%	0.054	9.069	0.222	1.015	10.306
22-Jun	1360	182	288.7	96%	0.027	5.393	0.103	0.492	5.988	433.1	96%	0.040	7.310	0.161	0.776	8.247	577.4	96%	0.053	9.070	0.221	1.035	10.326
23-Jun	1361	183	288.7	96%	0.027	5.393	0.103	0.502	5.998	433.1	96%	0.040	7.310	0.161	0.792	8.263	577.5	96%	0.053	9.071	0.221	1.056	10.347
24-Jun	1362	184	288.8	96%	0.027	5.394	0.103	0.512	6.008	433.1	96%	0.040	7.311	0.161	0.808	8.279	577.5	96%	0.053	9.071	0.220	1.077	10.368
25-Jun	1363	185	288.8	96%	0.027	5.394	0.103	0.522	6.019	433.2	96%	0.040	7.311	0.160	0.824	8.295	577.6	96%	0.053	9.072	0.220	1.098	10.390
26-Jun	1364	186	288.8	96%	0.026	5.394	0.102	0.532	6.029	433.2	96%	0.040	7.312	0.160	0.840	8.312	577.6	96%	0.053	9.072	0.219	1.120	10.412
27-Jun	1365	187	288.8	96%	0.026	5.395	0.102	0.543	6.040	433.3	96%	0.040	7.312	0.159	0.857	8.328	577.7	96%	0.053	9.073	0.218	1.142	10.434
28-Jun	1366	188	288.9	96%	0.026	5.395	0.102	0.553	6.050	433.3	96%	0.039	7.313	0.159	0.874	8.345	577.7	96%	0.053	9.074	0.218	1.165	10.457
29-Jun	1367	189	288.9	96%	0.026	5.396	0.102	0.564	6.061	433.3	96%	0.039	7.313	0.159	0.891	8.363	577.8	96%	0.053	9.074	0.217	1.188	10.479
30-Jun	1368	190	288.9	96%	0.026	5.396	0.101	0.575	6.073	433.4	96%	0.039	7.314	0.158	0.908	8.380	577.8	96%	0.052	9.075	0.217	1.211	10.503
01-Jul	1369	191	288.9	96%	0.026	5.396	0.101	0.587	6.084	433.4	96%	0.039	7.314	0.158	0.926	8.398	577.9	96%	0.052	9.076	0.216	1.235	10.527
02-Jul	1370	192	289.0	96%	0.026	5.397	0.101	0.598	6.095	433.5	96%	0.039	7.315	0.157	0.944	8.416	577.9	96%	0.052	9.076	0.216	1.259	10.551
03-Jul	1371	193	289.0	96%	0.026	5.397	0.101	0.610	6.107	433.5	96%	0.039	7.315	0.157	0.962	8.435	578.0	96%	0.052	9.077	0.215	1.283	10.575
04-Jul	1372	194	289.0	96%	0.026	5.397	0.100	0.621	6.119	433.5	96%	0.039	7.316	0.157	0.981	8.453	578.0	96%	0.052	9.077	0.215	1.308	10.600
05-Jul	1373	195	289.0	96%	0.026	5.398	0.100	0.633	6.131	433.6	96%	0.039	7.316	0.156	1.000	8.472	578.1	96%	0.052	9.078	0.214	1.333	10.625
06-Jul	1374	196	289.1	96%	0.026	5.398	0.100	0.645	6.143	433.6	96%	0.039	7.317	0.156	1.019	8.492	578.1	96%	0.052	9.079	0.214	1.359	10.651
07-Jul	1375	197	289.1	96%	0.026	5.399	0.100	0.658	6.156	433.6	96%	0.039	7.317	0.155	1.039	8.511	578.2	96%	0.052	9.079	0.213	1.385	10.677
08-Jul	1376	198	289.1	96%	0.026	5.399	0.099	0.670	6.169	433.7	96%	0.039	7.318	0.155	1.058	8.531	578.2	96%	0.051	9.080	0.212	1.411	10.704
09-Jul	1377	199	289.1	96%	0.026	5.399	0.099	0.683	6.181	433.7	96%	0.038	7.318	0.155	1.079	8.551	578.3	96%	0.051	9.080	0.212	1.438	10.730
10-Jul	1378	200	289.2	96%	0.026	5.400	0.099	0.696	6.194	433.8	96%	0.038	7.319	0.154	1.099	8.572	578.3	96%	0.051	9.081	0.211	1.465	10.758
11-Jul	1379	201	289.2	96%	0.026	5.400	0.099	0.709	6.208	433.8	96%	0.038	7.319	0.154	1.120	8.593	578.4	96%	0.051	9.082	0.211	1.493	10.786
12-Jul	1380	202	289.2	96%	0.025	5.400	0.098	0.723	6.221	433.8	96%	0.038	7.320	0.153	1.141	8.614	578.4	96%	0.051	9.082	0.210	1.521	10.814
13-Jul	1381	203	289.3	96%	0.025	5.401	0.098	0.736	6.235	433.9	96%	0.038	7.320	0.153	1.162	8.635	578.5	96%	0.051	9.083	0.210	1.550	10.842
14-Jul	1382	204	289.3	96%	0.025	5.401	0.098	0.750	6.249	433.9	96%	0.038	7.321	0.153	1.184	8.657	578.6	96%	0.051	9.083	0.209	1.579	10.871
15-Jul	1383	205	289.3	96%	0.025	5.401	0.098	0.764	6.263	434.0	96%	0.038	7.321	0.152	1.206	8.679	578.6	96%	0.051	9.084	0.209	1.608	10.901
16-Jul	1384	206	289.3	96%	0.025	5.402	0.097	0.778	6.277	434.0	96%	0.038	7.321	0.152	1.229	8.702	578.7	96%	0.050	9.085	0.208	1.638	10.931
17-Jul	1385	207	289.4	96%	0.025	5.402	0.097	0.793	6.292	434.0	96%	0.038	7.322	0.152	1.251	8.725	578.7	96%	0.050	9.085	0.208	1.668	10.961
18-Jul	1386	208	289.4	96%	0.025	5.402	0.097	0.807	6.306	434.1	96%	0.038	7.322	0.151	1.274	8.748	578.8	96%	0.050	9.086	0.207	1.699	10.992
19-Jul	1387	209	289.4	96%	0.025	5.403	0.097	0.822	6.321	434.1	96%	0.038	7.323	0.151	1.298	8.772	578.8	96%	0.050	9.086	0.207	1.730	11.023
20-Jul	1388	210	289.4	96%	0.025	5.403	0.096	0.837	6.337	434.1	96%	0.037	7.323	0.150	1.322	8.795	578.9	96%	0.050	9.087	0.206	1.762	11.055
21-Jul	1389	211	289.5	96%	0.025	5.403	0.096	0.852	6.352	434.2	96%	0.037	7.324	0.150	1.346	8.820	578.9	96%	0.050	9.088	0.206	1.794	11.088
22-Jul	1390	212	289.5	96%	0.025	5.404	0.096	0.868	6.368	434.2	96%	0.037	7.324	0.150	1.370	8.844	579.0	96%	0.050	9.088	0.205	1.827	11.120
23-Jul	1391	213	289.5	97%	0.025	5.404	0.096	0.884	6.383	434.3	97%	0.037	7.325	0.149	1.395	8.869	579.0	97%	0.050	9.089	0.205	1.860	11.153
24-Jul	1392	214	289.5	97%	0.025	5.405	0.095	0.900	6.399	434.3	97%	0.037	7.325	0.149	1.420	8.895	579.1	97%	0.050	9.089	0.204	1.894	11.187
25-Jul	1393	215	289.6	97%	0.025	5.405	0.095	0.916	6.416	434.3	97%	0.037	7.326	0.148	1.446	8.920	579.1	97%	0.049	9.090	0.204	1.928	11.221
26-Jul	1394	216	289.6	97%	0.025	5.405	0.095	0.932	6.432	434.4	97%	0.037	7.326	0.148	1.472	8.946	579.2	97%	0.049	9.090	0.203	1.963	11.256
27-Jul	1395	217	289.6	97%	0.025	5.406	0.095	0.949	6.449	434.4	97%	0.037	7.327	0.148	1.498	8.973	579.2	97%	0.049	9.091	0.203	1.998	11.291
28-Jul	1396	218	289.6	97%	0.025	5.406	0.094	0.966	6.466	434.4	97%	0.037	7.327	0.147	1.525	8.999	579.2	97%	0.049	9.092	0.202	2.033	11.327
29-Jul	1397	219	289.6	97%	0.024	5.406	0.094	0.983	6.483	434.5	97%	0.037	7.328	0.147	1.552	9.027	579.3	97%	0.049	9.092	0.202	2.069	11.363
30-Jul	1398	220	289.7	97%	0.024	5.407	0.094	1.000	6.501	434.5	97%	0.037	7.328	0.147	1.580	9.054	579.3	97%	0.049	9.093	0.201	2.106	11.400
31-Jul	1399	221	289.7	97%	0.024	5.407	0.094	1.018	6.519	434.5	97%	0.037	7.329	0.146	1.607	9.082	579.4	97%	0.049	9.093	0.201	2.143	11.437

	01-Aug	1400	222		289.7	97%	0.024		5.407	0.093		1.036	6.537	434.6	97%	0.036		7.329	0.146		1.636	9.110	579.4	97%	0.049		9.094	0.200		2.181	11.475
	02-Aug	1401	223		289.7	97%	0.024		5.408	0.093		1.054	6.555	434.6	97%	0.036		7.329	0.146		1.664	9.139	579.5	97%	0.048		9.094	0.199		2.219	11.513
	03-Aug	1402	224		289.8	97%	0.024		5.408	0.093		1.072	6.573	434.7	97%	0.036		7.330	0.145		1.693	9.168	579.5	97%	0.048		9.095	0.199		2.258	11.552
	04-Aug	1403	225		289.8	97%	0.024		5.408	0.093		1.091	6.592	434.7	97%	0.036		7.330	0.145		1.723	9.198	579.6	97%	0.048		9.096	0.198		2.297	11.591
	05-Aug	1404	226		289.8	97%	0.024		5.409	0.093		1.110	6.611	434.7	97%	0.036		7.331	0.144		1.753	9.228	579.6	97%	0.048		9.096	0.198		2.337	11.631
	06-Aug	1405	227		289.8	97%	0.024		5.409	0.092		1.129	6.630	434.8	97%	0.036		7.331	0.144		1.783	9.258	579.7	97%	0.048		9.097	0.197		2.377	11.671
	07-Aug	1406	228		289.9	97%	0.024		5.409	0.092		1.149	6.650	434.8	97%	0.036		7.332	0.144		1.813	9.289	579.7	97%	0.048		9.097	0.197		2.418	11.712
	08-Aug	1407	229		289.9	97%	0.024		5.410	0.092		1.168	6.670	434.8	97%	0.036		7.332	0.143		1.844	9.320	579.8	97%	0.048		9.098	0.196		2.459	11.754
	09-Aug	1408	230		289.9	97%	0.024		5.410	0.092		1.188	6.690	434.9	97%	0.036		7.333	0.143		1.876	9.352	579.8	97%	0.048		9.098	0.196		2.501	11.796
	10-Aug	1409	231		289.9	97%	0.024		5.410	0.091		1.208	6.710	434.9	97%	0.036		7.333	0.143		1.908	9.384	579.9	97%	0.048		9.099	0.195		2.544	11.838
	11-Aug	1410	232		290.0	97%	0.024		5.411	0.091		1.229	6.731	434.9	97%	0.036		7.334	0.142		1.940	9.416	579.9	97%	0.047		9.100	0.195		2.587	11.881
	12-Aug	1411	233		290.0	97%	0.024		5.411	0.091		1.249	6.751	435.0	97%	0.036		7.334	0.142		1.973	9.449	580.0	97%	0.047		9.100	0.195		2.631	11.925
	13-Aug	1412	234		290.0	97%	0.024		5.411	0.091		1.270	6.772	435.0	97%	0.035		7.334	0.142		2.006	9.482	580.0	97%	0.047		9.101	0.194		2.675	11.969
	14-Aug	1413	235		290.0	97%	0.024		5.412	0.090		1.292	6.794	435.0	97%	0.035		7.335	0.141		2.040	9.516	580.1	97%	0.047		9.101	0.194		2.720	12.014
	15-Aug	1414	236		290.1	97%	0.024		5.412	0.090		1.313	6.815	435.1	97%	0.035		7.335	0.141		2.074	9.550	580.1	97%	0.047		9.102	0.193		2.765	12.060
	16-Aug	1415	237		290.1	97%	0.023		5.412	0.090		1.335	6.837	435.1	97%	0.035		7.336	0.140		2.108	9.584	580.2	97%	0.047		9.102	0.193		2.811	12.106
	17-Aug	1416	238		290.1	97%	0.023		5.413	0.090		1.357	6.860	435.2	97%	0.035		7.336	0.140		2.143	9.619	580.2	97%	0.047		9.103	0.192		2.857	12.152
	18-Aug	1417	239		290.1	97%	0.023		5.413	0.090		1.380	6.882	435.2	97%	0.035		7.337	0.140		2.178	9.655	580.3	97%	0.047		9.103	0.192		2.904	12.199
	19-Aug	1418	240		290.1	97%	0.023		5.413	0.089		1.402	6.905	435.2	97%	0.035		7.337	0.139		2.214	9.691	580.3	97%	0.047		9.104	0.191		2.952	12.247
	20-Aug	1419	241		290.2	97%	0.023		5.414	0.089		1.425	6.928	435.3	97%	0.035		7.338	0.139		2.250	9.727	580.3	97%	0.046		9.104	0.191		3.000	12.296
	21-Aug	1420	242		290.2	97%	0.023		5.414	0.089		1.448	6.951	435.3	97%	0.035		7.338	0.139		2.287	9.764	580.4	97%	0.046		9.105	0.190		3.049	12.344
	22-Aug	1421	243		290.2	97%	0.023		5.414	0.089		1.472	6.975	435.3	97%	0.035		7.338	0.138		2.324	9.801	580.4	97%	0.046		9.106	0.190		3.099	12.394
	23-Aug	1422	244		290.2	97%	0.023		5.415	0.088		1.496	6.999	435.4	97%	0.035		7.339	0.138		2.362	9.838	580.5	97%	0.046		9.106	0.189		3.149	12.444
	24-Aug	1423	245		290.3	97%	0.023		5.415	0.088		1.520	7.023	435.4	97%	0.035		7.339	0.138		2.400	9.877	580.5	97%	0.046		9.107	0.189		3.200	12.495
	25-Aug	1424	246		290.3	97%	0.023		5.415	0.088		1.544	7.047	435.4	97%	0.034		7.340	0.137		2.438	9.915	580.6	97%	0.046		9.107	0.188		3.251	12.546
	26-Aug	1425	247		290.3	97%	0.023		5.415	0.088		1.569	7.072	435.5	97%	0.034		7.340	0.137		2.477	9.954	580.6	97%	0.046		9.108	0.188		3.303	12.598
	27-Aug	1426	248		290.3	97%	0.023		5.416	0.088		1.594	7.097	435.5	97%	0.034		7.341	0.137		2.516	9.994	580.7	97%	0.046		9.108	0.187		3.355	12.651
	28-Aug	1427	249		290.4	97%	0.023		5.416	0.087		1.619	7.122	435.5	97%	0.034		7.341	0.136		2.556	10.034	580.7	97%	0.046		9.109	0.187		3.408	12.704
	29-Aug	1428	250		290.4	97%	0.023		5.416	0.087		1.645	7.148	435.6	97%	0.034		7.341	0.136		2.597	10.074	580.8	97%	0.045		9.109	0.186		3.462	12.758
	30-Aug	1429	251		290.4	97%	0.023		5.417	0.087		1.670	7.174	435.6	97%	0.034		7.342	0.136		2.637	10.115	580.8	97%	0.045		9.110	0.186		3.517	12.812
	31-Aug	1430	252		290.4	97%	0.023		5.417	0.087		1.697	7.200	435.6	97%	0.034		7.342	0.135		2.679	10.156	580.8	97%	0.045		9.110	0.185		3.572	12.867
	01-Sep	1431	253		290.4	97%	0.023		5.417	0.086		1.723	7.227	435.7	97%	0.034		7.343	0.135		2.720	10.198	580.9	97%	0.045		9.111	0.185		3.627	12.923
	02-Sep	1432	254		290.5	97%	0.023		5.418	0.086		1.750	7.254	435.7	97%	0.034		7.343	0.135		2.763	10.240	580.9	97%	0.045		9.111	0.184		3.684	12.980
	03-Sep	1433	255		290.5	97%	0.022		5.418	0.086		1.777	7.281	435.7	97%	0.034		7.344	0.134		2.805	10.283	581.0	97%	0.045		9.112	0.184		3.741	13.036
	04-Sep	1434	256		290.5	97%	0.022		5.418	0.086		1.804	7.308	435.8	97%	0.034		7.344	0.134		2.849	10.326	581.0	97%	0.045		9.113	0.184		3.798	13.094
	05-Sep	1435	257		290.5	97%	0.022		5.419	0.086		1.832	7.336	435.8	97%	0.034		7.344	0.134		2.892	10.370	581.1	97%	0.045		9.113	0.183		3.856	13.152
	06-Sep	1436	258		290.6	97%	0.022		5.419	0.085		1.860	7.364	435.8	97%	0.033		7.345	0.133		2.936	10.414	581.1	97%	0.045		9.114	0.183		3.915	13.211
	07-Sep	1437	259		290.6	97%	0.022		5.419	0.085		1.888	7.392	435.9	97%	0.033		7.345	0.133		2.981	10.459	581.2	97%	0.045		9.114	0.182		3.975	13.271
	08-Sep	1438	260		290.6	97%	0.022		5.420	0.085		1.916	7.421	435.9	97%	0.033		7.346	0.133		3.026	10.504	581.2	97%	0.044		9.115	0.182		4.035	13.331
	09-Sep	1439	261		290.6	97%	0.022		5.420	0.085		1.945	7.450	435.9	97%	0.033		7.346	0.132		3.072	10.550	581.3	97%	0.044		9.115	0.181		4.095	13.392
	10-Sep	1440	262		290.6	97%	0.022		5.420	0.084		1.975	7.479	436.0	97%	0.033		7.347	0.132		3.118	10.596	581.3	97%	0.044		9.116	0.181		4.157	13.453
	11-Sep	1441	263		290.7	97%	0.022		5.421	0.084		2.004	7.509	436.0	97%	0.033		7.347	0.131		3.164	10.643	581.3	97%	0.044		9.116	0.180		4.219	13.515
	12-Sep	1442	264		290.7	97%	0.022		5.421	0.084		2.034	7.539	436.0	97%	0.033		7.347	0.131		3.211	10.690	581.4	97%	0.044		9.117	0.180		4.282	13.578
	13-Sep	1443	265		290.7	97%	0.022		5.421	0.084		2.064	7.569	436.1	97%	0.033		7.348	0.131		3.259	10.737	581.4	97%	0.044		9.117	0.179		4.345	13.642
	14-Sep	1444	266		290.7	97%	0.022		5.421	0.084		2.094	7.599	436.1	97%	0.033		7.348	0.131		3.307	10.786	581.5	97%	0.044		9.118	0.179		4.409	13.706
	15-Sep	1445	267		290.8	97%	0.022		5.422	0.083		2.125	7.630	436.1	97%	0.033		7.349	0.130		3.355	10.834	581.5	97%	0.044		9.118	0.178		4.474	13.770
	16-Sep	1446	268		290.8	97%	0.022		5.422	0.083		2.156	7.661	436.2	97%	0.033		7.349	0.130		3.404	10.883	581.6	97%	0.044		9.119	0.178		4.539	13.836
	17-Sep	1447	269		290.8	97%	0.022		5.422	0.083		2.187	7.693	436.2	97%	0.033		7.349	0.130		3.454	10.933	581.6	97%	0.043		9.119	0.178		4.605	13.902
	18-Sep	1448	270		290.8	97%	0.022		5.423	0.083		2.219	7.725	436.2	97%	0.033		7.350	0.129		3.504	10.983	581.6	97%	0.043		9.120	0.177		4.672	13.969
	19-Sep	1449	271		290.8	97%	0.022		5.423	0.083		2.251	7.757	436.3	97%	0.032		7.350	0.129		3.554	11.033	581.7	97%	0.043		9.120	0.177		4.739	14.036
	20-Sep	1450	272		290.9	97%	0.022		5.423	0.082		2.283	7.789	436.3	97%	0.032		7.351	0.129		3.605	11.084	581.7	97%	0.043		9.121	0.176		4.807	14.104
	21-Sep	1451	273		290.9	97%	0.022		5.424	0.082		2.316	7.822	436.3	97%	0.032		7.351	0.128		3.657	11.136	581.8	97%	0.043		9.121	0.176		4.876	14.173
	22-Sep	1452	274		290.9	97%	0.021		5.424	0.082		2.349	7.855	436.4	97%	0.032		7.352	0.128		3.709	11.188	581.8	97%	0.043		9.122	0.175		4.945	14.242
	23-Sep	1453	275		290.9	97%	0.021		5.424	0.082		2.382	7.888	436.4	97%	0.032		7.352	0.128		3.761	11.241	581.9	97%	0.043		9.122	0.175		5.015	14.312
	24-Sep	1454	276		291.0	97%	0.021		5.424	0.082		2.416	7.922	436.4	97%	0.032		7.352	0.127		3.814	11.294	581.9	97%	0.043		9.123	0.174		5.085	14.383
	25-Sep	1455	277		291.0	97%	0.021		5.425	0.081		2.449	7.955	436.5	97%	0.032		7.353	0.127		3.867	11.347	581.9	97%	0.043		9.123	0.174		5.157	14.454
	26-Sep	1456	278		291.0	97%	0.021		5.425	0.081		2.484	7.990	436.5	97%	0.032		7.353	0.127		3.921	11.401	582.0	97%	0.043		9.124	0.174		5.228	14.526
	27-Sep	1457	279		291.0	97%	0.021		5.425	0.081		2.518	8.024	436.5	97%	0.032		7.354	0.126		3.976	11.456	582.0	97%	0.042		9.124	0.173		5.301	14.598
	28-Sep	1458	280		291.0	97%	0.021		5.426	0.081		2.553	8.059	436.6	97%	0.032		7.354	0.126		4.031	11.511	582.1	97%	0.042		9.125	0.173		5.374	14.672
	29-Sep	1459	281		291.1	97%	0.021		5.426	0.081		2.588	8.094	436.6	97%	0.032		7.354	0.126		4.086	11.566	582.1	97%	0.042		9.125	0.172		5.448	14.746
	30-Sep	1460	282		291.1	97%	0.021		5.426	0.080		2.623	8.130	436.6	97%	0.032		7.355	0.125		4.142	11.622	582.2	97%	0.042		9.126	0.172		5.523	14.820
Second Calving. Second Lactation starts	01-Oct	1461	283	1	291.1	97%	0.021	0.33	5.427	0.080	0.238	2.659	8.404	436.7	97%	0.032	0.45	7.355	0.125	0.322	4.198	12.001	582.2	97%	0.042	0.56	9.126	0.171	0.400	5.598	15.296
	02-Oct	1462		2	291.1	97%	0.021	0.65	5.427	0.080	0.468		5.975	436.7	97%	0.031	0.88	7.356	0.125	0.634		8.114	582.2	97%	0.042	1.10	9.127	0.171	0.787		10.085
	03-Oct	1463		3	291.1	97%	0.021	0.96	5.427	0.080	0.690		6.197	436.7	97%	0.031	1.30	7.356	0.124	0.935		8.416	582.3	97%	0.042	1.62	9.127	0.171	1.161		10.458
	04-Oct	1464		4	291.2	97%	0.021	1.26	5.427	0.080	0.905		6.412	436.7	97%	0.031	1.71	7.356	0.124	1.226		8.707	582.3	97%	0.042	2.12	9.128	0.170	1.522		10.820
	05-Oct	1465		5	291.2	97%	0.021	1.55	5.428	0.079	1.112		6.619	436.8	97%	0.031	2.10	7.357	0.124	1.507		8.988	582.4	97%	0.042	2.61	9.128	0.170	1.871		11.168
	06-Oct	1466		6	291.2	97%	0.021	1.83	5.428	0.079	1.312		6.820	436.8	97%	0.031	2.48	7.357	0.123	1.779		9.259	582.4	97%	0.042	3.07	9.129	0.169	2.207		11.505

07-Oct	1467	7	291.2	97%	0.021	2.10	5.428	0.079	1.506	7.013	436.8	97%	0.031	2.84	7.358	0.123	2.041	9.521	582.5	97%	0.041	3.53	9.129	0.169	2.532	11.830
08-Oct	1468	8	291.2	97%	0.021	2.36	5.429	0.079	1.692	7.199	436.9	97%	0.031	3.20	7.358	0.123	2.293	9.774	582.5	97%	0.041	3.96	9.130	0.168	2.846	12.144
09-Oct	1469	9	291.3	97%	0.021	2.61	5.429	0.079	1.872	7.379	436.9	97%	0.031	3.53	7.358	0.122	2.537	10.018	582.5	97%	0.041	4.39	9.130	0.168	3.148	12.446
10-Oct	1470	10	291.3	97%	0.021	2.85	5.429	0.078	2.045	7.553	436.9	97%	0.031	3.86	7.359	0.122	2.772	10.253	582.6	97%	0.041	4.79	9.131	0.168	3.439	12.738
11-Oct	1471	11	291.3	97%	0.021	3.08	5.429	0.078	2.212	7.720	437.0	97%	0.031	4.18	7.359	0.122	2.998	10.479	582.6	97%	0.041	5.18	9.131	0.167	3.720	13.019
12-Oct	1472	12	291.3	97%	0.020	3.31	5.430	0.078	2.373	7.881	437.0	97%	0.031	4.48	7.359	0.122	3.216	10.697	582.7	97%	0.041	5.56	9.132	0.167	3.991	13.289
13-Oct	1473	13	291.3	97%	0.020	3.52	5.430	0.078	2.528	8.036	437.0	97%	0.031	4.77	7.360	0.121	3.426	10.907	582.7	97%	0.041	5.92	9.132	0.166	4.251	13.550
14-Oct	1474	14	291.4	97%	0.020	3.73	5.430	0.078	2.677	8.185	437.1	97%	0.031	5.05	7.360	0.121	3.628	11.110	582.7	97%	0.041	6.27	9.133	0.166	4.502	13.801
15-Oct	1475	15	291.4	97%	0.020	3.93	5.431	0.077	2.820	8.328	437.1	97%	0.031	5.33	7.361	0.121	3.823	11.304	582.8	97%	0.041	6.61	9.133	0.165	4.743	14.042
16-Oct	1476	16	291.4	97%	0.020	4.12	5.431	0.077	2.958	8.466	437.1	97%	0.030	5.59	7.361	0.120	4.010	11.491	582.8	97%	0.041	6.93	9.134	0.165	4.975	14.274
17-Oct	1477	17	291.4	97%	0.020	4.31	5.431	0.077	3.091	8.599	437.1	97%	0.030	5.84	7.361	0.120	4.189	11.671	582.9	97%	0.041	7.24	9.134	0.165	5.198	14.497
18-Oct	1478	18	291.5	97%	0.020	4.48	5.431	0.077	3.218	8.726	437.2	97%	0.030	6.08	7.362	0.120	4.362	11.843	582.9	97%	0.040	7.54	9.135	0.164	5.412	14.711
19-Oct	1479	19	291.5	97%	0.020	4.65	5.432	0.077	3.340	8.849	437.2	97%	0.030	6.31	7.362	0.119	4.527	12.009	582.9	97%	0.040	7.83	9.135	0.164	5.618	14.916
20-Oct	1480	20	291.5	97%	0.020	4.82	5.432	0.076	3.457	8.966	437.2	97%	0.030	6.53	7.363	0.119	4.686	12.168	583.0	97%	0.040	8.10	9.135	0.163	5.815	15.114
21-Oct	1481	21	291.5	97%	0.020	4.97	5.432	0.076	3.570	9.078	437.3	97%	0.030	6.74	7.363	0.119	4.839	12.320	583.0	97%	0.040	8.36	9.136	0.163	6.004	15.303
22-Oct	1482	22	291.5	97%	0.020	5.12	5.433	0.076	3.678	9.186	437.3	97%	0.030	6.94	7.363	0.119	4.985	12.466	583.1	97%	0.040	8.62	9.136	0.162	6.185	15.484
23-Oct	1483	23	291.6	97%	0.020	5.27	5.433	0.076	3.781	9.289	437.3	97%	0.030	7.14	7.364	0.118	5.124	12.606	583.1	97%	0.040	8.86	9.137	0.162	6.358	15.657
24-Oct	1484	24	291.6	97%	0.020	5.40	5.433	0.076	3.879	9.388	437.4	97%	0.030	7.33	7.364	0.118	5.258	12.740	583.1	97%	0.040	9.09	9.137	0.162	6.524	15.823
25-Oct	1485	25	291.6	97%	0.020	5.54	5.433	0.075	3.974	9.482	437.4	97%	0.030	7.50	7.364	0.118	5.386	12.868	583.2	97%	0.040	9.31	9.138	0.161	6.683	15.982
26-Oct	1486	26	291.6	97%	0.020	5.66	5.434	0.075	4.064	9.572	437.4	97%	0.030	7.67	7.365	0.117	5.508	12.990	583.2	97%	0.040	9.52	9.138	0.161	6.834	16.133
27-Oct	1487	27	291.6	97%	0.020	5.78	5.434	0.075	4.150	9.658	437.4	97%	0.030	7.84	7.365	0.117	5.624	13.107	583.3	97%	0.040	9.72	9.139	0.160	6.979	16.278
28-Oct	1488	28	291.6	97%	0.020	5.90	5.434	0.075	4.232	9.741	437.5	97%	0.030	7.99	7.366	0.117	5.735	13.218	583.3	97%	0.039	9.91	9.139	0.160	7.117	16.416
29-Oct	1489	29	291.7	97%	0.020	6.00	5.434	0.075	4.310	9.819	437.5	97%	0.030	8.14	7.366	0.116	5.841	13.324	583.3	97%	0.039	10.10	9.140	0.160	7.248	16.547
30-Oct	1490	30	291.7	97%	0.020	6.11	5.435	0.074	4.384	9.893	437.5	97%	0.029	8.28	7.366	0.116	5.942	13.424	583.4	97%	0.039	10.27	9.140	0.159	7.373	16.672
31-Oct	1491	31	291.7	97%	0.020	6.21	5.435	0.074	4.455	9.964	437.6	97%	0.029	8.41	7.367	0.116	6.038	13.520	583.4	97%	0.039	10.44	9.141	0.159	7.492	16.791
01-Nov	1492	32	291.7	97%	0.020	6.30	5.435	0.074	4.522	10.031	437.6	97%	0.029	8.54	7.367	0.116	6.129	13.611	583.5	97%	0.039	10.59	9.141	0.158	7.604	16.904
02-Nov	1493	33	291.7	97%	0.020	6.39	5.436	0.074	4.585	10.095	437.6	97%	0.029	8.66	7.367	0.115	6.215	13.697	583.5	97%	0.039	10.74	9.142	0.158	7.711	17.011
03-Nov	1494	34	291.8	97%	0.019	6.47	5.436	0.074	4.645	10.155	437.7	97%	0.029	8.77	7.368	0.115	6.296	13.779	583.5	97%	0.039	10.88	9.142	0.158	7.813	17.112
04-Nov	1495	35	291.8	97%	0.019	6.55	5.436	0.073	4.702	10.212	437.7	97%	0.029	8.88	7.368	0.115	6.374	13.856	583.6	97%	0.039	11.02	9.142	0.157	7.908	17.208
05-Nov	1496	36	291.8	97%	0.019	6.63	5.436	0.073	4.756	10.266	437.7	97%	0.029	8.98	7.369	0.114	6.446	13.929	583.6	97%	0.039	11.14	9.143	0.157	7.999	17.298
06-Nov	1497	37	291.8	97%	0.019	6.70	5.437	0.073	4.807	10.317	437.7	97%	0.029	9.08	7.369	0.114	6.515	13.998	583.7	97%	0.039	11.26	9.143	0.156	8.084	17.384
07-Nov	1498	38	291.8	97%	0.019	6.76	5.437	0.073	4.854	10.364	437.8	97%	0.029	9.17	7.369	0.114	6.580	14.063	583.7	97%	0.039	11.37	9.144	0.156	8.164	17.464
08-Nov	1499	39	291.9	97%	0.019	6.83	5.437	0.073	4.899	10.409	437.8	97%	0.029	9.25	7.370	0.114	6.640	14.123	583.7	97%	0.038	11.48	9.144	0.156	8.239	17.539
09-Nov	1500	40	291.9	97%	0.019	6.88	5.437	0.073	4.941	10.451	437.8	97%	0.029	9.33	7.370	0.113	6.697	14.180	583.8	97%	0.038	11.58	9.145	0.155	8.310	17.610
10-Nov	1501	41	291.9	97%	0.019	6.94	5.438	0.072	4.980	10.490	437.9	97%	0.029	9.40	7.370	0.113	6.750	14.233	583.8	97%	0.038	11.67	9.145	0.155	8.375	17.675
11-Nov	1502	42	291.9	97%	0.019	6.99	5.438	0.072	5.017	10.527	437.9	97%	0.029	9.47	7.371	0.113	6.799	14.283	583.8	97%	0.038	11.75	9.146	0.154	8.437	17.737
12-Nov	1503	43	291.9	97%	0.019	7.04	5.438	0.072	5.050	10.561	437.9	97%	0.029	9.54	7.371	0.112	6.845	14.329	583.9	97%	0.038	11.83	9.146	0.154	8.494	17.794
13-Nov	1504	44	292.0	97%	0.019	7.08	5.439	0.072	5.082	10.592	437.9	97%	0.029	9.60	7.371	0.112	6.888	14.371	583.9	97%	0.038	11.91	9.146	0.154	8.546	17.846
14-Nov	1505	45	292.0	97%	0.019	7.12	5.439	0.072	5.111	10.621	438.0	97%	0.028	9.65	7.372	0.112	6.927	14.410	584.0	97%	0.038	11.97	9.147	0.153	8.595	17.895
15-Nov	1506	46	292.0	97%	0.019	7.16	5.439	0.071	5.137	10.648	438.0	97%	0.028	9.70	7.372	0.112	6.963	14.446	584.0	97%	0.038	12.04	9.147	0.153	8.639	17.940
16-Nov	1507	47	292.0	97%	0.019	7.19	5.439	0.071	5.161	10.672	438.0	97%	0.028	9.75	7.372	0.111	6.996	14.479	584.0	97%	0.038	12.09	9.148	0.152	8.680	17.980
17-Nov	1508	48	292.0	97%	0.019	7.22	5.440	0.071	5.183	10.694	438.1	97%	0.028	9.79	7.373	0.111	7.025	14.509	584.1	97%	0.038	12.14	9.148	0.152	8.717	18.017
18-Nov	1509	49	292.1	97%	0.019	7.25	5.440	0.071	5.203	10.714	438.1	97%	0.028	9.82	7.373	0.111	7.052	14.536	584.1	97%	0.038	12.19	9.149	0.152	8.750	18.051
19-Nov	1510	50	292.1	97%	0.019	7.27	5.440	0.071	5.221	10.732	438.1	97%	0.028	9.86	7.374	0.110	7.076	14.560	584.1	97%	0.037	12.23	9.149	0.151	8.780	18.081
20-Nov	1511	51	292.1	97%	0.019	7.30	5.440	0.071	5.236	10.747	438.1	97%	0.028	9.89	7.374	0.110	7.097	14.581	584.2	97%	0.037	12.27	9.150	0.151	8.806	18.107
21-Nov	1512	52	292.1	97%	0.019	7.31	5.441	0.070	5.250	10.761	438.2	97%	0.028	9.91	7.374	0.110	7.116	14.600	584.2	97%	0.037	12.30	9.150	0.151	8.830	18.130
22-Nov	1513	53	292.1	97%	0.019	7.33	5.441	0.070	5.262	10.773	438.2	97%	0.028	9.94	7.375	0.110	7.132	14.616	584.3	97%	0.037	12.33	9.150	0.150	8.849	18.150
23-Nov	1514	54	292.1	97%	0.019	7.34	5.441	0.070	5.272	10.783	438.2	97%	0.028	9.95	7.375	0.109	7.145	14.630	584.3	97%	0.037	12.35	9.151	0.150	8.866	18.167
24-Nov	1515	55	292.2	97%	0.019	7.36	5.441	0.070	5.280	10.791	438.2	97%	0.028	9.97	7.375	0.109	7.156	14.641	584.3	97%	0.037	12.37	9.151	0.149	8.880	18.180
25-Nov	1516	56	292.2	97%	0.018	7.36	5.442	0.070	5.286	10.798	438.3	97%	0.028	9.98	7.376	0.109	7.165	14.649	584.4	97%	0.037	12.39	9.152	0.149	8.890	18.191
26-Nov	1517	57	292.2	97%	0.018	7.37	5.442	0.070	5.291	10.802	438.3	97%	0.028	9.99	7.376	0.108	7.171	14.656	584.4	97%	0.037	12.40	9.152	0.149	8.898	18.199
27-Nov	1518	58	292.2	97%	0.018	7.38	5.442	0.069	5.294	10.806	438.3	97%	0.028	10.00	7.376	0.108	7.176	14.660	584.4	97%	0.037	12.40	9.153	0.148	8.904	18.205
28-Nov	1519	59	292.2	97%	0.018	7.38	5.442	0.069	5.296	10.807	438.4	97%	0.028	10.00	7.377	0.108	7.178	14.662	584.5	97%	0.037	12.41	9.153	0.148	8.906	18.207
29-Nov	1520	60	292.3	97%	0.018	7.38	5.443	0.069	5.296	10.807	438.4	97%	0.027	10.00	7.377	0.108	7.178	14.662	584.5	97%	0.037	12.41	9.153	0.148	8.906	18.207
30-Nov	1521	61	292.3	97%	0.018	7.38	5.443	0.069	5.294	10.806	438.4	97%	0.027	10.00	7.377	0.107	7.176	14.660	584.6	97%	0.037	12.40	9.154	0.147	8.904	18.205
01-Dec	1522	62	292.3	97%	0.018	7.37	5.443	0.069	5.291	10.803	438.4	97%	0.027	9.99	7.378	0.107	7.172	14.657	584.6	97%	0.036	12.40	9.154	0.147	8.899	18.200
02-Dec	1523	63	292.3	97%	0.018	7.37	5.443	0.068	5.287	10.799	438.5	97%	0.027	9.98	7.378	0.107	7.166	14.651	584.6	97%	0.036	12.39	9.155	0.146	8.892	18.193
03-Dec	1524	64	292.3	97%	0.018	7.36	5.444	0.068	5.281	10.793	438.5	97%	0.027	9.97	7.378	0.107	7.158	14.643	584.7	97%	0.036	12.37	9.155	0.146	8.882	18.184
04-Dec	1525	65	292.3	97%	0.018	7.35	5.444	0.068	5.275	10.787	438.5	97%	0.027	9.96	7.379	0.106	7.149	14.634	584.7	97%	0.036	12.36	9.156	0.146	8.871	18.172
05-Dec	1526	66	292.4	97%	0.018	7.34	5.444	0.068	5.266	10.779	438.5	97%	0.027	9.94	7.379	0.106	7.138	14.623	584.7	97%	0.036	12.34	9.156	0.145	8.857	18.158
06-Dec	1527	67	292.4	97%	0.018	7.32	5.444	0.068	5.257	10.769	438.6	97%	0.027	9.93	7.379	0.106	7.126	14.611	584.8	97%	0.036	12.32	9.156	0.145	8.841	18.143
07-Dec	1528	68	292.4	97%	0.018	7.31	5.445	0.068	5.247	10.759	438.6	97%	0.027	9.91	7.380	0.105	7.111	14.597	584.8	97%	0.036	12.29	9.157	0.145	8.824	18.125
08-Dec	1529	69	292.4	97%	0.018	7.29	5.445	0.067	5.235	10.748	438.6	97%	0.027	9.89	7.380	0.105	7.096	14.581	584.8	97%	0.036	12.27	9.157	0.144	8.804	18.106
09-Dec	1530	70	292.4	97%	0.018	7.28	5.445	0.067	5.222	10.735	438.7	97%	0.027	9.86	7.380	0.105	7.079	14.564	584.9	97%	0.036	12.24	9.158	0.144	8.783	18.085
10-Dec	1531	71	292.5	97%	0.018	7.26	5.445	0.067	5.209	10.721	438.7	97%	0.027	9.84	7.381	0.105	7.060	14.545	584.9	97%	0.036	12.20	9.158	0.143	8.760	18.062
11-Dec	1532	72	292.5	97%	0.018	7.24	5.446	0.067	5.194	10.707	438.7	97%	0.027	9.81	7.381	0.104	7.040	14.526	584.9	97%	0.036	12.17	9.159	0.143	8.735	18.037
12-Dec	1533	73	292.5	97%	0.018	7.21	5.446	0.067	5.178	10.691	438.7	97%	0.027	9.78	7.381	0.104	7.019	14.505	585.0	97%	0.035	12.13	9.159	0.143	8.709	18.011

	13-Dec	1534		74	292.5	98%	0.018	7.19	5.446	0.067	5.162		10.675	438.8	98%	0.027	9.75	7.382	0.104	6.997		14.482	585.0	98%	0.035	12.09	9.159	0.142	8.681		17.983
	14-Dec	1535		75	292.5	98%	0.018	7.17	5.446	0.066	5.145		10.657	438.8	98%	0.026	9.71	7.382	0.104	6.973		14.459	585.1	98%	0.035	12.05	9.160	0.142	8.652		17.954
	15-Dec	1536		76	292.5	98%	0.018	7.14	5.447	0.066	5.126		10.639	438.8	98%	0.026	9.68	7.382	0.103	6.948		14.434	585.1	98%	0.035	12.01	9.160	0.142	8.621		17.923
	16-Dec	1537		77	292.6	98%	0.018	7.11	5.447	0.066	5.107		10.620	438.8	98%	0.026	9.64	7.383	0.103	6.922		14.408	585.1	98%	0.035	11.97	9.161	0.141	8.589		17.891
	17-Dec	1538		78	292.6	98%	0.018	7.09	5.447	0.066	5.087		10.600	438.9	98%	0.026	9.61	7.383	0.103	6.895		14.381	585.2	98%	0.035	11.92	9.161	0.141	8.556		17.858
	18-Dec	1539		79	292.6	98%	0.017	7.06	5.447	0.066	5.067		10.580	438.9	98%	0.026	9.57	7.383	0.103	6.867		14.353	585.2	98%	0.035	11.87	9.161	0.141	8.521		17.823
	19-Dec	1540		80	292.6	98%	0.017	7.03	5.448	0.066	5.045		10.558	438.9	98%	0.026	9.53	7.384	0.102	6.838		14.324	585.2	98%	0.035	11.82	9.162	0.140	8.485		17.787
	20-Dec	1541		81	292.6	98%	0.017	7.00	5.448	0.065	5.023		10.536	438.9	98%	0.026	9.49	7.384	0.102	6.808		14.295	585.3	98%	0.035	11.77	9.162	0.140	8.448		17.750
	21-Dec	1542		82	292.6	98%	0.017	6.97	5.448	0.065	5.000		10.514	439.0	98%	0.026	9.44	7.384	0.102	6.778		14.264	585.3	98%	0.035	11.72	9.163	0.140	8.410		17.712
	22-Dec	1543		83	292.7	98%	0.017	6.93	5.448	0.065	4.977		10.490	439.0	98%	0.026	9.40	7.385	0.101	6.746		14.232	585.3	98%	0.035	11.66	9.163	0.139	8.370		17.673
Mature Breeding	23-Dec	1544	1	84	292.7	98%	0.017	6.90	5.449	0.065	4.953	0.005	10.472	439.0	98%	0.026	9.35	7.385	0.101	6.713	0.008	14.208	585.4	98%	0.035	11.60	9.164	0.139	8.330	0.011	17.643
	24-Dec	1545	2	85	292.7	98%	0.017	6.87	5.449	0.065	4.928	0.006	10.448	439.1	98%	0.026	9.31	7.385	0.101	6.680	0.008	14.175	585.4	98%	0.035	11.55	9.164	0.138	8.289	0.011	17.602
	25-Dec	1546	3	86	292.7	98%	0.017	6.83	5.449	0.065	4.903	0.006	10.423	439.1	98%	0.026	9.26	7.386	0.101	6.646	0.009	14.141	585.4	98%	0.034	11.49	9.164	0.138	8.246	0.011	17.560
	26-Dec	1547	4	87	292.7	98%	0.017	6.80	5.449	0.064	4.878	0.006	10.397	439.1	98%	0.026	9.21	7.386	0.100	6.611	0.009	14.107	585.5	98%	0.034	11.43	9.165	0.138	8.203	0.012	17.517
	27-Dec	1548	5	88	292.8	98%	0.017	6.76	5.450	0.064	4.852	0.006	10.371	439.1	98%	0.026	9.16	7.386	0.100	6.576	0.009	14.071	585.5	98%	0.034	11.37	9.165	0.137	8.159	0.012	17.474
	28-Dec	1549	6	89	292.8	98%	0.017	6.72	5.450	0.064	4.825	0.006	10.345	439.2	98%	0.026	9.11	7.387	0.100	6.540	0.009	14.036	585.5	98%	0.034	11.30	9.166	0.137	8.114	0.012	17.429
	29-Dec	1550	7	90	292.8	98%	0.017	6.68	5.450	0.064	4.798	0.006	10.318	439.2	98%	0.026	9.06	7.387	0.100	6.503	0.010	13.999	585.6	98%	0.034	11.24	9.166	0.137	8.069	0.013	17.384
	30-Dec	1551	8	91	292.8	98%	0.017	6.65	5.450	0.064	4.770	0.007	10.291	439.2	98%	0.026	9.01	7.387	0.099	6.466	0.010	13.962	585.6	98%	0.034	11.18	9.166	0.136	8.023	0.013	17.338
	31-Dec	1552	9	92	292.8	98%	0.017	6.61	5.451	0.064	4.742	0.007	10.263	439.2	98%	0.025	8.95	7.388	0.099	6.428	0.010	13.925	585.6	98%	0.034	11.11	9.167	0.136	7.976	0.014	17.292
Classified as mature	01-Jan	1553	10	93	300.0	100%		6.57	5.550		4.714	0.007	10.271	450.0	100%		8.90	7.523		6.389	0.011	13.923	600.0	100%		11.04	9.335		7.928	0.014	17.277
	02-Jan	1554	11	94	300.0			6.53	5.550		4.685	0.007	10.243	450.0			8.85	7.523		6.350	0.011	13.884	600.0			10.98	9.335		7.880	0.014	17.229
	03-Jan	1555	12	95	300.0			6.49	5.550		4.656	0.007	10.214	450.0			8.79	7.523		6.311	0.011	13.845	600.0			10.91	9.335		7.831	0.015	17.180
	04-Jan	1556	13	96	300.0			6.45	5.550		4.627	0.008	10.185	450.0			8.74	7.523		6.271	0.012	13.806	600.0			10.84	9.335		7.781	0.015	17.131
	05-Jan	1557	14	97	300.0			6.40	5.550		4.597	0.008	10.155	450.0			8.68	7.523		6.231	0.012	13.766	600.0			10.77	9.335		7.731	0.016	17.082
	06-Jan	1558	15	98	300.0			6.36	5.550		4.567	0.008	10.126	450.0			8.62	7.523		6.190	0.012	13.726	600.0			10.70	9.335		7.681	0.016	17.032
	07-Jan	1559	16	99	300.0			6.32	5.550		4.537	0.008	10.096	450.0			8.57	7.523		6.149	0.013	13.685	600.0			10.63	9.335		7.630	0.017	16.981
	08-Jan	1560	17	100	300.0			6.28	5.550		4.506	0.009	10.065	450.0			8.51	7.523		6.108	0.013	13.644	600.0			10.56	9.335		7.578	0.017	16.931
	09-Jan	1561	18	101	300.0			6.23	5.550		4.475	0.009	10.035	450.0			8.45	7.523		6.066	0.013	13.602	600.0			10.49	9.335		7.527	0.018	16.879
	10-Jan	1562	19	102	300.0			6.19	5.550		4.444	0.009	10.004	450.0			8.39	7.523		6.024	0.014	13.561	600.0			10.41	9.335		7.474	0.018	16.828
	11-Jan	1563	20	103	300.0			6.15	5.550		4.413	0.009	9.973	450.0			8.33	7.523		5.982	0.014	13.519	600.0			10.34	9.335		7.422	0.019	16.776
	12-Jan	1564	21	104	300.0			6.10	5.550		4.382	0.010	9.942	450.0			8.27	7.523		5.939	0.015	13.477	600.0			10.27	9.335		7.369	0.019	16.723
	13-Jan	1565	22	105	300.0			6.06	5.550		4.350	0.010	9.911	450.0			8.21	7.523		5.896	0.015	13.434	600.0			10.19	9.335		7.316	0.020	16.671
	14-Jan	1566	23	106	300.0			6.02	5.550		4.318	0.010	9.879	450.0			8.15	7.523		5.853	0.016	13.392	600.0			10.12	9.335		7.263	0.021	16.618
	15-Jan	1567	24	107	300.0			5.97	5.550		4.286	0.011	9.848	450.0			8.09	7.523		5.810	0.016	13.349	600.0			10.04	9.335		7.209	0.021	16.565
	16-Jan	1568	25	108	300.0			5.93	5.550		4.254	0.011	9.816	450.0			8.03	7.523		5.766	0.016	13.306	600.0			9.97	9.335		7.155	0.022	16.512
	17-Jan	1569	26	109	300.0			5.88	5.550		4.222	0.011	9.784	450.0			7.97	7.523		5.723	0.017	13.263	600.0			9.89	9.335		7.101	0.023	16.458
	18-Jan	1570	27	110	300.0			5.84	5.550		4.190	0.012	9.752	450.0			7.91	7.523		5.679	0.017	13.220	600.0			9.82	9.335		7.047	0.023	16.405
	19-Jan	1571	28	111	300.0			5.79	5.550		4.158	0.012	9.720	450.0			7.85	7.523		5.635	0.018	13.176	600.0			9.74	9.335		6.992	0.024	16.351
	20-Jan	1572	29	112	300.0			5.75	5.550		4.125	0.012	9.688	450.0			7.79	7.523		5.591	0.018	13.133	600.0			9.67	9.335		6.938	0.025	16.297
	21-Jan	1573	30	113	300.0			5.70	5.550		4.093	0.013	9.656	450.0			7.73	7.523		5.547	0.019	13.089	600.0			9.59	9.335		6.883	0.025	16.243
	22-Jan	1574	31	114	300.0			5.66	5.550		4.060	0.013	9.624	450.0			7.67	7.523		5.503	0.020	13.046	600.0			9.51	9.335		6.828	0.026	16.189
	23-Jan	1575	32	115	300.0			5.61	5.550		4.027	0.013	9.591	450.0			7.60	7.523		5.459	0.020	13.002	600.0			9.44	9.335		6.773	0.027	16.135
	24-Jan	1576	33	116	300.0			5.57	5.550		3.995	0.014	9.559	450.0			7.54	7.523		5.414	0.021	12.958	600.0			9.36	9.335		6.718	0.028	16.081
	25-Jan	1577	34	117	300.0			5.52	5.550		3.962	0.014	9.527	450.0			7.48	7.523		5.370	0.021	12.915	600.0			9.28	9.335		6.663	0.028	16.026
	26-Jan	1578	35	118	300.0			5.47	5.550		3.929	0.015	9.494	450.0			7.42	7.523		5.326	0.022	12.871	600.0			9.21	9.335		6.608	0.029	15.972
	27-Jan	1579	36	119	300.0			5.43	5.550		3.896	0.015	9.462	450.0			7.36	7.523		5.281	0.023	12.827	600.0			9.13	9.335		6.553	0.030	15.918
	28-Jan	1580	37	120	300.0			5.38	5.550		3.864	0.015	9.430	450.0			7.30	7.523		5.237	0.023	12.783	600.0			9.05	9.335		6.498	0.031	15.864
	29-Jan	1581	38	121	300.0			5.34	5.550		3.831	0.016	9.397	450.0			7.23	7.523		5.193	0.024	12.740	600.0			8.98	9.335		6.443	0.032	15.810
	30-Jan	1582	39	122	300.0			5.29	5.550		3.798	0.016	9.365	450.0			7.17	7.523		5.148	0.025	12.696	600.0			8.90	9.335		6.388	0.033	15.755
	31-Jan	1583	40	123	300.0			5.25	5.550		3.766	0.017	9.333	450.0			7.11	7.523		5.104	0.025	12.652	600.0			8.82	9.335		6.333	0.034	15.701
	01-Feb	1584	41	124	300.0			5.20	5.550		3.733	0.017	9.301	450.0			7.05	7.523		5.060	0.026	12.609	600.0			8.75	9.335		6.278	0.035	15.647
	02-Feb	1585	42	125	300.0			5.16	5.550		3.700	0.018	9.269	450.0			6.99	7.523		5.015	0.027	12.565	600.0			8.67	9.335		6.223	0.036	15.594
	03-Feb	1586	43	126	300.0			5.11	5.550		3.668	0.018	9.237	450.0			6.93	7.523		4.971	0.028	12.522	600.0			8.59	9.335		6.168	0.037	15.540
	04-Feb	1587	44	127	300.0			5.06	5.550		3.635	0.019	9.205	450.0			6.86	7.523		4.927	0.028	12.479	600.0			8.52	9.335		6.114	0.038	15.486
	05-Feb	1588	45	128	300.0			5.02	5.550		3.603	0.019	9.173	450.0			6.80	7.523		4.883	0.029	12.436	600.0			8.44	9.335		6.059	0.039	15.433
	06-Feb	1589	46	129	300.0			4.97	5.550		3.570	0.020	9.141	450.0			6.74	7.523		4.839	0.030	12.392	600.0			8.37	9.335		6.005	0.040	15.379
	07-Feb	1590	47	130	300.0			4.93	5.550		3.538	0.021	9.109	450.0			6.68	7.523		4.796	0.031	12.350	600.0			8.29	9.335		5.950	0.041	15.326
	08-Feb	1591	48	131	300.0			4.88	5.550		3.506	0.021	9.078	450.0			6.62	7.523		4.752	0.032	12.307	600.0			8.21	9.335		5.896	0.042	15.273
	09-Feb	1592	49	132	300.0			4.84	5.550		3.474	0.022	9.046	450.0			6.56	7.523		4.708	0.033	12.264	600.0			8.14	9.335		5.842	0.043	15.220
	10-Feb	1593	50	133	300.0			4.79	5.550		3.442	0.022	9.015	450.0			6.50	7.523		4.665	0.033	12.222	600.0			8.06	9.335		5.788	0.045	15.168
	11-Feb	1594	51	134	300.0			4.75	5.550		3.410	0.023	8.983	450.0			6.44	7.523		4.622	0.034	12.179	600.0			7.99	9.335		5.735	0.046	15.115
	12-Feb	1595	52	135	300.0			4.71	5.550		3.378	0.024	8.952	450.0			6.38	7.523		4.579	0.035	12.137	600.0			7.91	9.335		5.681	0.047	15.063
	13-Feb	1596	53	136	300.0			4.66	5.550		3.346	0.024	8.921	450.0			6.32	7.523		4.536	0.036	12.095	600.0			7.84	9.335		5.628	0.048	15.011
	14-Feb	1597	54	137	300.0			4.62	5.550		3.315	0.025	8.890	450.0			6.26	7.523		4.493	0.037	12.053	600.0			7.77	9.335		5.575	0.050	14.959
	15-Feb	1598	55	138	300.0			4.57	5.550		3.283	0.026	8.859	450.0			6.20	7.523		4.450	0.038	12.012	600.0			7.69	9.335		5.522	0.051	14.908
	16-Feb	1599	56	139	300.0			4.53	5.550		3.252	0.026	8.829	450.0			6.14	7.523		4.408	0.039	11.970	600.0			7.62	9.335		5.469	0.053	14.857
	17-Feb	1600	57	140	300.0			4.49	5.550		3.221	0.027	8.798	450.0			6.08	7.523		4.366	0.041	11.929	600.0			7.55	9.335		5.417	0.054	14.806

	18-Feb	1601	58	141	300.0	4.44	5.550	3.190	0.028	8.768	450.0	6.02	7.523	4.323	0.042	11.888	600.0	7.47	9.335	5.365	0.056	14.755
	19-Feb	1602	59	142	300.0	4.40	5.550	3.159	0.029	8.738	450.0	5.96	7.523	4.282	0.043	11.848	600.0	7.40	9.335	5.313	0.057	14.705
	20-Feb	1603	60	143	300.0	4.36	5.550	3.128	0.029	8.708	450.0	5.91	7.523	4.240	0.044	11.807	600.0	7.33	9.335	5.261	0.059	14.654
	21-Feb	1604	61	144	300.0	4.32	5.550	3.097	0.030	8.678	450.0	5.85	7.523	4.198	0.045	11.767	600.0	7.26	9.335	5.209	0.060	14.604
	22-Feb	1605	62	145	300.0	4.27	5.550	3.067	0.031	8.649	450.0	5.79	7.523	4.157	0.046	11.727	600.0	7.19	9.335	5.158	0.062	14.555
	23-Feb	1606	63	146	300.0	4.23	5.550	3.037	0.032	8.619	450.0	5.73	7.523	4.116	0.048	11.687	600.0	7.11	9.335	5.107	0.064	14.506
	24-Feb	1607	64	147	300.0	4.19	5.550	3.007	0.033	8.590	450.0	5.68	7.523	4.075	0.049	11.647	600.0	7.04	9.335	5.056	0.065	14.457
	25-Feb	1608	65	148	300.0	4.15	5.550	2.977	0.034	8.561	450.0	5.62	7.523	4.034	0.050	11.608	600.0	6.97	9.335	5.006	0.067	14.408
	26-Feb	1609	66	149	300.0	4.11	5.550	2.947	0.035	8.532	450.0	5.56	7.523	3.994	0.052	11.569	600.0	6.90	9.335	4.956	0.069	14.360
	27-Feb	1610	67	150	300.0	4.06	5.550	2.917	0.035	8.503	450.0	5.51	7.523	3.954	0.053	11.530	600.0	6.83	9.335	4.906	0.071	14.312
	28-Feb	1611	68	151	300.0	4.02	5.550	2.888	0.036	8.474	450.0	5.45	7.523	3.914	0.055	11.492	600.0	6.77	9.335	4.856	0.073	14.264
	01-Mar	1612	69	152	300.0	3.98	5.550	2.858	0.037	8.446	450.0	5.40	7.523	3.874	0.056	11.453	600.0	6.70	9.335	4.807	0.075	14.217
	02-Mar	1613	70	153	300.0	3.94	5.550	2.829	0.038	8.418	450.0	5.34	7.523	3.835	0.058	11.415	600.0	6.63	9.335	4.758	0.077	14.170
	03-Mar	1614	71	154	300.0	3.90	5.550	2.800	0.039	8.390	450.0	5.29	7.523	3.795	0.059	11.378	600.0	6.56	9.335	4.709	0.079	14.123
	04-Mar	1615	72	155	300.0	3.86	5.550	2.771	0.040	8.362	450.0	5.23	7.523	3.756	0.061	11.340	600.0	6.49	9.335	4.661	0.081	14.077
	05-Mar	1616	73	156	300.0	3.82	5.550	2.743	0.042	8.335	450.0	5.18	7.523	3.718	0.062	11.303	600.0	6.43	9.335	4.613	0.083	14.031
	06-Mar	1617	74	157	300.0	3.78	5.550	2.714	0.043	8.307	450.0	5.13	7.523	3.679	0.064	11.266	600.0	6.36	9.335	4.565	0.085	13.985
	07-Mar	1618	75	158	300.0	3.74	5.550	2.686	0.044	8.280	450.0	5.07	7.523	3.641	0.066	11.230	600.0	6.29	9.335	4.517	0.088	13.940
	08-Mar	1619	76	159	300.0	3.70	5.550	2.658	0.045	8.253	450.0	5.02	7.523	3.603	0.067	11.193	600.0	6.23	9.335	4.470	0.090	13.895
	09-Mar	1620	77	160	300.0	3.66	5.550	2.630	0.046	8.227	450.0	4.97	7.523	3.565	0.069	11.157	600.0	6.16	9.335	4.423	0.092	13.851
	10-Mar	1621	78	161	300.0	3.63	5.550	2.602	0.047	8.200	450.0	4.91	7.523	3.527	0.071	11.122	600.0	6.10	9.335	4.377	0.095	13.806
	11-Mar	1622	79	162	300.0	3.59	5.550	2.575	0.049	8.174	450.0	4.86	7.523	3.490	0.073	11.086	600.0	6.03	9.335	4.331	0.097	13.763
	12-Mar	1623	80	163	300.0	3.55	5.550	2.548	0.050	8.148	450.0	4.81	7.523	3.453	0.075	11.051	600.0	5.97	9.335	4.285	0.100	13.719
	13-Mar	1624	81	164	300.0	3.51	5.550	2.521	0.051	8.122	450.0	4.76	7.523	3.416	0.077	11.016	600.0	5.91	9.335	4.239	0.102	13.676
	14-Mar	1625	82	165	300.0	3.47	5.550	2.494	0.053	8.097	450.0	4.71	7.523	3.380	0.079	10.982	600.0	5.84	9.335	4.194	0.105	13.634
	15-Mar	1626	83	166	300.0	3.44	5.550	2.467	0.054	8.071	450.0	4.66	7.523	3.344	0.081	10.948	600.0	5.78	9.335	4.149	0.108	13.592
	16-Mar	1627	84	167	300.0	3.40	5.550	2.441	0.055	8.046	450.0	4.61	7.523	3.308	0.083	10.914	600.0	5.72	9.335	4.104	0.111	13.550
	17-Mar	1628	85	168	300.0	3.36	5.550	2.414	0.057	8.022	450.0	4.56	7.523	3.272	0.085	10.881	600.0	5.66	9.335	4.060	0.114	13.509
	18-Mar	1629	86	169	300.0	3.33	5.550	2.388	0.058	7.997	450.0	4.51	7.523	3.237	0.087	10.847	600.0	5.60	9.335	4.016	0.117	13.468
	19-Mar	1630	87	170	300.0	3.29	5.550	2.362	0.060	7.973	450.0	4.46	7.523	3.202	0.090	10.815	600.0	5.53	9.335	3.973	0.120	13.427
	20-Mar	1631	88	171	300.0	3.26	5.550	2.337	0.061	7.948	450.0	4.41	7.523	3.167	0.092	10.782	600.0	5.47	9.335	3.930	0.123	13.387
	21-Mar	1632	89	172	300.0	3.22	5.550	2.311	0.063	7.924	450.0	4.36	7.523	3.132	0.094	10.750	600.0	5.41	9.335	3.887	0.126	13.347
	22-Mar	1633	90	173	300.0	3.18	5.550	2.286	0.065	7.901	450.0	4.32	7.523	3.098	0.097	10.718	600.0	5.36	9.335	3.844	0.129	13.308
	23-Mar	1634	91	174	300.0	3.15	5.550	2.261	0.066	7.877	450.0	4.27	7.523	3.064	0.099	10.686	600.0	5.30	9.335	3.802	0.132	13.269
	24-Mar	1635	92	175	300.0	3.11	5.550	2.236	0.068	7.854	450.0	4.22	7.523	3.030	0.102	10.655	600.0	5.24	9.335	3.760	0.136	13.231
	25-Mar	1636	93	176	300.0	3.08	5.550	2.211	0.070	7.831	450.0	4.17	7.523	2.997	0.104	10.624	600.0	5.18	9.335	3.718	0.139	13.192
	26-Mar	1637	94	177	300.0	3.05	5.550	2.187	0.071	7.808	450.0	4.13	7.523	2.964	0.107	10.594	600.0	5.12	9.335	3.677	0.143	13.155
	27-Mar	1638	95	178	300.0	3.01	5.550	2.162	0.073	7.786	450.0	4.08	7.523	2.931	0.110	10.564	600.0	5.07	9.335	3.636	0.146	13.118
	28-Mar	1639	96	179	300.0	2.98	5.550	2.138	0.075	7.764	450.0	4.04	7.523	2.898	0.113	10.534	600.0	5.01	9.335	3.596	0.150	13.081
	29-Mar	1640	97	180	300.0	2.95	5.550	2.114	0.077	7.742	450.0	3.99	7.523	2.866	0.115	10.504	600.0	4.95	9.335	3.556	0.154	13.044
	30-Mar	1641	98	181	300.0	2.91	5.550	2.091	0.079	7.720	450.0	3.95	7.523	2.834	0.118	10.475	600.0	4.90	9.335	3.516	0.158	13.008
	31-Mar	1642	99	182	300.0	2.88	5.550	2.067	0.081	7.698	450.0	3.90	7.523	2.802	0.121	10.446	600.0	4.84	9.335	3.476	0.162	12.973
	01-Apr	1643	100	183	300.0	2.85	5.550	2.044	0.083	7.677	450.0	3.86	7.523	2.770	0.124	10.418	600.0	4.79	9.335	3.437	0.166	12.938
	02-Apr	1644	101	184	300.0	2.82	5.550	2.021	0.085	7.656	450.0	3.82	7.523	2.739	0.128	10.390	600.0	4.73	9.335	3.398	0.170	12.903
	03-Apr	1645	102	185	300.0	2.78	5.550	1.998	0.087	7.635	450.0	3.77	7.523	2.708	0.131	10.362	600.0	4.68	9.335	3.360	0.174	12.869
	04-Apr	1646	103	186	300.0	2.75	5.550	1.975	0.089	7.615	450.0	3.73	7.523	2.677	0.134	10.334	600.0	4.63	9.335	3.322	0.179	12.835
	05-Apr	1647	104	187	300.0	2.72	5.550	1.953	0.092	7.595	450.0	3.69	7.523	2.647	0.137	10.307	600.0	4.58	9.335	3.284	0.183	12.802
	06-Apr	1648	105	188	300.0	2.69	5.550	1.930	0.094	7.575	450.0	3.65	7.523	2.616	0.141	10.280	600.0	4.52	9.335	3.247	0.188	12.769
	07-Apr	1649	106	189	300.0	2.66	5.550	1.908	0.096	7.555	450.0	3.60	7.523	2.587	0.144	10.254	600.0	4.47	9.335	3.209	0.192	12.736
	08-Apr	1650	107	190	300.0	2.63	5.550	1.886	0.099	7.535	450.0	3.56	7.523	2.557	0.148	10.228	600.0	4.42	9.335	3.173	0.197	12.704
	09-Apr	1651	108	191	300.0	2.60	5.550	1.865	0.101	7.516	450.0	3.52	7.523	2.528	0.151	10.202	600.0	4.37	9.335	3.136	0.202	12.673
	10-Apr	1652	109	192	300.0	2.57	5.550	1.843	0.103	7.497	450.0	3.48	7.523	2.498	0.155	10.177	600.0	4.32	9.335	3.100	0.207	12.642
	11-Apr	1653	110	193	300.0	2.54	5.550	1.822	0.106	7.478	450.0	3.44	7.523	2.470	0.159	10.152	600.0	4.27	9.335	3.064	0.212	12.611
	12-Apr	1654	111	194	300.0	2.51	5.550	1.801	0.109	7.460	450.0	3.40	7.523	2.441	0.163	10.127	600.0	4.22	9.335	3.029	0.217	12.581
	13-Apr	1655	112	195	300.0	2.48	5.550	1.780	0.111	7.442	450.0	3.36	7.523	2.413	0.167	10.103	600.0	4.17	9.335	2.994	0.222	12.551
	14-Apr	1656	113	196	300.0	2.45	5.550	1.759	0.114	7.424	450.0	3.32	7.523	2.385	0.171	10.079	600.0	4.12	9.335	2.959	0.228	12.521
	15-Apr	1657	114	197	300.0	2.42	5.550	1.739	0.117	7.406	450.0	3.28	7.523	2.357	0.175	10.055	600.0	4.07	9.335	2.924	0.233	12.492
	16-Apr	1658	115	198	300.0	2.39	5.550	1.719	0.119	7.389	450.0	3.25	7.523	2.329	0.179	10.032	600.0	4.03	9.335	2.890	0.239	12.464
	17-Apr	1659	116	199	300.0	2.37	5.550	1.698	0.122	7.371	450.0	3.21	7.523	2.302	0.184	10.009	600.0	3.98	9.335	2.856	0.245	12.436
	18-Apr	1660	117	200	300.0	2.34	5.550	1.679	0.125	7.354	450.0	3.17	7.523	2.275	0.188	9.986	600.0	3.93	9.335	2.823	0.251	12.408
	19-Apr	1661	118	201	300.0	2.31	5.550	1.659	0.128	7.338	450.0	3.13	7.523	2.248	0.192	9.964	600.0	3.89	9.335	2.790	0.257	12.381
	20-Apr	1662	119	202	300.0	2.28	5.550	1.639	0.131	7.321	450.0	3.10	7.523	2.222	0.197	9.942	600.0	3.84	9.335	2.757	0.263	12.354
	21-Apr	1663	120	203	300.0	2.26	5.550	1.620	0.135	7.305	450.0	3.06	7.523	2.196	0.202	9.921	600.0	3.80	9.335	2.724	0.269	12.328
	22-Apr	1664	121	204	300.0	2.23	5.550	1.601	0.138	7.289	450.0	3.02	7.523	2.170	0.207	9.899	600.0	3.75	9.335	2.692	0.275	12.302
2nd lactation ends	23-Apr	1665	122	205	300.0	2.20	5.550	1.582	0.141	7.273	450.0	2.99	7.523	2.144	0.212	9.879	600.0	3.71	9.335	2.660	0.282	12.277
	24-Apr	1666	123		300.0		5.550		0.144	5.695	450.0		7.523		0.217	7.740	600.0		9.335		0.289	9.624
	25-Apr	1667	124		300.0		5.550		0.148	5.698	450.0		7.523		0.222	7.745	600.0		9.335		0.296	9.630

	26-Apr	1668	125	300.0	5.550	0.151	5.702	450.0	7.523	0.227	7.750	600.0	9.335	0.303	9.637
	27-Apr	1669	126	300.0	5.550	0.155	5.705	450.0	7.523	0.232	7.755	600.0	9.335	0.310	9.644
	28-Apr	1670	127	300.0	5.550	0.158	5.709	450.0	7.523	0.238	7.761	600.0	9.335	0.317	9.652
	29-Apr	1671	128	300.0	5.550	0.162	5.713	450.0	7.523	0.243	7.766	600.0	9.335	0.324	9.659
Calves are weaned. Mature Cows are Culled	30-Apr	1672	129	300.0	5.550	0.166	5.716	450.0	7.523	0.249	7.772	600.0	9.335	0.332	9.667
	01-May	1673	130	300.0	5.550	0.170	5.720	450.0	7.523	0.255	7.778	600.0	9.335	0.340	9.674
	02-May	1674	131	300.0	5.550	0.174	5.724	450.0	7.523	0.261	7.784	600.0	9.335	0.348	9.682
	03-May	1675	132	300.0	5.550	0.178	5.728	450.0	7.523	0.267	7.790	600.0	9.335	0.356	9.690
	04-May	1676	133	300.0	5.550	0.182	5.732	450.0	7.523	0.273	7.796	600.0	9.335	0.364	9.699
	05-May	1677	134	300.0	5.550	0.186	5.737	450.0	7.523	0.279	7.802	600.0	9.335	0.372	9.707
	06-May	1678	135	300.0	5.550	0.190	5.741	450.0	7.523	0.286	7.809	600.0	9.335	0.381	9.716
	07-May	1679	136	300.0	5.550	0.195	5.745	450.0	7.523	0.292	7.815	600.0	9.335	0.389	9.724
	08-May	1680	137	300.0	5.550	0.199	5.750	450.0	7.523	0.299	7.822	600.0	9.335	0.398	9.733
	09-May	1681	138	300.0	5.550	0.204	5.754	450.0	7.523	0.306	7.829	600.0	9.335	0.407	9.742
	10-May	1682	139	300.0	5.550	0.208	5.759	450.0	7.523	0.313	7.836	600.0	9.335	0.417	9.752
	11-May	1683	140	300.0	5.550	0.213	5.764	450.0	7.523	0.320	7.843	600.0	9.335	0.426	9.761
	12-May	1684	141	300.0	5.550	0.218	5.768	450.0	7.523	0.327	7.850	600.0	9.335	0.436	9.771
	13-May	1685	142	300.0	5.550	0.223	5.773	450.0	7.523	0.334	7.857	600.0	9.335	0.446	9.780
	14-May	1686	143	300.0	5.550	0.228	5.778	450.0	7.523	0.342	7.865	600.0	9.335	0.456	9.790
	15-May	1687	144	300.0	5.550	0.233	5.783	450.0	7.523	0.349	7.873	600.0	9.335	0.466	9.801
	16-May	1688	145	300.0	5.550	0.238	5.789	450.0	7.523	0.357	7.880	600.0	9.335	0.476	9.811
	17-May	1689	146	300.0	5.550	0.243	5.794	450.0	7.523	0.365	7.888	600.0	9.335	0.487	9.822
	18-May	1690	147	300.0	5.550	0.249	5.799	450.0	7.523	0.373	7.897	600.0	9.335	0.498	9.833
	19-May	1691	148	300.0	5.550	0.254	5.805	450.0	7.523	0.382	7.905	600.0	9.335	0.509	9.844
	20-May	1692	149	300.0	5.550	0.260	5.811	450.0	7.523	0.390	7.913	600.0	9.335	0.520	9.855
	21-May	1693	150	300.0	5.550	0.266	5.816	450.0	7.523	0.399	7.922	600.0	9.335	0.532	9.866
	22-May	1694	151	300.0	5.550	0.272	5.822	450.0	7.523	0.407	7.931	600.0	9.335	0.543	9.878
	23-May	1695	152	300.0	5.550	0.278	5.828	450.0	7.523	0.416	7.940	600.0	9.335	0.555	9.890
	24-May	1696	153	300.0	5.550	0.284	5.834	450.0	7.523	0.426	7.949	600.0	9.335	0.567	9.902
	25-May	1697	154	300.0	5.550	0.290	5.840	450.0	7.523	0.435	7.958	600.0	9.335	0.580	9.915
	26-May	1698	155	300.0	5.550	0.296	5.847	450.0	7.523	0.444	7.967	600.0	9.335	0.592	9.927
	27-May	1699	156	300.0	5.550	0.303	5.853	450.0	7.523	0.454	7.977	600.0	9.335	0.605	9.940
	28-May	1700	157	300.0	5.550	0.309	5.860	450.0	7.523	0.464	7.987	600.0	9.335	0.618	9.953
	29-May	1701	158	300.0	5.550	0.316	5.866	450.0	7.523	0.474	7.997	600.0	9.335	0.632	9.966
	30-May	1702	159	300.0	5.550	0.323	5.873	450.0	7.523	0.484	8.007	600.0	9.335	0.645	9.980
	31-May	1703	160	300.0	5.550	0.330	5.880	450.0	7.523	0.494	8.017	600.0	9.335	0.659	9.994
	01-Jun	1704	161	300.0	5.550	0.337	5.887	450.0	7.523	0.505	8.028	600.0	9.335	0.673	10.008
	02-Jun	1705	162	300.0	5.550	0.344	5.894	450.0	7.523	0.516	8.039	600.0	9.335	0.688	10.022
	03-Jun	1706	163	300.0	5.550	0.351	5.902	450.0	7.523	0.527	8.050	600.0	9.335	0.702	10.037
	04-Jun	1707	164	300.0	5.550	0.359	5.909	450.0	7.523	0.538	8.061	600.0	9.335	0.717	10.052
	05-Jun	1708	165	300.0	5.550	0.366	5.917	450.0	7.523	0.549	8.072	600.0	9.335	0.732	10.067
	06-Jun	1709	166	300.0	5.550	0.374	5.924	450.0	7.523	0.561	8.084	600.0	9.335	0.748	10.082
	07-Jun	1710	167	300.0	5.550	0.382	5.932	450.0	7.523	0.572	8.096	600.0	9.335	0.763	10.098
	08-Jun	1711	168	300.0	5.550	0.390	5.940	450.0	7.523	0.584	8.108	600.0	9.335	0.779	10.114
	09-Jun	1712	169	300.0	5.550	0.398	5.948	450.0	7.523	0.597	8.120	600.0	9.335	0.796	10.130
	10-Jun	1713	170	300.0	5.550	0.406	5.957	450.0	7.523	0.609	8.132	600.0	9.335	0.812	10.147
	11-Jun	1714	171	300.0	5.550	0.415	5.965	450.0	7.523	0.622	8.145	600.0	9.335	0.829	10.164
	12-Jun	1715	172	300.0	5.550	0.423	5.974	450.0	7.523	0.635	8.158	600.0	9.335	0.846	10.181
	13-Jun	1716	173	300.0	5.550	0.432	5.982	450.0	7.523	0.648	8.171	600.0	9.335	0.864	10.198
	14-Jun	1717	174	300.0	5.550	0.441	5.991	450.0	7.523	0.661	8.184	600.0	9.335	0.881	10.216
	15-Jun	1718	175	300.0	5.550	0.450	6.000	450.0	7.523	0.675	8.198	600.0	9.335	0.900	10.234
	16-Jun	1719	176	300.0	5.550	0.459	6.009	450.0	7.523	0.688	8.212	600.0	9.335	0.918	10.253
	17-Jun	1720	177	300.0	5.550	0.468	6.019	450.0	7.523	0.703	8.226	600.0	9.335	0.937	10.271
	18-Jun	1721	178	300.0	5.550	0.478	6.028	450.0	7.523	0.717	8.240	600.0	9.335	0.956	10.291
	19-Jun	1722	179	300.0	5.550	0.488	6.038	450.0	7.523	0.731	8.254	600.0	9.335	0.975	10.310
	20-Jun	1723	180	300.0	5.550	0.497	6.048	450.0	7.523	0.746	8.269	600.0	9.335	0.995	10.330
	21-Jun	1724	181	300.0	5.550	0.507	6.058	450.0	7.523	0.761	8.284	600.0	9.335	1.015	10.350
	22-Jun	1725	182	300.0	5.550	0.518	6.068	450.0	7.523	0.776	8.300	600.0	9.335	1.035	10.370
	23-Jun	1726	183	300.0	5.550	0.528	6.078	450.0	7.523	0.792	8.315	600.0	9.335	1.056	10.391
	24-Jun	1727	184	300.0	5.550	0.539	6.089	450.0	7.523	0.808	8.331	600.0	9.335	1.077	10.412
	25-Jun	1728	185	300.0	5.550	0.549	6.100	450.0	7.523	0.824	8.347	600.0	9.335	1.098	10.433
	26-Jun	1729	186	300.0	5.550	0.560	6.111	450.0	7.523	0.840	8.363	600.0	9.335	1.120	10.455
	27-Jun	1730	187	300.0	5.550	0.571	6.122	450.0	7.523	0.857	8.380	600.0	9.335	1.142	10.477
	28-Jun	1731	188	300.0	5.550	0.582	6.133	450.0	7.523	0.874	8.397	600.0	9.335	1.165	10.500
	29-Jun	1732	189	300.0	5.550	0.594	6.144	450.0	7.523	0.891	8.414	600.0	9.335	1.188	10.523
	30-Jun	1733	190	300.0	5.550	0.606	6.156	450.0	7.523	0.908	8.431	600.0	9.335	1.211	10.546
	01-Jul	1734	191	300.0	5.550	0.617	6.168	450.0	7.523	0.926	8.449	600.0	9.335	1.235	10.570

02-Jul	1735	192	300.0	5.550	0.629	6.180	450.0	7.523	0.944	8.467	600.0	9.335	1.259	10.594
03-Jul	1736	193	300.0	5.550	0.642	6.192	450.0	7.523	0.962	8.486	600.0	9.335	1.283	10.618
04-Jul	1737	194	300.0	5.550	0.654	6.204	450.0	7.523	0.981	8.504	600.0	9.335	1.308	10.643
05-Jul	1738	195	300.0	5.550	0.667	6.217	450.0	7.523	1.000	8.523	600.0	9.335	1.333	10.668
06-Jul	1739	196	300.0	5.550	0.679	6.230	450.0	7.523	1.019	8.542	600.0	9.335	1.359	10.694
07-Jul	1740	197	300.0	5.550	0.692	6.243	450.0	7.523	1.039	8.562	600.0	9.335	1.385	10.720
08-Jul	1741	198	300.0	5.550	0.706	6.256	450.0	7.523	1.058	8.582	600.0	9.335	1.411	10.746
09-Jul	1742	199	300.0	5.550	0.719	6.270	450.0	7.523	1.079	8.602	600.0	9.335	1.438	10.773
10-Jul	1743	200	300.0	5.550	0.733	6.283	450.0	7.523	1.099	8.622	600.0	9.335	1.465	10.800
11-Jul	1744	201	300.0	5.550	0.747	6.297	450.0	7.523	1.120	8.643	600.0	9.335	1.493	10.828
12-Jul	1745	202	300.0	5.550	0.761	6.311	450.0	7.523	1.141	8.664	600.0	9.335	1.521	10.856
13-Jul	1746	203	300.0	5.550	0.775	6.325	450.0	7.523	1.162	8.685	600.0	9.335	1.550	10.885
14-Jul	1747	204	300.0	5.550	0.789	6.340	450.0	7.523	1.184	8.707	600.0	9.335	1.579	10.914
15-Jul	1748	205	300.0	5.550	0.804	6.355	450.0	7.523	1.206	8.729	600.0	9.335	1.608	10.943
16-Jul	1749	206	300.0	5.550	0.819	6.370	450.0	7.523	1.229	8.752	600.0	9.335	1.638	10.973
17-Jul	1750	207	300.0	5.550	0.834	6.385	450.0	7.523	1.251	8.774	600.0	9.335	1.668	11.003
18-Jul	1751	208	300.0	5.550	0.850	6.400	450.0	7.523	1.274	8.798	600.0	9.335	1.699	11.034
19-Jul	1752	209	300.0	5.550	0.865	6.416	450.0	7.523	1.298	8.821	600.0	9.335	1.730	11.065
20-Jul	1753	210	300.0	5.550	0.881	6.432	450.0	7.523	1.322	8.845	600.0	9.335	1.762	11.097
21-Jul	1754	211	300.0	5.550	0.897	6.448	450.0	7.523	1.346	8.869	600.0	9.335	1.794	11.129
22-Jul	1755	212	300.0	5.550	0.914	6.464	450.0	7.523	1.370	8.893	600.0	9.335	1.827	11.162
23-Jul	1756	213	300.0	5.550	0.930	6.481	450.0	7.523	1.395	8.918	600.0	9.335	1.860	11.195
24-Jul	1757	214	300.0	5.550	0.947	6.497	450.0	7.523	1.420	8.944	600.0	9.335	1.894	11.229
25-Jul	1758	215	300.0	5.550	0.964	6.514	450.0	7.523	1.446	8.969	600.0	9.335	1.928	11.263
26-Jul	1759	216	300.0	5.550	0.981	6.532	450.0	7.523	1.472	8.995	600.0	9.335	1.963	11.297
27-Jul	1760	217	300.0	5.550	0.999	6.549	450.0	7.523	1.498	9.021	600.0	9.335	1.998	11.332
28-Jul	1761	218	300.0	5.550	1.017	6.567	450.0	7.523	1.525	9.048	600.0	9.335	2.033	11.368
29-Jul	1762	219	300.0	5.550	1.035	6.585	450.0	7.523	1.552	9.075	600.0	9.335	2.069	11.404
30-Jul	1763	220	300.0	5.550	1.053	6.604	450.0	7.523	1.580	9.103	600.0	9.335	2.106	11.441
31-Jul	1764	221	300.0	5.550	1.072	6.622	450.0	7.523	1.607	9.131	600.0	9.335	2.143	11.478
01-Aug	1765	222	300.0	5.550	1.090	6.641	450.0	7.523	1.636	9.159	600.0	9.335	2.181	11.516
02-Aug	1766	223	300.0	5.550	1.110	6.660	450.0	7.523	1.664	9.187	600.0	9.335	2.219	11.554
03-Aug	1767	224	300.0	5.550	1.129	6.679	450.0	7.523	1.693	9.216	600.0	9.335	2.258	11.592
04-Aug	1768	225	300.0	5.550	1.148	6.699	450.0	7.523	1.723	9.246	600.0	9.335	2.297	11.632
05-Aug	1769	226	300.0	5.550	1.168	6.719	450.0	7.523	1.753	9.276	600.0	9.335	2.337	11.672
06-Aug	1770	227	300.0	5.550	1.189	6.739	450.0	7.523	1.783	9.306	600.0	9.335	2.377	11.712
07-Aug	1771	228	300.0	5.550	1.209	6.759	450.0	7.523	1.813	9.337	600.0	9.335	2.418	11.753
08-Aug	1772	229	300.0	5.550	1.230	6.780	450.0	7.523	1.844	9.368	600.0	9.335	2.459	11.794
09-Aug	1773	230	300.0	5.550	1.251	6.801	450.0	7.523	1.876	9.399	600.0	9.335	2.501	11.836
10-Aug	1774	231	300.0	5.550	1.272	6.822	450.0	7.523	1.908	9.431	600.0	9.335	2.544	11.879
11-Aug	1775	232	300.0	5.550	1.293	6.844	450.0	7.523	1.940	9.463	600.0	9.335	2.587	11.922
12-Aug	1776	233	300.0	5.550	1.315	6.866	450.0	7.523	1.973	9.496	600.0	9.335	2.631	11.965
13-Aug	1777	234	300.0	5.550	1.337	6.888	450.0	7.523	2.006	9.529	600.0	9.335	2.675	12.010
14-Aug	1778	235	300.0	5.550	1.360	6.910	450.0	7.523	2.040	9.563	600.0	9.335	2.720	12.054
15-Aug	1779	236	300.0	5.550	1.382	6.933	450.0	7.523	2.074	9.597	600.0	9.335	2.765	12.100
16-Aug	1780	237	300.0	5.550	1.405	6.956	450.0	7.523	2.108	9.631	600.0	9.335	2.811	12.146
17-Aug	1781	238	300.0	5.550	1.429	6.979	450.0	7.523	2.143	9.666	600.0	9.335	2.857	12.192
18-Aug	1782	239	300.0	5.550	1.452	7.003	450.0	7.523	2.178	9.701	600.0	9.335	2.904	12.239
19-Aug	1783	240	300.0	5.550	1.476	7.027	450.0	7.523	2.214	9.737	600.0	9.335	2.952	12.287
20-Aug	1784	241	300.0	5.550	1.500	7.051	450.0	7.523	2.250	9.773	600.0	9.335	3.000	12.335
21-Aug	1785	242	300.0	5.550	1.525	7.075	450.0	7.523	2.287	9.810	600.0	9.335	3.049	12.384
22-Aug	1786	243	300.0	5.550	1.549	7.100	450.0	7.523	2.324	9.847	600.0	9.335	3.099	12.434
23-Aug	1787	244	300.0	5.550	1.574	7.125	450.0	7.523	2.362	9.885	600.0	9.335	3.149	12.484
24-Aug	1788	245	300.0	5.550	1.600	7.150	450.0	7.523	2.400	9.923	600.0	9.335	3.200	12.534
25-Aug	1789	246	300.0	5.550	1.625	7.176	450.0	7.523	2.438	9.961	600.0	9.335	3.251	12.586
26-Aug	1790	247	300.0	5.550	1.651	7.202	450.0	7.523	2.477	10.000	600.0	9.335	3.303	12.638
27-Aug	1791	248	300.0	5.550	1.678	7.228	450.0	7.523	2.516	10.040	600.0	9.335	3.355	12.690
28-Aug	1792	249	300.0	5.550	1.704	7.255	450.0	7.523	2.556	10.080	600.0	9.335	3.408	12.743
29-Aug	1793	250	300.0	5.550	1.731	7.282	450.0	7.523	2.597	10.120	600.0	9.335	3.462	12.797
30-Aug	1794	251	300.0	5.550	1.758	7.309	450.0	7.523	2.637	10.161	600.0	9.335	3.517	12.851
31-Aug	1795	252	300.0	5.550	1.786	7.336	450.0	7.523	2.679	10.202	600.0	9.335	3.572	12.906
01-Sep	1796	253	300.0	5.550	1.814	7.364	450.0	7.523	2.720	10.244	600.0	9.335	3.627	12.962
02-Sep	1797	254	300.0	5.550	1.842	7.392	450.0	7.523	2.763	10.286	600.0	9.335	3.684	13.018
03-Sep	1798	255	300.0	5.550	1.870	7.421	450.0	7.523	2.805	10.329	600.0	9.335	3.741	13.075
04-Sep	1799	256	300.0	5.550	1.899	7.450	450.0	7.523	2.849	10.372	600.0	9.335	3.798	13.133
05-Sep	1800	257	300.0	5.550	1.928	7.479	450.0	7.523	2.892	10.415	600.0	9.335	3.856	13.191
06-Sep	1801	258	300.0	5.550	1.958	7.508	450.0	7.523	2.936	10.459	600.0	9.335	3.915	13.250

	07-Sep	1802	259		300.0		5.550		1.987	7.538	450.0		7.523		2.981	10.504	600.0		9.335		3.975	13.309
	08-Sep	1803	260		300.0		5.550		2.017	7.568	450.0		7.523		3.026	10.549	600.0		9.335		4.035	13.369
	09-Sep	1804	261		300.0		5.550		2.048	7.598	450.0		7.523		3.072	10.595	600.0		9.335		4.095	13.430
	10-Sep	1805	262		300.0		5.550		2.078	7.629	450.0		7.523		3.118	10.641	600.0		9.335		4.157	13.492
	11-Sep	1806	263		300.0		5.550		2.109	7.660	450.0		7.523		3.164	10.687	600.0		9.335		4.219	13.554
	12-Sep	1807	264		300.0		5.550		2.141	7.691	450.0		7.523		3.211	10.734	600.0		9.335		4.282	13.616
	13-Sep	1808	265		300.0		5.550		2.173	7.723	450.0		7.523		3.259	10.782	600.0		9.335		4.345	13.680
	14-Sep	1809	266		300.0		5.550		2.205	7.755	450.0		7.523		3.307	10.830	600.0		9.335		4.409	13.744
	15-Sep	1810	267		300.0		5.550		2.237	7.787	450.0		7.523		3.355	10.878	600.0		9.335		4.474	13.808
	16-Sep	1811	268		300.0		5.550		2.270	7.820	450.0		7.523		3.404	10.927	600.0		9.335		4.539	13.874
	17-Sep	1812	269		300.0		5.550		2.303	7.853	450.0		7.523		3.454	10.977	600.0		9.335		4.605	13.940
	18-Sep	1813	270		300.0		5.550		2.336	7.886	450.0		7.523		3.504	11.027	600.0		9.335		4.672	14.006
	19-Sep	1814	271		300.0		5.550		2.369	7.920	450.0		7.523		3.554	11.077	600.0		9.335		4.739	14.074
	20-Sep	1815	272		300.0		5.550		2.403	7.954	450.0		7.523		3.605	11.128	600.0		9.335		4.807	14.142
	21-Sep	1816	273		300.0		5.550		2.438	7.988	450.0		7.523		3.657	11.180	600.0		9.335		4.876	14.210
	22-Sep	1817	274		300.0		5.550		2.472	8.023	450.0		7.523		3.709	11.232	600.0		9.335		4.945	14.280
	23-Sep	1818	275		300.0		5.550		2.507	8.058	450.0		7.523		3.761	11.284	600.0		9.335		5.015	14.350
	24-Sep	1819	276		300.0		5.550		2.543	8.093	450.0		7.523		3.814	11.337	600.0		9.335		5.085	14.420
	25-Sep	1820	277		300.0		5.550		2.578	8.129	450.0		7.523		3.867	11.391	600.0		9.335		5.157	14.491
	26-Sep	1821	278		300.0		5.550		2.614	8.165	450.0		7.523		3.921	11.445	600.0		9.335		5.228	14.563
	27-Sep	1822	279		300.0		5.550		2.651	8.201	450.0		7.523		3.976	11.499	600.0		9.335		5.301	14.636
	28-Sep	1823	280		300.0		5.550		2.687	8.238	450.0		7.523		4.031	11.554	600.0		9.335		5.374	14.709
	29-Sep	1824	281		300.0		5.550		2.724	8.275	450.0		7.523		4.086	11.609	600.0		9.335		5.448	14.783
	30-Sep	1825	282		300.0		5.550		2.761	8.312	450.0		7.523		4.142	11.665	600.0		9.335		5.523	14.857
Mature Calving. Mature Lactation	01-Oct	1826	283	1	300.0	0.33	5.550	0.238	2.799	8.587	450.0	0.45	7.523	0.322	4.198	12.044	600.0	0.56	9.335	0.400	5.598	15.333
	02-Oct	1827		2	300.0	0.65	5.550	0.468		6.018	450.0	0.88	7.523	0.634		8.157	600.0	1.10	9.335	0.787		10.122
	03-Oct	1828		3	300.0	0.96	5.550	0.690		6.241	450.0	1.30	7.523	0.935		8.459	600.0	1.62	9.335	1.161		10.495
	04-Oct	1829		4	300.0	1.26	5.550	0.905		6.455	450.0	1.71	7.523	1.226		8.750	600.0	2.12	9.335	1.522		10.857
	05-Oct	1830		5	300.0	1.55	5.550	1.112		6.663	450.0	2.10	7.523	1.507		9.031	600.0	2.61	9.335	1.871		11.205
	06-Oct	1831		6	300.0	1.83	5.550	1.312		6.863	450.0	2.48	7.523	1.779		9.302	600.0	3.07	9.335	2.207		11.542
	07-Oct	1832		7	300.0	2.10	5.550	1.506		7.056	450.0	2.84	7.523	2.041		9.564	600.0	3.53	9.335	2.532		11.867
	08-Oct	1833		8	300.0	2.36	5.550	1.692		7.243	450.0	3.20	7.523	2.293		9.817	600.0	3.96	9.335	2.846		12.180
	09-Oct	1834		9	300.0	2.61	5.550	1.872		7.422	450.0	3.53	7.523	2.537		10.060	600.0	4.39	9.335	3.148		12.483
	10-Oct	1835		10	300.0	2.85	5.550	2.045		7.596	450.0	3.86	7.523	2.772		10.295	600.0	4.79	9.335	3.439		12.774
	11-Oct	1836		11	300.0	3.08	5.550	2.212		7.763	450.0	4.18	7.523	2.998		10.522	600.0	5.18	9.335	3.720		13.055
	12-Oct	1837		12	300.0	3.31	5.550	2.373		7.924	450.0	4.48	7.523	3.216		10.740	600.0	5.56	9.335	3.991		13.326
	13-Oct	1838		13	300.0	3.52	5.550	2.528		8.078	450.0	4.77	7.523	3.426		10.950	600.0	5.92	9.335	4.251		13.586
	14-Oct	1839		14	300.0	3.73	5.550	2.677		8.228	450.0	5.05	7.523	3.628		11.152	600.0	6.27	9.335	4.502		13.837
	15-Oct	1840		15	300.0	3.93	5.550	2.820		8.371	450.0	5.33	7.523	3.823		11.346	600.0	6.61	9.335	4.743		14.078
	16-Oct	1841		16	300.0	4.12	5.550	2.958		8.509	450.0	5.59	7.523	4.010		11.533	600.0	6.93	9.335	4.975		14.310
	17-Oct	1842		17	300.0	4.31	5.550	3.091		8.641	450.0	5.84	7.523	4.189		11.712	600.0	7.24	9.335	5.198		14.533
	18-Oct	1843		18	300.0	4.48	5.550	3.218		8.769	450.0	6.08	7.523	4.362		11.885	600.0	7.54	9.335	5.412		14.747
	19-Oct	1844		19	300.0	4.65	5.550	3.340		8.891	450.0	6.31	7.523	4.527		12.051	600.0	7.83	9.335	5.618		14.952
	20-Oct	1845		20	300.0	4.82	5.550	3.457		9.008	450.0	6.53	7.523	4.686		12.209	600.0	8.10	9.335	5.815		15.150
	21-Oct	1846		21	300.0	4.97	5.550	3.570		9.120	450.0	6.74	7.523	4.839		12.362	600.0	8.36	9.335	6.004		15.339
	22-Oct	1847		22	300.0	5.12	5.550	3.678		9.228	450.0	6.94	7.523	4.985		12.508	600.0	8.62	9.335	6.185		15.520
	23-Oct	1848		23	300.0	5.27	5.550	3.781		9.331	450.0	7.14	7.523	5.124		12.647	600.0	8.86	9.335	6.358		15.693
	24-Oct	1849		24	300.0	5.40	5.550	3.879		9.430	450.0	7.33	7.523	5.258		12.781	600.0	9.09	9.335	6.524		15.859
	25-Oct	1850		25	300.0	5.54	5.550	3.974		9.524	450.0	7.50	7.523	5.386		12.909	600.0	9.31	9.335	6.683		16.017
	26-Oct	1851		26	300.0	5.66	5.550	4.064		9.614	450.0	7.67	7.523	5.508		13.031	600.0	9.52	9.335	6.834		16.169
	27-Oct	1852		27	300.0	5.78	5.550	4.150		9.700	450.0	7.84	7.523	5.624		13.147	600.0	9.72	9.335	6.979		16.313
	28-Oct	1853		28	300.0	5.90	5.550	4.232		9.782	450.0	7.99	7.523	5.735		13.259	600.0	9.91	9.335	7.117		16.451
	29-Oct	1854		29	300.0	6.00	5.550	4.310		9.860	450.0	8.14	7.523	5.841		13.364	600.0	10.10	9.335	7.248		16.583
	30-Oct	1855		30	300.0	6.11	5.550	4.384		9.934	450.0	8.28	7.523	5.942		13.465	600.0	10.27	9.335	7.373		16.708
	31-Oct	1856		31	300.0	6.21	5.550	4.455		10.005	450.0	8.41	7.523	6.038		13.561	600.0	10.44	9.335	7.492		16.826
	01-Nov	1857		32	300.0	6.30	5.550	4.522		10.072	450.0	8.54	7.523	6.129		13.652	600.0	10.59	9.335	7.604		16.939
	02-Nov	1858		33	300.0	6.39	5.550	4.585		10.136	450.0	8.66	7.523	6.215		13.738	600.0	10.74	9.335	7.711		17.046
	03-Nov	1859		34	300.0	6.47	5.550	4.645		10.196	450.0	8.77	7.523	6.296		13.820	600.0	10.88	9.335	7.813		17.147
	04-Nov	1860		35	300.0	6.55	5.550	4.702		10.253	450.0	8.88	7.523	6.374		13.897	600.0	11.02	9.335	7.908		17.243
	05-Nov	1861		36	300.0	6.63	5.550	4.756		10.307	450.0	8.98	7.523	6.446		13.970	600.0	11.14	9.335	7.999		17.334
	06-Nov	1862		37	300.0	6.70	5.550	4.807		10.357	450.0	9.08	7.523	6.515		14.038	600.0	11.26	9.335	8.084		17.419
	07-Nov	1863		38	300.0	6.76	5.550	4.854		10.405	450.0	9.17	7.523	6.580		14.103	600.0	11.37	9.335	8.164		17.499
	08-Nov	1864		39	300.0	6.83	5.550	4.899		10.450	450.0	9.25	7.523	6.640		14.163	600.0	11.48	9.335	8.239		17.574
	09-Nov	1865		40	300.0	6.88	5.550	4.941		10.491	450.0	9.33	7.523	6.697		14.220	600.0	11.58	9.335	8.310		17.644
	10-Nov	1866		41	300.0	6.94	5.550	4.980		10.531	450.0	9.40	7.523	6.750		14.273	600.0	11.67	9.335	8.375		17.710
	11-Nov	1867		42	300.0	6.99	5.550	5.017		10.567	450.0	9.47	7.523	6.799		14.323	600.0	11.75	9.335	8.437		17.771
	12-Nov	1868		43	300.0	7.04	5.550	5.050		10.601	450.0	9.54	7.523	6.845		14.368	600.0	11.83	9.335	8.494		17.828

	13-Nov	1869		44	300.0	7.08	5.550	5.082		10.632	450.0	9.60	7.523	6.888		14.411	600.0	11.91	9.335	8.546		17.881
	14-Nov	1870		45	300.0	7.12	5.550	5.111		10.661	450.0	9.65	7.523	6.927		14.450	600.0	11.97	9.335	8.595		17.930
	15-Nov	1871		46	300.0	7.16	5.550	5.137		10.688	450.0	9.70	7.523	6.963		14.486	600.0	12.04	9.335	8.639		17.974
	16-Nov	1872		47	300.0	7.19	5.550	5.161		10.712	450.0	9.75	7.523	6.996		14.519	600.0	12.09	9.335	8.680		18.015
	17-Nov	1873		48	300.0	7.22	5.550	5.183		10.734	450.0	9.79	7.523	7.025		14.548	600.0	12.14	9.335	8.717		18.052
	18-Nov	1874		49	300.0	7.25	5.550	5.203		10.754	450.0	9.82	7.523	7.052		14.575	600.0	12.19	9.335	8.750		18.085
	19-Nov	1875		50	300.0	7.27	5.550	5.221		10.771	450.0	9.86	7.523	7.076		14.599	600.0	12.23	9.335	8.780		18.115
	20-Nov	1876		51	300.0	7.30	5.550	5.236		10.787	450.0	9.89	7.523	7.097		14.621	600.0	12.27	9.335	8.806		18.141
	21-Nov	1877		52	300.0	7.31	5.550	5.250		10.801	450.0	9.91	7.523	7.116		14.639	600.0	12.30	9.335	8.830		18.164
	22-Nov	1878		53	300.0	7.33	5.550	5.262		10.812	450.0	9.94	7.523	7.132		14.655	600.0	12.33	9.335	8.849		18.184
	23-Nov	1879		54	300.0	7.34	5.550	5.272		10.822	450.0	9.95	7.523	7.145		14.669	600.0	12.35	9.335	8.866		18.201
	24-Nov	1880		55	300.0	7.36	5.550	5.280		10.830	450.0	9.97	7.523	7.156		14.680	600.0	12.37	9.335	8.880		18.214
	25-Nov	1881		56	300.0	7.36	5.550	5.286		10.837	450.0	9.98	7.523	7.165		14.688	600.0	12.39	9.335	8.890		18.225
	26-Nov	1882		57	300.0	7.37	5.550	5.291		10.842	450.0	9.99	7.523	7.171		14.695	600.0	12.40	9.335	8.898		18.233
	27-Nov	1883		58	300.0	7.38	5.550	5.294		10.845	450.0	10.00	7.523	7.176		14.699	600.0	12.40	9.335	8.904		18.238
	28-Nov	1884		59	300.0	7.38	5.550	5.296		10.846	450.0	10.00	7.523	7.178		14.701	600.0	12.41	9.335	8.906		18.241
	29-Nov	1885		60	300.0	7.38	5.550	5.296		10.846	450.0	10.00	7.523	7.178		14.701	600.0	12.41	9.335	8.906		18.241
	30-Nov	1886		61	300.0	7.38	5.550	5.294		10.845	450.0	10.00	7.523	7.176		14.699	600.0	12.40	9.335	8.904		18.239
	01-Dec	1887		62	300.0	7.37	5.550	5.291		10.842	450.0	9.99	7.523	7.172		14.695	600.0	12.40	9.335	8.899		18.234
	02-Dec	1888		63	300.0	7.37	5.550	5.287		10.838	450.0	9.98	7.523	7.166		14.689	600.0	12.39	9.335	8.892		18.226
	03-Dec	1889		64	300.0	7.36	5.550	5.281		10.832	450.0	9.97	7.523	7.158		14.682	600.0	12.37	9.335	8.882		18.217
	04-Dec	1890		65	300.0	7.35	5.550	5.275		10.825	450.0	9.96	7.523	7.149		14.672	600.0	12.36	9.335	8.871		18.206
	05-Dec	1891		66	300.0	7.34	5.550	5.266		10.817	450.0	9.94	7.523	7.138		14.661	600.0	12.34	9.335	8.857		18.192
	06-Dec	1892		67	300.0	7.32	5.550	5.257		10.808	450.0	9.93	7.523	7.126		14.649	600.0	12.32	9.335	8.841		18.176
	07-Dec	1893		68	300.0	7.31	5.550	5.247		10.797	450.0	9.91	7.523	7.111		14.635	600.0	12.29	9.335	8.824		18.159
	08-Dec	1894		69	300.0	7.29	5.550	5.235		10.786	450.0	9.89	7.523	7.096		14.619	600.0	12.27	9.335	8.804		18.139
	09-Dec	1895		70	300.0	7.28	5.550	5.222		10.773	450.0	9.86	7.523	7.079		14.602	600.0	12.24	9.335	8.783		18.118
	10-Dec	1896		71	300.0	7.26	5.550	5.209		10.759	450.0	9.84	7.523	7.060		14.583	600.0	12.20	9.335	8.760		18.095
	11-Dec	1897		72	300.0	7.24	5.550	5.194		10.745	450.0	9.81	7.523	7.040		14.563	600.0	12.17	9.335	8.735		18.070
	12-Dec	1898		73	300.0	7.21	5.550	5.178		10.729	450.0	9.78	7.523	7.019		14.542	600.0	12.13	9.335	8.709		18.044
	13-Dec	1899		74	300.0	7.19	5.550	5.162		10.712	450.0	9.75	7.523	6.997		14.520	600.0	12.09	9.335	8.681		18.016
	14-Dec	1900		75	300.0	7.17	5.550	5.145		10.695	450.0	9.71	7.523	6.973		14.496	600.0	12.05	9.335	8.652		17.987
	15-Dec	1901		76	300.0	7.14	5.550	5.126		10.677	450.0	9.68	7.523	6.948		14.471	600.0	12.01	9.335	8.621		17.956
	16-Dec	1902		77	300.0	7.11	5.550	5.107		10.658	450.0	9.64	7.523	6.922		14.445	600.0	11.97	9.335	8.589		17.924
	17-Dec	1903		78	300.0	7.09	5.550	5.087		10.638	450.0	9.61	7.523	6.895		14.418	600.0	11.92	9.335	8.556		17.890
	18-Dec	1904		79	300.0	7.06	5.550	5.067		10.617	450.0	9.57	7.523	6.867		14.390	600.0	11.87	9.335	8.521		17.856
	19-Dec	1905		80	300.0	7.03	5.550	5.045		10.596	450.0	9.53	7.523	6.838		14.361	600.0	11.82	9.335	8.485		17.820
	20-Dec	1906		81	300.0	7.00	5.550	5.023		10.574	450.0	9.49	7.523	6.808		14.332	600.0	11.77	9.335	8.448		17.783
	21-Dec	1907		82	300.0	6.97	5.550	5.000		10.551	450.0	9.44	7.523	6.778		14.301	600.0	11.72	9.335	8.410		17.744
	22-Dec	1908		83	300.0	6.93	5.550	4.977		10.527	450.0	9.40	7.523	6.746		14.269	600.0	11.66	9.335	8.370		17.705
	23-Dec	1909	1	84	300.0	6.90	5.550	4.953	0.005	10.509	450.0	9.35	7.523	6.713	0.008	14.245	600.0	11.60	9.335	8.330	0.011	17.675
	24-Dec	1910	2	85	300.0	6.87	5.550	4.928	0.006	10.484	450.0	9.31	7.523	6.680	0.008	14.211	600.0	11.55	9.335	8.289	0.011	17.634
	25-Dec	1911	3	86	300.0	6.83	5.550	4.903	0.006	10.460	450.0	9.26	7.523	6.646	0.009	14.178	600.0	11.49	9.335	8.246	0.011	17.593
	26-Dec	1912	4	87	300.0	6.80	5.550	4.878	0.006	10.434	450.0	9.21	7.523	6.611	0.009	14.143	600.0	11.43	9.335	8.203	0.012	17.550
	27-Dec	1913	5	88	300.0	6.76	5.550	4.852	0.006	10.408	450.0	9.16	7.523	6.576	0.009	14.108	600.0	11.37	9.335	8.159	0.012	17.506
	28-Dec	1914	6	89	300.0	6.72	5.550	4.825	0.006	10.382	450.0	9.11	7.523	6.540	0.009	14.072	600.0	11.30	9.335	8.114	0.012	17.462
	29-Dec	1915	7	90	300.0	6.68	5.550	4.798	0.006	10.355	450.0	9.06	7.523	6.503	0.010	14.036	600.0	11.24	9.335	8.069	0.013	17.416
	30-Dec	1916	8	91	300.0	6.65	5.550	4.770	0.007	10.327	450.0	9.01	7.523	6.466	0.010	13.999	600.0	11.18	9.335	8.023	0.013	17.371
Repetition of Mature Cycle	31-Dec	1917	9	92	300.0	6.61	5.550	4.742	0.007	10.300	450.0	8.95	7.523	6.428	0.010	13.961	600.0	11.11	9.335	7.976	0.014	17.324