gland. In the present study, we addressed this hypothesis by investigating intracellular localization of IL-18 and its receptor in the bovine anterior pituitary gland. Twelve cattle of Japanese Black and Holstein were used. The anterior pituitary gland were freshly removed and subjected to RT-PCR, western bloltting, in situ hybridization and immunohistochemical analysis. Immuno-laser microdissection was performed to confirm mRNA expression in IL-18-immunnoreactive cells. IL-18 mRNA and protein was detected in the anterior pituitary tissue by RT-PCR and Western blotting. In situ hybridization showed that IL-18 mRNA were constantly localized in the anterior pituitary cells. Immunohistochemistry of IL-18 and specific hormones revealed the presence of IL-18 in bovine somatotrophs. Furthermore, the expression of GH mRNA in IL-18 immunoreactive cells was confirmed by immuno-laser microdissection. These results first demonstrated that somatotrophs produced IL-18. Subsequently, the distribution of IL-18 receptor alpha (IL-18R α) was investigated in the anterior pituitary gland to understand IL-18 signal among anterior pituitary cells. Bovine IL-18R α cDNA was partially sequenced and detected in the anterior pituitary gland by RT-PCR. Immunohistochemistry of IL-18R α, IL-18 and GH showed that IL-18R α was expressed in IL-18 immunoreactive cells and somatotrophs. In conclusion, we found that IL-18 and IL-18R colocalized in somatotrophs of bovine anterior pituitary gland. Our results suggest that IL-18 acts on somatotrophs as an immuno-endocrine mediator through autocrine pathway.

Acknowledgements: Grant-in-Aid for Scientific Research (B) (No.13460122) from the Ministry of Education, Science and Culture of Japan.

Key Words: IL-18, Somatotroph, Immuno-Endocrine

Production, Management and the Environment: Impact of Culling Rate on Dairy Profitability

203 Historical examination of culling of dairy cows from herds in the United States. H. D. Norman* and E. Hare, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*, *Beltsville, MD*.

Dairy producers need cows that reproduce, stay alive, and produce well, but information on culling rate and herd life has not always been readily available so that producers can minimize cow losses. A recent examination of cow survival in Dairy Herd Improvement herds provided information on culling rate since 1980. Cows were excluded if the herd discontinued testing during their productive period or they were sold for dairy purposes. Survival rates for individual parities were the fraction of cows with an opportunity to calve that did calve. Number of parities by breed and year of first calving was determined to provide an indicator of herd life before culling. Survival rates for second through eighth parities were 73, 50, 32, 19, 10, 5, and 2%, respectively, for Holsteins. Survival to second parity was 72% for Ayrshires, 69% for Brown Swiss, 66% for Guernseys, and 75% for Jerseys; corresponding survival to fifth parity was 22, 23, 15, and 26%. Although survival to second parity declined only slightly after 1980, survival to later parities dropped substantially. Survival rates for Holsteins were 77, 57, 39, 24, 14, 8, and 4% in 1980 for second to eighth parities but declined to 74, 49, 28, 16, 8, 4, and 1% in recent years. Mean number of parities declined from 3.2 for Ayrshires, 3.2 for Brown Swiss, 2.8 for Guernseys, 3.2 for Holsteins, and 3.4 for Jerseys that first calved in 1980 to 2.9, 2.9, 2.4, 2.8, and 3.2 for cows that first calved in 1992. Across calving years, about 36, 26, and 17% of Holsteins were first-, second-, and third-parity cows, respectively. Mean calving age ranged from 44 mo for Guernseys to 49 mo for Brown Swiss, a decline from earlier estimates, and recent years show a continuing decline. The increase in culling rate and subsequent reduction in mean calving age must be driven by dairy management choices rather than a decline in genetic merit of the population as genetic estimates indicate that substantial genetic improvement is being made in productive life.

Key Words: Culling, Herd Life, Survival

204 The impact of timing of the culling event on profitability in dairy herds. R. Cady*, *Monsanto*, *St. Louis, MO*.

Every cow is eventually culled. Thus, it is not a question of if a cow will be culled, but rather when she will be culled. Culling is primarily an economic risk management practice, influenced by existing economic conditions, risk tolerance of the dairy management team, and dairy cattle management skills. The only exceptions to this would be loss due to death, theft, or cows that are simply too difficult to manage (eg. kickers).

Knowledge of three factors is necessary to successfully manage culling: 1) how often does the event occur (turnover), 2) when does the event occur (timing), and 3) why the event occurred at that time (reason). The cow's life is a continuum from birth to death, divided into a growth and maturation process followed by a series of parturition/lactation events. Thus, the risk of cull is more than a simple function of increasing risk with increasing time because the initiation of each new lactation increases the risk of cull every time it occurs. Subsequent pregnancy reduces the likelihood of being culled.

Internal and external, controllable and uncontrollable factors influence culling. An example of an uncontrollable risk is increased culling associated with age. An external uncontrollable factor is beef price. Many factors however are within management purview, such as mitigating disease incidence, changing risk tolerance, production level, reproductive performance, transition cow care, and herd long-term growth goals.

Culling management is more complex than simply reducing herd turnover rate. There is an optimum time to cull a cow based on her productive, reproductive and health status and probability for future economic success. Culling too early limits profitability through the loss of the ability to recover costs of investment. Culling too late limits profitability because of lost opportunity to gain higher profits with a more profitable cow. Opportunity exists to better manage the timing of cull events.

Acknowledgements: Dr. Sandra Godden, University of Minnesota, Dr. Steve Stewart, University of Minnesota

Key Words: Culling, Risk Managment, Profitability

205 Culling: nomenclature, definitions and some observations. J. Fetrow*[1], K. Nordlund[2], and D. Norman[3], [1]*Univeristy of Minnesota*, *St. Paul*, [2]*University of Wisconsin*, *Madison*, [3]*USDA AIPL*, *Beltsville, MD*.

In advance of the Discover Conference on Culling in Dairy Herds in October, 2004, a subcommittee was formed for the purpose of laying out a proposed set of definitions of terms relating to culling on dairy farms. This paper is the product of that effort. In addition to the specific charge, the committee has chosen to make some observations on the general topic of culling in dairy cattle and on appropriate ways to examine the underlying factors surrounding the exit of cows from a dairy.

Key Words: Dairy, Culling

206 The effect of animal removal on herd internal growth rate. A. Skidmore*, *Blue Seal Feeds, Inc.*, *Londonderry, NH*.

The decision making process and reasons for removing an animal from a herd has been extensively studied. This study was designed to evaluate the effect of animal removal on herd size and herd internal growth rate. An inventory control model was adapted to develop a simple model for evaluation. Herd size is very dynamic and dependent on many factors. The factors that influence the dynamics of herd size were indentified as: calving interval, percent of calvings that result in a heifer calf, initial size of cow herd, initial size of the replacement herd, percent heifer calves stillborn, culled or died, age at first calving, average age of cows, and percent cows culled or died. The model was initialized with the following values: calving interval = 390 days; percent of calvings resulting in a heifer calf = 49; age at first calving = 24; percent calves stillborn, died, or culled = 20; and initial herd size = 100 cows. In table 1 are the results of animal removal on future cow herd size and average annual herd internal growth rate after ten years.

Growth in herd size is not a linear function under steady state conditions. The length of the planning horizon will affect the results. Herd size increases at an exponential rate while average annual herd internal growth rate increases at a diminishing rate. Herd size increases to 111, 137, 186, 229, 386, and 648 cows for years 3, 5, 8, 10, 15, and 20 repectively when animal removal rate is 25% and the initial herd size is 100 cows. The average annual herd internal growth rate was 3.54, 6.50, 8.07, 8.64, 9.42, and 9.79 percent for years 3, 5, 8, 10, 15, and 20 respectively.

Animal removal rates have a significant effect on the rate at which a herd can grow from internal increase.

Table 1. The effect of animal removal on future cow herd size and average annual internal growth rate after ten years.

Animal Removal Rate (%)	Future cow herd size	Average annual herd internal growth rate (%)
15	458	16.44
25	229	8.64
35	108	.77
45	47	-7.27
55	18	-15.76

Key Words: Culling, Internal Herd Growth

207 A bankers view on culling. G. Sipiorski*, *Citizens State Bank of Loyal, Loyal, WI.*

A banker's main interest regarding the cull rate on a dairy is the potential loss of collateral. The loan officer has a fiduciary responsibility to the financial institution to maintain a loan to value ratio that is in compliance with the lending policy. There will generally be a loan covalent singed by the dairy producer that will outline the number of dairy animals that need to be maintained on the premise at all times.

The banker is also interested in the number of animals maintained in a milking herd for production and gross income purposes. The cash flow proforma that was completed to help secure the loan is directly dependent on the production per cow and on the number of cows held in the milking herd. If there is a current slip in the herd size for the short term the long term affect will be a shortage in gross milk and income. When the cash flow does not meet expectations the entire loan or loans will become jeopardized. This could lead to loans being placed on the bankers "watch list" or worst yet ending up in the "nonperforming" or "work out" files. Loans that end up in these areas reflect badly on the loan officer, the lending entity as well as the dairy producer.

These are the internal concerns of a lender that get them exited about culling rates. There will be even more lender interest in the issue in the west or dairy areas where collateralized assets are mostly livestock and few other assets such as machinery or land. Unfortunately this will lead to some producers holding on to poorer production cows just to satisfy the nose count for a lender inspection. This generally will occur when replacement cost are running at historically high dollar levels.

Thus far we have addressed the bankers concerns for maintaining lower cull rates and holding milking herd numbers. A good lender's main desire is for the success of the dairy producer. When the dairy is profitable all parties involved benefit.

The attached cash flows reflect the results of a 25%, 35% and 45% cull rates on three similar operation examples. The results on pages 3-5 demonstrates the Accrual Earning on line 55 and the Capital Repayment Margin on line 76. The figures show the huge economic impact of higher culling rates. The narrative summary on page 7 addresses 23 bench marking areas of performance. Note worthy are the Return on Assets (ROA), Return on Net Worth or Equity (ROE) and the Cost of Producing One Hundred Pounds of Milk.

The short term survivability, long term success and financial progress are clearly demonstrated in the financial papers. Producers that can maintain lower cull rates under 35% will find greater long term financial progress.

208 Genetics of longevity and productive life. K. Weigel*, *University of Wisconsin, Madison.*

Dairy cow longevity is influenced by many management factors, yet surprising genetic variation exists between families. Breeders once attempted to improve longevity by selecting for udders, feet and legs, and other conformation traits, but it became apparent that daughters of many high type sires still succumbed to early culling. In 1994, the USDA Animal Improvement Programs Laboratory introduced national genetic evaluations for length of productive life (PL). This trait is measured as time from first calving until culling or 84 mo of age, with a limit of 10 mo per lactation (to penalize cows with poor reproductive performance). The range in PL PTA among Holstein sires is huge - more than 8 mo between the best and worst bulls and roughly 4.5 mo between the top and bottom deciles. Selection for PL and its incorporation into economic indices (at 10-15% of the weight) has led to greater propagation of sire families in which cows resist culling more effectively. However, culling data that serve as the basis for evaluation of PL arrive late in life, often after important selection decisions have been made. Therefore, attention has shifted to components of PL that are measured earlier in life, such as female fertility, maternal calving ease, and resistance to mastitis, lameness, and metabolic disorders. The introduction of daughter pregnancy rate and daughter calving ease in 2003 was a major step in improving fertility and calving performance. Considerable effort is now being invested in the measurement and analysis of data regarding specific health disorders, such as mastitis, ketosis, displaced abomasum, lameness, and metritis. These traits are routinely recorded in the on-farm management software programs of many commercial dairies, and heritability estimates (0.04 to 0.14) are within the range observed in more tightly controlled veterinary recording schemes in Scandinavia. In addition, the range in lactation incidence rates between sire families is more than two-fold. In summary, programs for genetic improvement of dairy cow longevity are continually evolving in an effort to obtain early, accurate, and comprehensive information about all aspects of this complex trait.

Key Words: Genetics, Llongevity, Productive Life

209 Culling from a dairyman's perspective: a function of goals and management. J. Nocek*, *Spruce Haven Farm and Research Ctr, Auburn, NY.*

Spruce Haven is a 1600 cow commercial and research dairy. Growth has been accomplished by herd aquisition and purchased heifers. Culling rate is a moving target depending upon when the latest expansion occurred and how it occurred. Usually the incorporation of cows from whole-herd buyouts has resulted in an increased first year culling rate of purchased cows ranging from 35 to 50% for multiparous cows. Incorporation of heifers usually does not affect first year culling compared to the static herd. In both scenarios, it is important to understand that unless complementary replacements are also purchased, cow numbers will drop in the two subsequent years. When evaluating culling rate during expansion, we usually identify purchased animals versus our static herd for the first year after purchase. Culling is a result of management: using culling to manage signifies being several steps behind. Category culling rate (i.e.

repro, health, etc.) is a tool we use to evaluate management within a given period of time. In an expansion mode, usually voluntary culling takes a lower priority compared to involuntary issues. Culling rate for any given category can become camouflaged by ?real? management reasons for culling (i.e., cow comfort can be the rea-son for many culling categories including low production, lameness, and injury). Beef prices also play a critical role in some culling activities, especially for cows targeted to cull for reproductive reasons. Death loss is a culling category that most farmers choose to avoid but is a real number that oftentimes exceeds 8%. Culling is a reflection of many events that transpire in a static and expanding herd. Culling reflects management; therefore, our philosophy is culling is a tool with which our management can be measured.

Key Words: Culling, Management, Dairy

Ruminant Nutrition: Exploring the Boundaries of Efficiency in Lactation

210 Metabolic relationships in supply of nutrients in lactating cows.

H. Tyrrell*[1] and K. Cummins[2], [1]*USDA/CSREES*, *Washington, DC*, [2]*Auburn University*, *Auburn, AL.*

The work reported in this symposium represents the current activities of members of the NC-1009 Multi-State Research Committee, an activity which has continued for nearly thirtyfive years and several project numbers and revisions. Members of this series of projects have been the core of National Academy of Science Subcommittees responsible for the revision of the Nutrient Requirements of Dairy Cattle published by the National Research Council. It was recognized a number of years ago that the conventional additive methods for the determination of nutrient requirements and the nutritive value of a ration fed to lactating cows was too simplistic a model to permit significant improvements in our ability to develop improved feeding systems for high producing dairy cows. This is particularly true for meeting energy and protein requirements of the high producing cow. The other presentations in this symposium will focus on current concepts of nutrient supply for lactation. It is critical, however, to not lose sight of established boundaries of efficiency in lactation. It was demonstrated clearly in the development of the Net Energy for Lactation System that the majority of the variation in the Net Energy Value of a ration is associated with pre-absorptive metabolism (85%) compared to variation in post-absorptive processes. The modern high producing dairy cow is significantly more efficient in the conversion of dietary energy to energy in milk produced. However, metabolizable energy required for maintenance and for each calorie in milk is remarkably similar to the cow a century ago. Improvement in gross efficiency of milk production is the result of dilution of maintenance.

Key Words: Lactation, Efficiency, Nutrients

211 Integration of ruminal metabolism in dairy cattle.

J. L. Firkins*[1], A. N. Hristov[2], M. B. Hall[3], and G. A. Varga[4], [1]*Ohio State University*, *Columbus*, [2]*University of Idaho*, *Moscow*, [3]*USDA*, *Madison, WI*, [4]*Pennsylvania State University*, *University Park.*

Objective 1 of the NC1009 Cooperative Regional Research Project is to integrate various aspects of ruminal metabolism that affect the secretion of milk protein. Our overall aim is to quantify properties of feeds that determine the availability of nutrients critical to milk production. Specific goals are to integrate carbohydrate and nitrogen metabolism to provide fuel and precursors for metabolism by the digestive tract, mammary gland, and peripheral tissues to improve the efficiency of milk production while minimizing the loss of dietary nutrients to the environment. Thus, the current objectives of this paper are to review past research and highlight need for future research related to aspects of microbial population changes, feed degradability, microbial metabolism of dietary nutrients, VFA production, and flow of microbial protein (and AA) to the duodenum. Improved procedures for analysis of carbohydrate fractions are needed to better predict ruminal degradation of structural and non-structural carbohydrates and efficiency of microbial protein synthesis. Differences in concentrate and forage composition and particle size among studies are variables that influence these results. New procedures and data will be discussed to assess manipulation of bacterial and protozoal populations in vivo, with future goals being to better explain differences among animals fed similar diets and to integrate data to predict how production of milk components will vary among different dietary conditions. Whenever possible, current perspectives will be addressed to improve the integration of ruminal metabolism in dairy cattle for improved parameterization or better evaluation of computer models such as Molly, CPM, or NRC.

Key Words: Ruminal Metabolism, Microbial Protein Synthesis, Models

212 Regulation of key metabolic processes in lactation.

S. Donkin*[1], J. Knapp[2], M. VandeHaar[3], and B. Bequette[4], [1]*Purdue University*, *West Lafayette, IN*, [2]*University of Vermont*, *Burlington*, [3]*Michigan State University*, *East Lansing*, [4]*University of Maryland*, *College Park.*

Research conducted under the NC-1009 multi-state project focuses on quantifying the properties of feeds that determine nutrient availability for milk production and on identifying the metabolic interactions among nutrients and tissues. Knowledge from these complementary research areas is integrated to challenge and refine nutrition systems for dairy cattle in a multi-faceted, quantitative manner using mechanistic models. The overall objective for this work is to provide information for the dairy industry that will improve the accuracy of feeding systems to predict the metabolic, production, and health responses of dairy cows in an environmentally responsive, profitable, and sustainable manner. An understanding of glucose and amino acid metabolism is central to this mission as they are critical metabolic commodities for milk synthesis. Often the metabolism of these nutrients within tissues and exchange among tissues dictates their availability for milk synthesis. Liver and portal drained viscera collaboratively dictate the availability of nutrients for use by muscle, storage in adipose tissue, and use in mammary metabolism and milk synthesis. Metabolism of these nutrients is sensitive to the rate of their appearance in blood, changes in hormone profiles, and responsiveness of tissues to hormonal changes. The net metabolism of absorbed nutrients in tissues is the combination of fluxes through individual reactions which comprise classical metabolic processes and pathways. These processes and their integration are described and the limiting elements identified with respect to nutrient use for milk production. Information pertaining to molecular events and key metabolic reactions is highlighted with regards to glucose and amino acid metabolism. Limitations for input and output relationships and the application of current biochemical and molecular knowledge to predictive models of nutrient metabolism in dairy cattle are identified.

Key Words: Lactation, Metabolism, Modeling

213 Nutrient supply for milk production by splanchnic tissues in dairy cows.

C. Reynolds*[1], B. Bequette[2], and J. Knapp[3], [1]*The Ohio State University*, *Wooster*, [2]*University of Maryland*, *College Park*, [3]*J.D. Heiskell & Co.*, *Tulare, CA.*

A major focus of the NC-1009 regional project is the quantification of nutrient supply and utilization for production in lactating dairy cows. These data are integrated with measurements of fermentative and digestive processes through mathematical representations, with the overreaching goal of improving the nutritional management of dairy cows, thereby improving the efficiency and profitability of the dairy enterprise, and the health and longevity of the dairy cow. Together, the tissues of the portal-drained viscera (PDV; the gastrointestinal tract, pancreas, spleen and associated adipose) and liver determine the quantity and pattern of the nutrients available for production through their central roles