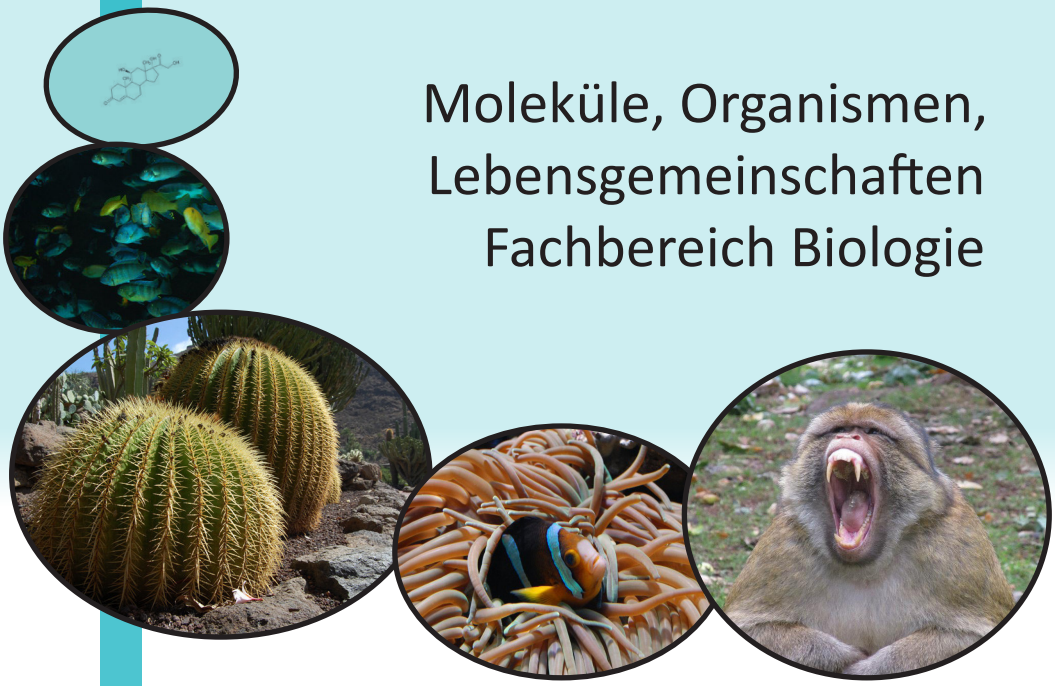
Tagungsband

Stress auf allen Ebenen

Moleküle, Organismen, Lebensgemeinschaften
Fachbereich Biologie



15. Dezember 2014
Biozentrum Klein Flottbek
Ohnhorststraße 18
22609 Hamburg

Organisiert von den Studierenden des Master-Studiengangs Biologie

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

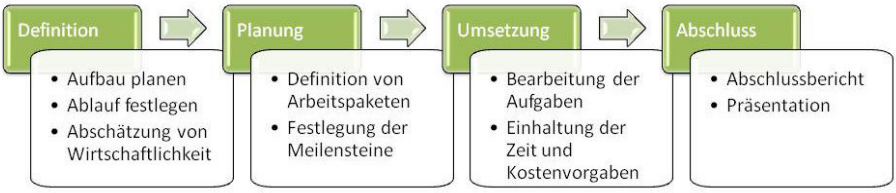
„Stress auf allen Ebenen - Moleküle, Organismen, Lebensgemeinschaften“

Das Wort „**Stress**“ werden die Meisten mit persönlichen Erfahrungen aus Beruf, Studium und Alltag verknüpfen. Doch Stress ist in der Biologie viel mehr als eine negative Erfahrung - es ist ein Motor der Evolution. Der Einfluss von Stress lässt sich bei Individuen und Lebensgemeinschaften beobachten und ist bis auf die Ebene von Zellen und Molekülen zu erkennen. Dabei stellt sich die Frage, was bedeutet Stress auf unterschiedlichen Ebenen eigentlich? Und welche Reaktionen ruft Stress hervor? Aktuelle Forschungsprojekte und -ergebnisse zu diesem Thema sollen auf der Tagung des Fachbereichs Biologie vorgestellt und diskutiert werden.

Wir, Studierende des Masterstudiengangs Biologie wünschen Ihnen eine erfolgreich Tagung mit interessanten Gesprächen und Anregungen für neue Ideen und Kooperationen.

Die Organisation:
Die Tagung wird im Rahmen einer Lehrveranstaltung von den Studierenden des Master of Science Biologie organisiert.
Durch „**problemorientiertes Lernen**“ sollen die Studierenden nach Abschluss der Veranstaltung das Wissen haben eine Tagung zu organisieren und durchzuführen. Was ist projektorientiertes Lernen? Projektarbeit (auch oft als Zukunftswerkstatt bezeichnet) ist das selbstständige Bearbeiten einer Aufgabe oder eines Problems durch eine Gruppe von der Planung über die Durchführung bis zur Präsentation des Ergebnisses. Projektarbeit ist eine Methode demokratischen und handlungsorientierten Lernens, bei der sich Lernende zur Bearbeitung einer Aufgabe oder eines Problems zusammenfinden, um in größtmöglicher Eigenverantwortung immer auch handelnd lernend tätig zu sein, eingefahrene Gleise verlassen und Ideen für Neues entwickeln.

Man kann Projektunterricht bezeichnen als “ganzheitliche, integrative Lernform“, der ein Höchstmaß an curricularer Offenheit zukommt und die den bestmöglichen Raum für Lernendenmitbestimmung und -orientierung bereitstellt.
So sieht der Unterricht in Projektphasen aus:



http://www.hd-mint.de/lehrkonzepte/lehrkonzepte/projektarbeit/

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Vorträge
in chronologischer Reihenfolge

Prof. Dr. Arp Schnittger

Reaktionen der Pflanzen nach DNA-Schäden

Prof. jun. Dr. Mirjam Perner
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“Gestresste“ Mikroben in extremen Habitaten

Mikroben besiedeln nahezu jeden Lebensraum auf unserem Planeten. Man findet sie von der Atmosphäre bis in die Tiefsee und sogar in Gesteinen tief unter dem Meeresboden. Einige sind optimal an außergewöhnliche oder radikale Bedingungen, die in extremen Habitaten vorherrschen können, adaptiert. So existieren unterschiedliche Mikroben in bspw. jeweils besonders heißen, kalten oder aus unserer Perspektive toxischen Habitaten. Hier lege ich den Fokus auf den Stress, dem verschiedene Mikroben, die hydrothermale Tiefseequellen besiedeln, ausgesetzt sind: In hydrothermalen Tiefseesystemen herrschen bspw. besonders hohe Temperaturen, Sauerstoff kann mitunter gar nicht vorhanden sein, und toxische Substanzen, wie z.B. Schwermetalle, können in sehr hohen Konzentrationen vorliegen.

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AG Jürgens (BEE)

Some like it hot: Stress in Wüstenrändern

Wüsten gelten allgemein als Ökosysteme mit einem hohem Stressfaktor. Organismen die in Wüsten überleben haben sich an die harschen klimatischen und edaphischen Bedingungen angepasst. Der allgegenwärtige Klimawandel droht die Wüstenränder weltweit auszudehnen und die Verbreitungsgrenzen von Organismen zu verschieben. Wüstenränder sind die Ökotonbereiche zwischen ariden Wüsten und semi-ariden Grasländern bzw. Steppen. In Ökotonen lassen sich Effekte von Stress auf die ökologische Nische einzelner Arten sowie auf die Artenzusammensetzung in Pflanzengesellschaften besonders gut analysieren. Wir haben einen Datensatz zusammengetragen der diverse Pflanzengesellschaften in Wüstenrändern und die dort vorherrschenden klimatischen Bedingungen umfasst. Diese Daten stammen aus den Wüsten Nord- und Südafrikas. Wir verwenden multivariate Gradientenanalyse und hierarchische Generalisierte Modelle, sogenannte HOF-Modelle, zur Charakterisierung der Art-Antwort Kurven auf verschiedene Stressgradienten, z.b. Maximal-Temperatur, jährliche Niederschlagsmenge etc. Wir identifizieren damit eindeutige hitzetolerante Arten und quantifizieren deren ökologische Nische, weiterhin betrachten wir die Konsequenzen für die Artenzusammensetzung der Pflanzengesellschaften und deren Resilienz in den betrachteten Wüstenrändern.

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Four mutations in the target site for cardenolides explain the insensitivity of Oncopeltus fasciatus to highly toxic plant chemical defenses

Intricate adaptations of herbivorous insects to plant chemical defenses are widespread. Understanding the genetic basis of these adaptations is a central question in chemical ecology. Oncopeltus fasciatus, the large milkweed bug, is specialized on plants producing toxic secondary compounds called cardenolides which are specific inhibitors of the Na,K-ATPase. Genetic analyses indicate that O. fasciatus possesses three gene copies bearing different amino acid substitutions in the cardenolide target site. We expressed the cardenolide sensitive Na,K-ATPase α-subunit of Drosophila melanogaster in combination with different β-subunits in baculovirus-infected Sf9 cells and introduced the amino acid substitutions observed in the different ATPase α-copies of O. fasciatus. To determine the functional importance of the introduced substitutions, the sensitivity of the ATPase activity to increasing cardenolide concentrations was measured and compared to that of nervous tissue of O. fasciatus which was highly insensitive to the cardenolide. The substitutions significantly decreased Na,K-ATPase sensitivity to cardenolide in a stepwise manner. The combined substitutions at four positions closely mimicked the behavior of the Na,K-ATPase of nervous tissue. They thus appear to be responsible for the pronounced insensitivity of O. fasciatus to cardenolides and are central for the adaptation to its host plant's chemical defenses.

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How to reduce stress with toxic food – The Senecionine Monooxygenase of *Longitarsus jacobaeae*

The flea beetle *Longitarsus jacobaeae* is one of very few animals that are specialized on tansy ragwort (Senecio jacobaea). This common wild flower is known to be highly toxic, not only for insects but also for cattle and horses due to its content in pyrrolizidine alkaloids, mainly senecionine-N-oxide. This compound serves (the plant) as defense mechanism against herbivores and is responsible for hepatotoxic or even lethal effects for farm animals.
In this study we investigated which physiological adaptions allow Longitarsus jacobaeae to feed unharmed on Senecio jacobaea. The challenge in dealing with pyrrolizidine alkaloids consists in their conversion from N-oxides into tertiary alkaloids in the herbivores' gut which then bring about the toxic effects. We identified sequences in the beetle's transcriptome that are similar to known flavin-monooxygenases. Based on this information we were able to express and harvest the recombinant protein in Sf9 cells. Activity tests with tertiary senecionine demonstrated that the flea beetle has a senecionine-monooxygenase able to specifically convert tertiary senecionine into the harmless N-oxide and furthermore that this enzyme is more active than the previously described enzyme of the arctiid moth Tyria jacobaeae. The main tissue for this metabolization could be identified by quantitative real-time PCR.

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Beweidung – Stress und Möglichkeit

Beweidung bedeutet für Pflanzen Stress durch Verlust von Biomasse und durch Bodenverdichtung. Doch während einige Arten diesen Stress nicht überstehen, gibt es andere die ihn nutzen.

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Thermal limits of lizards along a steep environmental gradient

Temperature is a crucial aspect in reptile's biology and most species attempt to reach and maintain a certain target body temperature (T_{pref}) that allows optimal performance. Body temperature below T_{pref} result in poor performance and higher temperature lead to heat stress and overheating. However, "cold blooded" animals are only able to achieve body temperatures within the operative environmental temperature range. Temperature preferences of the animals and the potential to compensate temperature fluctuations behaviorally or physiologically could predict the distribution of species but also the extinction risk in the face of climate warming. We investigated the thermal ecology of three Malagasy lizard species in their natural habitat along a steep environmental gradient to find out whether the animal's distribution is restricted by the thermal regime. Our findings show that all species show high behavioral flexibility but only little physiological adaptation and the distribution of the species is mainly limited by the environmental temperature.

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Stress - Wie sich die Pflanze wehrt

Pflanzen sind ständig physikalischem, chemischem und biologischem Stress ausgesetzt. Gegen diesen wehrt sich die Pflanze durch Zellwandverstärkungen. Super-Resolution-Mikroskopie erlaubt nun einen Einblick in deren Struktur.

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Energetics of Lepilemur leucopus

Lepilemur leucopus is present in the dry deciduous and xerophytic spiny forest of southern Madagascar. The climate is characterized by hot wet summers, with temperatures above 40°C and cold dry winters, with temperatures below 10°C at night, due to / through climate change the greatest warming and decreases in rainfall are expected in this region. Using indirect calometry with portable analyzers following standard techniques we measured the resting metabolic rate (RMR) of *Lepilemur leucopus* under different ambient temperatures in the wet and dry season. We defined the "thermal neutral zone" (equilibrium between heat production and heat loss) of this species between an ambient temperature of 25-30°C, below and after that the animals have to produce heat or cool down. Due to climate change, regional warming and decreases in rainfall could lead to huge heat stress for *Lepilemur leucopus*.

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Cell Death Regulation in Plants

Cell death is important for plant growth and development. *The Arabidopisis thaliana* SENESCENCE ASSOCIATED E3 UBIQUITIN LIGASE1 (SAUL1) is a member of the plant U-box armadillo repeat (PUB-ARM) protein family and is an essential regulator of leaf senescence, cell death and immunity in plants. Mutant saul1 plants lacking expression of the SAUL1 gene show early senescence and cell death in stress conditions. In order to understand the SAUL1 signaling pathway and the function of SAUL1 in cell death control, we performed a suppressor screen with saul1 plants. We identified 8 independent allelic suppressors rescuing the saul1 phenotype. With the help of next generation sequencing and map-based approaches we will identify different suppressors that are part of the SAUL1 signaling network.

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Stress signaling cascades in *Fusarium graminearum*

The fungal pathogen Fusarium graminearum forms specialized infection cushions (ICs) essential for penetration of wheat floral-leaf cells. To understand the molecular basis of infection cushion development, ICs and non-invasive runner hyphae (RH) were isolated by laser capture microdissection (LCM) and separately subjected to RNAseq. Quantitative expression analysis show marked differences in gene expression patterns between RH and ICs:
The majority of known and putative secondary metabolite gene clusters, including those responsible for trichothecene and butenolide production, are significantly up-regulated in ICs.

Carbohydrate-modifying enzymes (CAZymes) with proven capacities for cell-wall degradation are exclusively present in ICs. In total, 174 genes encoding for CAZymes are differentially expressed (42 in RH, 132 in ICs).
Genes encoding for enzymes involved in reactive-oxygen species metabolism reside in the upper ranks of differentially expressed genes (DEGs). Secreted ROS-related enzymes (SREs), presumably involved in plant-defense response, are relatively enriched in ICs.

We identified a large subset of transcripts encoding for putative effector proteins.
By use of this novel transcriptional profiling of runner hyphae and infection cushions from a fungal plant pathogen obtained under in planta conditions, we gain new insights in the initial infection process of F. graminearum on wheat. Complementary to this approach, functional characterization of genes and histological analyses are ongoing. First results will be presented.

In general, we conclude that infection cushions serve as an armory of virulence factors, enabling the pathogen to enter the host.

Jonathan Bank
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AG Herwig

Dealing with stress during winter - Influence of thyroid hormones on metabolism and spontaneous daily torpor in the Djungarian hamster

Djungarian hamsters (*Phodopus sungorus*) live in a seasonally changing environment. To cope with harsh winter conditions they undergo multiple changes in behaviour and physiology including daily torpor, a state of hypometabolism and hypothermia. The physiology of these homeothermic animals is well adapted to survive hypothermia, however the driving mechanisms are not well understood. Thyroid hormones (TH) play a key role in regulation of seasonal as well as acute changes in metabolism. In our study we investigated effects of TH on the torpor response. TH levels were increased by giving T4, T3 or decreased by methimazole via drinking water. Body temperature was recorded during the entire experiment and gene expression was analysed by qPCR. High or low serum T3 levels had pronounced reciprocal effects on torpor bout frequency and duration. Expression of genes involved in T3 metabolism (dio2, dio3) indicated a tissue specific response to treatment. T
orpor per se affected dio2 and dio3 expression irrespective of treatment or tissue, suggesting down regulation of T3 production during hypometabolism. Uncoupling proteins, target genes of T3, were affected by treatment as well as torpor. Understanding molecular pathways influenced by TH action will help to understand general regulatory mechanisms of metabolism and body temperature.

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Fighting the Rivals - Secondary Metabolites as Bioactive Compounds

For the successful infection of its host plant wheat, the phytopathogenic ascomycete Fusarium graminearum forms complex infection structures like lobate appressoria and infection cushions. By the use of a transcriptome sequencing approach of these structures, it was found that the production of the secondary metabolites deoxynivalenol (DON), butenolides and aurofusarin is drastically upregulated during infection of wheat floret organs compared to epiphytically growing hyphae. The lack of aurofusarin, DON, and butenolide biosynthesis does not compromise initial infection. However, it is assumed that these secondary metabolites are produced to act as bioactive compounds. In vitro analyses showed that DON, aurofusarin, and butenolides display antimicrobial and antifungal activity. Aurofusarin, for example, inhibits growth of Bacillus subtilis and Candida albicans. This bioactive function could prevent biotic stress for F. graminearum caused by antagonistic
organisms. Our results provide novel insights in co-evolutionary aspects of pathogenic development and stress prevention.

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Sauerstoffversorgung und Sauerstoffmangel bei Wirbeltieren

Um eine fortlaufende Energieproduktion sicherzustellen, haben Tiere eine Reihe von Strategien zur verbesserten Sauerstoffaufnahme und –verteilung entwickelt. Dazu gehören unter anderem die respiratorischen Proteine, die bei den Wirbeltieren zur Familie der Globine gehören. Hämoglobin und Myoglobin zählen dabei zu den bekanntesten und am besten untersuchten Proteinen in der biomedizinischen Forschung. Unsere Studien der letzten Jahre führten zur Entdeckung von sechs weiteren Globintypen: Androglobin, Neuroglobin, Cytoglobin, Globin E, Globin X und Globin Y. Die Untersuchung dieser "-neuartigen" Globine zeigt eine spannende Evolutionsgeschichte dieser Proteine und breit gefächertes Funktionsspektrum, teilweise jenseits der Sauerstoffversorgung.

Eine Reduktion der zur Verfügung stehenden Sauerstoffmenge kann durch Umweltbedingungen oder Krankheiten verursacht werden. Exemplarisch können anhand tauchender Säuger (Wale und Robben) und verschiedenen Fischarten verschiedene Strategien aufgezeigt werden, welche die Sauerstoffversorgung verbessern, den Sauerstoffverbrauch minimieren oder alternative Stoffwechselwege nutzen. Ein besonderer Fokus der vorgestellten Arbeiten liegt dabei auf dem Gehirn, welches bei Wirbeltieren besonders sensitiv gegenüber Sauerstoffmangel ist.

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Real-time monitoring of stress-induced hydrogen peroxide production by *Fusarium graminearum* using the fluorescent indicator protein "HyPer"

The plant pathogenic ascomycete *Fusarium graminearum* (teleomorph Gibberella zeae) is the main causal agent of the head blight disease of wheat (*Triticum aestivum* L.). This leads to major economic losses by accumulation of mycotoxins.
Reactive oxygen species (ROS), like hydrogen peroxide (H_2O_2) and superoxide anions, play an important role in the interaction between the host plant and the fungus. They are used to induce oxidative stress on both sides. The plant-derived ROS is supposed to inhibit fungal growth inside the plant tissue, while F. graminearum as a necrotrophic pathogen releases ROS in order to harm the host plant.
By use of a novel fluorescent indicator protein for H_2O_2, called HyPer, we, for the first time, established a technique to monitor H_2O_2-dynamics in fungal cells. In the presence of H_2O_2, HyPer changes its conformation, leading to altered fluorescence characteristics allowing ratiometric readouts.
Analyses of HyPer-expressing strains of *F. graminearum* using fluorometry and confocal laser scanning microscopy revealed rapid fluctuations of intracellular H2O2-concentrations in response to various stresses like oxidative, osmotic, and thermal stress. HyPer is, therefore, an excellent tool for real-time ratiometric analyses of stress-induced production of ROS.

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Role of adenosine in the processing of olfactory information

Stress is the response of an organism to unfavourable environmental conditions and often leads to adjustment of physiological functions or behaviour. The olfactory system is designed to analyse the animal´s chemical surroundings and therefore is suitable for the perception of a variety of stress-factors such as the odour of predators. Odours are detected by olfactory sensory neurons in the nasal epithelium which convey the information to the olfactory bulb (OB), the first relay station of the olfactory sensory pathway in the CNS. Although animals dispose only a limited repertoire of odorant receptors in the sensory neurons they are able to discriminate thousands of odours. This is achieved by intense processing of the sensory information by local neuronal circuits in the OB creating odour-specific activity patterns. We suggest that adenosine plays a role in the refinement of these activity patterns. Adenosine is a ubiquitous neuromodulator, involved in many physiological processes e.g. the induction of sleep. In our everyday life we use the blockade of adenosine A1-receptors by caffeine, an ingredient of coffee, to counteract the dampening effect of adenosine on neuronal activity. In the OB adenosine reduces background activity and therefore increases the signal to noise ration of the odour signal.

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Die Funktion von NDR1-ähnlichen Proteinen in Peroxisomen und in der pflanzlichen Pathogenantwort

Nicht nur Tiere, sondern auch Pflanzen besitzen ein angeborenes Immunsystem. So sind Wildpflanzen, im Gegensatz zu hoch gezüchteten landwirtschaftlichen Kulturpflanzen, in der Regel in der Lage, Angriffe durch Krankheitserreger erfolgreich abzuwehren. Peroxisomen sind wie Mitochondrien und Chloroplasten ein essentielles Zellorganell in nahezu allen höheren Organismen. Seit Kurzem ist bekannt, dass Peroxisomen eine wichtige Rolle in der pflanzlichen Immunität spielen. Durch bioinformatische Vorhersagen und experimentelle Proteom-Analysen haben wir mehrere, bislang unbekannte Peroxisomenproteine in der Modellpflanze Arabidopsis thaliana mit Ähnlichkeit zu bereits charakterisierten Verteidigungsproteinen gefunden. Interessanterweise wird die Steuerung einiger Verteidigungsproteine zu Peroxisomen offenbar durch alternatives Spleißen reguliert. Unter den neu vorhergesagten Peroxisomen-Proteinen sind etliche Homologe des prototypischen Abwehrproteins NDR1 (NON-RACE-SPECIFIC DISEASE RESISTANCE 1). Die Zielsteuerung zu Peroxisomen wurde für etliche Homologe in vivo nachgewiesen. Mit Hilfe von Expressionsanalyse, reverser Genetik, Modellierungsversuchen und Proteinkristallisation versuchen wir momentan, die Funktion dieser Proteine in der Pathogenantwort aufzuklären.

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Effects of anthropogenic habitat fragmentation on different aspects of amphibian diversity in Ranomafana rainforest, Madagascar

Madagascar's ecosystems are severely influenced by anthropogenic habitat alterations such as deforestation, degradation and fragmentation. Although in general these disturbances of natural ecosystems are thought to have negative effects on biodiversity, there is no consistent pattern on species' and communities' reactions and therefore, ecosystem consequences remain poorly known. Usually, not all species react in the same way to disturbances. Undisturbed forests outside protected areas are declining rapidly and today's protected areas might not be sufficient to protect all extant species in the long-term. For conservation planning it is hence important to understand fragmentation effects on biodiversity and assess the diversity and conservation value of disturbed habitats.

In a three-year study we determined different aspects of amphibian diversity along streams and in terrestrial forest parts, and analyzed differences on a gradient of three major habitat types: continuous forest (i.e., Ranomafana National Park), forest fragments, and matrix (secondary vegetation, banana plantations, rice fields). In general, fragmentation effects on diversity were weak, i.e. there were no differences in species richness between continuous forest and fragments, but differences in species composition. This indicates that fragments represent suitable habitat for amphibians. Species richness and composition in the matrix varied highly between different matrix types. Streams in the matrix and banana plantations harboured as many species as continuous forest and fragments, indicating that even highly altered habitats can act as vital corridors and/or habitats for many species if at least some habitat structures such as small gallery forests along streams are maintained. However, diversity in secondary vegetation and rice fields was significantly reduced.

We conclude that forest fragments and even some matrix habitats outside protected areas are important refuges of amphibian diversity in Madagascar, and should be included to a greater extent in conservation planning. We discuss the exposure to high natural disturbances (e.g., cyclones) as a factor that predisposes the exceptional resilience of Madagascan amphibians to anthropogenic disturbances.

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Extremwetter, Stress für Pflanzen?

Der Klimawandel macht sich u.a. durch Häufung von Starkregen und Trockenperioden bemerkbar. Wie reagieren Nutzpflanzen auf kurzzeitige Überflutung? Welche molekularen Mechanismen werden aktiviert?

Posterbeiträge in alphabetischer Reihenfolge

Michael Baum
Molekulare Evolutionsbiologie

Poison is a matter of perspective: The Lily of the valley (*Convallaria majalis*) and the Onion Beetle (*Lilioceris merdigera*, Chrysomelidae, Criocerinae)

Abstract:
Elected the „Poisonous Plant of the Year 2014“ in Germany, the Lily of the valley *Convallaria majalis* owes its toxicity to the production of cardenolides.
Cardenolides are able to inhibit the ubiquitous enzyme Na/K-ATPase, which is found in the plasma membrane of all animal cells. Nevertheless, larvae and imagines of Lilioceris merdigera, often found on Allium sp., do feed on the leaves of *C. majalis*.
After feeding on *C. majalis* for 5 days followed by Allium for 3 days, the defensive secretions of L. merdigera did not contain any cardenolides and neither did the beetle itself. Sequence analysis of the beetle Na/K-ATPase revealed none of the mutations known to make the enzyme less sensitive to cardenolides in other species. In tracer feeding experiments with ^{3}H-marked cardenolides, the bulk of radiation was recovered from the beetle feces, indicating a protective mechanism in the gut wall to prevent cardenolides from entering the hemolymph.
Disposing cardenolides via feces may be advantageous to the larvae of *L. merdigera*. They cover themselves with a fecal shield, which often exceeds the size of the larvae itself. The ability of the fecal shield to offer chemical protection was assessed in a bio-assay with predatory ants.

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Sp100 isoform-specific regulation of human Adenovirus type 5 (Ad5) gene expression

Abstract:
PML-NBs (PML nuclear bodies) are multiprotein complexes that have been implicated in a general antiviral defense based on their capacity to recruit SUMOylated host restriction factors upon interferon stimulation and stress. Paradoxically, the genomes of various DNA viruses become associated with PML-NBs, and initial sites of viral transcription/replication centers are often juxtaposed to these domains. To ensure efficient viral replication, restriction factors must be inhibited by expressing viral early gene products that functionally limit PML-NB-associated antiviral effects. To benefit from the co-activating capabilities of Sp100A and simultanously prevent transcriptional repression by Sp100B/C/HMG, Ad5 employs several features to selectively and individually target these isoforms, by relocalization of Sp100B/C/HMG from PML-NBs prior to association with viral replication centers. In contrast, Sp100A is kept at the PML tracks that surround the newly formed viral replication centers as designated sites of active transcription. We conclude that host-restriction factors Sp100B/C/HMG are potentially inactivated by active displacement from these sites, whereas Sp100A is retained to amplify Ad5 gene expression. In sum, we provide evidence that Ad5 selectively counteracts antiviral responses, and at the same time benefits from proviral PML-NB associated components by actively recruiting them to PML track-like structures.

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FSP BIOGUM

Dem Stress durch Züchtung ein Schnippchen schlagen?

Abstract:
Durch die Züchtung stresstoleranter Pflanzen erhofft man sich, auch unter unsicheren Bedingungen Erträge erwirtschaften zu können, die Konflikte um die Ressource „Land“ zu vermindern sowie die zu erwartenden Einflüsse des Treibhauseffektes (weniger Niederschläge) auffangen zu können. Im Bereich trockentoleranter Pflanzen wird hauptsächlich am Mais geforscht. Hier gibt es sowohl konventionelle Züchtungsansätze unter Nutzung biotechnologischer Methoden (molekulare Marker) als auch erste gentechnisch veränderte Pflanzen. Am Beispiel dreier ausgewählter Maislinien wird aufgezeigt, welche Forschungsfragen aus Sicht der Technikfolgenabschätzung beim Anbau und der Nutzung dieser Pflanzen bearbeitet werden.

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Efficient replication of human Adenovirus type 5 (Ad5) requires PTM of the cellular co-repressor KAP1

Abstract:
KAP1 (KRAB-associated protein 1) plays a major role in multiple cellular processes like apoptosis, DNA repair and gene silencing. Recruitment of KAP1 to chromatin promotes its compaction by increasing H3K9me2/3 repressive histone marks, thereby potentiating KAP1 interaction with HP1. KAP1 is phosphorylated in response to DNA damage and accumulates as pKAP1-S824 to become functionally inactive resulting in chromatin relaxation. Vice versa inhibition of KAP1 phosphorylation prevents decondensation of heterochromatin repair foci, which renders cells hypersensitive to DSB inducing agents.
Recently, we reported that alteration of chromatin structure plays a key role in efficient Ad5 replication. Here, we provide evidence that viral phosphoprotein E1B-55K functionally cooperates with the C-terminal part of the KAP1 host-cell factor. We further demonstrate that KAP1 phosphorylation at serine 824 is a crucial step for efficient viral gene expression and progeny production. Simultaneously, we can show a decrease in levels of SUMOylated KAP1 during Ad infection, known to mediate chromatin-decondensation, as well as a vice versa effect of KAP1 overexpression on the SUMOylation status of Ad5 proteins. Based on our findings, we hypothesize that Ad-mediated modulation of PTM (posttranslational modifications) of KAP1 minimizes chromatin condensation and gene silencing, thereby maintaining efficient viral gene expression.

Anna-Lena Cory
AG Ethologie

Mating on time: Mechanisms of mate attraction in Argiope bruennichi

Abstract:
For mate attraction, female spiders use sex pheromones found in the web silk and/or on the female body. Pheromone emission is dynamic and may be enhanced by virgin females close to oviposition. However, experimental studies about chemical mate attraction in web-building spiders are scarce. In field experiments, we varied pheromone source and female age and examined mate attraction measured as the number of male visitors per female/web within two hours in the orb-web spider *Argiope bruennichi*. To compare the attraction efficiency of female bodies with that of web silk, we put virgin females in neutral non-pheromone webs of sub-adult conspecifics and we used webs of pheromone-transmitting females without the females. Both types of webs were placed into a natural population and we found that receptive females on neutral webs attracted more males than webs alone built by receptive females. Young, middle-aged and old, virgin females or their webs were brought to the field simultaneously and we found that independent of the pheromone source; old females were more attractive than young and middle-aged females. The results suggest that females increase pheromone production with number of days they remain unmated which affects silk and body.

Eva-Maria Disch
Molekulare Pflanzenphysiologie

Membrane-Associated Ubiquitin Ligases in Plant Immunity

Abstract:
Plants use different strategies and mechanisms to fight against pathogen infections. Plant U-box armadillo repeat (PUB-ARM) ubiquitin ligases are regulators of development, stress responses and pathogen defense. We have previously identified a small conserved subgroup of PUB-ARM ubiquitin ligases that have an elongated C-terminus carrying an additional ARM repeat domain. This domain is essential and sufficient to associate this group of PUB-ARM proteins to the plasma membrane. Arabidopsis saul1 mutant plants lacking expression of the SAUL1 gene, which encodes the plasma membrane-associated SENESCENCE-ASSOCIATED UBIQUITIN LIGASE 1, show early cell death and auto-immune phenotypes. These mutants are less susceptible to different pathogens. All phenotypes can be rescued by high temperature or by additionally knocking out the PAD4 or EDS1 defense gene, respectively.

Hannes Gonschior
AG Warnecke

Versuche zur Biosynthese bakterieller Glycolipide in Säugerzellen

Abstract:
Hitzeschock-Experimente mit Zellen des Schleimpilzes Physarum polycephalum sowie mit Säugerzellen führen zu einen schnellen Biosynthese von Steryl-Glycosiden (Murakami-Murofushi et al., J. Biol. Chem. 1997; 272: 486-9; Kunimoto et al., Cell Struct. Funct. 2002; 27: 157-62). Dabei wird ein Zuckerrest auf das Membranlipid Sterol (z.B. Cholesterol = Cholesterin) übertragen. Die biologische Funktionen dieses neuen Glycolipids in den Zellen sind nicht bekannt; die Steryl-Glycoside werden aber als Mediatoren der Stress-Antwort angesehen.
Bei Pflanzen, vielen Pilzen und einigen Bakterien sind Steryl-Glycoside normaler Bestandteil zellulärer Membranen (Grille et al., Progr. Lipid Res. 2010; 47: 262-288). Die Gene einiger Glycosyltransferasen, die den Zucker auf das Sterol übertragen, wurden bereits kloniert.
In dieser Bachelorarbeit sollen Cholesterol-Glycosyltransferasen aus den humanpathogenen Bakterien Helicobacter pylori, Borrelia burgdorferi und Borrelia hermsii in Säugerzellen exprimiert werden, um dort die Biosynthese verschiedener Cholesteryl-Glycoside zu verursachen. Diese Zellen wären für Experimente über die Hitzeschock-Reaktion geeignet. Nach der Transfektion von CHO- und Cos-7-Zellen mit entsprechenden Plasmiden auf Basis des pQETris-Systems von Qiagen konnte mit Hilfe eines Enzymassays mit radioaktiv markierten Substraten keine Cholesterol-Glycosyltransferase-Aktivität detektiert werden.

Wing Hang Ip
Arbeitsgruppe Virale Transformation, Heinrich-Pette Institut, Leibniz-Institut für Experimentelle Virologie

Modulation of the IKK complex during human Adenovirus (Ad) infection

Abstract:
Human Adenovirus (Ad) infections show a high mortality rate in patients with strongly impaired immune response due to strong cytokine storm and uncontrolled immune responses. Activation of pro-inflammatory cytokines is induced early after infection by activation of the cellular NF-kB pathway. Here, we observe a regulatory loop between Ad and cellular factors of the NF-kB stress pathway, indicating that the activation of NF-kB is crucial for efficient Ad replication. Our results show that formation of the IKK complex after stimulation of the NF-kB pathway is impaired upon Ad infection. We also observe that Ad induces the relocalization of the IKKα into foci surrounding the newly formed viral replication centers, designated sites of active transcription in the host cell nucleus. Mimicking removal of IKKα in the cell, knock down of this cellular IKK component using RNAi techniques resulted in significantly impaired Ad replication. Vice versa, overexpression of IKKα increased Ad progeny production. We conclude that IKKα is actively recruited to sites of Ad gene expression to selectively counteract antiviral responses, and simultanously benefit from NF-kB constituents. Our findings provide insights into novel strategies for manipulating transcriptional regulation, to either inactivate, or amplify viral gene expression.

Jonas Koch
AG Burmester

Functional analysis of the vertebrate globin-repertoire in cell culture

Abstract:
Hemoglobin (Hb) and myoglobin (Mb) have well established functions in oxygen transport and storage. In recent years, six additional globin types (androglobin [Adgb], neuroglobin [Ngb], cytoglobin [Cygb], globin E [GbE], globin X [GbX] and globin Y [GbY]) have been identified in vertebrates. The functions of these globins are still poorly understood. In addition to specific roles in O2 supply, several functional hypotheses have been put forward. These include a role in intracellular signaling, decomposition or production of nitric oxide and the detoxifying of reactive oxygen (ROS). We employed a strictly comparative approach in a cell culture system. Mouse neuronal cells (HN33) were stably transfected with zebrafish (*Danio rerio*) Mb, Ngb, Cygb 1 and 2, or GbX, with mouse (*Mus musculus*) Mb or Ngb, or with chicken (*Gallus gallus*) GbE. HN33 cells transfected with the empty vector (pcDNA3.1+) were employed as mock-control. The cells were kept under hypoxic conditions (1 % O2 for 6, 24 and 48 h) and ROS-stress was induced by hydrogen peroxide (H2O2) for 24 h. Cell viability was measured via the activity of the mitochondrial dehydrogenases and the ATP-amount of the cells. The results suggest that all globins enhance cell viability under hypoxia with variable efficiency and that GbX and Ngb most efficiently protect from ROS. In addition, we measured globin-induced ROS-production, which show that Ngb and GbE increase ROS under hypoxia and H2O2-induced stress. These results allow evaluating different hypothesis of globin functions.

Jennifer Lohr
AG Dobler

Biological role of triplicated Na, K-ATPase1α genes in the large milkweed bug, with regard to target-site insensitivity against cardiac glycosides

Abstract:
Plants produce a wide variety of secondary metabolites, including alkaloids, terpenoids and glycosides, many of which serve as antiherbivore or antimicrobial defense compounds. In response, a substantial number of insect species have evolved adaptations specific to the particular defensive compounds of their host plants. The large milkweed bug, *Oncopeltus fasciatus* feeds on cardiac glycoside containing plants, and as a result must cope with the blocking of its Na, K-ATPase´s. As an adaptation to counter the toxic effects of these cardiac glycosides, milkweed bugs contain three copies of the Na, K-ATPα subunit coding gene (copies A-C). Molecular docking simulations, as well as genetically engineered Na, K-ATPase constructs, suggest that the three copies differ greatly in their sensitivity to cardiac glycosides. Moreover, a preliminary gene-expression study indicates that the two putatively less sensitive copies (A and B) are expressed in the gut where the cardinolides are processed, whereas the putatively more sensitive copy (copy C) is localized to the brain, where the glial sheath likely acts as a barrier against cardenolides. The goal of our research is to systematically categorize the function and expression patterns of these gene copies using RNAi. An advantage of the insect system is that dsRNA can be injecting into adults (or in fact any life stage), after which screens can be run immediately for phenotypic changes. Our approach will be to knock out each copy of the ATP1α gene and look for differences in the expression of the other gene copies qPCR.

Rainer Neumann
AG Verhaltensbiologie

Comparative assessment of adaptive developmental plasticity in African golden-silk spiders: males in Nephila senegalensis (but not in N. fenestrata) accelerate sexual maturation in response to female silk cues

Abstract:
Phenotypic plasticity allows animals to deal with environmental uncertainty, but plasticity may also bear fitness costs. In male spiders, female silk cues have been proposed to induce plastic adjustment of maturation to female availability. In general, males should accelerate development in response to female cues. *Nephila senegalensis* and *N. fenestrata* are closely related, but differ considerably in size, developmental durations, and ecology. *N. senegalensis* occurs in more variable habitats and female availability should be less predictable in this species. Based on these assumptions, we expected stronger plastic responses in *N. senegalensis* males compared to *N. fenestrata* males. We reared spiders under standardized conditions in climate-control chambers. Spiders in the 'Female cues treatment' were regularly presented with virgin females´ silk, while spiders in the 'No cues treatment' were reared in the absence of such cues. We recorded the duration of male development until reaching maturity. Males in *N. senegalensis* matured several days earlier when presented with female silk cues, which could entail significant benefits under natural conditions. *N. fenestrata* males showed no response to female cues at all. We suggest that males in this species are able to rely on abiotic cues due to less variable female presence in natural populations.

Janina Rahlff
AG Biologische Ozeanographie

Cellular and physiological responses to heat stress in neritic copepods

Abstract:
A better understanding and ability to measure environmental-induced stress is of growing importance given ongoing, climate-driven changes in marine habitats. Poikilothermic invertebrates inhabiting coastal areas and estuaries are particularly appropriate model organisms for studying the effects of stress since they are naturally exposed to environmental fluctuations in key abiotic factors such as temperature or salinity. This study examined the effect of heat stress on *Acartia tonsa* and *Eurytemora affinis*, two nertic copepods by quantifying the biochemical (expression of heat shock proteins Grp78, Hsp70, Hsp90) and organismal (O2 consumption rates) responses. A second objective was to examine the role of acclimation to warmer conditions on biochemically responses to heat stress. Increasing temperature caused increased amounts of Hsp transcripts and increased respiration rates. Accumulating protein quantities over time could be detected. Acclimation to warmer temperature significantly decreased the heat stress response leading to lower Hsp levels compared to non-acclimated individuals. The temperature-associated plasticity for the activation of heat shock proteins in copepods together with their sustainable efficacy and efficiency during cellular protection may explain why this protein family is evolutionary so well-conserved among eukaryotes.

Sabrina Schreiner
Arbeitsgruppe Virale Transformation, Heinrich-Pette Institut, Leibniz-Institut für Experimentelle Virologie

Viral oncoprotein E1B-55K binding to specific PML isoforms is essential for efficient transformation of primary rodent cells

Abstract:
E1B-55K from adenovirus type 5 (Ad5) is an antiapoptotic protein and contributes in vitro to complete cell transformation of primary rodent cells. Inhibition of p53-activated transcription plays a key role in processes by which E1B-55K executes its oncogenic potential. Additional functions of E1B-55K or protein interactions with cellular factors, such as Daxx (death-associated protein) including SUMO posttranslational modification and integrity of nuclear multiprotein complexes (PML-NBs) may also contribute to the transformation process. However, the biochemical consequences of PML-associated E1B-55K by SUMO conjugation have so far remained elusive. We performed mutational analysis to define a PML interaction motif within the E1B-55K polypeptide. These studies showed that E1B-55K/PML binding is not required for p53 and Daxx interaction; but illustrates a prerequisite for efficient E1B-55K SUMO conjugation. Additionally we observed that E1B-55K lacking PML-IV or PML-V binding was no longer capable of E1B-55K-dependent SUMOylation of p53. Surprisingly, these E1B-55K mutants also lost the ability to inhibit p53 mediated transactivation and showed reduced transforming potential in primary rodent cells. These results together with the observation that p53 SUMOylation is required for efficient cell transformation, provides evidence that the SUMO ligase activity of the viral oncoprotein is intimately linked to its growth promoting oncogenic activities.

Kim Schwarze
AG Burmester

Globins in a turtle's shell: The globin repertoire of the Chinese softshell turtle (Pelodiscus sinensis) and the western painted turtle (Chrysemis picta bellii)

Abstract:
Globins are small heme-containing proteins that reversibly bind oxygen and thus play an important role in respiration, but may also have other functions. Globins offer a unique opportunity to study the functional evolution of genes and proteins. We have characterized the globin repertoire of two different turtle species: the hypoxia-sensitive Chinese softshell turtle (*Pelodiscus sinensis*) and the anoxia-tolerant western painted turtle (*Chrysemis picta bellii*). In the genomes of each species, we have identified eight distinct globin types. Therefore, along with the coelacanth, turtles appear to be the only vertebrates with a full globin repertoire. Phylogenetic analyses revealed an early divergence of distinct globin types and a closer relationship of myoglobin and globin E on the one hand, and hemoglobin and globin Y on the other. Quantitative real-time RT-PCR experiments reveal that most of the turtle's globins are expressed in a tissue-specific manner. Like in birds, expression and localization of the globin E protein in the turtles is restricted to the eye, in the pigment epithelium. Globin E may either play a myoglobin-like role in oxygen supply in the metabolically active cells or have functions in detoxification of reactive oxygen species.

Tagungsprogramm **Stress auf allen Ebenen** 15. 12.2014

Uhrzeit	Vortragstitel	Wer	Raum
Ab 8Uhr	Registrierung		Vorraum
09:00	Begrüßung/Eröffnung der Tagung durch den Dekan	Prof. Graener	Carl v. Linne Hörsaal
09:15	Begrüßung durch die FB Sprecherin	Prof. Schneider	
09:30	Reaktionen der Pflanzen nach DNA-Schäden	Prof. Arp Schnittger	
09:50	"Gestresste" Mikroben in extremen Habitaten	Jun. Prof. Mirjam Perner	
10:10	Some like it hot: Stress in Wüstenrändern	Dr. Jens Oldeland	
10:30	Four mutations in the target site for cardenolides explain the insensitivity of Oncopeltus fasciatus to highly toxic plant chemical defenses	Safaa Dalla	
10:50	Kaffeepause		
11:20	How to reduce stress with toxic food – The Senecionine Monooxygenase of Longitarsus jacobaeae	Dr. Renja Romey-Glüsing	Carl v. Linne Hörsaal
11:40	Beweidung – Stress und Möglichkeit	Dr. Stefanie Nolte	
12:00	Extremwetter, Stress für Pflanzen?	PD Dr. Sabine Lüthje	
12:20	Mittagspause		
13:20	Postersession		
14:20	Thermal limits of lizards along a steep environmental gradient	Ole Theisinger	Carl v. Linne Hörsaal
	Stress - Wie sich die Pflanze wehrt	Prof. Christian Voigt	Großer Hörsaal
14:40	Energetics of Lepilemur leucopus	Bianca Wist & Janina Bethge	Carl v. Linne Hörsaal
	Cell Death Regulation in Plants	Tanja Kotur	Großer Hörsaal
15:00	Sauerstoffversorgung und Sauerstoffmangel bei Wirbeltieren	Prof. Thorsten Burmester	Carl v. Linne Hörsaal
	Stress signaling cascades in Fusarium graminearum	Dr. Jörg Bormann	Großer Hörsaal
15:20	Kaffeepause/Postersession		
16:20	Role of adenosine in the processing of olfactory information	Dr. Daniela Hirnet	Carl v. Linne Hörsaal
	Real-time monitoring of stress-induced hydrogen peroxide production by Fusarium graminearum using the fluorescent indicator protein "HyPer"	Michael Mentges	Großer Hörsaal
16:40	Dealing with stress during winter - Influence of thyroid hormones on metabolism and spontaneous daily torpor in the Djungarian hamster	Jonathan Bank	Carl v. Linne Hörsaal
	Fighting the Rivals - Secondary Metabolites as Bioactive Compounds	Anika Glasenapp	Großer Hörsaal
17:00	Funktion von NDR1-ähnlichen Proteinen in Peroxisomen und in der pflanzlichen Pathogenantwort	Prof. Sigrun Reumann	Großer Hörsaal
	Effects of anthropogenic habitat fragmentation on different aspects of amphibian diversity in Ranomafana rainforest, Madagascar	Jana Riemann	Carl v. Linne Hörsaal
17:20	Pause zum Raumwechsel		
17:30	Abschlussvortrag	Sibylle Lachmann	Carl v. Linne Hörsaal
18:00	Abschlusswort	Dr. Markus Brändel	Carl v. Linne Hörsaal
Ab 20:00 Bioparty am Grindel			