Programme of the Annual Meeting of the Netherlands Society for Behavioural Biology
Soesterberg, 23-25 November 2011

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Wednesday, 23 November

17:30 *Registration*

18:00 *Dinner*

Baerends lecture – chair: Simon Verhulst
20:00 **Jens Krause** (Humboldt University Berlin)
Social Networks and Collective Behaviour

21:00 *Posters + first drink in Cecilia Kapel sponsored by Brill, publisher of Behaviour; bar open in the main building*

Thursday, 24 November

07:30 *Breakfast*

Session: Applied behavioural biology – chair: Liesbeth Bolhuis
09:00 **Inonge Reimert** (Wageningen University)
Behavioural and physiological indicators of emotional state in pigs
09:30 **Elske de Haas** (Wageningen University)
Fear and stress in groups of laying hens
10:00 **Lies Zandberg** (Wageningen University) *Social network analysis of horses (*Equus caballus*) and the effects of removal of individuals*

10:30 *Coffee/tea*

Session: Bird behaviour – chair: Katharina Riebel
11:00 **Sanne Moorman** (Utrecht University)
Memory-related dominance of the left hemisphere in the songbird brain
11:20 **Martina Muller** (University of Groningen) *Is within-clutch variation in yolk androgens an adaptive maternal effect to modulate sibling competition in birds?*
11:40 **Pralle Kriengwatana** (University of Western Ontario)
Effects of juvenile stress on learning, body composition, and immune function

Invited lecture: New Chair in Behavioural Biology
12:00 **Marc Naguib** (NIOO; new Professor Behavioural Ecology Wageningen University)
Animal communication networks

12:45 *Lunch*

13:45 ***Poster session***
(see below for a list of the posters) + Coffee/tea

Session: Acoustic signals – chair: Carel ten Cate
15:00 **Wouter Halfwerk** (Leiden University)
Urban noise affects community ecology
15:30 **Errol Neo** (Leiden University) *The impact of artificial noise on swimming behaviour and spatial distribution of captive zebrafish (*Danio rerio*)*
16:00 **Hans Slabbekoorn** (Leiden University) *Spectral flexibility in singing chiffchaffs during experimental noise exposure in the field*

16:30 *Huishoudelijke vergadering/general meeting**

17:30 *Bar open (in the Winter Garden)*
18:00 *Dinner in the Winter Garden*

Invited Lecture – chair: Marc Naguib
20:00 **Julia Fischer** (German Primate Center and Göttingen University)
Monkey minds: From simple communication to complex cognition

21:00 *Drinks in the Winter Garden sponsored by Noldus Information Technology; Demonstration (in the Cecilia Kapel) of The Observer*

Friday, 25 November

07:30 *Breakfast*

Session: Emergent properties and multilevel effects – chair: Joris Koene

09:00 **Monique de Jager** (NIOO-CEME, Yerseke)
Individual behavior in self-organized mussel beds

09:30 **Michael Briga** (University of Groningen)
Effects of foraging costs on lifespan depend on developmental conditions

09:50 **Jelle Boonekamp** (University of Groningen) *Telomere length behaves as biomarker of somatic redundancy rather than biological age*

10:10 **Giulia Gracceva** (University of Groningen) *Early environment and maternal phenotype influence personality development and stress sensitivity in rats*

10:30 *Coffee/tea*

Session: Applied behavioural biology – chair: Peter Roessingh

11:00 **Valerie van den Bos** (University of Amsterdam)
Stereotypic behaviour in zoo-housed animals

11:20 **Irene Camerlink** (Wageningen University)
Relation between social behaviours, genetics and growth rate in finishing pigs

11:40 **Courtney Daigle** (Michigan State University) *Developments and directions of monitoring non-cage laying hens using a wireless body mounted sensor*

12:00 **Paul Koene** (Wageningen University) *Behavioral ecology of captive species: using behavioral adaptations to assess and enhance welfare of captive animals*

12:30 *Lunch*

Session: Communication and partner choice – chair: Johan Bolhuis

13:30 **Paulien de Bruijn** (University of Amsterdam)
Context-dependent communication in a non-social insect

14:00 **Jorg Massen** (Utrecht University) *Primate stock exchange: opportunistic partner choice or long-term stable relationship?*

14:30 **Arne Iserbyt** (Antwerp University) *Frequency-dependent mating patterns and the maintenance of female polymorphism in damselflies*

15:00 **Alzbeta Talarovicova** (University of Groningen) *Female genital masculinisation, maternal androgens and behavioural adaptations of two wild* Cavia *species*.

15:30 *Poster prizes and closure by Simon Verhulst (president of the Netherlands Society for Behavioural Biology)*

Coffee/tea + end of meeting

Please remember to return your room key and name badge before leaving!

Posters

Joris Koene (VU University Amsterdam) *True injection of male accessory gland products via a love dart in a hermaphroditic land snail.*

Marije Oostindjer (Wageningen University) *Increased opportunities to interact with the mother affect responses of piglets to weaning and a change of environment*

Paul Koene (Wageningen University) *Environmental change and effects on welfare of captive King Penguins (*Aptenodytes patagonicus*).*

Paul Koene (Wageningen University) *Social Network Analysis in laying hens (*Gallus gallus domesticus*).*

Seyedmehdi Amininasab (University of Groningen) *Preliminary study on the breeding biology of the Penduline tit (*Remiz pendulinus*) in Iran.*

Ioannis Leris (Utrecht University) *Guppies remember shoal locations in a spatial memory task.*

Erica van Rooij (Macquarie University Sydney) *Mate choice for bill colour in a sexually monomorphic finch.*

* Agenda huishoudelijke vergadering/general meeting

1. Notulen jaarvergadering 2010
2. Verslag over 2011
3. Financieel jaarverslag & verslag Kascommissie
4. Benoeming nieuwe Kascommissie
5. Plannen en begroting voor 2012
6. Bestuurssamenstelling
   Alleen de termijn van de voorzitter (Simon Verhulst) loopt af – hij stelt zich beschikbaar voor een 2e termijn.
7. Rondvraag
8. Sluiting

Sponsors

We thank the following institutions for financial support:

The division Earth and Life Sciences of the Netherlands Organisation for Scientific Research (ALW / NWO), Noldus Information Technology, Brill (publisher of Behaviour), and Royal Society Publishing (poster prize).

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Contributed presentations NVG meeting Soesterberg 2011

Telomere length behaves as biomarker of somatic redundancy rather than biological age

Jelle J. Boonekamp, Mirre J.P. Simons, Lia Hemerik & Simon Verhulst; Behavioural Biology, University of Groningen, the Netherlands

Telomeres are terminal DNA-protein complexes that act as 'protective caps' of linear chromosomes. Telomeres shorten with age and when telomeres reach a critical length this induces cell-cycle arrest or apoptosis. These properties make telomere length (TL) a candidate biomarker of ageing, but studies on the association between TL and mortality in humans have yielded inconsistent results. Here we show with meta-analysis that TL does indeed predict mortality when studies are pooled. However, we find that this mortality association diminishes significantly with sampling age, explaining most of the observed heterogeneity. We demonstrate with simulation models that this observation cannot be reconciled with the hypothesis that TL is proportional to biological age. Instead we propose TL to be a biomarker of somatic redundancy-the body's capacity to absorb damage-a model that fits the observed data. Our results suggest that diminishing somatic redundancy with age may be causal to the ageing process and provides a novel explanation for diminishing mortality associations reported for other biomarkers of ageing (blood pressure, cholesterol and body mass index). Considering diminishing somatic redundancy with age as causal agent of ageing may critically advance our understanding of the ageing process.

Effects of foraging costs on lifespan depend on developmental conditions

Michael Briga, Egbert Koetsier & Simon Verhulst; Behavioural Biology, University of Groningen, the Netherlands

Growing up in a poor environment is known to have long-term negative effects on many fitness related traits. However, these long-term effects have mainly been investigated in high quality adult environments. Here, we investigate whether individuals that experienced improved rearing environments cope better or worse with increased foraging costs during adulthood. We perform our experiments in zebra finches. We manipulate the rearing environment by having birds growing in small broods or in large broods. Birds from large broods have impaired growth. In adults we manipulate the energetic cost per food reward, which are either low or high. We find that in the low cost environment, the quality of the rearing environment does not affect lifespan. In the high cost environment however, birds from small broods live longer than birds from large broods. Our results show that the effects of increased foraging costs on life span depend on developmental conditions and those individuals from improved rearing environments cope better with increased foraging costs.

Relation between social behaviours, genetics and growth rate in finishing pigs

Irene Camerlink, P. Bijma & J.E. Bolhuis; Adaptation Physiology Group, Wageningen University, The Netherlands

Group housed animals affect each other's welfare, health and productivity through their social behaviour. The social effect of a pig on growth rate of its pen mates is partly genetic and can be described by a Social Breeding Value (SBV). The SBV is an individual's heritable effect on the growth of its pen mates. The mechanisms underlying SBVs in pigs are largely unknown. Here we investigate 1) the effect of social behaviours on growth rate in pigs, and 2) the relationship between social behaviours and SBVs in group housed pigs. On a commercial pig farm, 324 fattening pigs in 45 pens (8 pigs per pen) were observed at 12 w of age using 2-min instantaneous scan sampling for 6 h during daytime. Pens had a barren floor and contained a single space feeder. Estimated SBVs for growth rate were available for each pig and production data were gathered after slaughter. The ethogram distinguished between behaviours given and received. Results were analysed with SAS 9.1. by a Mixed Procedure. Pigs that received more oral manipulation grew less ($P<0.05$). Pigs receiving more social nosing had a higher growth rate ($P<0.05$). For instance, pigs that received social nosing more than 1.5% of the time grew on average 30.3 ± 12.7 g/d faster than pigs that did not receive nosing from their pen mates ($P<0.05$). Pigs with a SBV above group average tended to show more social nosing ($P=0.1$) than pigs with a SBV below average. Our results show that negative social behaviours tend to decrease growth while positive social behaviours can increase growth performances in pigs. Pigs with a high SBV for growth rate tended to show more positive behaviours, suggesting opportunities for breeding towards improved social behaviours and group productivity simultaneously.

Developments and directions of monitoring non-cage laying hens using a wireless body mounted sensor

Courtney L. Daigle[1], Debasmit Banerjee[2], Janice M. Siegford[1], Subir K. Biswas[2] & Janice C. Swanson[1]; [1]Animal Behavior & Welfare Group, Department of Animal Science, MSU, East Lansing, USA, [2]NeEWS Laboratory, Department of Electrical & Computer Engineering, MSU, East Lansing, USA

A novel lightweight (10g) wireless body-mounted sensor system was developed to remotely monitor the location and activity of laying hens within non-cage housing systems. Social demand and legislation in the United States and Europe are catalyzing a transition within the egg industry towards non-cage housing systems. However, flock size in non-cage systems can reach upwards of tens of thousands of hens, which makes visually monitoring individual bird health, welfare, and movement difficult. This sensor was placed inside a casing and mounted on a hens back with a figure eight nylon harness. The casing was

colored to match hen feather color and painted with a unique number for easy visual identification. Pilot research on a small test flock of 25 hens shows agreement of at least 84% was consistently obtained between data from the sensor system and video concerning the hen's proximity to key resources (i.e., nestboxes, perches, water, and feeder) and further work in a larger group of 135 hens shows agreement of at least 77%. Preliminary matching of sensor accelerometer data to video observations suggest a strong relationship between accelerometer data showing high levels of activity with video observations of hens performing behaviors, such as dustbathing, that involve vigorous movement. A similar relationship was observed between accelerometer data showing low levels of activity with observations of less active behaviors, such as sitting or preening. Currently the system is being trained to recognized specific behaviors from individual hens to be used in a real-life context. Hens quickly habituated to sensor presence indicated by minimal differences in hen resource use and physical body measurements when compared to non-sensor wearing hens. Future work will combine location and activity detection to provide a real-time monitoring system capable of tracking individual hen location and resource use in large groups.

Context-dependent communication in a non-social insect

Paulien J.A. de Bruijn[1], Astrid T. Groot[1,2], Arne Janssen[1], Maurice W. Sabelis[1] & Martijn Egas[1]; [1]Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, The Netherlands, [2]Max Planck Institute for Chemical Ecology, Jena, Germany

Communication is the basis of social interactions. It involves sending and receiving signals and a decision of the receiver as to which action to undertake. Signals may be sent in a fixed form (e.g. sex-pheromones) or in a form that varies in relation to the context (e.g. signals conveying information on the quality of a food source). Because danger may come from a variety of sources and these sources vary in the risk they impose, it is hypothesized that alarm signals are context-dependent. Indeed, the literature on vocal alarm in vertebrates lends support for this hypothesis, but the literature on chemical alarm signals, largely pertaining to invertebrates, lacks a critical test and seems to suggest that alarm pheromones do not vary within species. We have tested for context-dependence of an alarm pheromone of the Western Flower Thrips, *Frankliniella occidentalis*. In the presence of danger, thrips larvae excrete anal droplets containing an alarm pheromone that is supposed to consist of decyl acetate and dodecyl acetate. Although it is known that the ratio of the two alarm chemicals change with the age of the thrips larvae, it is not known whether it can change with the type of predator imposing death risk to thrips larvae. Our experiments provide evidence that signal-sending thrips larvae modify the ratio of the two alarm chemicals depending on whether they face the risk of being eaten by a predatory mite (low risk) or by a predatory bug (high risk) and that the alarm pheromone induces a response in the signal-receiving thrips larvae that depends on the context perceived by the sender. In future tests we hope to assess whether thrips larvae communicate the nature of danger to kin and non-kin larvae.

Fear and stress in groups of laying hens

Elske N. de Haas, Marjolein S. Kops, Elizabeth J. Bolhuis & Bas T. Rodenburg; Adaptation Physiology Group, Wageningen University, The Netherlands

In laying hens, fearfulness at a young age has shown to be a predisposition for performing feather pecking at an adult age. Our objective was to understand the mechanism by which fearfulness leads to feather pecking. Therefore, we compared fear-responses of individual birds from a low mortality line (selected for low mortality due to cannibalism) and a control line (80 birds/line). The fear tests were: an Open Field (OF) test at 6 wk. of age and a Manual Restraint (MR) test at 33 wk. of age. Behavioural responses in the OF test were recorded, and plasma-corticosterone concentrations were determined immediately after the MR test. Individual and group correlation values between both tests were compared with the pearson correlation procedure. Only on group level strong correlations between fearful behaviour in the OF test and corticosterone response after the MR test were found ($r=0.64$). Chicks from the low mortality line showed a reduced fear response in the OF compared with chicks from the control line. Feather pecking occurrences were low and could therefore not be associated with fearfulness or stress. This study shows that fearfulness in a group can have long-lasting effects on stress levels in the group, which may create a risk in the development of feather pecking. The results of this study can help in understanding the relation between fearfulness and feather pecking.

Individual behavior in self-organized mussel beds

Monique de Jager; Spatial Ecology Department, NIOO-CEME, The Netherlands

When it comes to the field of evolutionary ecology, we often assume that animal behavior has evolved to be adaptive to a given environment. However, the fact that animal behavior can also affect environmental conditions and thereby can shape the animal's habitat is frequently disregarded. Here, we show that the movement and cooperative behavior of mussels have evolved through the interaction between individual mussel behavior and environmental complexity. In mussel beds, mussels self-organize into a labyrinth-like pattern that both provides shelter against wave action and predation and maintains low levels of competition for food at the same time. Our mesocosm experiments show that young mussels make use of a Lévy walk to move around in search of conspecifics. Using an individual based model, we discovered that this Lévy walk is the most efficient movement strategy to create a patterned mussel bed. After settling down in a patterned bed, mussels decrease the risk of becoming

dislodged by producing a glue-like substance, called byssus threads, and attaching themselves with these byssus threads to conspecifics. As both the recipient as well as the producer of the byssus thread benefit from the attachment, free-riding might be a preferred strategy in a cooperating population. However, our mesocosm experiments show no signs of free-riding mussels as well as any conditional cooperation when including artificially created free-riders. Using an individual based model, we discovered that cooperative mussel behavior evolves through the interplay between self-organized pattern formation and multi-level effects of cooperation. Overall, we can conclude that the movement and cooperative behavior of mussels are not only affected by local conditions but also shape the environment in which they thrive.

Early environment and maternal phenotype influence personality development and stress sensitivity in rats

Giulia Gracceva, Jaap M. Koolhaas & Ton G.G. Groothuis; Behavioral Physiology & Behavioral Biology CBN, University of Groningen, The Netherlands

Animal personality it is predominantly studied from a functional and evolutionary perspective and not much attention has been paid to its (potential adaptive) developmental plasticity. This may be relevant since either the mother or the young may adjust personality according to changes in the environment. Since in rodents the sex ratio of the litter influences later aggression, we studied the effect of litter composition on the development of personality in the Groningen wild-type rat, known for variation in personality. We use litters of 6 pups with either a strong male or female bias. We measured aggression, defensive burying and open field behaviour as well as the level of plasma corticosterone after a challenge. Contrary to expectation the treatment did not have main effects on single behaviors. Nevertheless, correlations between behaviours changed over time irrespectively of the treatment suggesting that early handling may disrupt adult personality. Both prenatal litter size and maternal body weight before pregnancy predicted plasma corticosterone levels of the offspring which are linked to personality structure. Similarly, maternal burying behavior and body weight also predicted offspring burying behavior. Overall these findings suggest (1) long-lasting effects (programming) of the prenatal-maternal environment on personality and (2) additional plasticity in personality due to early postnatal handling.

Urban noise affects community ecology

Wouter Halfwerk & Hans Slabbekoorn; IBL, Leiden University, The Netherlands

Anthropogenic noise can affect animals through disturbance or through masking of acoustic signals and cues. The impact of noise is likely to be species-specific and may therefore alter species interactions within ecological communities. For instance, noise can change population dynamics if breeding behaviour of competing species is affected differentially. We examined whether urban noise had an impact on two bird species, the great tit (*Parus major*) and the blue tit (*Cyanistes caeruleus*), that are known to compete over nest cavities. We provided an equal number of noisy and control nest boxes and found a species-specific occupancy pattern. Great tits were found to breed more often in quiet control boxes, whereas blue tits were found more often in the noisy nest boxes. Furthermore, we found an impact of noise on clutch size within species, with blue tits in noisy nest boxes laying smaller clutches. Our data show that great tits avoid settling in a noisy nest box and suggest that blue tits may indirectly benefit from anthropogenic noise through heterospecific competition release. Anthropogenic noise can alter complex interactions among species, which may not always translate into a clear impact of noise at the individual or population level.

Frequency-dependent mating patterns and the maintenance of female polymorphism in damselflies

Arne Iserbyt; Evolutionary Ecology Group, Antwerp University, Belgium

As in many polymorphic systems, frequency-dependent selection is thought to be one of the most powerful mechanisms to maintain phenotypic and genetic variation within populations. Polymorphism limited to the female sex occurs in a number of taxa, but is especially common in damselflies. When present, co-existence of multiple female morphs is commonly explained as an evolutionary outcome to reduce excessive male harassment. In the polymorphic damselflies *Nehalennia irene* and *Ischnura elegans*, we show under experimental and field conditions that harassment level towards female morphs is related to their frequency in the population. Specifically, the rarest morph in the population may have an advantage over the other(s), because these females are less preferred and less chosen by mate searching males. Similarly under natural conditions, the rarest morph is relatively more single and thus less prone to time consuming and sometimes costly mating activities. These results indicate negative frequency-dependent male mate searching and contribute to our understanding of female polymorphism and its underlying mechanisms.

Behavioral ecology of captive species: using behavioral adaptations to assess and enhance welfare of captive animals

Paul Koene; Department of Animal Sciences, Wageningen University, The Netherlands

Species with specific environmental adaptations may show specific behavioral adaptations, difficulty in adapting to a new environment, and hence suboptimal functioning and fitness. Discrepancy between natural behavioral adaptations and behavioral possibilities in captivity may cause welfare problems. Aim of the project is to estimate a species' suitability for living in captivity, assess welfare, suggest environmental

changes, and find species characteristics that underlie welfare problems in captive animals. Databases of species characteristics are set-up using literature of natural behavior (1) and captive behavior (2). Species characteristics are grouped in eight functional behavioral ecological fitness-related categories related to space, time, metabolic, safety, reproductive, comfort, social and information adaptations using a model of welfare optimization. Assessments of the strength of behavioral adaptations in relation to environmental needs are made based on results available from literature. The databases with literature on species level are coupled with databases of behavioral observations (3) and welfare assessments (4) under captive conditions. The represented structure produces best professional judgments, shows discrepancies between environmental responses in different environments and suggests ways for improvement (environmental changes). The functional behavioral category approach is compared with and incorporates principles, methods and outcomes developed in the Welfare Quality® project. Behavioral data from many MSc-projects covering 10 Dutch zoos and 45 species are used (mammals, birds and reptiles). In conclusion, the comparison of the complete repertoire of behaviors in natural and captive environments highlights welfare problems, the solution of welfare problems by environmental changes and the species characteristics underlying zoo animal welfare problems.

Effects of juvenile stress on learning, body composition, and immune function

B. (Pralle) Kriengwatana, H. Wada, S.D.T Aitken & S.A. MacDougall-Shackleton; Psychology, University of Western Ontario, USA

In a variety of songbirds, stress during early development (before nutritional independence) has been shown to impair adult song and reduce volume of some brain regions of the song control system. Early stress has also been shown to impair spatial ability and reduce hippocampal volume in a food-storing bird. Although development of these brain regions likely continue throughout the juvenile period (after nutritional independence, but before sexual maturation), very few experiments have considered the effects stress on brain and behaviour during this period. We tested the hypothesis that nutritional stress during the juvenile stage in zebra finches adversely affects song learning and production, visual and spatial associative learning abilities, and behavioural flexibility. We also measured body composition and immune function to investigate whether cognitive ability is associated with body condition, and whether this relationship is affected by developmental stress. Our preliminary results indicate that juvenile stress increases immune function and percentage of body fat, but reduces song production and spatial associative learning ability. This suggests that birds that experience stress as juveniles may invest in growth of physiological systems, but at the expense of impaired cognition.

Primate stock exchange: opportunistic partner choice or long-term stable relationships?

J.J.M. (Jorg) Massen & E.H.M. (Liesbeth) Sterck; Behavioural Biology, Utrecht University, The Netherlands

Primate research on social relations over the last decades has resulted in two distinct and opposite hypotheses. Either primates do not entertain true social relations and social bonds are merely a by-product of social interactions over short periods with the goal of satisfying immediate needs, or primates do entertain long-term, stable and enduring social bonds with each other. Whereas the first hypothesis suggest that social acts are traded on a biological market, the latter suggests that such exchanges are merely a by product of or a way of maintaining the social bond. Here we report on a long-term observational study on two different species of macaques. We show that these macaques do not exchange commodities on the short term. Furthermore, we show that proximity is the main predictor of the exchange of commodities. Finally we show that these proximity patterns are stable over several years, suggesting that they differ from random and show true differentiations in interaction patterns among group members. Therefore, we conclude that at least the macaques in our study entertain long-term, stable and enduring social bonds that result in the exchange of commodities.

Memory-related dominance of the left hemisphere in the songbird brain

Sanne Moorman[1], S.M.H. Gobes[2], M. Kuijpers[1], M.A. Zandbergen[1] & J.J. Bolhuis[1]; [1]Behavioural Biology and Helmholtz Institute, Utrecht University, The Netherlands, [2]Organismic & Evolutionary Biology and Centre for Brain Science, Harvard University, Cambridge, USA

There are several behavioural and neural parallels between birdsong learning and human speech acquisition. Zebra finches learn their songs during a sensitive phase, by imitating an adult conspecific (usually their father), much like human infants learn to speak. Songbirds' first vocalizations are called subsong, and do not resemble adult song very well, similar to 'babbling' in human infants. By comparing these sounds to a memorized template, the vocalizations develop into a good copy of the model. In adult humans, speech and language-related neural activity occurs predominantly in two brain regions, namely Broca's and Wernicke's areas. Broca's area is most important for speech production, while Wernicke's area is involved in language perception and understanding. Analogous brain regions with a similar functional dissociation exist in the avian brain. The HVC (proper name) is involved in vocal production, while the caudomedial nidopallium (NCM) is important for auditory perception and song memory. In humans, language-related activity is mostly lateralized to the left hemisphere. A left-sided dominance for speech perception was already demonstrated in three-months-old infants. Given the

many parallels between songbirds and humans, we investigated whether there is similar hemispheric dominance in song processing in juvenile songbirds. To this end, we exposed three groups of male zebra finches (54-59 days old) to either song of their father, an unfamiliar conspecific song, or no song. We measured neuronal activation bilaterally in the Wernicke-like brain region NCM, and the Broca-like brain region HVC. There were remarkable lateralization differences between those brain regions. In the NCM, we found a left-sided dominance of responsiveness to the tutor song, but not in the other two groups. Thus, we demonstrated memory-specific lateralization in this brain region. In the HVC, neuronal activation was significantly greater in the left side than in the right side, in all stimuli groups. Since the birds did not sing before and during stimulus exposure, the lateralized activation pattern may reflect off-line song processing. Similar to the speech-induced lateralization of human infants, the present findings suggest that there is left-sided dominance for song processing in juvenile male zebra finches.

Is within-clutch variation in yolk androgens an adaptive maternal effect to modulate sibling competition in birds?

Martina Muller & Ton Groothuis, Behavioural Biology, Institute of Behavioural Neurosciences, University of Groningen, The Netherlands

Two decades ago, avian egg yolks were discovered to contain substantial concentrations of maternal androgens that vary systematically over the laying sequence in many species but in different patterns. Experimental studies have shown that more often than not, embryonic exposure to higher yolk androgen concentrations produces nestlings with more competitive phenotypes although mothers apparently must balance these benefits with some associated costs such as increased energy expenditure and compromised immune function. It many species, mothers lay more eggs than they succeed in rearing in most years. Evolutionary theory posits that surplus offspring serve as a "reproductive bonus" in extremely good years or as replacement offspring when some eggs or chicks fail; hatching asynchrony facilitates trimming of competitively disadvantaged late-hatching (marginal) chicks when resources become insufficient to rear the whole brood. These ideas have been applied to explain patterns of within-clutch variation in yolk androgens: yolk androgens may compensate or enhance the competitive asymmetries among siblings arising from hatching asynchrony and facilitate adaptive brood survival or brood reduction strategies. In a comparative analysis, we find a negative correlation between hatching spread and change in yolk androgens over the laying sequence -higher yolk testosterone exposure in marginal chicks appears to only be profitable when differences between synchronous early chicks (core chicks) and marginal chicks are small. This may reflect two reproductive strategies: it has been suggested that larger hatching spreads are associated with species in which marginal offspring serve primarily as replacement offspring (e.g. obligate brood reducers), and smaller hatching spreads are found in species in which marginal chicks are more likely to contribute a "reproductive bonus" in good years. In the latter case, yolk testosterone may help them overcome the disadvantages of hatching late when abundant food cancels out some of the associated costs of yolk testosterone. We also find that in species in which a larger proportion of the brood hatches asynchronously, clutches show a steeper increase in yolk androgen concentrations over the laying sequence. In other words, mothers appear to supply marginal eggs more generously with yolk testosterone if they contribute more to the brood's potential reproductive value. In addition to between-species comparisons in patterns of yolk androgens over the laying sequence, we discuss within-species variation as well as avenues for further research.

Animal communication networks

Marc Naguib; Department of Animal Ecology, Netherlands Institute of Ecology (NIOO-KNAW), The Netherlands

Animals need to obtain information on their conspecifics in order to decide on behavioral strategies in mate choice or in resolving conflicts over competition for resources. One important source of information are signals by conspecifics. Information obtained for others' signals can be derived from specific signal traits or from the way there are used in signaling interactions with others. In a social network, animals often have to evaluate relative differences among conspecifics in order to assess who is the best available partner for reproduction or who is the strongest competitor, and such relative information may best be obtained by attending to asymmetries of their signaling interactions. Song birds are an excellent model to study interactive aspects in communication as birds frequently use their song to interact over long distances with rival males. These interactions commonly are asymmetric in the sense that each of the interactants is using its songs differently in relation to the opponent's songs. This talk outlines the general framework of animal communication networks and discusses the broader implications for social networks using birdsong as an example.

The impact of artificial noise on swimming behaviour and spatial distribution of captive zebrafish (*Danio rerio*)

Errol Neo, Lisa Parie, Frederique Bakker, Peter Snelderwaard & Hans Slabbekoorn; IBL, Leiden University, The Netherlands

Over the last century, human activities in and around the water have introduced an increasing amount of artificial noise to the underwater environment. Since fish are known to use sounds for a variety of functions, the increasing anthropogenic noise levels underwater may negatively affect fish by means of physical damage, physiological stress, communication disruption, behavioural modification and distribution change. Although various anthropogenic noise sources

have been identified and addressed, little is known about how different features of noise exposure vary in their impact on fish. To test for the effects of temporal structure of noise on fish, two complementary experiments were conducted using zebrafish exposed to artificially generated noise types varying in terms of pulse intermittency, repetition rate and predictability. In one set-up, fish had no escape option, in the other set-up they could escape our noise exposure. We will report behavioural changes in terms of individual swimming speed, group cohesion, and spatial avoidance and also address the rate of habituation.

Behavioural and physiological indicators of emotional state in pigs

Inonge Reimert[1], Liesbeth Bolhuis[1] & Bas Rodenburg[2]; [1]Adaptation Physiology Group, [2]Animal Breeding and Genomics Centre, Wageningen University, The Netherlands

In welfare research it has become more and more important to know the emotional state of an animal. There are several behavioural measures that could indicate negative emotional state in pigs, but there very few behavioural measures that could indicate positive emotional state. Moreover are there also physiological measures that could indicate the emotional state a pig is in? The aim of this study was therefore to investigate how pigs could express their emotional state in different situations. Various behavioural and physiological measures were scored during the experience of supposedly positive (5 min access to a room full with straw, peat and chocolate raisins) and supposedly negative (5 min of social isolation combined with negative, unpredictable interventions) situations. During the supposedly positive situations pigs showed more play, tail wagging, tail posture changes and barks. During the supposedly negative situations pigs showed more freezing, escape attempts, defecating, ears back, ear posture changes, tail low and high- and low-pitched vocalisations. Moreover the increase in saliva cortisol concentration was higher after the negative situation than after the positive situation. The results of this study indicate that a supposedly positive situation elicited a different behavioural and physiological profile than the supposedly negative situation and vice versa. This suggests that the behavioural and physiological profiles could be used as indicators of emotional states in pigs.

Spectral flexibility in singing chiffchaffs during experimental noise exposure in the field

Hans Slabbekoorn, Rick van Beek & Tamara Hoogenboom; IBL, Leiden University, The Netherlands

Worldwide and ongoing urbanization makes that anthropogenic noise is on the rise above and below the water surface. Typical low-frequency traffic noise may cause stress, disturb and interfere, and may also mask acoustic signals, for example in frogs, fish, and birds. Previous studies have revealed consistent patterns in many urban bird species in that noisy sites are associated with singing at higher frequencies. The process underlying these patterns was tested experimentally in great tits by Halfwerk & Slabbekoorn (2009), but not all species may respond in the same way to fluctuating noise conditions (Verzijden et al. 2010). In our latest investigations we exposed singing chiffchaffs to city noise and inverse city noise to investigate the spectral flexibility of this species. Are they shifting up and down in frequency use depending on the noise conditions? And how rapid are these shifts? Within the first song or do they adjust only after a certain period of exposure? And finally, do chiffchaffs match great tits in the underlying mechanism of noise-dependent song type use? Do they selectively use high or low syllables or do they simply shift syllables up and down?

Female genital masculinisation, maternal androgens and behavioural adaptations of two wild cavy species *Cavia aperea* and *Cavia magna*

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Female genital and behavioural masculinisation is a pathology in humans but occurs by default in a number of wild mammalian species. These provide intriguing study species for analysing the endocrine and genetic basis of this phenomenon as well as its adaptive value. These are still poorly understood, due to the fact that these species are difficult to study since they are either dangerous (e.g. spotted hyena) and or heavily protected (lemur, elephant) or live a secret live (European mole). Recently a much more convenient study species became available for research, the wild cavy *Cavia magna*. It differs from the closely related *Cavia aperea* in genital morphology, with the female *C. magna* having an enlarged clitoris that is lacking in the female *C. aperea*. Interestingly, the two species also differ in habitat and social structure. *Cavia aperea* lives in a polygynous society in relatively dry grassland areas, whereas *C. magna* in a promiscuous society with a "solitary social system", in wetter, often flooded areas where animals tolerate each other, but have a minimum of social interactions. These two species provide an excellent opportunity to get more insight into the developmental mechanism and function of female masculinization. Here we describe general differences in female external genital morphology of *C. aperea* and *C. magna* as well as in their hormonal profile during pregnancy and their behaviour. Females *C. aperea* and *C. magna* differ in levels of androstenedione during mid-pregnancy with *C. magna* showing 4-fold stronger increase compared to *C. aperea*. *Cavia magna* males and females are also generally more active with no apparent sex differences in behaviour in the novel environment when compared to *C. aperea*. This suggests that elevated levels of androgens during pregnancy may induce female masculinization of both

genetials and behaviour. This is supported by manipulation of maternal androgens during pregnancy in the *C. magna*. Together with the different social structure observed in the wild populations, the difference in hormonal environment during development, and differences in genital morphology, these two species provide a very attractive model for further studies in how prenatal hormones may affect life history strategies.

Stereotypic behaviour in zoo-housed animals

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Many animals perform stereotypic behaviour in captivity, which is considered an indicator of underlying welfare problems. Although this mechanism is only partly understood, it has been attempted to eliminate the repetitive behaviour by enrichment techniques. So far, these have proven to be moderately successful, possibly because enrichment does not target the right problems. To get more insight into the causes of stereotypic behaviour, this study assesses the factors that influence behaviour of Asian elephants (*Elephas maximus*) in zoos. The research included 15 individuals in three zoos and the measured factors were age, zoo, temperature, visitors, weather and time of day. The data was subjected to principal component analysis and redundancy analysis to find the main patterns in behaviour. This showed that behaviour is mainly influenced by individual differences and stereotypic behaviour is positively correlated with age. While enrichment did encourage foraging behaviour, it did not affect stereotypy. These results suggest that the limited success of enrichment techniques in controlling stereotypic behaviour might be caused by a failure to address the true causes of the behaviour. They highlight the need for more fundamental insight into the mechanisms that promote the development of abnormal repetitive behaviour.

Social network analysis of horses (*Equus caballus*) and the effects of removal of individuals

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To analyse and depict preferred companions and interactions within a group a social network analysis is a very suitable tool. With this analysis it is possible not only to measure the strength of social relationships between individuals, but group structure, social patterns and cohesion as well. This network can also be used to identify the effects of removal and (re)introduction of different individuals on group level. We have studied the social network of an all mare herd of 9 horses. On basis of the nearest neighbour data a weighted social network of the herd is determined. Furthermore agonistic and grooming interaction frequencies were scored. The network on basis of nearest neighbour data had be found significant positively correlated with grooming frequency however not significantly with agonistic interactions. In our experiments one horse was isolated (within visual and auditory contact) for 24 hours, and pre-experimental, experimental and post-experimental days were observed. The social networks of these separate days were calculated, whilst excluding the interactions of the isolated animal for all three days, to be able to see the effects on the remainder of the herd. Comparison of these networks showed that on the experimental day major changes took place in the network. On the post experimental days the situations change back to be similar to the pre- experimental days. This study has shown that isolation of animals not only affects the isolated animal, but also has an effect on the remaining network.

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Preliminary study on the breeding biology of the Penduline tit (*Remiz pendulinus*) in Iran

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We investigated for the first time the breeding biology of the Penduline Tit (*Remiz pendulinus*) in Iran. The study was conducted in the Zarrinkola artificial wetlands area (328ha) in Mazandaran province. Nest building started mid-June and fledging occurred at the end of August. Nests were woven from spider webs, wool and animal hair, as well as soft plant materials, and were suspended from twigs and branches in *Salix* species around the wetland. In contrast to European penduline tits nests (1 hole), there are 1-2 holes per nest. Clutch sizes varied from 6-8 eggs. Mean incubation time was 15 days. Nesting success was low. Of all the nests, only 20% produced fledglings. Most nests were destroyed by children and failed during the nest building stage. Average breeding success (average proportion of fledged young per nest) was 62%. Given the large losses during the nest building stage due to children, it seems that education of the local people could be effective in conservation of penduline tit nests and increasing the birds' breeding success. The breeding biology of Iranian penduline tits differed in some aspects with European penduline tits, which will be discussed.

True injection of male accessory gland products via a love dart in a hermaphroditic land snail

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Sexual conflict shapes the evolution of many behaviours and processes involved in reproduction. Nearly all evidence supporting this comes from species where the sexes are separated. However, a substantial proportion of animals and most plants are hermaphroditic and theoretical work predicts that sexual conflict plays an important role even when the sexes are joined within one individual. This seems to have resulted in bizarre mating systems, sophisticated sperm packaging and complex reproductive morphologies. By far the best-known example of such an extreme strategy is the shooting of so-called love-darts in land snails. Such darts are forcefully stabbed through the partner's skin and the substance carried on the dart has been shown to enhance paternity. All known love darts carry the active substance on their outside and enter this into the partner's blood by stabbing, in some cases repeatedly. Here, we show that species of the snail genus *Everettia* possess a dart that serves as a real injection needle. Their dart is round in cross-section, contains numerous channels, and has perforations along the side of the dart. Histology and electron microscopy show that these holes connect to the channels inside the dart and run all the way up to the elaborate mucus glands that are attached to the dart sac. This strongly suggests that the gland product in directly injected into the partner's blood. Clearly, it remains to be demonstrated how this dart is actually used during mating and whether it indeed enhance sperm storage and/or paternity.

Environmental change and effects on welfare of captive King Penguins (*Aptenodytes patagonicus*)

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Captivity can have a major influence on health and welfare of (previously) wild animals. How large this influence is on King Penguins in Rotterdam Zoo, the Netherlands, was investigated in this study by changing the feeding schedule and providing crushed ice. The observations were done during a period of 6 weeks. Four treatments (A, B, C, D) were given in randomized order. Normally the animals received one fish in the morning (09:00, on shore) and more fish in the afternoon (14:00, in the water) (A = control). In the second treatment (B) parts of the exhibit floor were covered with crushed ice after the afternoon feeding. On days with treatment C there is an extra feeding moment: the amount of food that is normally given in the afternoon is now divided over a feeding at 11 AM and the normal feeding at 14 PM (both in the water). Treatment D is a combination of treatment B and C; there is an extra feeding moment at 11 AM and crushed ice was provided in the afternoon. Recording of the general activity of the animals was done by scan sampling every 10 minutes. In between every two scans continuous recording of sexual and aggressive interactions took place. For the data analyses in this study SCRT 1.1 (Single Case Randomization Test) was used to calculate p-values. The introduction of an extra feeding moment induced a significant decrease in time spent sleeping and aggressive interactions and a significant increase in time spent swimming. The use of crushed ice on the exhibit floors resulted in a significant increase in time spent resting and time spent in comfort behavior but a significant decrease in time spent sleeping and swimming. In addition, there was a significant short-term increase in aggressive interactions. The ice application seems to provide a basic resource for which the animals are motivated to fight. Overall, the welfare of the King Penguins in Rotterdam appears to be good with some concern regarding aggression and (homo)sexual behavior. The environmental changes increase activity and welfare, but have some downsides that can be solved. They offer a potential welfare benefit for these captive animals.

Social Network Analysis in laying hens (*Gallus gallus domesticus*)

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Concepts and parameters have been developed in Social Network Analysis (SNA). Aspects of the network allow to characterize subgroups, transfer of information and individual actions and preferences. Wild chicken are naturally part of only small social networks, but domestic hens can be housed in numbers up to 10.000 of individuals. There is a lack of knowledge about the social network in such situations. Asher describes a small network of hens based on feather pecking behaviour, but almost no data are available about the social network in laying hens. The activities, location and nearest neighbour (NN) of 8 laying hens (with good visible marks on their backs) were video recorded during 21 days of which 6 days are analysed by scan sampling every 10 minutes during the 16 hours daylight period. Preferences and aversions between hens were analysed in total and related to specific behaviours (dust bathing, drinking, feeding, social behaviour, feather pecking, moving, ground scratching, sitting/standing, not seen and other) and commodities (nest perch, the drinking area, the feeding area, the grid area, the litter area, the nests (if sure the hen is in one) and the perches) using Matman and Ucinet software. Preliminary analysis shows that hens have almost no preferred or avoided neighbour (hen1 was more than expected the neighbour of hen7). Some hens showed preferred activities (hen4 drinking, hen6 feeding, hen5 feather pecking and hen8 hiding). Some hens also showed preferred commodities (hen4 the drinking area and hen6 the feeding area). During feeding no preferred NN was found, during grooming only hen1 and hen3 were more than expected each others' neighbour. In

conclusion preliminary analysis of the social network of 8 laying hens showed no strong social network and only a very limited number of social preferences.

Guppies remember shoal locations in a spatial memory task

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The ability to learn and remember the location of conspecifics potentially provides anti-predator, foraging and mating benefits to grouping animals. Here, we investigated whether the guppy (*Poecilia reticulata*) – a well-studied model organism for behavioural ecology – remembers the location of a conspecific shoal in a simple maze setup. Previous work on poecilids has revealed that males prefer to shoal with female groups to increase their mating chances, while females choose same-sex shoals to minimize sexual harassment by males. Thus shoal location memory might depend on the sex of the individual and of the shoal. To address these questions, single male and female guppies were introduced to a test tank for 5 min with an all-male or all-female shoal at one end and an empty container at the other. The subjects were then returned to their starting point, held behind opaque barriers for 5 min, and allowed to choose between the two hidden outer compartments, which now contained no conspecifics. Subjects spent significantly more time in the compartment that had previously housed the shoal, results consistent with them learning and remembering this location. We discuss the influence of the sex of subjects and the shoal on shoal location memory. Our results indicate that guppies readily learn the location of conspecifics in their environment.

Increased opportunities to interact with the mother affect responses of piglets to weaning and a change of environment

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We investigated effects of increased opportunities to interact with the mother on the ability of piglets to cope with weaning stress and a change in environment from barren to enriched or vice versa. Piglets were housed in barren or enriched pens with their mother confined in a farrowing crate or loose-housed preweaning. Enrichment consisted of increased space allowance, straw, wood shavings, peat and branches. Piglets were weaned at d 29 and relocated to a barren or enriched pen (2x2x2 factorial arrangement, eight treatments, eight pens per treatment, four pigs per pen). Behaviour was recorded on d 1, 5, 9 and 12 postweaning. Weanling piglets from loose-housed sows showed less damaging behaviours directed at pen mates than piglets from confined sows (belly nosing: 0.3 versus 0.7%, P=0.04; other oral manipulative behaviours: 0.8 versus 0.9% of observations, P=0.05) and more play behaviour (0.9 versus 0.7%, P=0.02). Piglets from a loose-housed sow switching from a barren to enriched environment showed the highest levels of play behaviour (1.8%) and lowest levels of belly nosing (0.03%) while piglets from a confined sow switching from an enriched to a barren environment showed highest levels of belly nosing (1.6%, P=0.09) and low levels of play (0.1%, P=0.04). Having more opportunities to interact with the mother before weaning seems to buffer the detrimental effects of weaning and of changing from an enriched to barren environment in piglets. It also increased the positive response to obtaining environmental enrichment, suggesting the mother positively affects stress-resilience or emotional state.

Mate choice for bill colour in a sexually monomorphic finch

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We studied the function and evolution of ornaments in a monomorphic species with a gradient in bill colour over its geographic range. There was no mate choice function of ornaments for a social or extra-pair mate. Bill colour, however, seems to be an important cue in mate choice, with birds preferring a mate with similar bill colour to its own, suggesting that bill colour might play a role in species recognition and therefore speciation.