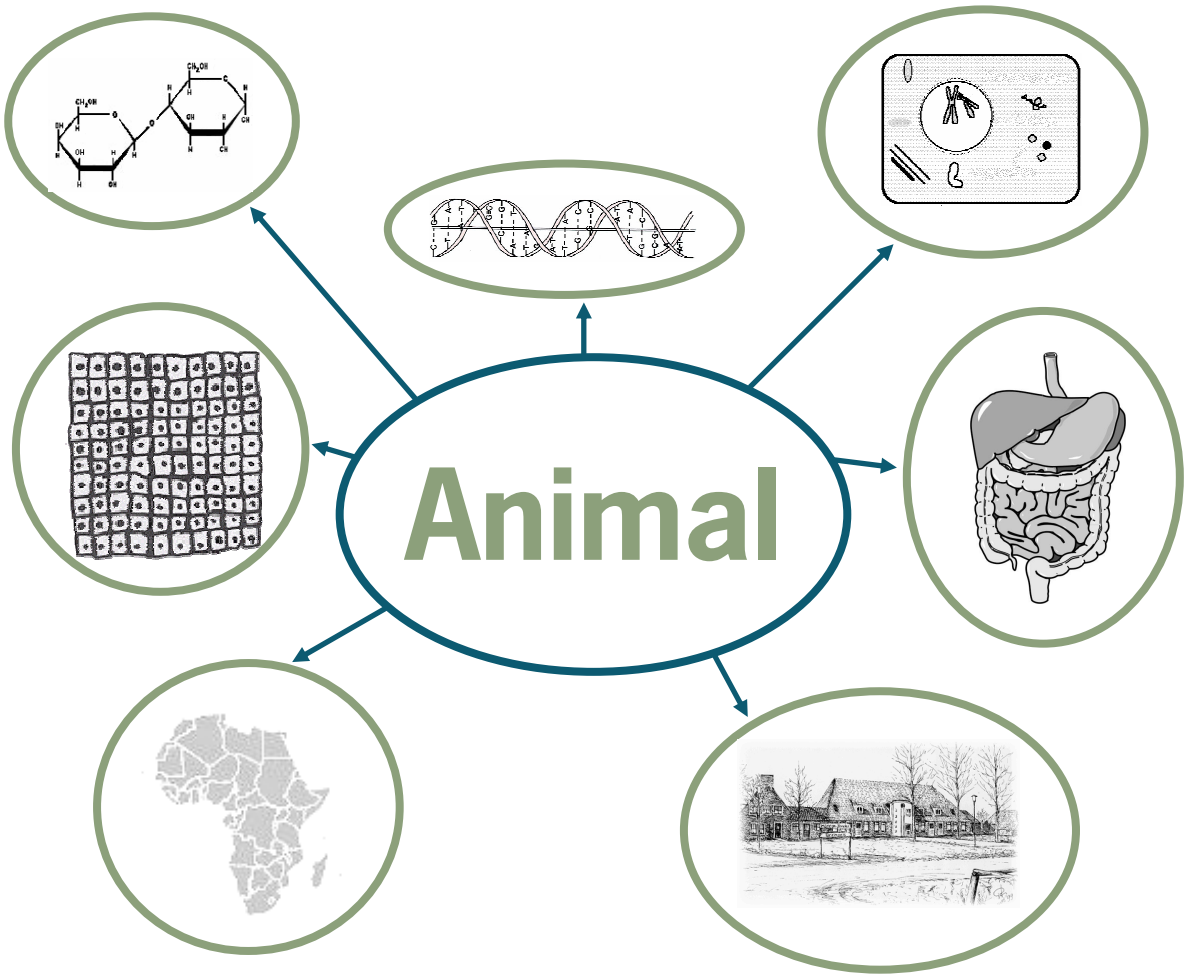
WIAS Science Day

2007



Thursday March 8th

Hotel *De Nieuwe Wereld*, Marijkeweg 5, Wageningen

The Graduate School WIAS WAGENINGEN INSTITUTE of ANIMAL SCIENCES

WAGENINGEN UNIVERSITY
WAGENINGEN UR

WIAS Associated PhD Students

Welcome

Welcome at WIAS Science Day 2007.

The WIAS Science day is the annual meeting where WIAS PhD students present their work to the WIAS community and other interested people. WIAS PhD students organized this day for the first time in 1997, and this year you can enjoy the 11th WIAS Science Day.

This year we divided the WIAS Science Day in two sessions. In the first session different disciplines will cover the intriguing features of birds. After the break, we will zoom in on research with chicken. The second session will show the multidisciplinary scope on animal models used within the Animal Sciences Group. The first part will focus on the research topics concerning mammals, the second part consists of presentations on physiology, stress and food effects in aquatic models.

In addition to these WIAS PhD presentations, we invited Bas Rodenburg and Sjoerd Wendelaar Bonga to introduce themselves and their work to you. Bas Rodenburg has received the prestigious Veni grant in 2006. Sjoerd Wendelaar Bonga recently became the chair of the International Advisory Board.

To give a further overview of the research that is currently performed within WIAS, several posters are presented during lunch break. Subsequently, the best poster presentation and best oral presentation will be awarded. In addition, the best recent publication of a PhD student will be awarded with the WIAS Publication Prize, and a staff member who is actively involved in organizing WIAS courses and seminars will receive the WIAS Education Prize.

Finally, we get together with drinks and a dinner to further discuss the presented research and enjoy the company of our colleagues.

We wish you an informative and inspiring WIAS Science Day 2007!

The WIAS Science Day Committee,

Esther Ellen
Lia Hoving
Prescilla Jeurink
Tosca Ploegaert
Anke Schennink
Laura Star

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10.30 David Lentink – How swifts control their glide performance with morphing wings

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11.20 Marinus van Krimpen – Effect of dietary energy and NSP concentration and particle size of NSP on eating behaviour, feather pecking behaviour and performance of laying hens

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Invited speaker: Bas Rodenburg

Incubation through the embryo's point of view

Sander Lourens

Adaptation Physiology Group

Goal of any hatchery operation is to hatch a good quality day old chick out of any fertile hatching egg that was set. A day old chick of good quality can be defined as a chick of high performance potential. Incubation conditions have impact on hatchability and broiler performance until slaughter age but quantification of day old chick quality however is subject of only a few studies. In these studies, factors as breed, age of the parent stock, egg size, storage, turning frequency, etc. on external appearance after hatch are discussed, and not factors that affect the interaction of the embryo with its direct environment during incubation. Despite a wealth of incubation literature, consistent information about specific requirements that embryos have is poor. When the specific requirements are understood and matched with the environmental conditions, embryonic development and chick quality will be highest. Because the development of an embryo into a healthy hatchling is amazingly complex, this process needs to be simplified to understand the very basic principles of nutrient utilisation and the exchange of gas, mass and heat between egg and environment. During incubation embryos consume O_2 and produce waste products as H_2O, CO_2 and heat, and unused nutrients remain after hatch in the residual yolk. In this review the factors are discussed that limit or stimulate embryonic development in terms of nutrient utilisation, growth and heat production. Within this concept, embryo temperature is presented as key factor that affects metabolic rate, embryo development, hatching results and chick quality.

How swifts control their glide performance with morphing wings

David Lentink[1], Ulrike Müller[1], E.J. Stamhuis[2], R. de Kat[3], W. van Gestel[1], L.L.M. Veldhuis[3], P. Henningsson[4], A. Hedenström[4], J.J. Videler[2,5], Johan van Leeuwen[1]

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[2]Department of Marine Biology, Groningen University, Haren, the Netherlands
[3]Department of Aerospace Engineering, Delft University of Technology, Delft, the Netherlands
[4]Department of Theoretical Ecology, Lund University, Lund, Sweden
[5]Institute of Biology, Leiden University, Leiden, the Netherlands

Birds continually change the shape and size of their wings not only during flapping, but also during gliding flight. When gliding birds adjust wing sweep they are presumably exploiting the profound effect of wing morphology on aerodynamic performance. Theoretical gliding models predict that birds should adjust sweep to suit glide speed, supporting the concept that morphing wings improve glide performance. However, these models predict only coarsely the degree of improvement because they extrapolate the wing's performance envelope from aerodynamic theory. Here, we describe the aerodynamic and structural performance of actual swift wings, as measured in a wind tunnel, and on this basis build a semi-empirical glide model. By measuring inside and outside swifts' behavioural envelope, we show that swifts can substantially improve glide performance: e.g. swifts can halve sink speed or triple turning rate by choosing the most suitable wing sweep. Extended wings are superior for slow glides and turns; swept wings are superior for fast glides and turns. This superiority is due to better aerodynamic performance — with the exception of fast turns. Fast turns cause extreme loads that can only be accommodated by swept wings, which, although aerodynamically inferior, have superior structural strength and dynamic stability. Finally, our glide model predicts that cost-effective gliding occurs at speeds of 8-10 m s^{-1}, whereas agility-related figures of merit peak at 15 to 25 m s^{-1}. Swifts in fact roost at 8-10 m s^{-1}, thus our model can explain behavioural choices in roosting swifts. Morphing adjusts wing performance to the task at hand not only in birds, but could also control the flight of new and improved bird-sized aircraft.

Effect of dietary energy and NSP concentration and particle size of NSP on eating behaviour, feather pecking behaviour and performance of laying hens

Marinus van Krimpen[1], René Kwakkel[2], Carla van der Peet-Schwering[1], Leo den Hartog[3,4], Martin Verstegen[2]

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[2]Animal Nutrition Group
[3]Animal Production Systems Group
[4]Nutreco R&D, Boxmeer, The Netherlands

An experiment with 588 ISA Brown layer strains was conducted to measure the effect of dietary energy (11.8 versus 10.6 MJ/kg) and NSP (133 versus 195 g/kg) concentration and particle size of the NSP fraction (fine versus coarse) on eating behaviour, feather pecking behaviour and egg-performance of laying hens from 18 to 40 weeks of age. Seven experimental diets were tested, each replicated seven times.

Energy reduction, NSP addition and coarse grinding of NSP increased average eating time with 14.2%, 17.2% and 7.9%, respectively. Eating rate was not affected by energy concentration and coarseness of NSP, but NSP addition decreased eating rate with 21.0%.

Dietary treatments did not affect feather condition scores convincingly, although energy reduction and NSP addition improved feather condition scores in some individual weeks. Hens fed normal energy diets showed lower mortality rates if high-NSP diets were supplemented (31.6 versus 44.1%), whereas in low energy diets mortality decreased when hens were fed low-NSP diets (13.1 versus 28.6%) (P=0.071).

Hens that were fed low energy diets compensated for 10% reduction in energy concentration by 9.3% higher asymptotic feed intake (143.0 versus 130.8 g/d). Egg performance and body gain of the hens were not affected by dietary treatments.

It is concluded that hens that were fed low energy, high (coarsely ground) NSP diets spend more time on feed intake, compared with hens that were fed normal energy or low NSP diets. However, these effects were not necessarily reflected by a reduced feather pecking behaviour.

Chicken embryo development during pre-incubation egg storage

Inge Reijrink[1], Henny van Straaten[2], Ron Meijerhof[3], Bas Kemp[1], Henry van den Brand[1]

[1]Adaptation Physiology Group
[2]Department of Anatomy and Embryology, Maastricht University, Maastricht, The Netherlands
[3]HYBRO B.V., Boxmeer, The Netherlands

The average hatchability of broiler chicken eggs is between 80 and 85%. Since the percentage of infertile eggs is about 5%, this means that 10 to 15% of the embryos die during the period of storage and incubation. Egg storage has been reported to have both detrimental as well as beneficial effects on hatchability and seems to be a quantitatively important determinant of embryonic death. During storage changes occur in the egg components (various albumen layers, yolk, egg shell and its membranes) and in the embryo. At oviposition the latter is composed of a multilayered blastoderm with a total of 30.000 to 90.000 cells according to rough estimates. Changes in the blastoderm have not been detected at the morphological, but at the cellular level, but these changes are not very well defined, neither at qualitative nor at quantitative levels. Therefore, in this study, parameters are tested to evaluate embryo development during the storage period with the ultimate goal to improve hatchability and chick quality. Parameters are the proliferative and apoptotic potential and are measured using the number of mitotic, apoptotic and total cells of the blastoderm by accurate countings. Various methods are available to measure these parameters and the advantages and disadvantages of each method will be discussed.

Associations between changes in fear response and performance in adult laying hens housed in battery cages

Koen Uitdehaag, Hans Komen, Bas Rodenburg

Animal Breeding and Genetics Group

This study investigated differences between 12 pure-bred lines in fear response at 23 and 46 weeks of age and the development of the fear response over age. Furthermore, it was studied whether differences in these patterns were associated with differences in performance traits, such as production, mortality and bodyweight.

Laying hens housed in battery cages are kept in a very stimulus-poor environment. Besides other detrimental effects, prolonged exposure to such an environment reduces the ability to adequately respond to possible challenges. Laying hens kept in battery cages will, for example, show stronger fear responses to apparently harmless stimuli than laying hens kept in other housing systems. Fear responses differ between hens of the same age, but hens may also differ in the development of their fear response over age. The development of a bird's fear response over age is thought to reflect the bird's ability to cope with the barren conditions of the cage housing system. An inappropriate fear response may not only cause impaired welfare but may also have negative effects on performance.

Results from our study suggest that there are considerable differences between lines in fear response and its development over time. These results suggest that it would be possible to select for birds with more appropriate fear responses. Development of fear response indeed also affects performance of laying hens in battery cages. Fear response and performance of laying hens in battery cages are therefore associated traits and selection for less fearful birds is expected to improve production as well.

Organic, more healthy?

Ruth Adriaansen-Tennekes[1], Henk Parmentier[2], Huub Savelkoul[3]

[1]Louis Bolk Institute, Driebergen, The Netherlands
[2]Adaptation Physiology Group
[3]Cell Biology and Immunology Group

Most consumers of organic produce either buy organic because they like the taste more or because they believe it is more healthy. True scientific evidence in this direction is missing. Most of the literature that can be found is either anecdotal and/or has never been reproduced.
In able to give an accurate answer to this question, not only does the model need to be extensively investigated, the produce used in the feeding experiment needs to be fully examined as well.
In a first attempt to investigate the abovementioned question a national experiment with several partners has been set up. Each partner is zooming in on one or two aspects of the primary question: Is organic more healthy? Here a problem arises: how can health status, let alone more health be measured? In general, if an organism is not healthy, it may become sick. Common sense suggests that the immune system is the organ to investigate more elaborately when considering health.
Wageningen in collaboration with the Louis Bolk Institute is concentrating on the developing immune system throughout two generations of chickens. The chicken has been chosen as animal model, as there are three lines available, each with a different antibody response to SRBC. In this animal model genetic aspects that may play a role can be examined as well.
Two generations are being examined as in literature it is proposed that the effects may increase over generations. Each generation is examined on parameters that represent the innate immune system as well as the specific immune system. Preliminary results to date are very promising, but as the blinding of the feed has still not been broken, it is unclear what may be more healthy or if this question can be answered by the results produced in this experiment.

Invited speaker: Sjoerd Wendelaar Bonga

Farmers' perception of exotic multipurpose fodder trees, constraints to adoption and preference in the Ethiopian Highlands

Abebe Mekoya Kassa[1], Simon Oosting[1], Salvador Fernandez-Rivera[2], Akke van der Zijpp[1]

[1]Animal Production Systems Group
[2] International Livestock Research Institute, Addis Ababa, Ethiopia

Many organizations in Ethiopia promoted for many years multipurpose fodder trees (MPFT) through the introduction of exotic species for livestock feed and soil improvement. Despite the apparent benefits, the adoption of exotic MPFT (EMPFT) by farmers has been limited. Structured questionnaires and focus group interviews were conducted in three districts and two production systems (cereal and horticulture-based livestock systems) in the Ethiopian highlands to elucidate farmers' perceptions on EMPFT, constraints to adoption, preference to exotic and local MPFT, and feed value assessment with laboratory indicators. Most farmers (95.3%) had awareness of EMPFT and the principal sources of information were development agents (75.3%). About 52.4% of farmers were motivated to plant EMPFT for feed value. Motivation for other purposes depended on cropping system, vegetation cover and availability of alternative local MPFT. Farmers had positive perception on EMPFT for their feed value and contribution to soil and water conservation. Major constraints to adoption were agronomic problems (31.8%), low multipurpose value (20.6%), and land shortage (18.2%). Farmers preferred local MPFT to exotics for biomass, multi-functionality, life span, and compatibility. In terms of feed value, ease of propagation, and growth potential local MPFT were lower than or comparable to exotics. There was strong correspondence between farmers feed value score and laboratory results. We concluded that development organizations should focus on information-and input-sharing systems among farmers, dissemination of MPFT that can fit in to the overall farming objectives, and be aware that farmers' knowledge and locally available MPFT are valuable to alleviate local problems.

Finite element simulations predict remodelling criteria for the collagen fibril framework in articular cartilage

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[1]Experimental Zoology Group
[2]Materials Technology Group, Faculty of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, The Netherlands

Articular cartilage (AC) is the load bearing material that covers the articulating surfaces of diarthrodial joints in mammals. The collagen fibril framework (CFF) in AC plays an important role in the unique mechanical features of AC. It develops from a randomly oriented mesh at birth to the layered structure at maturity that is commonly known as the 'Benninghoff model'.
A fibril reinforced poroviscoelastic swelling (FRPVS) model has been developed that can accurately simulate mechanical behavior of AC. It accounts for the composition and structure of the AC and includes the structure and behaviour of the CFF. Implementing this FRPVS-model into finite element code provides insight into AC mechanics and mechanobiology.
Finite element simulations were performed mimicking development of CFF from birth to maturity. Cartilage samples with different CFF were subjected to 5% strain applied over 10s. Strain was then kept constant for 300s during which the tissue reached mechanical equilibrium.
Simulations with a random framework ('birth') clearly show a non-homogeneous stress state throughout the CFF at every moment in the simulation. With the mature 'Benninghoff' CFF, results show that the collagen is distributed and oriented such that, in equilibrium, each fibril carries an equal amount of stress. At the end of the compression step, when stresses are highest, the Benninghoff model concentrates stresses in the superficial layer.
These simulations indicate that a state of equal fibril stress can be used as a criterion to simulate remodelling of the CFF. Such a criterion further enables us to predict collagen remodelling for different load regimes, and for a variety of cartilage pathologies.

Hepatitis E virus transmission in pigs under controlled conditions

Martijn Bouwknegt[1,2], Klaas Frankena[2], Gerard Wellenberg[3], Ana Maria de Roda Husman[1], Wim van der Poel[4], Mart de Jong[2]

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[2]Quantitative Veterinary Epidemiology Group
[3]Animal Health Service, Deventer, The Netherlands
[4]Animal Sciences Group of Wageningen UR, Lelystad, The Netherlands

Autochthonous hepatitis E virus (HEV) infections in humans from industrialized countries caused by genotype 3 strains are increasingly observed, but their sources are mostly unknown. HEV is ubiquitous in pigs worldwide and high similarity between human and porcine strains of HEV is suggestive of possible zoonotic transmission. However, for pigs to be a reservoir posing a risk for public health, HEV should be able to persist in, and therefore be transmitted among, pigs. To quantify HEV transmission in pigs, two trials of 15 pair-wise transmission experiments were conducted. Per trial, 20 susceptible pigs were housed in five stables, each stable containing two compartments with one pig and one compartment with two pigs. From compartments with two pigs, one pig was intravenously inoculated with HEV. Subsequently, fecal samples from pigs were taken three times per week to examine viral excretion. If a susceptible pig excreted virus at three consecutive samplings it was transferred to the next compartment within a stable to infect the next susceptible pig, and again for the third contact pig. Transmission chain ended when either third contact pigs were infected, or when virus excretion by an infectious pig stopped. Analysis of data results in estimation of the basic reproduction ratio, defined as the average number of cases caused by one infectious pig during its entire infectious period in a fully susceptible population. Preliminary results suggest that R0 for HEV in pigs is significantly greater than 1, but final results and conclusions will be presented.

The effect of different flow regimes on the growth and physiology of the scleractinian coral *Galaxea fascicularis* in a closed aquarium system

Miriam Schutter[1,3], John Crocker[1], Max Janse[2], Ronald Osinga[1], René Wijffels[3], Johan Verreth[1]

[1]Aquaculture and Fisheries Group
[2]Burgers Zoo, Arnhem, The Netherlands
[3]Bioprocess Engineering Group

Water flow is one of the most important abiotic factors influencing the growth of scleractinian corals. Different aspects of flow, such as speed, turbulence and direction, affect prey capture efficiency, exchange rate of dissolved gasses and nutrients, and removal of sediment or mucus.
A long term experiment is performed in a large tank system in Burgers Ocean to examine the effect of different flow regimes (0 cm/s, 10 cm/s, 20 cm/s and 30 cm/s, bidirectional flow) on growth. An additional treatment with unidirectional flow (20 cm/s) is included to compare the effects of unidirectional and bidirectional flow. Ten nubbins (single polyp clones of a coral colony) of *Galaxea fascicularis* are used for each treatment. Growth of these nubbins is measured every six weeks by buoyant weighing and by making polyp counts, and every three weeks by image analysis for surface area for a 30 week period.
In short-term experiments, the efficiency of these corals to capture artemia nauplii under the selected flow regimes is studied in a 1500 cm^3 flow cell. Additional short-term experiments are performed to study photosynthesis and respiration of the corals under the same flow regimes. These short term experiments may provide an explanation for the observed differences in growth.
So far, it is found that the coral nubbins grow less in the zero flow regime, while there is not much difference found in growth between the other flow regimes. Water flow speed seems to have little effect on photosynthetic rate. The experiments are still in progress.

Effects of dissolved oxygen concentration on maximum feed intake and growth of Nile Tilapia (*Oreochromis niloticus*)

Tran Duy An[1], Johan Schrama[1], Anne van Dam[2], Johan Verreth[1]

[1]Aquaculture and Fisheries Group
[2]Department of Environmental Resources, UNESCO-IHE, The Netherlands

Growth of fish depends on feed intake. Modeling and predicting growth requires information on ad libitum feed intake of fish. Feed intake/satiation in fish is regulated by physiological, social and/or environmental factors. Despite the recognition of environmental effects, ambient oxygen concentration has scarcely been seen as a major factor determining feed intake in fish. Oxygen uptake for metabolism in fish is limited by gill surface area and dissolved water oxygen concentration. When oxygen supply does not satisfy oxygen demand, fish may stop eating. This hypothesis was tested and data were obtained for validation of a growth model. Two weight classes of fish (20 g and 140 g) were used. For each class, 6 tanks were used of which half were exposed to one of two oxygen regimes (aeration, high water flow through and no aeration, low water flow through) at 32.8 ^{o}C for 25 days. The fish were fed manually twice per day to apparent satiation with a commercial diet. Feed intake and growth (in g/fish/d, % BW/d or g/kg$^{0.8}$/d) of the fish under high oxygen concentration was significantly higher than under low oxygen concentration ($p < 0.01$). Feed intake (g/kg$^{0.8}$/d) of the small fish under low oxygen concentration (2.8 mg/L) was 22.4 % lower than under high oxygen concentration (5.5 mg/L) and of the big fish under low oxygen concentration (3.2 mg/L) was 24.3 % lower than under high oxygen concentration (5.8 mg/L). The data suggested the importance of gill surface area in feed intake and growth in fish.

Evolution of glucocorticoid receptors with different glucocorticoid sensitivity

Ellen Stolte[1,2], Aurélia de Mazon[1], Karen Leon-Kloosterziel[1], Sandra Janssen[1], Maria Jęsiak[1], Lidy Verburg - Van Kemenade[1], Gert Flik[2], Huub Savelkoul[1]

[1]Cell Biology and Immunology Group
[2]Animal Physiology, Radboud University, Nijmegen, The Netherlands

Glucocorticoids (GCs) play a pivotal role in vertebrate physiology and prepare an organism to cope with stressors by increasing metabolic activity to prepare the organism for fight or flight. Moreover, GCs (cortisol) strongly influence the immune system. GCs are therefore commonly used to treat a variety of immune diseases. However, the efficacy of treatment is greatly influenced by individual variation in sensitivity to GCs, caused by differences in glucocorticoid receptors (GRs). Variable receptor profiles result from variations in GR genes, or alternative splicing of the coding gene. We investigated the evolution of GR genes by comparison of genomic GR sequences of several vertebrates species. Exon length and amino acid sequence are conserved among all classes of vertebrates in line with a strong conservational evolutionary pressure. Interestingly, teleostean fishes have two different GR genes. Moreover, one of the encoded fish GR proteins has a nine amino acid insert in the DNA binding region which results from alternative splicing. Quantitative PCR and *in situ* hybridization showed differential expression of the duplicate GR genes and products of alternative splicing in teleostean fishes. Moreover, the different receptors and receptor subtypes display different affinities for dexamethasone and different trans-activation capacities for cortisol *in vitro*. This suggests different functions for the receptor subtypes. As a result of an early genome duplication, teleostean fishes express different, evolutionary related, functional GR proteins within a single organism. As a result teleostean fishes present a model to investigate the molecular basis of cortisol resistance and different regulatory functions of cortisol.

Determination of allele origin in crossbred animals

Albart Coster – Animal Breeding and Genetics Group

Feeding level does not affect P4 levels or embryo survival in Intermittently Suckled sows

Rosemarijn Gerritsen – Adaptation Physiology Group

Life-history characteristics of Volga-Akhtuba floodplain fish

Konrad Gorski – Aquaculture and Fisheries Group

Environmental factors affecting the prevalence of insect bite hypersensitivity in Dutch horses

Ilse van Grevenhof – Animal Breeding and Genetics Group

Exploring tradeoffs between prevention, monitoring and control of Avian Influenza – a welfare economic approach

Natascha Longworth – Business Economics Group

Effect of feed on early development of chicks

Roos Molenaar – Adaptation Physiology Group

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Mohammad Ali Nematollahi – Aquaculture and Fisheries Group

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Yang Zhao – Quantitative Veterinary Epidemiology

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