

alternative housing systems. At the end of the day, it is the stockperson who will ensure the success or failure of any sow housing system and the well-being of sows within that system. However, the tools do exist to safeguard pig well-being and productivity when removing them from confinement systems and, importantly, perhaps address some of the negative public perceptions about the swine industry.

Key Words: Sows, Alternative housing, Well-being

492 Animal welfare and international trade: European and American perspectives. A. Lawrence* and D. Oglethorpe, *The Scottish Agricultural College*.

International trade in agriculture has developed enormously since the 2nd World War, and with it demands for liberalisation of the trade have grown. In 1994 the pressure for liberalisation resulted in agriculture being included in the General Agreement on Tariff and Trade (GATT). Despite this attempt to arrive at globally applied rules on agricultural trade, many countries still operate "systems", which in various ways are designed to protect national agriculture industries. Since 1995 the GATT rules have been enforced by the World Trade Organisation (WTO), and the EU and the US have so far initiated the majority of disputes over application of the rules. This tension between the US and EU over agriculture trade has relevance to the debate over animal welfare and its incorporation in international trade rules.

In recent WTO negotiations the EU has proposed that the growing importance of animal welfare as a socio-economic issue, requires that international trade agreements take account of it. Specifically, the European Commission would like to see support for animal welfare fall into the "Green Box" of agricultural support payments — those payments seen as delivering public goods and services and not influencing production decisions. Although it is likely that improved margins could be gained from improving the animal welfare attributes of a product, the EU contend that improved animal welfare is partly a public good that is demanded by society at large.

The EU has proposed three approaches to resolve the incorporation of animal welfare into international trade negotiations: multilateral agreements on protection of animal welfare, appropriate labelling to allow consumers to make informed choices, and the use of some form of compensatory payments to balance any increased costs of production resulting from raising animal welfare standards. What is important to provide however, is evidence to suggest that society does actually derive a non-market benefit from the existence of animal welfare farm systems. If this is the case, it will then be worthwhile comparing the costs of delivering those animal welfare benefits, compared to the cost of delivering other public goods or services from agriculture, such as biodiversity or amenity. We will examine these two issues and we will discuss the role that public/consumer attitudes in the EU and the US may play in determining the market for 'animal welfare foods'.

Key Words: Welfare, Trade policy, European

Forages & Pastures Symposium: Forage strategies for arid climates

493 Supplementing grazing beef cattle: If, when, with what, and especially how often? J. E. Huston*, *Texas Agricultural Experiment Station, Texas A&M University System*.

The literature was reviewed on the needs for and responses to supplementation by beef cattle grazing range forages. Only cases of adequate quantity of forage were considered. Rangelands vary in climatic conditions and plant species composition thereby causing differences in diet quality among occupied areas and during seasonal periods within those areas. Also, nutrient requirements of the cow unit vary with genetic potential and stage of production. An extensive dataset collected in western Texas (average annual rainfall = approximately 500 mm) over a 17-year period was used to illustrate responses to supplemental feeding and various feeding practices. Unsupplemented, mature beef cows lost 18.4% of their fall weight (including reproductive tissues) before the beginning of the breeding season (April 1) and conceived at a rate of 81%. Cows fed the equivalent of one-half of their daily protein requirements in a concentrated supplement lost 12.9% of fall weight and had a 91% conception rate, a satisfactory reproductive rate in a mixed-age herd. Various preparations and supplementary nutrients were tested against this standard response. Several experiments were conducted to compare the relative responses from feeding identical weekly amounts of supplemental feeds but broken into daily, three times per wk, and weekly portions. Generally, feeding interval did not affect mean responses in reduced body weight and condition score under the conditions of these studies and with the supplements offered. Those fed weekly (approximately 6.5 kg at a single weekly feeding) showed less variability in supplement and forage consumed and in changes in body weight. These data and inferences drawn are summarized in "The Eleven Commandments of Supplemental Feeding of Beef Cattle."

Key Words: Beef-cattle, Supplemental-feeding, Feeding-interval

494 Complementary forages and grazing systems for beef cattle production on arid rangelands in the Western US. T. DelCurto*, D. W. Bohnert, C. S. Schauer, and G. D. Pulsipher, *Eastern Oregon Agricultural Research Center, Oregon State University, Union and Burns*.

Western beef cattle producers are faced with numerous challenges relative to forage resources and nutritional opportunities. Specifically, much of the western US is characterized by high elevation rangelands that typically have short growing seasons and limited, highly-variable, precipitation. As a result, forage availability and quality are often low throughout much of the grazing period and limit optimal beef cattle production. Numerous opportunities exist, however, to improve the nutritional plane of beef cattle grazing arid rangelands. The introduction

of complementary forages can lengthen the period of adequate nutrition. Forage species including alfalfa, forage kochia, crested wheatgrass, and winterfat have all been shown to offer unique nutritional advantages. Likewise, forage species that tolerate winter grazing and snow can provide economic advantages to western producers by decreasing the reliance on feeding harvested hays to cattle during the winter period. Grazing systems that utilize topographical characteristics of rangelands to enhance the nutrition of cattle production are also potential opportunities. For example, using pastures with southern exposures early and northerly aspects late can effectively increase the nutritional plane of grazing cattle. In addition, the use of rangelands that have diverse forb and shrub components late in the grazing period will improve the nutritional plane of the cattle. Care must be taken, however, to develop grazing systems that maintain or enhance the biological diversity of the forage base and long-term sustainability of the rangeland resource. In summary, nutritional opportunities do exist to improve the nutritional plane of cattle grazing western rangelands. Specific strategies need to be tailored to the resources available to beef cattle producers and will necessarily differ from location to location.

Key Words: Complementary forages, Grazing systems, Western rangelands

495 Management strategies for optimal distribution and use of arid rangelands. D. W. Bailey*, *Montana State University*.

Application of existing and novel management techniques can alter traditional livestock grazing patterns and significantly improve the sustainability of arid rangelands. Livestock often congregate and heavily graze riparian areas and other sensitive rangeland while abundant forage remains in other areas. Increasing the uniformity of grazing can help protect fisheries, wildlife habitat and other vegetative and watershed resources. For years, managers have improved grazing distribution in extensive arid pastures by developing new water sources. In addition, strategic supplement placement can be used to lure cattle to graze areas that typically receive little use. Placement of low moisture molasses blocks in steeper areas that were far from water increased forage use by 14% at distances up to 600 m from supplement in foothill rangeland. Recent research has examined the potential of breed and individual animal selection to improve grazing distribution patterns. Cattle breeds developed in mountainous terrain utilize rugged rangeland more ($P < 0.05$) uniformly than breeds developed in more gentle terrain. In pastures that were grazed by cattle identified as "hill climbers" (previously observed on rugged terrain), more residual vegetation ($P < 0.05$) was left on gentle slopes and areas closer to water than in pastures grazed

by cattle identified as "bottom dwellers" (previously observed on gentle terrain near water). Cattle may use rugged rangeland more uniformly after weaning and during periods when temperatures are more moderate (spring, early summer, and fall). Herding shows great promise for protecting sensitive rangeland. Preliminary data show that residual riparian forage in pastures where livestock were herded was up to two times higher than in a control pasture. The integration of herding and strategic supplement placement appears to be more effective than herding alone. Many concerns associated with the sustainability of grazing on arid rangelands can be resolved by manipulating livestock grazing behavior through management.

Key Words: Grazing, Distribution, Behavior

496 Whole ranch management systems to optimize forage use and meet multiple use goals. L. R. Roath*, *Colorado State University.*

Optimal forage use must account for the needs of the land and of the grazing animals, simultaneously! The challenge in designing systems to meet these criteria is to: 1) account for food choices of an array of grazing animals in time and space; 2) recognize what that means to relative food availability and relative depletion rates; 3) determine what the standing quantity of quality is and how many animals of what types it can supported (i.e. stocking rate); 4) determine the influence of the

Goat Species Symposium: Assisted reproduction in goats

497 Update on estrus synchronization in a minor species. N.C. Whitley*, *University of Maryland Eastern Shore, Princess Anne, MD.*

Estrus synchronization allows for parturition at the most suitable time to take advantage of niche markets, feed supplies, labor and/or rising price trends. In the past, the synchronization of estrus in goats has focused primarily on dairy goats to allow for optimal timing of milk production. However, recent interest in meat goat production has resulted in attempts to use dairy goat, sheep and cattle synchronization regimes in meat goat management systems. Methods of synchronization have included techniques as simple as alteration of light patterns or manipulation of social inputs (i.e. the buck effect) and those as complex as varying timed hormonal treatments combined with light alteration and the buck effect. The synchronization of estrus using timed hormonal treatments seems to be more convenient in many meat goat production situations. Examples of hormones used include melatonin, progestagens (administered orally, as an injection or by using intra-vaginal releasing devices), gonadotropins/GNRH (or agonists) and/or prostaglandins alone or in combination. As is seen with sheep and cattle, breed and/or breed type, stage of production and environmental impacts can influence synchronization success in goats. The introduction of breeds developed in other countries for rapid growth, such as the Boer goat, and increased consumer and producer interest have added to the impetus for developing cost efficient and/or highly effective estrus synchronization regimes. New research is being conducted and various synchronization methods are being attempted in goats, a minor species, and the objective of this paper is to review these efforts.

Key Words: Estrus Synchronization, Meat Goats, Hormone

498 Current status of cryopreserving goat semen. P. H. Purdy*, ¹*USDA-ARS National Animal Germplasm Program, Fort Collins, CO.*

The success of goat sperm cryopreservation may be evaluated by multiple cellular characteristics. Classically, sperm cell motility, viability, acrosomal membrane integrity as well as other in vitro assays have been used to assess the success of cryopreservation and fertilizing potential. Ideally, multiple evaluations would be performed to evaluate how successful a freezing protocol is or how successfully a particular semen sample freezes. Successful cryopreservation of mammalian sperm is a relative concept, particularly when compared with sperm from other species. Dairy bulls have been selected for the ability to "freeze well" for generations and consequently these bulls have repeatedly high percentages of motile, viable sperm cells post-thaw that are capable of fertilizing oocytes. On the other hand, buck, ram, boar and stallion sperm is less

grazing use on the forage resource and feedback mechanisms; and 5) find and monitor reliable indicators of both plant and animal performance that will provide information on a time scale that will allow managers to adjust management choices to create sustainable management systems. This is a daunting job!

Prototype conceptual and applied models are being developed at Colorado State University to take some of the mystery out of this enormous task. The question of distribution of forage use and removal has been addressed scientifically by Dr. Larry Rittenhouse and Dr. Tom Hobbs. Progress is being made to use this conceptual information in predicting landscape use patterns and then making predictions of relative stocking rates for multiple grazing animal species. This work has allowed assessment of landscape level stocking rates and is now being tested for reliability. Preliminary indications are that the application of these models provides much additional information for the decision process about appropriate stocking rates but does not supplant the need for monitoring protocol for plants, plant communities, individual animals and populations. Monitoring tools like fecundity rates, animal weight, body condition for wild and domestic grazing animals and the Grazing Response Index, community dynamics, grazing pattern and rate of forage depletion for plants will be discussed, as well as, discussing the influences weather and growth dynamics of forage quality and availability. How managers might use these approaches to affect decisions on their operations will be suggested.

consistent in these and other attributes post-thaw and potentially less fertile. The purpose of this review is to assess the current status of cryopreserving goat sperm and will include a review of literature that describes post-thaw motility, viability, acrosomal integrity, in vitro fertilization and other sperm cell attributes. In addition, the review will also compare the post-thaw sperm cell attributes of goats with that of other species to identify areas of research with consistent satisfactory results and those areas that could be enhanced to match the other species.

Key Words: Goat, Sperm, Cryopreservation

499 Effects of short-term nutritional priming and multiple superovulation regimes on superovulated dairy goats. N. Buzzell, S. Blash, M. Cutler, D. Melican, J. Jameson, P. Flanagan, M. Olson, and W. Gavin, *GTC Biotherapeutics Inc., Spencer MA.*

This study examined the effects of nutritional priming (NP) and multiple superovulation regimes on oocyte production in superovulated dairy goats using 389 non-lactating does, 1-10 years old, during the non-breeding season (December to May). The does were body condition scored (BCS scale: 1-5) and then randomly assigned to 2 equal groups. All does were fed hay ad lib; but the experimental group received an additional 0.5 kg/head/day of concentrated feed (DM crude protein = 19%) 2-3 weeks prior to oocyte collection. The donors were synchronized with progesterone vaginal implants (300 mg) on Day 0 and PGF2 α (5 mg IM) on Day 7. The superovulation regime consisted of FSH twice daily (64mg/day IM) on Days 12-15. The implants were removed on Day 14 or 15 and GnRH was given (5mg IM) on Day 16. Estrus was detected by vasectomized bucks on Days 15 & 16. The reproductive response was assessed by exposing the uterus through a midline incision and by retrograde flushing of both oviducts to collect oocytes. The ova collected in donors with BCS 2, 3, 4 were 10.6 \pm 1.4, 10.1 \pm 0.5, 6.2 \pm 2.7 for NP does, and 8.7 \pm 1.0, 9.7 \pm 0.6, 12.6 \pm 3.7 for nonNP does, respectively. Two tendencies emerged that could not be verified statistically because of the variability of oocyte collection. First, nutritional priming appears to reduce oocyte production in overconditioned does. Second, compared to underconditioned does in the nonNP control group, experimental does with lower BCS tended to be more reproductively responsive to nutritional priming. Additionally, historical data for does with repeat superovulatory regimes were analyzed. Ova collected from donors in their first superovulation regime (12.10.5) were significantly greater than ova from donors in their fourth regime (40.9). Thus, when devising a protocol to maximize oocyte production, nutritional priming should be considered for underconditioned does but not for overweight