

"CONFLICT AND COOPERATION – BRIDGING EVOLUTION, ECOLOGY AND IMMUNOLOGY"

PHD STUDENT MEETING, MARCH, 16-18, 2017, BAUTZEN

PROGRAM

THURSDAY, MARCH 16

12.00-14.00h

Arrival

Check-in & Registration

14.00-15.30h

Meet & Greet

15.30-17.00h

Session 1 - Talks

18.00-19.00h

Dinner

19.00-20.00h

Invited Speaker - Talk by

Dr. Lena Bayer-Wilfert,

University of Exeter

FRIDAY, MARCH 17

08.00-09.00h

Breakfast

09.30-11.00h

Session 2 - Talks

11.00-11.30h

Coffee Break

11.30-13.00h

Session 3 - Talks

13.00-14.30h

Lunch & Recreation

14.30-16.00h

Session 4 - Talks

16.00-16.30h

Coffee Break

16.30-18.30h

Poster Session

18.30-19.30h

Dinner

19.30-20.30h

Invited Speaker - Talk by

Dr. Heiko Vogel,

MPI CE Jena

SATURDAY, MARCH 18

08.00-09.00h

Breakfast

9.30-10.30h

Session 5 -Talks

10.30-11.00h

Coffee Break

11.00-12.00h

Session 6 -Talks

SESSION 1 - THURSDAY, MARCH 16 - 15.30 TO 17.00H

15.30-16.00h

Dr. Ramsy Agha, IGB Berlin

"Ecological implications fungal parasitism on phytoplankton"

16.00-16.30h

Sara Bellinvia, U Bayreuth

"Stowaways: Sexually transmitted opportunistic microbes in the common bedbug *Cimex lectularius*?"

16.30-17.00h

Uta Müller, FU Berlin

"Association honey bee pathogens and wild bee communities"

SESSION 2 - FRIDAY, MARCH 17 - 09.30 TO 11.00H

09.30-10.00h

Barbora Bílková, CU Prague

"Chicken, egg and immunity: Variability in immune defence of different breeds"

10.00-10.30h

Hana Velová, CU Prague

"How to properly measure inflammation in birds? LPS-induced immune response and its association to individual traits in great tit"

10.30-11-00h

Martin Těšický, CU Prague

"Different species, yet the same alleles: shared polymorphism in innate immunity receptors in the tit family"

SESSION 3 - FRIDAY, MARCH 17 - 11.30 TO 13.00H

11.30-12.00h

Ensieh Habibi, TU Dresden

"Separating mitochondrial and nuclear effects on male and female fertility in *Drosophila melanogaster*"

12.00-12.30h

Reda Gamal, TU Dresden

"Chitinase encoding genes in *Drosophila melanogaster*: Any sexual functions?"

12.30-13.00h

Manja Saebelfeld, IGB Berlin

"Daphnia in the dark - simulating input of humic dissolved organic carbon"

SESSION 4 - FRIDAY, MARCH 17 - 14.30 TO 16.00H

14.30-15.00h

Bin Jiang, FU Berlin

"Evolution of behaviour under different predation regime in a dragonfly genus"

15.00-15.30h

Jiří Hadrava, CU Prague

"Pollination networks: The role of opportunistic dipteran pollinators"

15.30-16.00h

Loreen Knöbel, Senckenberg Museum Dresden

"Dump your parents and conquer the world - How hybrids can populate environments 'too extreme' for their parental species"

SESSION 5 - SATURDAY, MARCH 18 - 09.30 TO 10.30H

09.30-10.00h

Thorben Sieksmeyer, FU Berlin

"Beyond nutrition: host-microbiota interactions drive shifts in the behavioural phenotypes of cockroaches "

10.00-10.30h

Shulin He, FU Berlin

"Differences in immunity between termite castes revealed by *de novo* transcriptome sequencing"

SESSION 6 - SATURDAY, MARCH 18 - 11.00 TO 12.00H

11.00-11.30h

Baydaa ElShazely, FU Berlin

"AMP resistance fitness cost"

11.30-12.00h

Guozhi Yu, FU Berlin

"Resistance evolution: AMPs vs. antibiotics"

POSTER SESSION FRIDAY, MARCH 17 - 16.30 TO 18.30H

Pauline Sell, U Münster

"Specificity of oral immune priming in *Tribolium castaneum*"

Barbara Eckel, TU Dresden

"The evolution of sperm metabolism in insects"

Ruijian Guo, TU Dresden

"Mitonuclear interaction and age effects on male fertility in *Drosophila*"

Dr. Biz Turnell, TU Dresden

"Female mediation of sperm metabolism in storage: an investigation across time, species, and storage organs".

Jindřich Břejcha, CU Prague

"Sexual shape dimorphism in *Trachemys scripta*"

Christin Manthey, FU Berlin

"Evolution of larval growth rates in insects"

ABSTRACTS

DR. LENA BAYER-WILFERT, UNIVERSITY OF EXETER

“MAN-MADE EPIDEMICS: HOW ECOLOGY AND EVOLUTION MEET IN POLLINATOR DISEASES”

Honeybees are arguably one of the most intensively managed insect species, while still free to interact with other wild pollinators, sharing both floral resources and pathogens. Anthropogenic influence can drastically alter the epidemiology of host-parasite interactions in this system. Deformed Wing Virus is a particular case in point: this virus has long been associated with honeybees, but was considered largely benign. In combination with *Varroa destructor* however – an emerging ectoparasitic mite that can directly transmit the virus to the bee’s hemolymph, circumventing many of its anti-viral defence mechanisms – this virus is associated with a risk in over winter mortality of honeybee hives. We have shown that Deformed Wing Virus is a re-emerging disease in honeybees, its current global epidemic fuelled by *Varroa* but driven by European populations of *Apis mellifera*. This virus is however not limited to honeybees, and we will discuss our current work on the risks this poses to managed and wild pollinator communities and how changes in host-parasite ecology can impact pathogen evolution.

DR. HEIKO VOGEL, MAX PLANCK INSTITUTE FOR CHEMICAL ECOLOGY JENA

“SECONDARY METABOLITES, CARCASSES AND MICROBIOTA – ECOLOGICAL IMMUNOLOGY IN INSECTS”

Selective pressures from host plant secondary chemistry and natural pathogens may contribute to driving herbivore insects towards a restricted host range. In the first part of the presentation, I will address the cause and consequences of host plant specialization of the heliothine moth *Heliothis subflexa* (Lepidoptera, Noctuidae), which feeds exclusively on plants in the genus *Physalis*. We found that *H. subflexa* has modified its immune system to benefit from the antibacterial properties of withanolide, an immune-suppressive compound from its host plant *Physalis*, and thereby gains a higher tolerance to the insect pathogen *Bacillus thuringiensis*. In contrast, its close relative *Heliothis virescens*, a broad generalist herbivore, does not benefit from withanolides. In the second part, I will discuss certain aspects of the peculiar ecology of burying beetles (*Nicrophorus* spp.). These beetles have evolved to occupy a unique ecological niche by reproducing on small vertebrate cadavers buried in the soil. Carrion is a valuable but ephemeral resource, with intense competition of bacterial and fungal decomposers, which decrease its nutritional value and render it unpalatable to animals. Adult burying beetles utilize effective counterstrategies, reducing microbial activity by treating the carcass with anal and oral secretions. However, although the anal exudates have been shown to contain molecules with antimicrobial activity, little is known about the sources, identity and complexity of antimicrobials. We discuss the context-dependent expression dynamics of candidate antimicrobial peptides and their potential role in environmental sanitation and carcass preservation. Furthermore, a detailed characterization of microbial communities resulted in the identification of an abundant and diverse range of bacteria and yeasts. Based on the metabolic potential of the identified microbiota, we hypothesize that the symbionts are involved in detoxification of noxious chemicals, digestion of otherwise inaccessible nitrogen and energy sources and the production of antimicrobials.

SARA BELLINIA, U BAYREUTH

"STOWAWAYS: SEXUALLY TRANSMITTED OPPORTUNISTIC MICROBES IN THE COMMON BEDBUG *CIMEX LECTULARIUS*?"

Although sexual selection has been regarded as the main driver of reproductive trait evolution, environmental factors might play an important role as well. For example, bacteria are ubiquitously found in reproductive organs and have been shown to damage sperm. In response, males have even evolved antimicrobial ejaculates, suggesting that selection pressure is induced by sexually transmitted opportunistic microbes. However, little is known about the identity of the transmitted microbes and the extent of their transmission. Here we describe the bacterial communities of reproductive organs of female and male bedbugs (*Cimex lectularius*). By sequencing the bacteria of dissected reproductive organs from non-mated and mated individuals, we could show that the bacterial communities of the female paragenital organ, the mesospermae, and the male intromittent organ were significantly different from each other, but similar to the bacterial community of the seminal vesicles. Furthermore, mating increased bacterial beta diversity in females, whereas in males it decreased. Both findings indicate that bacteria are transmitted during mating. Future studies will need to investigate the effects of the most frequently found sexually transmitted bacteria on female and male fitness to describe the importance of environmental bacteria on the evolution of reproductive traits.

BARBORA BÍLKOVÁ, CU PRAGUE

"CHICKEN, EGG AND IMMUNITY: VARIABILITY IN IMMUNE DEFENCE OF DIFFERENT BREEDS"

Domestic chicken is a model species for avian immunology and also an agriculturally important animal. Intensive selection towards productivity in modern laying breeds led to loss of genetic polymorphism and decrease of natural immunologically important variability. This could subsequently cause decrease in anti-parasitic resistance of these birds. Nevertheless, so far poorly studied ancient chicken breeds are valuable source of diversity. Therefore, we aimed to describe immunological variability in five ancient chicken breeds (Araucana, Booted bantam, Czech, Minorca and Rosecomb bantam). We focused on haematological parameters, as traits reflecting individual health, and amounts of antimicrobial-defence proteins in egg white that protect developing embryo. Flow cytometric analysis shows significant differences in haematological parameters, mainly in relative counts of heterophils and lymphocytes between breeds Araucana and Czech. By mass-spectrometry analysis, we described 11 antimicrobial proteins. These proteins form 46.81 % of the egg white protein mass. Amount of these proteins differ between eggs of our chicken breeds. In this study, we described differences in ancient chicken breeds in both haematological parameters and amounts of defence proteins in egg whites. These breeds could be a valuable source of immunological variability potentially useful in further breeding of domestic chicken towards natural resistance to infections.

HANA VELOVÁ, CU PRAGUE

"HOW TO PROPERLY MEASURE INFLAMMATION IN BIRDS? LPS-INDUCED IMMUNE RESPONSE AND ITS ASSOCIATION TO INDIVIDUAL TRAITS IN GREAT TIT"

The main aim was to design new methodological approach appropriate for measuring inflammatory immune response in free-living birds. As stimulant we used lipopolysaccharide (LPS) of *Salmonella enterica* injected into wing webs of 46 great tits (*Parus major*). Tissue biopsies were subsequently collected 24 hours after LPS application. First, we analysed tissue transcriptome in two individuals to select key immune genes playing important role during inflammation. The total number of differentially expressed genes between LPS treated and control tissue was 1930, from which 81 have immune function. The second main step was to measure expression of chosen proinflammatory cytokines (IL1B and IL6), which are crucial signalling molecules important for immune activation, in additional 44 individuals using qPCR. The gene expression level of both cytokines is positively correlated, but surprisingly there is no relationship with the thickness of the skin swelling. Therefore, measuring the skin swelling as a proxy of inflammation may be not sufficient. Furthermore, we found relationship between cytokine expression level and sex. Our study contributes to development of new methodological tools for more accurate measuring of inflammatory immune response in wild tits with the potential to be broadly used also in other non-model birds.

MARTIN TĚŠICKÝ, CU PRAGUE

"DIFFERENT SPECIES, YET THE SAME ALLELES: SHARED POLYMORPHISM IN INNATE IMMUNITY RECEPTORS IN THE TIT FAMILY"

Toll-like receptors (TLRs) are molecules of vertebrate innate immunity that directly recognize pathogen-derived molecules. Examination of genetic variation in TLRs helps to reveal mechanisms of host immunity co-adaptation to pathogenic pressures. Three evolutionary mechanisms can explain the origin of shared polymorphism in immune genes: balancing selection leading to ancestrally inherited trans-species polymorphism (TSP), introgression and convergent evolution. In this contribution, we show the amount of species-specific variability in TLRs (including putative individual adaptations) and interspecifically shared variation (common adaptations). Using MiSeq we have described genetic polymorphism in functionally relevant regions of TLR4 and TLR5 and six neutral markers in 192 individuals representing 20 species of tit family (Paridae). Out of the 14 and 23 positively selected amino acid sites in TLR4 and TLR5, respectively, 4 and 14 were located in the close proximity to functional sites. Shared alleles in TLRs occurred only in closely related species, probably representing TSP. However, part of the shared alleles was predicted to originate from introgression suggesting that balancing selection/TSP, introgression and convergence all contribute to shared immunologically relevant variability in tits. Regardless the evolutionary mechanism, the shared time-proven polymorphism among species may be highly important in pathogen detection.

ENSIEH HABIBI, TU DRESDEN

"SEPARATING MITOCHONDRIAL AND NUCLEAR EFFECTS ON MALE AND FEMALE FERTILITY IN *DROSOPHILA MELANOGASTER*"

There is a tight coordination between mitochondria and nuclear genome and any incompatibilities between mitochondria and nuclear genes could disturb mitochondrial functions, lead to oxidative stress and result in diseases, including fertility problems. This is expected to be prominent in males because mitochondrial inheritance is exclusively maternal. In order to test the quality of the co-functioning of different, experimentally mismatched mitonuclear combinations, we try to assess this effect on the reproductive success on flies by examining sperm competition in males and fecundity in female. We also measure the effect of mitonuclear interaction on levels of oxidative stress by looking at the expression of genes involved in mitochondria oxidative stress defense, in particular, genes activated by mitochondrial unfolded stress response (UPR^{MT}).

REDA GAMAL, TU DRESDEN

"CHITINASE ENCODING GENES IN *DROSOPHILA MELANOGASTER*: IS THERE ANY SEXUAL FUNCTIONS?"

Insect cuticle composed of polysaccharide chitin, proteins, and lipids that interact with each other and distributed in distinct horizontal layers. Chitin, a polymer of N-acetyl-b-D-glucosamine, is the major component of insects' procuticle that scaffolding epidermis and tracheal cuticle. Cuticle rigidity, due to its components extensive cross-linking, hampers insects body growth and morphogenesis. Thus, during development, insect runs through moulting cycles. Chitinolytic enzymes; including chitinases, degrade chitin to low molecular weight oligosaccharides. Ten Chitinase encoding genes (*Chts*) of *Drosophila melanogaster* were previously identified. However, less is known about each *Chts* specific functions. In our study, we seek to identify those chitinases involved in moulting and/or in any other sexual functions. Thus, *Chts* expression profiling, during *D. melanogaster* different developmental stages, performed. Profiling data displayed the unique expression pattern of *Cht12*, which extremely expressed in male than in the female. This, however, raises the possibility that *Cht12* might be involved in male sexual functions. *Cht12*-GFP subcellular distribution revealed that it localized mainly in testes, seminal vesicle and ejaculatory bulb of male genital system. Yet, *Cht12* function is not known, and we aimed in our study to discover how far *Cht12* could be involved in males' sexuality.

LOREEN KNÖBEL, SENCKENBERG MUSEUM DRESDEN

"DUMP YOUR PARENTS AND CONQUER THE WORLD - HOW HYBRIDS CAN POPULATE ENVIRONMENTS 'TOO EXTREME' FOR THEIR PARENTAL SPECIES"

Since the concept of hybridisation emerged in the 18th century, the biologist community was indifferent about its impact on speciation and evolution. Only with the vast development of molecular methods in the last decades, the zoologist's perception of hybridisation changed from a rarely occurring "reproductive mistake" yielding inferior offspring, to a possible source for superior adaptation to new environments neither parents could fit thanks to novel genetic variation. To study the putative impact of hybridisation on evolution we chose a model systems that involves the two contrasting outcomes of hybridisation - reduced fitness vs. superior adaptation - at the same time but at different places. Secondary contact between the different species of the *Mytilus edulis* species complex usually leads to the formation of stable mosaic hybrid zones. Only exception is a *M. edulis* x *M. trossulus* hybrid zone in Europe where a *Mytilus trossulus* hybrid swarm populates the Baltic - a habitat with salinity conditions outside the ecological tolerance of the swarm's parental species. We are mapping cDNA reads from hybrid specimen of two different salinity conditions from the Baltic against orthologous transcripts from both pure parental species, and investigating homo- and heterozygous advantages for different GO terms.

THORBEN SIEKSMEYER, FU BERLIN

"BEYOND NUTRITION: HOST-MICROBIOTA INTERACTIONS DRIVE SHIFTS IN THE BEHAVIOURAL PHENOTYPES OF COCKROACHES "

Recent studies have shown that host-microbiota interactions can lead to dramatic changes in host phenotype. We investigate the causal drivers of microbe-associated shifts in host phenotype by examining how feeding behaviour is modulated by microbiota interactions in two omnivorous cockroaches: *Blatta orientalis* and *Blattella germanica*. We conducted food-choice experiments after challenging hosts with a common entomopathogenic soil bacterium to understand the impact of pathogens on host macronutrient preference. We find that immune challenge by a pathogenic microbe drives a sharp decline in carbohydrate intake and results in a relative increase in the ratio of protein to carbohydrate (P:C) consumed. Additionally, infected cockroaches reduce their overall nutrient intake, which is consistent with an illness-induced anorexia-like response. We show for the first time that cockroach feeding behaviour is dynamically modulated by a pathogen, and examine the influence of modified feeding behaviour on host immunity. We also investigate whether in addition to pathogens, gut commensals are causally responsible for shifts in host behavioural phenotype. Here, we conduct food-choice and immune-challenge experiments in germ-free cockroaches, which have been refaunated with gut microbiota that are experimentally adapted to variable macronutrient (P:C) diets.

SHULIN HE, FU BERLIN

"DIFFERENCES IN IMMUNITY BETWEEN TERMITE CASTES REVEALED BY *DE NOVO* TRANSCRIPTOME SEQUENCING"

Effective immunity is essential for maintaining insect society integrity but the mechanisms that connect immunity at the level of the individual to the level of society are poorly understood. Here, we begin to resolve this issue by addressing the interaction between individual immunity and caste identity in the termite *Neotermes castaneus*. We characterize the transcriptomic responses of different castes to a general immune challenge by sequencing mRNAs from false workers, soldiers and reproductive following injection with a cocktail of heat-killed pathogens. We found many more genes to be differentially regulated in reproductives (1420 and 398 genes down- and upregulated respectively) than soldiers (90 and 108 genes) or false workers (135 and 71 genes). We go on to conduct a quantitative analysis of the specific changes to immune regulation across the castes following pathogen exposure, before discussing the implications of these findings for our understanding of the evolution of immunity in eusocial termites.

PAULINE SELL, U MÜNSTER

"SPECIFICITY OF ORAL IMMUNE PRIMING IN *TRIBOLIUM CASTANEUM*"

In many invertebrate species, enhanced survival of infection has been observed after prior exposure to the same pathogen ('immune priming'). In insects, oral infection is assumed to be the natural route of infection with the spore-forming bacterium *Bacillus thuringiensis*. The major virulence factors of *B. thuringiensis* are the plasmid-encoded Cry toxins that are toxic upon ingestion and characterised by high insecticidal specificity. While priming via septic wounding in the red flour beetle *Tribolium castaneum* shows a high level of specificity, it is unclear whether the same phenomenon can also be observed via oral immune priming. Thus, we investigated in our study whether *T. castaneum* can mount an immune priming response to three different strains of *B. thuringiensis* that are known for their entomopathogenic activity. We conducted a full-factorial experiment by using our well-established high throughput method for oral infections of individualised larvae. We here demonstrate that immune priming can be triggered by oral uptake of the spore supernatant in two of the three bacterial strains. Furthermore, the results point to a certain level of specificity towards two of the strains. We are currently exploring whether the priming response to the third strain might be dependent on the spore dose. However, our results suggest that specificity towards *B. thuringiensis* is also present in oral priming.

JINDŘICH BREJCHA, CU PRAGUE

"SEXUAL SHAPE DIMORPHISM IN *TRACHEMYS SCRIPTA*"

Trachemys scripta is freshwater turtle species with females larger than males in body size. Males use elongated foreclaws during courtship to convince females to mate. When female is receptive, it lets male to mount in copulatory position on its carapace while protrude tail with cloaca from the shell. Here we are interested in differences of plastral shape (ventral shell) between the sexes in *Trachemys scripta elegans*, as a result of growth, and quality of individual. We compare plastral shape of individuals with their secondary sexual characteristics. Our results unambiguously showed that response in plastron shape in size-shape space of *Trachemys scripta* is exact the same for change in foreclaws length and for non-allometric component vector. The shape change is characterized by compression of pectoral scute and enlargement of humeral scute of masculine phenotype, i.e. bigger surface of plastron for attachment of forelimb muscles. As length of claws is in *Trachemys scripta* controlled by hormone levels (Evans 1952), we suppose that plastron shape response to RSC reflect changes mediated by sex steroids.