are affected by the design of the feeding trial. Trials should include 4 or more different background forages and 4 levels of the target plant, including 0. Dried forages, even those species with high levels of volatile secondary plant compounds, appear to provide calibrations as accurate and precise as calibrations using fresh or frozen plant material. The addition of samples to the calibration equation from animals on the same base forage but with 0 levels of the predicted species as animals being predicted can improve the precision and accuracy of predictions significantly. Animal variables such as breed, sex and age can affect fecal spectra but not necessarily the prediction of the target plant.

Key Words: Goat, Sheep, Microhistological

Sheep Species: Biology and Management of Low-input Lambing Management in Easy-Care Systems

669 Genetic and physiological effects on maternal behavior and lamb survival. C. M. Dwyer*, *SAC*, *Edinburgh, UK*.

Failure in the development of the ewe-lamb bond has been implicated in 80% of lamb pre-weaning deaths. Increased shepherding inputs have been used to improve lamb survival. However, a better understanding of the ewe-lamb bond and applying management and genetic techniques to improve this relationship provide a sustainable route to reduce lamb mortality. Appropriate expression of maternal behavior by the ewe (licking the lamb, low-pitched bleating, udder acceptance) can be disturbed in primiparous ewes, and in ewes undernourished in pregnancy. In addition, using two breeds of sheep (Scottish Blackface, Suffolk), we have shown that significant variation exists between breeds in both the quality of maternal behavior (e.g. percent time spent licking lamb in 2 hours after lamb birth: Blackface = 60.7%, Suffolk = 43.8%, s.e.d. = 2.6%, $P < 0.001$), and lamb vigor (e.g. time to stand after birth (min, means with 95% confidence intervals): Blackface = 15.3 (12.1 to 19.4), Suffolk = 25.7 (20.3 to 32.6), $P < 0.001$). Embryo transfer between breeds demonstrates that these behavioral differences are intrinsic to the breed and are not influenced by partner behavior. The observed behavioral differences result in higher lamb mortality in the Suffolk breed compared to Blackfaces (14% vs. 3%, $P < 0.001$). Investigation of maternal physiology showed higher circulating concentrations of estradiol, and estradiol:progesterone ratio, in Blackface ewes in late gestation in comparison to Suffolk ewes (estradiol concentration (pg.ml): Blackface = 11.4, Suffolk= 7.9, s.e.d. = 0.9, $P < 0.001$), and estradiol concentration was correlated with maternal licking and low-pitched bleating ($r^2 = 20\%$, $P < 0.005$). These data suggest that genetic differences in maternal behavior in sheep may be mediated by variation in the physiological processes underpinning the onset of maternal care. In addition to breed differences in behavior, significant sire effects within breed exist for lamb vigor, and lamb behaviors are heritable ($h^2 = 0.15$ to 0.35). Taken together these data suggest there is considerable potential to improve lamb survival by selection and management to improve ewe maternal behavior, and by genetic selection for lamb vigor.

Key Words: Maternal Behavior, Neonate Survival, Sheep

670 Management of maternal-offspring behaviour to improve lamb survival in low input systems. J. Everett-Hincks* and K. Dodds, *AgResearch*, *Invermay Agricultural Centre, Mosgiel, Otago, New Zealand*.

This paper provides an investigation into the environmental and management effects on lamb survival on high performing sheep farms in New Zealand. Improved lambing percentage is the biggest contributor to higher profits on New Zealand sheep farms. Many sheep breeders have selected and bred ewes for increased fecundity over the last four decades. Lamb survival is an important issue in highly fecund sheep flocks. The increased proportion of ewes having triplets is of concern to farmers and to industry as lamb mortality in the 24 hours post-partum is highest in triplets. The majority of lamb deaths occur in the first three days after birth and range from 5 to 30% for individual sheep flocks. These losses are unacceptable from animal welfare and production perspectives. The ability of a lamb to survive to weaning is determined by the successful execution of a number of processes. These are driven by genetics, behaviour, physiology and the environment, including on farm management practices. This study investigated the effects of dam body condition in pregnancy, weather over lambing, lamb birth weight and maternal behaviour on single, twin and triplet lamb viability at birth and survival through to weaning for 24 industry flocks (28525 lambs; 3474 singles, 18510 twins, and 6541 triplets) from 2003 to 2005. Ewes with higher body condition scores in mid pregnancy had heavier lambs at birth. Lambs weighing 6 to 8 kg at birth were more likely to be viable at birth and survive to weaning than heavier or lighter lambs. Weather conditions during late pregnancy proved as important as conditions during lambing in determining lamb viability and survival through to weaning. Older ewes and ewes with triplets require considerably more attention for farmers to realise their production potential. This paper explores the effect of environmental and management factors on lamb birth weight and survival and uses this information to formulate appropriate management programmes to improve lamb survival rates under low-input farming systems.

Key Words: Lamb Survival, Management, Sheep

671 Evaluation of Dorper, Dorset, Katahdin, and Rambouillet crossbred ewes in high- and low-input production systems. K. A. Leymaster*, *USDA-ARS, U.S. Meat Animal Research Center*, *Clay Center, NE*.

The primary objective was to evaluate wool (Dorset, Rambouillet) and hair (Dorper, Katahdin) dam breeds for their ability to complement Romanov germplasm as crossbred ewes managed in distinct production systems. Romanov ewes were mated with 18 rams of each dam breed to produce crossbred ewes for evaluation through 3 yr of age in two production systems. In the high-input system, labor and harvested feed were provided for sheep in confinement facilities and ewes were limited to rearing two lambs with additional lambs reared artificially. Ewes in the low-input system lambed on pasture and were responsible for rearing all lambs. No labor or supplemental feed were provided before weaning. A total of 830 crossbred ewes produced 1,962 litters and 4,171 lambs from 2,172 multisire exposures to two terminal sire

breeds (Suffolk, Texel). Fertility rate (FR), number born (NB), lamb losses between birth and 24 wk (LOSS), number at 24 wk (N24), and 24-wk litter weight (LTRWT) were analyzed as a trait of the ewe. Effects of year of birth, dam breed, production system, sire breed, ewe age and their two-way interactions were estimated. Random effects of sires of crossbred ewes and repeated effects of ewes across ages were fitted. Ewe age affected all traits and often interacted with dam breed and production system ($P < 0.05$). The interaction of dam breed x sire breed on FR ($P < 0.05$) was due to change in rank as well as magnitude. Suffolk-sired litters had greater LOSS and lesser N24 than litters by Texel rams ($P < 0.05$). Interactions of dam breed with production system were not detected. The high-input system had greater ($P < 0.05$) values than the low-input system for NB, N24, and LTRWT24 and approached significance for FERT and LOSS. Main effects of dam breed were detected ($P < 0.05$) only for NB and N24, with Katahdin crossbred ewes producing the most lambs, followed by Dorset and Dorper and then Rambouillet. Other key traits need to be considered before use of these dam breeds is recommended.

Key Words: Production Systems, Hair Breeds, Sheep

672 Pasture lambing prolific sheep. J. W. McNally*, *Tamarack Lamb & Wool*, *Hinckley, MN*.

Since the 1960s most Midwestern farm flocks have adopted an intensive sheep management system that entails winter lambing inside a barn. While this system has become very specialized, the high labor requirement of winter lambing, and the high cost of lambing indoors has meant most farm flocks have remained rather small and insignificant in financial contribution. Most flock owners responded by pushing lambing rates higher with a corresponding assumption that prolific sheep require extra care and attention that can only be afforded by lambing indoors. Tamarack Lamb & Wool added the Booroola *Fec*B gene to Dorset ewes in 1987 through selective crossbreeding, resulting in a lambing rate of 240 to 280% in ewes that carry the *Fec*B gene. Previously a fall and winter lambing flock, the flock was moved to late spring pasture lambing to accommodate the growing numbers of sheep. The benefits of lambing on pasture included better milk production and greater newborn survival, lower labor, considerably lower input costs, and the ability to run much larger numbers of sheep limited only by the forage resources that could be fenced. The core management considerations for pasture lambing are: 1) proper timing of lambing to synchronize with lactation quality feed and reasonable weather; 2) proper management of forage resources; 3) suitable animal genetics; and 4) minimal disturbances in the lambing paddock such as dogs, people, predators, first time mothers, or supplementary feeding. Tools used to manage feed and animals include 1) use of drift lambing; 2) set stocking after lambing; 3) rotational grazing; and 4) use of high energy tillable crops for fall finishing. Pasture lambing requires education of both sheep and shepherd. A new set of stock handling skills are required from the shepherd, and sheep can take several years to unlearn their barn lambing habits. Over the past 16 years the system used at Tamarack Lamb & Wool has been so successful that it has remained remarkably the same. The greatest change has been to relax the labor requirement as the sheep have become increasingly proficient at rearing lambs on pasture.

Key Words: Management, Lambing, Sheep

673 What does it mean to be locally adapted and who cares, anyway? F. D. Provenza*, *Utah State University*, *Logan*.

Sustainability is about ongoing adaptation in ever changing environments. What might that mean in the 21st Century? In ″The Long Emergency″ Jim Kunstler argues the availability of fossil fuels will decline severely in the first half of the 21st Century, and the massive deficits won't be countered by alternative sources of energy. This seeming catastrophe will create opportunities as communities come to rely on foods locally produced. Agriculture will be at the heart of communities, but its lifeblood won't be fossils to fuel machinery or fertilizers, herbicides and insecticides to grow and protect plants in monocultures, antibiotics and anthelmintics to maintain the health of herbivores, or nutritional supplements and pharmaceuticals to sustain humans. Rather, from soils and plants to herbivores and people we'll learn what it means to be locally adapted. Plants will be used as nutrition centers and pharmacies, their vast arrays of primary (nutrients) and secondary (pharmaceuticals) compounds useful in nutrition and health. Animals will be locally adapted to landscapes where they'll live from conception to consumption. Livestock will be produced in easy-care systems that match their production needs with locally available forages, and that involve an ongoing dialog among genes, social and biophysical environments, one that causes neurological, morphological and physiological changes in utero and early in life and confers survival advantages as the environment of rearing matches the environment where animals then live. Historically, the likelihood of a match was high as animals were conceived, reared, and reproduced in the same environment, and the strong fidelity animals' show to the sites where they are reared ensures they are locally adapted. Fossil-fuel subsidized management practices have created mismatches by requiring mother and offspring to be separated early in life and offspring to live in environments different from where they were conceived and reared. In this century, we will of necessity create easy-care ecosystems that nurture relationships among soil, water, plants, herbivores and people to sustain their collective wellbeing.

Key Words: Sustainability, Adaptability, Profitability