numbers of expressed sequence tags (EST) for cattle and swine. Over 150,000 bovine and 50,000 porcine EST sequences are publicly available. The cDNA clones used to produce the EST sequences are also useful resources for the production of microarrays used to profile gene expression patterns. At MARC, primers designed to amplify genomic samples for mapping bovine and porcine EST sequences have also been successful in amplifying sheep DNA. To date, 276 bovine-derived and 128 porcine-derived EST primer pairs have generated sheep amplification products. Sequence variation between different animals in the form of single nucleotide polymorphisms (SNP) will be the future platform for high-throughput automated genotyping technologies and evaluation of marker associations of phenotypes and important genes. The sheep industry must focus on the relevant traits which improve the viability and efficiency of lean lamb production. Genomic tools are rapidly changing our ability to efficiently identify and utilize genetic variation.

Key Words: Sheep, Genetics, Genomics

586 Nutrient recommendations for sheep: gaps in information and future approaches. H.C. Freetly*, *USDA, ARS, Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, NE.*

Developing nutrient recommendations is an iterative process that involves taking available information, making a set of recommendations, testing the recommendations, and using the new information to refine the recommendations. The National Research Council last published its recommendations of sheep nutrient requirements in 1985. Given the elapsed time, the question has been raised, do those recommendations need to be refined? Changes in the demographics of the sheep industry have resulted in changes in the types of sheep raised and management used. These changes have resulted in some deficiencies in the previous recommendations. Recommendations for the growing lamb do not take into consideration 1) decreases in maintenance energy with increased age, 2) the effect of previous nutrition on subsequent performance, 3) breed type differences, or 4) defined amino acid utilization. Recommendations for the ewe do not take into account 1) dynamic changes in body weight, 2) dynamic adjustments for gestation and lactation, 3) large litter sizes, and 4) defined amino acid utilization. Using the existing equations to predict nutrient recommendations for large lambs and ewes results in extending the input data beyond that used to parameterize the equations. Recommendations for mature rams are absent. Since the last recommendations were developed, a sparse amount of research has been conducted that addresses these deficiencies. This paucity of available research suggests that major changes in the system would be difficult to make. The mathematical structure of the system will determine what research needs to be conducted. The current recommendations are mathematically based on a net energy system. Alternative model structures can be used to develop the future nutrient recommendations. A consensus on the structure of the next mathematical model will provide guidance to investigators in their experimental designs that will allow them to focus their resources on collecting the information required to parameterize the system.

Key Words: Sheep, Nutrition

Animal Production and the Environment: Challenges and Solutions

587 CNMPs, TMDLs, CAFOs/AFOs, effluent guidelines, and other issues. T. Hebert*[1], [1]*Capitolink, LLC.*

Livestock agriculture faces enormous challenges and opportunities that are driven by events and programs at both the federal and state levels. Most of these are directly related to proposed and coming changes in key water quality regulatory policies. These include proposed rules for permitting of Concentrated Animal Feeding Operations (CAFOs)and their related Effluent Limitation Guidelines, Comprehensive Nutrient Management Plans (CNMP's), the final rulemaking on Total Maximum Daily Loads (TMDL's). In addition, the farm bill is also in the process of being re-authorized, and a key item for consideration is potential funding to help livestock producers manage manures more effectively and to protect water quality. The status of these matters, the outlook for their final disposition, and some key implications for the livestock sector will be discussed.

Key Words: CAFO, CNMP, TMDL

588 Challenges and opportunities facing animal agriculture: Optimizing nutrient management in the atmosphere and biosphere of the earth. E. B. Cowling*[1], [1]*North Carolina State University.*

Humans need food. Humans use energy. Production of food and combustion of fossil fuels increase concentrations of biologically active N in the atmosphere, soils, and surface and ground waters of the earth. These increases are caused in part by demand for animal protein in human diets, increased use of synthetic N fertilizers, and widespread planting of N-fixing legumes. The world's crops, forests, and fisheries respond to N enrichment with some positive benefits (e.g., increased food, feed, timber, and fish production) and some negative consequences (e.g., acidification and euthtrophication of aquatic and terrestrial ecosystems, decreased biodiversity, increased regional haze, global warming, and such human health impacts as nitrate contamination of drinking water and increased pulmonary and cardiac disease caused by exposure to toxic ozone and fine particulate matter).
So far, most pollution abatement strategies have aimed at resolving one or another pollution problem in which oxidized or reduced forms of N play an important part. The time has come to consider more fully integrated strategies by which N management practices can be optimized to increase agricultural, forest, and fish production while decreasing N-induced soil-, air-, and water pollution.
The challenges and opportunities facing animal agriculture include joining with EPA, university, and other stakeholders in: 1) making realistic assessments of actual positive and negative impacts of N and particulate matter emissions from animal agriculture, and 2) developing practical (economic) guidelines and strategies for: a) minimizing use of fossil fuels in agriculture, b) improving feed conversion efficiency in poultry, egg, swine, cattle, and dairy production, c) conserving and reusing valuable nutrients in animal wastes, d) minimizing N and P losses from manures, e) developing horizontally and vertically integrated systems of meat production and manure management through production and marketing of high-return value-added products.

Key Words: Atmosphere, Biosphere, Nutrient Management

589 Animal production impacts on nitrogen emissions to air and ground water: a Dutch case with a European perspective. Wim de Vries*[1], Hans Kros[1], Oene Oenema[1], Gert Jan Reinds [1], and Max Posch[2], [1]*Alterra Green World Research, Wageningen, the Netherlands,* [2]*National Institute of Public health and the Environment, Bilthoven, the Nether.*

In the Netherlands, intensive animal husbandry has led to very high N emissions into the environment. The estimated total annual N input flux per hectare on agricultural land for the year 1997 is 485 kg for the Netherlands compared to 146 kg for the European Community. The animal manure production in the Netherlands is approximately 5 times the average European value (265 kg compared to 56 kg) and the same holds for the N surplus (256 kg compared to 52 kg).
To gain insight in the fate of N input in the Netherlands, a study was carried out analysing the nitrogen fluxes for 250 × 250 m2 grid cells with a simple N balance model representing all crucial processes in the N chain. Results of average annual fluxes (kton N.yr-1) for the year 1997 equalled 1077 for the total N input and 261 for the total N emission to air, ground water and surface water, i.e. 140 for NH3 emission, 103 for N leaching and 18 for runoff to the sea.
Despite the relative low N leaching and N runoff compared to the N input, it does cause an excess of critical limits for nitrate in ground water (50 mg.l-1) and nitrogen in surface water (2.2 mg.l-1) in large parts of the Netherlands. We calculated the maximum allowable nitrogen application on the basis of the critical limits given above and the acceptable ammonia emission related to the protection of biodiversity of natural areas. Results showed a reduction of 50 to 70% is needed to reach the ceilings necessary to protect the environment against all adverse impacts.
On a European scale NH3 emissions are the major cause of elevated N deposition. Results of atmospheric deposition measurements at 317 forested plots, mostly concentrated in central Europe, showed that more

than 50% of the investigated plots received a nitrogen input above a deposition level at which the species diversity of the ground vegetation may be at risk.

Key Words: Nitrogen, Critical loads, Animal production

590 The role of nutrition in reducing nutrient output from ruminants. L.D. Satter*[1], T.J. Klopfenstein[2], and G.E. Erickson[2], [1]*U.S. Dairy Forage Research Center, Madison,WI,* [2]*University of Nebraska, Lincoln.*

Much of the effort expended on nutrient management has focused on the post-excretion product. It is important to keep in mind that management of the diet can have important impacts on quantitative and qualitative aspects of the excreted nutrient. Surveys of nutritionists and extension specialists show that dairy producers are advised to feed .45-.50% phosphorus (P)(DM basis) in their lactating cow diets. This is 20-30% in excess of NRC (2001) requirements. Feeding to requirement would reduce P excretion by 30% or more, and would reduce solubility and potential for runoff of the P that is applied to fields. Nitrogen (N) excretion by dairy cows can also be decreased, but by a lesser amount. Balancing RUP and RDP, and use of protected methionine along with strategic selection of protein supplements that are relatively rich in lysine, may permit a 10-15% reduction in total N excretion, with most of the reduction occurring in urinary N. Urinary urea, following conversion to ammonia, is the N excretion product most vulnerable for loss to the environment. Feedlot cattle routinely consume P in excess of NRC (1996) predicted requirements, and recent research suggests the NRC estimates of the P requirement are high. Decreasing dietary P from the industry average (.35% P) to the NRC predicted requirement (.22-.28%) decreased P input by 33 to 45% and excretion by 40-50% in nutrient balance studies. With grain-based feedlot diets, overfeeding P is inevitable. At minimum, supplemental P sources should be removed from diet formulations. More accurate formulation of feedlot diets for protein provides opportunity for reducing N excretion. Using the NRC model for metabolizable protein, and employing phase-feeding, N inputs may be decreased by 10-20% from the feedlot industry average of 13.5% dietary CP. This translates into a 12-21% reduction in N excretion, and 15-33% reduction in ammonia volatilization in open-dirt feedlot pens. Diet formulation can have important impact on the amount of N and P excreted in both dairy and beef. It is much easier to control potential pollutants by managing their release into the environment than to recover or confine them once they are released.

Key Words: Nitrogen, Phosphorus, Ruminant

591 Nutritional strategies to reduce environmental emissions from non-ruminants. P.R. Ferket*[1], R.C. Angel[2], E. van Heugten[1], and T.A. van Kempen[1], [1]*College of Agriculture and Life Sciences, North Carolina State University, Raleigh, NC 27695,* [2]*Department of Animal Science, University of Maryland, College Park, MD 20742-2311.*

The amount of nutrients (i.e. N, P, Zn and Cu) and associated odors emitted from production animals into the environment can be modulated by several different nutritional strategies, but their practical application is dependent upon costs and other biological limitations. In general, nutrient excretion may be reduced by avoiding the feeding of excessive amounts or using nutritional manipulations to enhance nutrient utilization in the animal. Manufacture and handle feed to minimize wastage and improve feed/gain. Develop feeding programs that are specific for sex and strain of animal, increase the number of feed phases, and formulate diets according to the minimum nutrients required to satisfy production goals. Use the ideal protein concept to estimate amino acid requirements and use synthetic amino acids supplements to reduce N emission. Use feed ingredients with high digestibility and nutrient bioavailability, and formulate diets based on nutrient availability instead of total nutrient content. Nutrient digestibility of feedstuffs is dependent upon processing conditions, genetic characteristics of the grains and oilseeds, and the presence of nutritional antagonists in the diet. Avoid feed ingredients that lead to odor production (e.g. fishmeal and some easily fermentable feed ingredients). Use feed additives, such as antibiotics, nonstarch polysaccharides, direct-fed microbials, organic acids, microbial enzymes (i.e. phytase, carbohydrases, and proteases) to increase the digestibility and absorption of nutrients or to modulate microflora. Finally, a cost factor for the control or disposal of nutrients or odor should be considered in the feed formulation to optimize the various nutritional strategies discussed above. Regardless of biological and economic limitations, significant reductions in nutrient and odor emission from non-ruminants can be achieved by appropriate nutritional strategies.

Key Words: nutrition, nutrient and odor emission, non-ruminants

592 Development of comprehensive nutrient management plans: Practical aspects of getting nutrient management plans implemented . Mary Combs*[1], [1]*USDA-Natural Resources Conservation Service, Raleigh, NC.*

The 1998 Clean Water Action Plan required the EPA and USDA to jointly develop a unified strategy to minimize the environmental and health impacts of the nation's animal feeding operations (AFOs). This Unified National Strategy for Animal Feeding Operations identified a national expectation that all AFOs develop and implement Comprehensive Nutrient Management Plans (CNMPs) by 2009. Focusing on the smaller, non-regulated (federal) AFOs with limited resources, NRCS and its partners may need to assist with an estimated 262,700 CNMPs across the U.S. to meet this expectation.

Significant CNMP development and implementation issues remain: (1) Substantial resources for staff and training are required to provide this accelerated technical assistance for CNMP development. Developing the CNMP is just the first step; considerable follow-up with producers is required to assist with operation, maintenance, and revision of the Plans as producers' needs change. (2) More research is needed in several critical areas to better understand nutrient movement and validate states' phosphorus indexes and models that assess potential nutrient losses. (3) In areas of concentrated AFOs and limited land for application, nutrient management policy may result in no technically or economically feasible solutions for the producer. (4) Both regulators and technical specialists must recognize the economic situation of producers. The cost of waste management systems is site specific, and is not only a function of operation size. The special challenges to limited resource farmers must be considered. (5) Cost sharing and incentives are inadequate to meet the needs. In North Carolina, USDA's Environmental Quality Incentives Program and the N.C. Agricultural Cost-Share Program fund about 1/3 of the existing demand. (6) Ensuring compatibility with state programs, laws, rules, and certification criteria for technical specialists will continue to a significant coordination effort. (7) NRCS's image by its customers continues to evolve. NRCS practice standards, developed to support voluntary USDA programs, are becoming regulatory instruments, as federal or state regulations reference these standards.

Key Words: AFO, CNMP, NRCS

Novel Genes and Gene Products

593 Differential display as a tool to identify a steroid-induced gene. Robert Kemppainen*, *Auburn University, Auburn, Alabama .*

Differential display is one of several methods designed to identify differentially induced or expressed genes and has been used successfully in many studies to identify new genes in various tissues or cells. The basic method involves collection of RNA from target tissues followed by cDNA synthesis using oligo-dT primers designed to make cDNA from subpopulations of the mRNA. These different cDNA's are then used as templates in PCR in conjunction with the original oligo-dT primer and a set of arbitrary upstream primers. Labeled PCR products are loaded onto sequencing gels so that side-by-side comparisons can be made to identify up- or down-regulated genes. We used the technique to identify dexamethasone-induced genes in a pituitary cell line. Since steroid negative feedback requires gene transcription/translation and the identity of steroid-induced genes is unknown, differential display seemed to be an ideal technique for this purpose. Cells were treated with dexamethasone or its vehicle and RNA was collected and used for differential display. The screen performed used 240 primer combinations, surprisingly; only about 20 induced bands were consistently generated. Of the