and audits. Another development is the fundamental change in the economic structure of how food is sold, the change from a push to a pull economy. Animal welfare and associated issues provide a valuable framework for ethical discussion and the possibility of teaching collaborations with social scientists.

Key Words: Animal welfare, Ethics, Teaching

Breeding and Genetics: Dairy Breeds

249 Crossbreds of Normande/Holstein, Montbeliarde/Holstein, and Scandinavian Red/Holstein compared to pure Holsteins for reproduction and survival. B. J. Heins, L. B. Hansen*, and A. J. Seykora, *University of Minnesota*, *St. Paul*.

Normande/Holstein, Montbeliarde/Holstein, and Scandinavian Red/Holstein crossbreds were compared to pure Holsteins for reproduction and survival. Cows were in 7 commercial dairies in California. Daughters of Normande, Montbeliarde, and Scandinavian Red sires were from imported semen. Holsteins were required to have a recorded sire with an NAAB code to assure they were sired by A.I. sires. For days open, cows were required to be at least 250 days in milk and those with greater than 250 days open were truncated to 250 days. Least squares means for days to first breeding were 69 for Holsteins, 62 for Normande/Holstein, 65 for Montbeliarde/Holstein, and 66 for Scandinavian Red/Holstein crossbreds, and differences were significantly different than pure Holsteins for Normande/Holstein and Montbeliarde/Holstein crossbreds. First service conceptions rates were 22% for Holsteins, 35% for Normande/Holstein, 31% for Montbeliarde/Holstein, and 30% for Scandinavian Red/Holstein crossbreds and, again, differences from Holstein were significant for the Normande/Holstein and Montbeliarde/Holstein crossbreds. Least squares means for days open were 150 for pure Holsteins, 123 for Normande/Holstein, 131 for Montbeliarde/Holstein, and 129 for Scandinavian Red/ Holstein crossbreds, and all three crossbred groups had significantly fewer days open than pure Holsteins. Crossbreds surpassed pure Holsteins for survival for any reason to 30-d, 150-d, and 305-d postpartum during first lactation and for percentage with a second lactation.

Key Words: Crossbreeding, Heterosis, Reproduction

250 Crossbreds of Jersey/Holstein compared to pure Holsteins for body weight, dry matter intake, feed efficiency, and body condition score. B. J. Heins, L. B. Hansen, A. J. Seykora*, A. R. Hazel, J. G. Linn, M. L. Raeth-Knight, and W. P. Hansen, *University of Minnesota*, *St. Paul*.

Jersey/Holstein crossbreds (n = 24) were compared to pure Holsteins (n = 19) for body weight (BW), dry matter intake (DMI), feed efficiency, and body condition score (BCS) during first lactation. Cows were housed in the University of Minnesota research facility at the St. Paul campus and calved from September 2004 to January 2005. Jersey/Holstein crossbreds and pure Holsteins were sired by 6 Jersey and 6 Holstein AI bulls selected for Net Merit. Pure Holsteins were taller (141.1 vs 134.2 cm) and had larger heart girths (187.5 vs 180.6 cm) than Jersey/Holstein crossbreds at calving. Cows were individually fed a TMR twice daily, and feed was mixed with a drum mixer. Feed weighbacks were collected once daily and cows were weighed bi-weekly. Milk production was recorded daily and milk composition was from monthly DHI. Best Prediction was used to calculate actual production (fat plus protein) for each cow for the first 150 d of first lactation. Fat plus protein production was 308 kg for Jersey/Holstein crossbreds and 309 kg for Holsteins. Ratio of fat plus protein production (kg) divided by DMI (kg) for the first 150 d of lactation was 0.11 for both Jersey/Holstein crossbreds and Holsteins. Body weights and body condition scores were recorded once every two weeks from 1 to 26 weeks postpartum. Independent variables were breed, random effect of cow within breed, week postpartum within breed, month of calving, and age at calving (linear, mo). Statistical analysis was performed for the first two weeks and 1 to 26 weeks. Holstein cows had significantly higher BW and significantly lower BCS than Jersey/Holstein crossbreds. There were no differences in DMI between Jersey/Holstein crossbreds and pure Holsteins.

Table 1.

Breed	1st two weeks BW (kg)	1 to 26 weeks DMI (kg/d)	BCS
Holstein	516.0	11.6	2.97
	508.0	19.1	2.80
Crossbred	472.7	11.5	3.14
	471.7	19.0	2.92

Key Words: Crossbreeding, Feed efficiency, Body condition score

251 Crossbreds of Jersey/Holstein compared to pure Holsteins for production, calving difficulty, stillbirths, and fertility. B. J. Heins, L. B. Hansen, A. J. Seykoa, A. R. Hazel*, J. G. Linn, D. G. Johnson, and W. P. Hansen, *University of Minnesota*, *St. Paul*.

Jersey/Holstein crossbreds (n = 77) were compared to pure Holsteins (n = 72) for 305-d milk, fat, and protein production, calving difficulty, stillbirths, days to first breeding, first service conception rate, and days open during first lactation. Cows were housed at two University of Minnesota research facilities and calved from September 2003 to May 2005. Jersey/Holstein crossbreds were bred to Montbeliarde sires, and Holstein cows were bred to Holstein sires. Best Prediction was used to calculate actual production (milk, fat, and protein) for 305-d lactations. Adjustment was made for age at calving and herd-year and records less than 305 d were projected to 305 d. Jersey/Holstein crossbreds (258 kg) and pure Holsteins (259 kg) were not significantly different for fat production, but pure Holsteins had significantly higher milk (7266 vs 6693 kg) and protein (229 vs 214 kg) production than Jersey/Holstein crossbreds. For fat plus protein production, the Jersey/Holstein crossbreds (471 kg) and pure Holsteins (488 kg) were not significantly different. Calving difficulty scores were 1, 2, 3 (no difficulty) and 4, 5 (calving difficulty), and stillbirths were 1 (alive) and 0 (dead) within 24 hr of birth. Age at calving, herd-year, sex of calf, and breed were

included in the statistical model. Calving difficulty and stillbirth rates did not differ significantly for the Jersey/Holstein crossbreds versus pure Holsteins. Jersey/Holstein crossbreds (78 d) had significantly fewer days to first breeding than pure Holsteins (88 d). Least squares means for days open were 139 for Jersey/Holstein crossbreds and 155 for pure Holsteins.

Key Words: Crossbreeding, Heterosis, Production

252 Crossbreds of Normande/Holstein, Montbeliarde/Holstein, and Scandinavian Red/Holstein compared to pure Holsteins for 305-d production. B. J. Heins*, L. B. Hansen, and A. J. Seykora, *University of Minnesota*, *St. Paul*.

Normande/Holstein crossbreds (n = 245), Montbeliarde/Holstein crossbreds (n = 494), and Scandinavian Red/Holstein crossbreds (n = 328) were compared to pure Holsteins (n = 380) for 305-d milk, fat, and protein production during first lactation. Cows were housed in seven commercial dairies in California and calved from June 2002 to January 2005. All Holstein sires and Holstein maternal grandsires of all cows were required to have a code assigned by the National Association of Animal Breeders to assure they were sired by AI bulls. Daughters of Normande, Montbeliarde, and Scandinavian Red sires were from imported semen. Scandinavian Red was a mixture of Swedish Red and Norwegian Red. Best Prediction was used to calculate actual production (milk, fat, and protein) for 305-d lactations. Adjustment was made for age at calving and milking frequency, and records less than 305 d were projected to 305 d. Herd-year-season (4-month seasons within the seven herds) and the genetic level of Holstein maternal grandsire (linear) were included in the model for statistical analysis. Pure Holsteins had significantly higher milk (9757 kg), fat (346 kg), and protein (305 kg) than all crossbreds except Scandinavian Red/Holstein crossbreds (340 kg) were not significantly different than pure Holsteins for fat production. Fat plus protein production was used to gauge the overall productivity of pure Holsteins versus crossbreds. The Scandinavian Red/Holstein (637 kg) crossbreds were not significantly different from the pure Holstein (651 kg) for fat plus protein production; however, the Normande/Holstein (596 kg) and the Montbeliarde/Holstein crossbreds (627 kg) had significantly lower fat plus protein production than pure Holsteins.

Key Words: Crossbreeding, Heterosis, Production

253 Economic efficiency and genetic improvement of alternative breeding schemes for Taiwan dairy cattle population. C. L. Chang*[1] and I. L. Mao[2], [1]*Hsin-chu Branch, COA-LRI*, *Hsin-chu, Taiwan, ROC*, [2]*Michigan State University*, *East Lansing*.

Seven practical alternative breeding schemes were designed and the economic efficiency and genetic improvement would be compared with that of Current Breeding Scheme(CBS) to determine an optimum schemes for Taiwan dairy cattle population. CBS included 20% of cows were bred by natural service (NS) bulls, 20% were bred by untested selected AI bulls, and 60% were bred by imported semen from progeny test proven AI bulls. Proposed alternative breeding schemes included the use of bulls from progeny test for AI services (PT/AI), the use of bulls with high pedigree merit but untested for AI and natural services (untLB/AI/NS), the use of a MOET nucleus population to produce AI and NS bulls (MOET/AI/NS), the use of imported semen from the top 40% (FS40) or top 20% (FS20) U.S. proven bulls to breed local cows, the use of embryos to produce untested AI bulls (untFEB), or to produce AI bulls by paternal half-sib performance (STFEB). Deterministic models were used to estimate the genetic gain and economic efficiency for each of the consecutive 25 years considering the genetic difference between the U.S. and the target population and the effect of genotype by environment interaction. The breeding schemes were ranked in descending order by genetic gain as STFEB, untFEB, MOET/AI/NS, FS20, FS40, untLB/AI/NS, and PT/AI. All breeding schemes surpassed the genetic gain by the current breeding scheme (CBS), except PT/AI, by 35%, 29%, 23%, 17%, 12%, and 5%, respectively. Yet the ranking of the designed breeding schemes based on their economic efficiency was different from that based on their rates of genetic progress. The use of imported embryos to produce AI bulls tested by half-sib performance (STFEB) was the optimum scheme in terms of economic efficiency and the rate of genetic progress.

Key Words: Economic profit, Genetic gain, Alternative breeding schemes

254 Genetic parameters of monthly test day milk yields in Iranian buffaloes. H. Farhangfar*[1] and J. Rahmaninia[2], [1]*Birjand University*, *Birjand, Iran*, [2]*Zabol University*, *Zabol, Iran*.

A total of 7315 monthly test day milk yields at first lactation from 1123 Iranian buffaloes distributed in 381 herds and which calved from 1993 to 2005 were used to estimate genetic parameters. A covariance function which consisted of orthogonal legendre polynomials of 5th order was applied to model monthly test day milk yields of individual animals at two genetic (1423 levels) and permanent environment effects (1123 levels). In the model, environmental fixed effects of herd, year and month of recording, milktimes, as well as age of animals at the time of recording were included. The results obtained at the present research showed that heritability of monthly test day milk yields initially decreased from the beginning of lactation towards the middle of the lactation and after that it increased towards the end of the lactation. The heritability estimates ranged from 0.17 (at month 5) to 0.78 (at month 10). Genetic correlations between adjacent monthly test days were mostly greater than 0.7 and decreased as the interval between test days increased. Permanent environmental correlations among test day milk yields were positive and showed the same pattern observed for the genetic correlations.

Key Words: Genetic parameters, Monthly test day milk yield, Iranian buffaloes

255 Revised estimates of lifetime net merit for dairy breeds and breed crosses. P. M. VanRaden and M. E. Tooker*, *Animal Improvement Programs Laboratory, USDA*, *Beltsville, MD*.

Dairy breeds and breed crosses were compared using updated net merit (NM), cheese merit (CM), and fluid merit (FM) formulas that include calving ease and daughter pregnancy rate (DPR). National data for milk, fat, protein, productive life, somatic cell score, and DPR were each evaluated using an all-breed animal model. New estimates of breed differences were compared to phenotypic breed differences and to previous estimates from studies that only included herds containing crossbred cows. Estimates of general heterosis from previous studies were used in the current research and not re-estimated. New estimates of breed effects were generally intermediate between the previous estimates and the phenotypic breed differences; all three estimates were similar. For calving ease, percentages of difficult births in first parity (%DBH) were estimated to be 7.9% for over 3.5 million Holstein (HO), 0.8% for 22,318 Jersey (JE), 4.7% for 5,909 Brown Swiss (BS),

3.3% for 1,418 Guernsey, 4.4% for 520 Ayrshire and 7.8% for 205 Milking Shorthorn. First generation crosses of JE x HO exceeded HO by $22 for NM and by $123 for CM, and BS x HO crosses exceeded HO by $32 for NM and by $102 for CM. All comparisons were at the genetic base of zero for each breed, and no crossbreds exceeded HO for FM. For later generations, backcrosses to HO are preferred for NM, whereas for CM, three-breed crosses may provide profit equal to HO backcrosses. Economic values were from 2003 and included relative emphasis of 33% on protein, 22% on fat, 11% on productive life, 9% against somatic cell score, 7% on daughter pregnancy rate, 7% on udder composite, 4% on feet and leg composite, 4% on calving ease, and 3% against body size composite. Economic values may need revision again during 2006 to account for a new definition of productive life, a new evaluation of calf livability, higher prices for butterfat relative to protein, and higher replacement heifer costs. Routine updates of economic values and breed differences can help producers to manage crossbreeding programs.

Key Words: Genetic evaluations, Net merit, Crossbreeding

256 A survey of Australian dairyfarmers to establish farmer attitudes to crossbreeding. M. F. Pyman* and K. L. Macmillan, *University of Melbourne*, *Werribee, Victoria, Australia*.

A survey in 2004 documented the experiences and attitudes of Australian dairyfarmers to crossbreeding, complimenting the data gathered in Victorian dairy herds comparing the performance of crossbred cows with their straightbred herd mates in terms of health, production and reproduction. The information was recorded to establish whether farmers believed there were advantages to be gained from crossbreeding in terms of sustainability, profitability, ease of management and flexibility of the breeding process. Three focus group meetings were conducted to discuss the advantages and disadvantages of Jersey Holstein crossbreds versus straightbred Holstein cows, the reasons for selecting a particular breed type, how and where breeding information was sought and what other economic data might be required to demonstrate the advantage of one breed over another. The focus group material was used to develop a 10 minute telephone questionnaire in which 201 random computer assisted telephone interviews were conducted. Response rate was high (83%) with most respondents (91%) having had some personal experience with Jersey Holstein crossbred cows even though less than 4% had crossbred cows as their principle breed type. The major perceived advantages of Holsteins were high production (78%), size (33%), sale value (31%) and good temperament (25%). Crossbreds were seen to have the advantage of high components (73%), smaller size (39%), hybrid vigour (23%) and better fertility (18%). Although high proportions of farmers noted the individual benefits that accrued from milking crossbreds, most indicated they would not be prepared to alter the composition of their herd to improve profitability, herd conception rates or herd management. Their attitudes related to the uncertainty of a breeding program after the first cross, a perceived stigma associated with small, uneven crossbred cows and the superior economic value of a purebred herd.

Key Words: Crossbreeding, Herd management, Herd composition

257 A comparative study of the reproductive performance of Holstein and Jersey Holstein first cross cows in 15 Australian dairy herds. M. F. Pyman*, G. A. Anderson, and K. L. Macmillan, *University of Melbourne*, *Werribee, Victoria, Australia*.

The reproductive performance of first cross (F1) Jersey Holstein crossbred cows was compared to Holstein cows in 15 dairy herds as part of a larger study of crossbreeding in the Australian dairy industry. The objective of the industry funded study is to assess the profitability and sustainability of crossbreeding for seasonally calving dairy farms. Data were collected over a single lactation in 2003/2004 from 5,086 cows including 3,053 Holsteins and 821 F1 Jersey Holstein cows, ranging in age from 2 years to 16 years. The first service conception rate to artificial insemination however was based on 2,661 Holsteins and 728 F1 crossbred cows. Each herd was pasture-based and seasonally calving and located in Victoria, the major dairying state in Australia. Seasonality in Australia implies that herds should have an average calving interval close to 365 days with peak calving coinciding with peak grass growth and availability of pasture in Spring and Autumn. Farm profitability is therefore closely linked to the reproductive performance of the herd as reflected in the compactness of the calving pattern. Significant differences were found in the first service conception rate to AI (CR1; 55% vs 45%; $P < 0.001$), pregnancy rate after 42 days of breeding (PR6W; 63% vs 52%; $P < 0.001$), pregnancy rate after 14 weeks of breeding (PR14W; 80% vs 72%; $P < 0.001$) and the not pregnant rate at the end of 21 weeks of breeding (NIC; 18% vs 25%; $P < 0.001$) for the Jersey Holstein crossbreds compared to the Holsteins after the least squares means for these parameters were adjusted for herd, age and the interval from calving to the start of mating. The results suggest that crossbreeding can improve the reproductive performance of the herd where a twelve month calving interval is desired, particularly in temperate climates with grazing cows on pasture- based diets.

Key Words: Seasonal calving, Crossbreeding, Reproductive performance

258 Weights and hip heights for Holstein, Jersey and their reciprocal crosses in the Virginia Tech crossbreeding project. K. M. Olson*, B. G. Cassell, D. R. Winston, and J. A. D. R. N. Appuhamy, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Heifers from the crosses of the Holstein and Jersey breeds were first born starting in June 2003 at Virginia Tech. Four Holstein and four Jersey bulls were used as foundation sires with matings to purebred dams. Weight and hip height data through late 2005 included 112 heifers with each having records for at least two months. Weights and hip heights were adjusted to a constant age (CA) at each month (birth to 23 months). A mixed model using repeated records was used to analyze weights and hip heights separately. Effects in the model included year-season, breed group with sire listed first [HH (n=39), HJ (n=30), JH (n=23), JJ (n=20)], dam parity (1, 2, 3 and later), breed by parity interaction, twin status and breed by CA interaction. Significant effects for monthly weights included breed group, breed by CA at weight, year-season and dam parity. Significant effects for hip heights were breed group, breed by CA at height and year-season. Least square means (LSM) for 3 months, 12 months and 18 months for weights and hip heights are presented in table 1. Visual inspection of breed group means by age suggests a positive heterosis for weight (untested).

Table 1. LSM for body weights and hip heights

	Body Weight (kg)			Hip Height (cm)		
Month	3	12	18	3	12	18
Breed						
HH[a]	103	318	475	98	129	139
HJ	93	304	420	93	123	132
JH	93	302	424	95	125	134
JJ	79	258	323	82	116	124

[a]Sire breed first followed by dam breed; H=Holstein; J=Jersey

Key Words: Crossbreeding, Body weight, Hip height

259 Genetic evaluation of milking speed for Brown Swiss dairy cattle. G. R. Wiggans*[1], L. L. M. Thornton[1], and R. R. Neitzel[2], [1]*Animal Improvement Programs Laboratory, Agricultural Research Service*, *Beltsville, MD*, [2]*Brown Swiss Association*, *Beloit, WI*.

Genetic parameters and breeding values (EBV) were estimated for milking speed in Brown Swiss cattle. Owner recorded milking speed scores on a 1 to 8 scale (low to high) were collected by the Brown Swiss Association as part of its linear type appraisal program starting in 2004. Data were 6,483 records on 6,017 cows in 352 herds. A total of 13,192 ancestors and seven unknown parent groups, each including four years of birth, also were included. The model included fixed effects for herd appraisal date, parity-stage of lactation, and random effects for permanent environment, animal and error. Four 90-day stages of lactation were defined. An Average Information REML variance estimation procedure produced heritability of 0.22 and repeatability of 0.41. The residual variance was 1.13. There was little trend in EBV of cows born 1999 through 2002. The 109 bulls with 10 or more daughters had a range in EBV of 2.7. Speed increased with stage of lactation for first parity cows by 0.37. There was not a clear trend in second parity, and in third and later parities, there was a drop of 0.20 from the first to the third 90-day period, then an increase of 0.10 in the last period. For the 109 bulls with 10 or more daughters, significant correlations between evaluations for milking speed and other traits were 0.22 for milk, 0.53 for productive life and -0.37 for somatic cell score. The association of faster milking speed with lower somatic cell score was not expected. The milking speed information can provide useful EBV given the moderate heritability. Similar data is being collected for Holsteins, so this evaluation system could be extended to that breed.

Key Words: Milking speed, Brown Swiss, Variance components

Companion Animals: Companion Animal Research: Contributions and Conflicts

260 Marrying science to society — hurdles for the use of companion animals in research. G. Golab*, *American Veterinary Medical Association*, *Schaumburg, IL*.

Scientists and veterinarians are most comfortable when decisions about when and how to use animals in research involve a careful balance between the expected benefits of the knowledge gained and the potential costs to the animals and other stakeholders involved. This logical analysis is consistent with the methodical approach that scientists most often take when studying any complex problem. Not surprisingly, frustration results when carefully considered advice about what constitutes appropriate use and care appears to go unheeded. But why does such advice go unheeded? Because, rightly or wrongly, decisions about animal use always have been and are likely to continue to be decisions of public policy. Public policy has as much or more to do with attitudes, ethics, morals, perception and cultural norms as it has to do with scientific truth. The impact that science and scientists have on public policy depends on the degree of public trust that can be achieved. Establishing trust and dialog becomes even more critical when the species used are those with which large numbers of the public have special relationships in their own homes (i.e., companion animals). This presentation will focus on the factors influencing public understanding and trust of science and scientists. Scientific literacy and public engagement will be discussed as strategies to maximize the influence of science on animal welfare decision-making.

Key Words: Animal welfare, Public trust, Companion animal research

261 Conserving endangered wild felids – the invaluable domestic cat connection. W. F. Swanson*, *Cincinnati Zoo's Center for Conservation and Research of Endangered Wildlife*, *Cincinnati, OH*.

Most of the world's 36 wild cat species are facing escalating threats to their future survival, primarily due to habitat loss and persistent poaching. America's most popular companion animal, the domestic cat, is playing a key role in ongoing efforts to conserve these endangered felid populations. Laboratory research with domestic cats has provided us with a broader understanding of general felid physiology, including reproduction, disease and stress susceptibility, and nutrition, which has contributed to improved exhibitry, diets and reproductive management of nondomestic felids. For example, basic studies with domestic cats have permitted the validation of urinary and fecal hormone analysis for assessment of reproductive cyclicity, seasonality, pregnancy and adrenocortical activity in nondomestic cats. Findings from fecal hormone monitoring have lead to modifications in exhibitry and husbandry that serve to enhance captive propagation while minimizing captive stress. Similarly, systematic studies of in vivo embryogenesis and embryo metabolism in naturally–bred domestic cats have provided a normative database of early pregnancy that forms the basis for improving culture of in vitro–generated embryos and creation of offspring after embryo transfer in endangered felids. Applied studies in domestic cats also have investigated immune responses to exogenous gonadotropins and the cross–species fertilization of domestic cat oocytes in efforts to optimize the success of assisted reproductive procedures in nondomestic cats. Other ongoing studies are assessing the suitability of diets, formulated based on domestic cat requirements, for meeting the nutritional needs of nondomestic cats and conducting comparative assessments of the nutritional status of free–living animals consuming natural prey. In conclusion, the domestic cat continues to represent an invaluable research model and ally in our efforts to maintain, manage and conserve their nondomestic relatives – the wild felids. (NIH grant RR 15388)

Key Words: Conservation, Reproduction, Nutrition