683 Analyzing the rear shape of dairy cows in 3D to better assess body condition score. Amélie Fischer*[1,2], Thibault Luginbühl[3], Laurent Delattre[3], Jean-Michel Delouard[3], and Philippe Faverdin[1], *[1]INRA/Agrocampus-Ouest UMR 1348 Pegase, St-Gilles, France, [2]Institut de l'élevage, Le Rheu, France, [3]D'Ouest, Lannion, France.*

Body condition is an important trait in dairy cow management, mainly because it reflects the level and the use of body reserves and indirectly reproductive and health performance. Body condition score (BCS), which is done visually or by palpation, is the usual method on farm but is subjective and not very sensitive. The aim was here to develop and to validate 3DBCS which estimates BCS from 3D-shapes of dairy cows rear, the body area commonly used to assess BCS. For the calibration, a set of 57 3D-shapes from 56 Holstein cows with large BCS variability (0.5 to 4.75 on a 0–5 scale) were transformed with a principal component analysis (PCA). A multiple linear regression was fitted on the principal components to assess BCS. Four anatomical landmarks were extracted to normalize the 3D-shapes: the validation results of a manual labeling proved the concept. Then an automated labeling method was developed to extract them. Prior to the PCA, the 3D-shapes were either regularized to fill in the holes or not regularized. External validation was evaluated on 2 sets: one with cows used for calibration, but with a different lactation stage (valididem) and one with cows not used for calibration (validdiff). Repeatability was estimated with 6 cows scanned 8 times each the same day. The automated method performed slightly better than manual method for external validation (RMSE = 0.27 versus 0.34 for validdiff) and both were more repeatable than usual BCS ($\sigma = 0.20$ for 3DBCS and 0.28 for BCS). Surprisingly, regularizing the 3D-shapes performed slightly less than without regularization. Nevertheless regularization should be an interesting process before BCS assessing, especially to avoid discarding too many 3D-shapes. The first results of 3D-BCS monitoring in dairy cows with a fully automated method show promising results in terms of phenotyping. The next step will try to reduce scanning time to decrease the number of bad 3D-shapes due to cow's movement without losing too much resolution.

Key Words: body condition score, 3D imaging, principal component analysis

684 Modelling performance consequences on the probability of reproducing, and thereby on productive lifespan in dairy cows. Ho N. Phuong[1,3], Pierre Blavy[1,3], Olivier Martin[1,3], Luc Delaby[2,4], Philippe Schmidely[1,3], and Nic C. Friggens*[1,3], *[1]INRA UMR MoSAR, Paris, France, [2]INRA UMR PEGASE, Rennes, France, [3]AgroParisTech, Paris, France, [4]AgroCampusOuest, Rennes, France.*

Reproductive success is a key component of lifetime efficiency (ratio of total energy in milk to total energy intake over the lifespan) as failure to get in calf results in culling and thus has a negative effect on productive lifespan. At the animal level, breeding and feeding management can substantially affect milk yield, body condition, and energy balance of cows, which are all major contributors to reproductive failure in dairy cattle. This study developed a reproductive module that was incorporated into an existing lifetime performance model to enable prediction of the performance consequences of different breeding and feeding strategies on probability of reproducing, and thereby on productive lifespan. This then allows more realistic prediction of cow lifetime efficiency. The model is dynamic and stochastic with an individual cow being the unit of modeling and one day being the unit of time. To evaluate the reproductive module, data from a French study including Holstein and Normande cows fed with high concentrate diet and data from a Scottish study including Holstein cows selected for high and average genetic merit for fat plus protein, fed with high versus low concentrate diets were used. On average, the model consistently simulated reproductive performance of various genotypes of cow across feeding systems. Relative to the French data, the model significantly under-predicted first service conception rate for Normande cows (48% vs. 58% for predicted vs. observed). On the Scottish data, simulated conception to first service was not significantly different from observed but interval traits (days to first service, days open) were under predicted, which was mainly due to the discrepancy between simulated and observed voluntary waiting periods. Simulation showed that genetic selection for greater milk production impaired reproductive performance and thus reproductive lifespan, but not lifetime efficiency. However, the definition of lifetime efficiency used did not include associated costs or consider herd-level effects, which should be included to allow more accurate simulation of lifetime profitability in different scenarios.

Key Words: dairy cow, lifetime efficiency, productive lifespan

685 Modeling the effect of forage allowance, forage mass, and body condition on calf weaning weight and calving conception interval of primiparous cows grazing Campos grasslands. Martín Claramunt*[1], Mariana Carriquiry[2], and Pablo Soca[3], *[1]Facultad de Veterinaria, Universidad de la República, Paysandú, Paysandú, Uruguay, [2]Facultad de Agronomía, Universidad de la República, Montevideo, Montevideo, Uruguay, [3]Facultad de Agronomía, Universidad de la República, Paysandú, Paysandú, Uruguay.*

The relationships among forage allowance (FA), forage mass (FM), and BCS during early (E) and middle gestation (M), calving (C) and lactation (L), and calf weight at weaning and calving conception interval (CCI) were studied employing records from an experiment that evaluated the effect 2 levels of FA on productivity of primiparous beef cows grazing Campos grassland. The study took place in Facultad de Agronomía, Uruguay (31°S 57°W). Eighty primiparous cows were assigned to a completely randomized experiment of 2 FA in spatial replication on 2 blocks during 2 years. The experiment started in autumn −150 d postpartum (dpp; early gestation [e]) and finished 190 dpp. Annual FA averaged 2.5 and 4 kg DM/kg liveweight (LW) for low (L) and high (H) FA, respectively. Cow LW and FM were measured monthly to adjust FA using the "put and take" method. The BCS was recorded (1–8 points scale). Calf birth weight (CBW) and weaning weight were recorded and calf weight adjusted at 205 d (CW) of age was estimated. Date of subsequent calving was recorded and CCI was calculated subtracting 285 d of gestation. Models were obtained by multiple regressions selected by Stepwise procedure (JMP 6.0). The BCSe, FAm, FMl, BCSe×FMl and CBW explain CW ($CW = -8.6 + (13\times BCSe) + (4.9\times FAm) + (0.036\times FMl) + (1.8\times CBW) - [0.024\times (BCSe - 5.6) \times (FMl - 1400)]$) ($r^2 = 0.54$; $P < 0.01$; Mean = 187; RMSE = 15). An increase in one unit of BCSe, FAe, and FMl increase CW in 13, 4.9 and 0.036 kg respectively. The interaction BCSe*FMl showed an increase in CW when BCSe increases, in FMl levels below 2000 kg DM/ha without effect on greater values. The CCI was affect by BCSc, Julian calving day (CD) and their interaction ($CCI = 191 - (8.6\times BCSc) - (0.6\times CD) + \{0.4\times[(BCSc - 4.5)*(CD - 56)]\}$) ($r^2 = 0.39$; $P < 0.01$; Mean = 121; RMSE = 14). The BCSc mainly explains the CCI confirming his value to predict the reproductive response. Those

models contribute to the study of CW and CCI, and could be employed to predict the productive and reproductive response of primiparous beef cows grazing Campos grassland.

Key Words: rangeland, grazing management, cow production

686 Associations between milk quality, type of bedding, and milking management on large Wisconsin dairy farms. Robert F. Rowbotham*[1,2] and Pamela L. Ruegg[1], *[1]University of Wisconsin-Madison, Madison, WI, [2]Grande Cheese Company, Brownsville, WI.*

The objective of this study was to determine bedding and milking management practices associated with bulk tank (BT) quality (SCC and TBC), on large Wisconsin dairy farms. Ninety percent (325 of 360) of Wisconsin dairy farms producing in excess of 11,340 kg of milk daily participated in a personally administered survey consisting of 60 scripted questions. Milk quality test results were obtained from milk marketers for a 2-year period for 255 farms. Results were analyzed for 230 farms using the same bedding type (IB = Inorganic, MB = Manure solids, OB = Other organic) in all pens during the entire study period. Farms milked between 270 and 8,100 cows (mean = 908), selling an average of 33,714 kg daily. Farms which herd tested (n = 204) had an average RHA of 12,831 kg (IB), 11,746 kg (MB), or 11,973 kg (OB). The relationships between bulk tank somatic cell score (BTSCS), bedding type, and management practices were analyzed in a repeated measures model using PROC MIXED (SAS 9.4). Bulk tank SCS was least in the winter and spring, intermediate in the fall, and greatest in the summer with seasonal differences decreasing with increasing farm size ($P < 0.001$). Farms using Iodine based postdip had greater BTSCS than those using other postdips ($P = 0.011$) and BTSCS was lower on farms drying teats and wiping off predip than on those not drying teats ($P < 0.001$). Farms with a WMP using MB had a greater BTSCS than those using IB or OB. The SCS for farms without a WMP was less for herds using IB as compared with herds using OB ($P < 0.05$). Bulk TBC did not vary seasonally (Tukey adjusted $P > 0.2$) or among bedding types (Tukey adjusted $P > 0.75$).

Table 1 (Abstr. 686). Bulk tank SCS and SCC among farms with differing bedding types and presence of written milking protocols (WMP)

WMP	Bedding	n	SCS	SE SCS	SCC ($\times 10^3$)
Yes	Inorganic	122	4.06^{b}	0.08	210^{b}
Yes	Manure	17	4.55^{c}	0.14	293^{c}
Yes	Other organic	31	4.09^{b}	0.11	213^{b}
No	Inorganic	34	3.76^{a}	0.10	169^{a}
No	Manure	8	3.87^{ab}	0.16	183^{ab}
No	Other organic	18	4.30^{bc}	0.13	245^{bc}

^{abc}Results with different superscripts within column differ (Tukey adjusted $P < 0.05$).

Key Words: bedding, milk quality, SCC

687 Using routinely recorded herd data to predict and benchmark herd and cow health status. Kristen L. Parker Gaddis*[1], John B. Cole[2], John S. Clay[3], and Christian Maltecca[4], *[1]Department of Animal Sciences, University of Florida, Gainesville, FL, [2]Animal Genomics and Improvement Laboratory, ARS, USDA, Beltsville, MD, [3]Dairy Records Management Systems, Raleigh, NC, [4]Department of Animal Science, North Carolina State University, Raleigh, NC.*

Genetic improvement of dairy cattle health using producer-recorded data is feasible. Estimates of heritability are low, indicating that genetic progress will be slow. Improvement of health traits may also be possible with the incorporation of environmental and managerial aspects into herd health programs. The objective of this study was to use the more than 1,100 herd characteristics that are regularly recorded on farm test days to benchmark herd and cow health status. Herd characteristics were combined with producer-recorded health event data. Parametric and non-parametric models were used to predict and benchmark health status. Models implemented included stepwise logistic regression, support vector machines, and random forests. At both the herd- and individual-level, random forest models attained the highest accuracy for predicting health status in all health event categories when evaluated by 10-fold cross validation. Accuracy of prediction (SD) ranged from 0.59 (0.04) to 0.61 (0.04) in logistic regression models, 0.55 (0.02) to 0.61 (0.04) in support vector machine models, and 0.61 (0.04) to 0.63 (0.04) with random forest models at the herd level. Accuracy of prediction (SD) at the cow level ranged from 0.69 (0.002) to 0.77 (0.01) for support vector machine models and 0.87 (0.06) to 0.93 (0.001) with random forest models. Results of these analyses indicate that machine-learning algorithms, specifically random forest, can be used to accurately identify herds and cows likely to experience a health event of interest. It was concluded that accurate prediction and benchmarking of health status using routinely collected herd data is feasible. Nonparametric models were better able to handle the large, complex data compared with traditional models. Further development and incorporation of predictive models into herd management programs will help to continue improvement of dairy herd health.

Key Words: health, machine learning, prediction

688 Using parlor data to map liner performance. John F. Penry*[1], Stefania Leonardi[2], John Upton[3,1], Paul D. Thompson[1], and Douglas J. Reinemann[1], *[1]University of Wisconsin-Madison, Madison, WI, [2]Universita delgi Studi di Milano, Milan, Lombardia, Italy, [3]Animal & Grassland Research & Innovation Centre, Teagasc, Moorepark, Co. Cork, Ireland.*

Liner performance can be described in terms of milking gentleness, speed and completeness of milk-out, with gentleness being the most important. It is widely accepted that peak milking speed will be increased as vacuum and the milking phase of pulsation are increased, but it is also known that raising the vacuum and b-phase duration increases teat end congestion. Increasing liner compression (LC) also results in higher milk flow rates while also elevating the risk of teat end hyperkeratosis. The aim of this experiment was to characterize the average milk flow rate of 8 liners, representing differing LC estimates, across a range of pulsation and vacuum settings. The 36-d trial involved an 80-cow herd milking 2× at the UW-Madison Dairy Cattle Centre. The parlor was fitted with 8 commercial liners (round, triangular, vented and non-vented models), which were rotated through all stalls during the trial. Treatments were a combination of selected system vacuum and pulsation settings with a fixed 295ms d-phase. Nine treatments were used representing commercially applied settings for vacuum and pulsation applied over 3 equal periods in a central composite experimental design. Treatment settings for system vacuum level ranged from 36 to 49 kPa and pulsator ratios from 50:50 to 70:30. During the course of each 9 treatment cycle, the central point (42.3 kPa and 60:40 pulsator ratio) was applied every third day allowing for an estimate of within treatment variability. Parlor average milk flow (AMF) data were analyzed using a MIXED model in SAS 9.3. This model assessed the effect of liner, treatment, milking stall, milking time and milker. The SAS RSREG procedure was used to produce individual liner response surfaces. Liners with lower LC did not produce as high an AMF under high vacuum and long b-phase

compared with a high LC liner due to the effects of teat end congestion during each individual pulsation cycle. Knowledge of individual liner compression estimates and, where available a response surface, is highly useful for determining the optimum vacuum and pulsation settings without compromising gentleness of milking.

Key Words: liner, performance, compression

689 A survey of management practices adopted by goat breeders in Azad Jammu and Kashmir (AJK), Pakistan. Ghulam Bilal*[1], Muhammad Moaeen-ud-Din[1], Muhammad Waseem[1], Naveed Ullah[1], James Reecy[2], Muhammad Khan[3], and Muhammad Yaqoob[1], *[1]Laboratories of Animal Breeding and Genetics, Faculty of Veterinary and Animal Sciences, PMAS-Arid Agriculture University, Rawalpindi, Pakistan, [2]2Department of Animal Science, Iowa State University, Ames, IA, [3]Institute of Animal Sciences, Faculty of Animal Husbandry, University of Agriculture, Faisalabad, Pakistan.*

A survey was carried out to gather information on current goat farming practices in 4 districts of Azad Jammu and Kashmir (Muzafrabad, Nelum Valley, Kotly, Mirpur). Survey included farmers (n = 50) of 5 goat breeds of AJK (Jattal, Buchi, Bairli, and Lambri and Kooti). Vaccination was never practiced by 42% farmers against prevailing diseases whereas 30% did vaccination occasionally and 28% on regular basis. Diseases for which vaccination was practiced were CCP (100%), enterotoxaemia (95.55%), FMD (31.03%) and HS and goat pox (3.45%). None of the farmer vaccinated against rabies and anthrax. As far as parasitic control is concerned, 30% of farmers did not deworm their flock while 44% of farmers dewormed their herds occasionally and 26% farmers did so on a regular basis. About 42% farmers were using traditional ways of treatment while other farmers got treatment for their goats from veterinary doctors on regular basis. Prevailing goat production system in the region was agro forestry (88%) followed by rangeland base system and crop livestock. Forty-eight percent of farmers had sheds for their herds, whereas 22% of farmers had only night confinement system and 40% confined their animals during winter season. Mostly farmer were relying on natural pasture (60%). Only 20% farmers used mineral mixture for their goats. Mating season of goats was April to June (84%). All respondents adopted ram selection and mating was not planned in most cases (98%). Animals were mainly marketed either to middlemen or local market (68%). The results from the present study could be used to formulate policies related to feeding, breeding and health management for overall improvement of goat production in the region.

Key Words: goat, Pakistan, management practices