

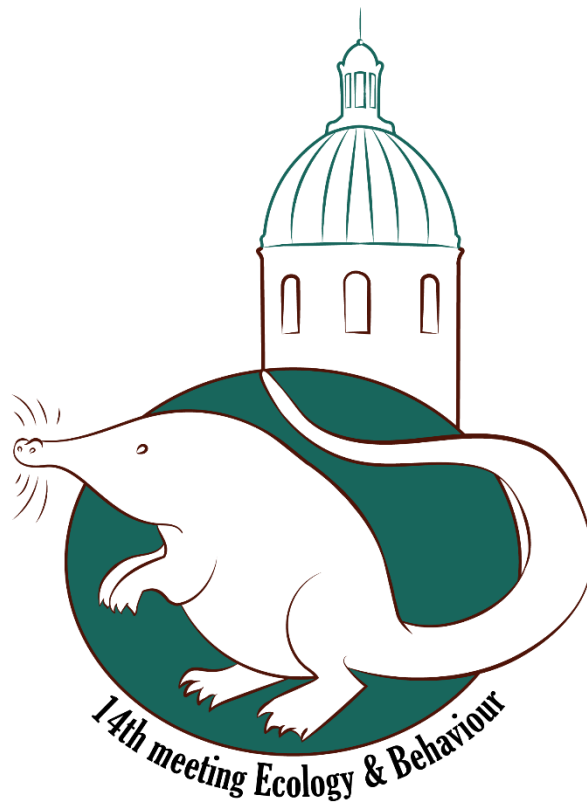
Abstract book

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Sexual selection and parental care

The role of behaviour in heredity: towards the Inclusive Evolutionary Synthesis

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Heredity can be defined as patterns of parent-offspring resemblance. It is a major factor of evolution by natural selection or drift. The mainstream vision of heredity tends to reduce heredity to the sole transmission of the DNA sequence. However, in the last 40 years, evidence has been accruing that parent-offspring resemblance also rests on numerous other types of information that are not encoded in the DNA sequence i.e. that are not encoded into genes. In effect, DNA sequence information is discovered as being far from being able to explain the whole complexity of life. Many of these mechanisms involve behaviour. These results are often viewed as this challenging of the mainstream vision but in fact they mainly constitute a generalisation of the Modern Synthesis of evolution. Interestingly, these discoveries resulted from the very success of that approach as it is the fantastic development of DNA sequencing technologies that revealed the limits of a gene-only vision of life. After a few definitions, I will present a diagram that I suggest can help better understanding inheritance. I will then develop 3 general examples of non-genetic inheritance to illustrate the fact that it is pervasive and involves subtle mechanisms. I'll be brief about the third example, that of cultural inheritance, as it will be developed in the plenary of Lucy Aplin on Tuesday afternoon. Building on these examples, I will work at unifying these elements into an 'Inclusive Evolutionary Synthesis' (IES) that would generalise the modern synthesis of evolution, with the ambition of encompassing all dimensions of heredity, be they genetic or non-genetic. This IES does not refute the modern Synthesis of evolution but rather generalizes it with the ambition to better capture all the complexity of life.

Keywords: Cultural transmission, epigenetics

*Speaker

True love? Understanding the evolution of monogamy

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Why do some animals mate with one partner rather than many? In my talk, I review factors related to 1) parental care, 2) habitat limitation, 3) mate availability and 4) time constraints, to see what support is found regarding their importance in explaining the occurrence of monogamy, whether shown by one sex (monogyny or monandry) or by both sexes (mutual monogamy). I focus on reproductive rather than social monogamy whenever possible, and review the empirical literature for birds, mammals and fishes, with occasional examples from other taxa. I find that each of these factors adequately explain mating pattern in some taxa, but not in all. The factor that shows greatest support across taxa is habitat limitation. In contrast, while a need for parental care might explain monogamy in freshwater fishes and birds, there is clear evidence that this is not the case in marine fishes and mammals. Hence, reproductive monogamy does not appear to have a single overriding explanation, but is more taxon specific. A common expectation is that monogamy leads to no or little sexual selection. However, sexual selection can be substantial also under mutual monogamy, and both sexes can be subject to such selection. I provide an example of sexual selection under monogamy from my own work on the Western Australian seahorse. Overall, despite much research on genetic mating patterns, reproductive monogamy is surprisingly poorly understood and more work of experimental and comparative nature is still needed.

Keywords: Sexual selection, male care, sperm competition

*Speaker

Does maternal mouthbrooding influence aggression and brain anatomy in adult fish?

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Maternal care is widespread amongst animal taxa, with examples from mammals, birds, reptiles, amphibians, fish and invertebrates. This parental strategy is known to influence offspring growth and survival as well as behaviour and brain anatomy. However, little is known of how maternal care may influence the relationship between brain anatomy and aggressive interactions in adult fish. One-year-old African cichlids that were either deprived of maternal mouthbrooding at three days post fertilisation or left for the natural duration of maternal care, were observed for aggressive interactions in two contexts. In the first, two adult male fish, naïve to each other, were observed interacting in a novel environment with a single shelter resource. Each fish was tested twice, once with a fish of the same rearing condition and once with the opposing, before being observed interacting with a mirror. Following behavioural assays brains were removed and imaged to determine gross anatomical differences and shape variation using geometric morphometrics. Further, a subsection of brain samples was stained to determine differences in neuron densities between rearing conditions. These measurements will then be compared to aggressive behaviours in order to determine the correlations between brain anatomical variation and aggression under different levels of maternal care. Preliminary results indicate that while there are no differences in dorsal brain shape, there are significant differences between brain region sizes. Behaviour has yet to be analysed. The influence of maternal care on the development of this integral organ has wide implications for the evolution of behaviour in African cichlids.

Keywords: Maternal Care, Aggression, Cichlid, Behaviour

*Speaker

Evidence of sperm competition among parrots

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Sperm competition is an important mechanism of postcopulatory sexual selection that has shaped the evolution of sperm morphology. Previous studies have reported that sperm competition has a concurrently directional and stabilising effect over sperm size. Species that show higher levels of extra-pair paternity and larger testes (proxies of sperm competition) display longer sperm and lower coefficients of variation within and between males (CVwm and CVbm, respectively). For this reason, mean sperm length, CVwm and CVbm have been proposed as indexes to estimate the level of sperm competition of species. The effect that sperm competition has on sperm morphology has been explored only for passerine species and mainly for passerines that breed in temperate zones. Now we provide evidence that this postcopulatory sexual selection force has also driven the variation of sperm morphology of parrot species that breed in the tropics. Our results support the view that sperm competition does take place among tropical birds. We also present evidence that indicates that sperm competition is higher among sexually dichromatic species and among species that breed at high densities.

Keywords: Sperm competition, sperm morphology, parrots

*Speaker

Cat Fight Amongst the Sexes: social organisation and spacing patterns dictate promiscuity in Asiatic lionesses

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To maximize individual fitness, males and females of the same species often engage into strategies that are at loggerheads. Sexually selected infanticide is a male strategy which is costly for females, as killing of dependent young by males cause considerable loss to maternal investment. African lions are social, with a group/pride comprising of females, their cubs and a coalition of adult males. Coalition males maintain territorial exclusivity on a group of females and sire all cubs born to a pride during their tenureship. Infanticide is prevalent among lions where invading males kill cubs during a ‘takeover’ after ousting the resident males. Asiatic lions, living as a single relic population in India exhibit a contrasting social structure with males and females staying separately. In here, male ranges encompass multiple female groups and vice-versa. We investigate the consequences of such a land-tenure system on the mating strategy of Asiatic lions. Observations on 134 mating events between 21 males and 49 females revealed that lionesses are promiscuous, females readily mating with multiple rival coalitions. However, promiscuity was primarily shown by experienced lionesses who had litters before. Selective female promiscuity has considerably buffered cub infanticide by confusing paternity amongst males, and also might have invigorated an inbred population by increasing genetic diversity of litters. This novel mating strategy for lions might have evolved owing to spatial segregation between the genders caused by smaller modal prey in the Asiatic system. Our results thus highlight resource mediated behavioral plasticity amongst territorial species inhabiting diverse eco-regions.

Keywords: behavioural plasticity, female reproductive strategies, infanticide, sexual conflict, social carnivore

*Speaker

Extended maternal care as a potential precursor to sociality in the orchid bee *Euglossa viridissima*

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Extended parental care has often been viewed as precursor to derived forms of sociality. In the facultative social orchid bee *Euglossa viridissima*, a foundress mother mass provisions brood cells and lays eggs within a small nesting cavity, then seals the cavity from within to await 58-63 days for offspring emergence, whereupon brood cell provisioning re-commences; the nest may then become social (*e.g.* mother plus daughter). We tested for benefits of extended maternal care in *E. viridissima* by removing foundress females from nests after they had provisioned and laid eggs, paired with control nests in which we did not remove the foundress female. Brood survival through to offspring emergence was high (87%; mean \pm SD 8.2 \pm 3.7 offspring per nest) in nests with foundress females but low (41%, mean \pm SD 3.0 \pm 2.7 offspring per nest) in nests without foundress females. Nests suffered from attack by many parasitic or cleptoparasitic species. We recorded intranidal behaviours of foundress females, who undertook considerable brood care and nest maintenance as well as nest defence behaviours. These benefits to brood survival could explain why *E. viridissima* females remain with their developing offspring. The extended lifespan of females, as seen in *E. viridissima*, could lead to considerable overlap of foundress with offspring, increasing the opportunity for sociality in this species. Enhanced survival of offspring when guarded also highlights a potential benefit of sociality through protection of pupae.

Keywords: orchid bees, parental removal, brood care, facultative social, maternal care

*Speaker

Sexual selection and evolution of phenotypic plasticity in reproductive behaviour

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Empirical evidences suggest that sperm competition is an important evolutionary phenomenon that can influence male morphology, anatomy and physiology and thus can have profound effects on their reproductive fitness. Theory states that males can perceive potential level of sperm competition through the presence of rivals in their vicinity and can allocate their ejaculate resources accordingly. Plastic responses in males to variation in intra-sexual competition are diverse and widespread. Males of many species show morphological, physiological, and behavioural plasticity in response to pre-mating and post-mating reproductive competition (RC). This suggests that plasticity is broadly beneficial. We investigated the evolution of this plasticity in reproductive traits using *Drosophila melanogaster* populations evolving under different levels of sexual selection. We show that with increase in the number of early-life competitors, reproductive investment of males in the regime with higher sexual selection drops after an initial increase, whereas that in the selection regime with lower sexual selection, increases continuously. We also show that the memory of this early life experience wears off in their later ages. Furthermore, our study finds that males change their reproductive strategies depending upon the identity of rival males. This suggests that the pattern of reproductive investment is not only quantity dependent but also quality dependent.

Keywords: sexual selection, phenotypic plasticity

*Speaker

Parental Investment in Nest Attentiveness Reduces Nest Predation in Arctic Sandpipers

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*Speaker

Incubation is a key period for arctic shorebirds given the short breeding season. Adults must find the best compromise to allocate their time and energy between parental cares to their eggs and feeding outside the nest to maintain their own body condition. However, beyond parental cares, reproductive success also relies on nest protection, as predation is the main threat for eggs. If a diversity of antipredator behaviours has been described in shorebirds, we assumed that daily incubation behaviour also modulates predation risk on the clutch. By monitoring the incubation behaviour of seven sandpiper species (genus *Calidris*) in 12 Arctic sites, we investigated the influence of the frequency (NR) and total duration of incubation recesses (TDR) on the probability of the nest to become predated. NR and TDR greatly varied between species, years and sites, and NR was a poor predictor of the nests' fate. However, under comparable conditions, depredated nests showed significantly higher TDR than successful nests, especially for uniparental species. Two independent mechanisms are believed to explain these results: cryptic incubating adults are more difficult to locate than unattended eggs; adults feeding close to the nest can draw predators' attention. Regardless of the factors explaining the large inter-annual or inter-site variations in TDR at local population levels, our study shows that, on average, nests with low TDR have a lower probability to become predated. Hence, if predation acts as a biotic selective pressure that shapes many traits of shorebird life histories, it also favours a high nest attentiveness.

Keywords: Nest predation, Nest survival, Breeding behaviour, Incubation strategy, Incubation recesses, Arctic sandpipers, *Calidris*

Should parents reduce or increase parental care when facing infection?

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Parental care is a key component of an organism's reproductive investment and is likely to trade-off with investment in immune traits. Yet it is unclear whether parents facing infection should mainly respond to the risk of disease transmission to offspring by reducing parental care, or alternatively by showing terminal investment and increasing care towards the current brood. Likewise, in species where both parents provide care, the effects of infection on a focal parent's decision to care might be influenced by the presence of a partner. Here we investigate the effects of pathogenic infection and the presence of a male partner on maternal care in the burying beetle *Nicrophorus vespilloides*, a species where both parents provide elaborate forms of care. Specifically, we test whether the presence of a male partner influences time spent caring by a female parent that is either (i) infected by bacteria, (ii) inoculated with heat-killed bacteria, (iii) wounded or (iv) left untouched. We anticipate that infected females will spend less time caring to reduce the risk of transmission to their offspring, regardless of their partners' contribution to parental care. In contrast, we expect that immune-challenged females will increase their reproductive investment and time caring only when they are on their own, while they should reduce their care in presence of a male partner. Our study will help better understanding how caring parents respond to infections and, more generally provide insights into the impact of diseases on the evolution of social traits.

Keywords: burying beetles, immunity, life history trade, offs, parental care, reproductive investment

*Speaker

Does anal gland scent of Alpine marmots encode genetic make-up?

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Research on sexual selection has provided growing empirical evidence showing that many species exhibit non-random mating according to the "genetic compatibility" hypothesis. Females are expected to prefer males possessing alleles that are compatible with their own genetic make-up, based on genome-wide characteristics or on characteristics at specific loci (e.g. the Major Histocompatibility Complex). Because genes are not directly assessable, they need to be expressed through individual phenotype to influence mate choice. Chemical communication has been suggested as a good candidate to provide information on individual's genetic make-up and to identify a compatible mate. We tested this prediction in the Alpine marmot (*Marmota marmota*), a cooperatively breeding species, where mate choice are based on genetic characteristics. We sampled anal gland scent of 63 sexually mature Alpine marmots and combined "gas chromatography and mass spectrometry" data with genetic analyses to test whether anal gland secretion carried information about genetic distance at the whole-genome and at the MHC class II proteins. We established a concordance between genetic distance at the whole-genome and chemical distance calculated between each dyad of individuals. Furthermore, we may predict a positive correlation between chemical distance and genetic distance at the MHC class II proteins. To conclude, our results suggest that chemical cues have the potential to act as effective signals for mate assessment in the Alpine marmot.

Keywords: Genetic compatibility hypothesis, Mate assessment, MHC, Olfactory cues, Relatedness

*Speaker

Ecophysiology and Ecotoxicology

Reliability of Environmental Quality Standards: the curse of bioavailability

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In most cases environmental quality standards for the aquatic environment concern concentrations of a list of compounds that should not be exceeded in water, sediment or suspended matter. However, this approach has several weaknesses in protecting the aquatic ecosystem. First of all measuring micro pollutants in water or sediment do reflect the pollution at a certain moment only. It is possible, or even likely that in running water the concentration at another moment is highly different from the moment of sampling. Even with a very frequent sampling this variability will never be covered completely. In addition a whole set of environmental factors including pH, temperature, water hardness, sediment composition affect the bioavailability of the measured compounds. This means that the concentration measured at a certain site may result in a different accumulation and effect than the same concentration at another site. As a consequence concentrations of micro pollutants in water and/or sediment are not necessary related to effects on the aquatic communities. To tackle this problem micro pollutants can be measured directly in biota, integrating bioavailability and exposure over time. To this species are needed that are relative tolerant to pollution and that are capable of accumulating high levels of micro pollutants in their tissues. In this study we compare different aquatic species for which we relate the accumulated levels of organic and inorganic micro pollutants to effects on the community structure. In most cases safe body concentrations could be estimated above which the ecological quality was always low.

Keywords: Fates and effects of contaminants in aquatic ecosystems

*Speaker

Wildlife cancer

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Malignant cells have been influencing host life history traits since the transition from unicellular to metazoan life. These cells originate from normal cells that lose their cooperative behavior during the host's lifetime, become malignant, and proliferate at greater rates than would normal cells. Even if they do not necessarily lead to invasive cancers, oncogenic phenomena are extremely prevalent in host populations, and not just in post-reproductive individuals as previously believed. As for microbiota and parasites, (i) host phenotypic traits might influence malignant cell dynamics, (ii) malignant cells might be responsible for host phenotypic alterations and (iii) environmental perturbations could impact malignant cell dynamics. As human impacts on wildlife are predicted to increase rather than decrease (for example, in the context of urbanization), acknowledging the possible links between human activity and cancer in wild populations is crucial.

Keywords: Vertebrate ecophysiology

*Speaker

Stress-related behavioural changes may affect bee-plant network interactions. An experimental study with solitary bees and artificial flowers

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Stress is a major force than can change individual behaviour. Consequently, stressors may play an important role in shaping ecological relationships such as in animal pollination in which stressed individuals may interact differently from their not stressed partners. Here, we tested the effect of an acute dose of a common pesticide on the activities of mason bees, an important European pollinator. Bees that had learned to recognize food in artificial flowers in a training session were either treated with the pesticide (stress) or received a control treatment without pesticide. Bees under stress were impacted by the pesticide and presented a distinctly different set of behaviours compared to the non-stressed group (controls) and reduced nectar feeding in the stressed group, under laboratorial conditions. A combined effect of flying behaviour and number of flowers visited resulted in a reduction of network specificity. This could suggest a potential impact on fruit and seed productivity at populational and community level.

Keywords: bees, ecotoxicology, experimental biology, stress, network interaction

*Speaker

Refuges and context-dependent effect of anthropogenic structures on the stress level of a wild ungulate

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Wild animals are living in variable environments and need to continuously adjust to environmental changes. While some of these are predictable (e.g. seasonal cycles), some others are not (e.g. extreme climatic events). To cope with environmental perturbations, individuals activate the endocrine system which results in the secretion of glucocorticoids (stress hormones). When the system is regularly activated, baseline level of stress increase and individuals reach a state of chronic stress that generates negative consequences on fitness. These past years, unpredictable changes due to the intensification of human activities have increased markedly and have become a major selective force. Here, we analysed variations of faecal glucocorticoid metabolites (FGM), which reflects baseline stress level, in roe deer *Capreolus capreolus* from a wild population living in a fragmented agricultural landscape. Using GPS locations, we aimed to assess whether proximity with anthropogenic structures, access to refuges (woodland patches), and perception of risks influenced FGM levels. We found that roe deer closer to anthropogenic structures by day had higher FGM levels, but this relationship was dependent on access to refuges. When the access to refuges was more important, the effect of the distance to anthropogenic structures was lower and even disappeared. We also found that the effect of this interaction on FGM levels disappeared by night, suggesting that the same anthropogenic structures are not perceived as risky (stressful) during night than during day.

Keywords: Stress hormones, *Capreolus capreolus*, faecal glucocorticoid metabolites, human disturbance, space use

*Speaker

Gut microbiota and host-related responses of *Xenopus laevis* tadpoles exposed to nanoparticles

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The worldwide increase of nanoparticle (NPs) uses and production raises the question of the potential consequences of their release in the environment, especially in the aquatic environment in which it is likely to accumulate. Among these NPs, boron nitride nanotubes (BNNT) or graphene family materials such as graphene oxide are triggering high expectations for the development of new applications. Thus, there is a need to evaluate their biological risk. Gut microbiota constitute a compartment of crucial importance in regulation of host homeostasis. However, most of ecotoxicological studies neglect its role in toxicity-related responses of host organisms. Thus, the aim of this work is to assess the effects of exposure to these NPs toward the gut microbial communities of *X. laevis* tadpoles and to determine the consequences of these changes on host physiological responses. For this purpose, growth of larva exposed to NPs was monitored and total DNA from intestines was extracted. The structure of microbiota was assessed by high-throughput sequencing, targeting the V4-V5 region of the bacterial 16S rRNA gene (Illumina MiSeq). Bioinformatic analysis indicated that exposure to graphene oxide or BNNT led to changes in the gut bacterial communities through diversity decrease or change in taxa relative abundances. Opposite effects were observed on host physiology, resulting in a dose-dependent decrease or increase of larval growth rate after exposure to graphene oxide or BNNT respectively. The results obtained suggest a strong implication of the phylum Bacteroidetes in the host response related to growth parameters.

Keywords: Microbiota, graphene oxide, boron nitride nanotubes, ecotoxicology

*Speaker

Seasonal modulations of energy metabolism in the freshwater mussel, *Dreissena polymorpha*

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Energy metabolism, referring to a set of key processes in the management and production of cellular energy, is essential for the well-functioning of an organism. Biotic (i.e. reproducer status) and abiotic (i.e. temperature) conditions changes may impact the organisms energy status. When organisms face stress, energy is mainly required for defenses mechanisms to the detriment of other function such as growth and reproduction, and trade-off lead to variations of energy management and production. In-depth understanding of this processes should allow the development of more relevant and integrative biomarkers that reflect the health of organisms. The freshwater mussel *Dreissena polymorpha* is considered as a model species in ecotoxicology since this mussel is a filter feeding organism, reflecting thus the water quality of the rivers in which it lives. Since seasonal variations play an important role in the responses of an organism, the follow-up of cellular energy metabolism modulations along a reproductive cycle constitutes an essential step for the characterization of any physiological response as a potential biomarker to be used in ecotoxicological studies. In that respect, a panel of different process involved in energy metabolism of *Dreissena polymorpha* is followed during one reproductive cycle to assess natural variations. Markers of oxidative phosphorylation and energy nucleotides balance as well as several markers of energy fuels were analyzed. ATP production processes were targeted at the molecular level through gene expression, down to the cellular level, with enzymatic activities and reserves concentrations, in the freshwater mussel *Dreissena polymorpha*.

Keywords: Energy, *Dreissena polymorpha*, ATP

*Speaker

The effect of elevated temperature on the physiology and swimming behaviour of the european minnow

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Group living has a variety of costs and benefits, which are not always distributed equally among individuals within a group. Individuals toward the front of groups may have better access to food but may be more vulnerable to predation. The spatial position that individuals occupy may also be related to individual characteristics such as food demand or aerobic capacity. In swimming fish schools, individuals with higher metabolic demands or that are more efficient swimmers may be located near the front of groups. However, little is known about how environmental factors such as temperature modulate links between position within fish schools and physiological traits. Here we examine how acclimation temperature affects metabolic traits in juvenile common minnows (*Phoxinus phoxinus*) and in turn how this affects their positional preference within a swimming school. Sixty-three groups of 10 wild-caught minnows each were acclimated to three temperatures (16°C, 19°C, 22°C) and the positional preference (rank within the swimming school) of one focal fish per group was recorded in a swim tunnel at two different speeds (3cm s⁻¹, 6cm s⁻¹). Metabolic traits; standard and maximum metabolic rates (SMR, MMR) of focal individuals within each group were then estimated using intermittent flow respirometry. It was found that SMR and MMR increased at higher acclimation temperatures. Individuals with a high MMR were found at the front of schools more often. This effect was dependent on speed. The results from this demonstrate the complexity in linking temperature effects with physiological and behavioural traits.

Keywords: metabolic rate, fish, climate change, swimming behaviour, group behaviour

*Speaker

Evolution of chemical defenses in mimetic Heliconiini Butterfly communities

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Butterflies from Heliconiini tribe are chemically defended and display striking colors perceived as a warning signal by predators. Distantly-related species then share similar colour pattern within locality because of convergent evolution generated by predator learning behavior. Although chemical defenses play a key role in such convergent evolution of color pattern, little is known about the evolution of toxicity in the *Heliconius* genus. These butterflies contain cyanogenic glucoside toxins obtained by different metabolic pathways, either neosynthesized and/or sequestered from plants during larval stage. *Heliconius* caterpillars indeed exclusively feed on *Passiflora* leaves and more than 30 different cyanogenic glucosides have been reported in these plants. Here we investigate the toxicity evolution across Heliconiini tribe, and specifically test for the effect of phylogeny, acquisition pathways and mimetic interactions. LC-MS/MS was performed to identify and quantify toxins on wild caught 377 individuals from 32 Heliconiini species (covering 48% of the genus *Heliconius*). Using the well-resolved phylogeny of Heliconiini, we then uncover the evolutionary history of toxicity by estimating ancestral states for each toxin and test for the effect of ecological factors such as mimetic interactions among species and host-plant specialization using phylogenetically-corrected ANOVAs. Chemical analyses revealed important variations across Heliconiini species, pointing at strong toxin diversification within the most species-rich genus: *Heliconius*. Moreover, butterfly species involved in the same mimicry ring contains different toxins in various concentrations and metabolic origins. Mimetic interactions and predation pressure are the main drivers of variations in chemical profile across Heliconiini species.

Keywords: Coevolution, Toxin variations, Passion, vine butterflies, Müllerian mimicry, Warning signal, Diversification

*Speaker

Effects of high altitude hypoxia in snake development and plasticity

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The average temperature at the Earth's surface could increase of 1.5 °C between 2030 and 2052 leading to a disappearance of species estimated worldwide between 15 and 37% and a change of species distribution areas. Like the valleys, which provided a refuge during periods of glaciations, high altitude areas could have a similar role in periods of global warming. However the short, medium and long term acute and chronic hypoxia on physical ability and reproduction of reptiles is still low known. The aim goal of this thesis will be evaluate adaptability of one species of reptiles, the viperine snake (*Natrix maura*), to the altitude hypoxia and her capacity to use mountain areas as a refuge to climate change.

For study how hypoxia can change the embryonic development, the performance and phenotype of juveniles after hatching, we follow egg development and first month of live of snakes in high altitude at Pic du Midi de Bigorre (2900 asl). For eggs we are interested the modification in heart rate, mass and oxygen consumption during time and for juveniles we interested in general phenotype, swim performance and oxygen consumption.

In general, we can observe a strong modification in phenotype with smaller individuals in high altitude leading less good swim performance with small capacity to physical reacclimatisation when they come back to normoxia. That can show than hypoxia can be a barrier to colonize high altitude refuges

Keywords: Snakes, Embryonic metabolism, Developmental plasticity, High altitude hypoxia, Plasticity, Respirometry, Heart rate, Performances

*Speaker

Monitoring of environmental pollution: combination of various bioassays

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Freshwater ecosystems are nowadays exposed to many chemicals which are emitted to surface water through municipal and industrial waste water effluents. Water quality monitoring is frequently restricted to the measurement of physical and chemical parameters. However, established alarm thresholds for these parameters are related to toxic levels of polluting substances, and they usually do not take into consideration risks posed by chronic exposures at low pollutant concentrations, which are frequently complex mixtures with genotoxic potential. Due to their role in aquatic ecosystems and vulnerability to pollution fish represent one of the key elements of ecosystem monitoring programs. A relevant approach would be the monitoring of several biomarkers simultaneously in the combination with various bioassays. Moreover, different tissues can accumulate and metabolize pollutants to different degrees, depending on their biochemical characteristics, which is why it is important to perform these bioassays on multiple types of fish tissues (erythrocytes, liver, gills, gonads, muscle). Comet assay is as a rapid and sensitive method for measuring DNA damage in individual cells. It allows the detection of DNA strand breaks and alkali-labile sites by measuring the migration of DNA fragments. The inclusion of lesion-specific DNA repair enzymes in the procedure allows the detection of various DNA base alterations, such as oxidative base damage. Analysis of micronuclei frequencies serves as a biomarker of chromosomal damage. It allows detection of both clastogenic and aneugenic effects of chemical agents. Analysis of metals and metalloids (ICP-OES) in various fish tissues was used as a biomarker of accumulation.

Keywords: ecogenotoxicology, fish tissues, freshwater

*Speaker

Phylogenetics and population genomics

Systematics, biogeography and evolution of Indo-Pacific birds

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Why are species where they are? And how did they get there? Using birds inhabiting the Indo-Pacific island world and drawing on an array of molecular, distributional, morphological trait and other data my research seeks to answer these fundamental questions. I will give an introduction to this intriguing study system and show how molecular data have helped us understand how species and populations are related and how this has led to a more refined understanding of biogeography and the build-up of biodiversity through space and time. I will also talk about how the integration of multiple lines of data and analytical approaches have helped answering some questions but at the same time generated a lot of new ones. Finally, I will let you in on some of my ongoing work, which I expect will provide a more in-depth understanding of the mechanisms that govern the contemporary distributional patterns of birds in the region.

Keywords: Biogeography of Indo, Pacific birds

*Speaker

Tracking six millenia of horse selection, admixture and management with complete genome time-series

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The domestication of the Horse and its impact on warfare, transportation and agriculture, have revolutionized human history. Even though most modern breeds have been engendered within the last couple of centuries, humans have managed horse livestock for over five millenia. Recent selective and management strategies have tremendously impacted the genetic structure of horse populations. As a result, modern patterns of genetic diversity can only partly help reconstruct the horse domestication process prior to the modern era. Recent research in our laboratory, carried out in the framework of the ERC PEGASUS programme, has endeavoured to sequence complete horse genomes from across their whole temporal and geographical domestication range in order to identify how the many past human cultures progressively forged the horse genome by means of selection, drift and admixture. This work revealed two different dynamics at play within early and late domestication stages, involving the selection for different functional pathways, different management strategies for the genetic resource available, including stallion diversity, and a recent increase in the genomic deleterious load. Our new genome dataset now allows us to document such changes at unprecedented scales and reveals unexpected features of the whole population dynamic underlying horse domestication.

Keywords: Paleogenomics of mammalian populations

*Speaker

Are dry-cured meat *Penicillium* fungi special?

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Human actions on the environment are often, and rightly, seen as disturbance. However, humans can also be considered as niche constructor for some species, especially those found in factories. Whether these species are helpful, harmless or dangerous for humans, they all had to adapt to new environments very recently. Fungi from the genus *Penicillium* provide a unique example of adaptation to human-mediated environments. Some of them are selected and actively inoculated for cheese (e.g. *P. camemberti* and *P. roqueforti*) or dry-cured meat (*P. nalgiovense*) production. Others are involved in spontaneous colonization of the resulting products, such as *P. salami* on various sausages. Horizontal gene transfers between cheese-making *Penicillium* have already been described as playing a role in the adaptation to dairy environment. HGT provides a fast way to acquire genes increasing fitness in a new environment. In this study, we assessed whether dry-cured meat *Penicillium* use HGT to acquire putative adaptive gene in this particular environment. We evidenced horizontal gene transfers between the distantly related *P. nalgiovense* and *P. salami*, suggesting a potential role in their adaptation to the dry-cured meat environment.

Keywords: Fungi, Genomics, Horizontal gene transfers, Adaptation

*Speaker

Historical biogeography and the evolution of environmental niche in Datureae (Solanaceae)

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A main goal in biogeography is to understand patterns of clade distribution, that is, why lineages have dispersed and established populations in some areas and not in others. Distribution patterns are shaped by abiotic factors (e.g. climate), biotic factors (e.g. competition), and historical aspects (e.g. dispersal limitation). We examined the historical biogeography of the tomato family (Solanaceae) and the factors influencing species distributions in the trumpet flower tribe (Datureae). Using biogeographic stochastic mapping, we showed that the cosmopolitan tomato family originated in South America, with an estimated 120 expansions to other regions of the world, particularly North and Central America. The Datureae clade represents one of those successful expansions from South to North America. We inferred a dated phylogeny for Datureae which suggests that this dispersal from the Andes took place between 30-15 million years ago and was accompanied by major changes in floral morphology, fruit type, and life history. Indeed, the North American genus *Datura* is the only case of reversion from fleshy berries to the ancestral capsules in the family. Despite these changes, this analysis of environmental niche evolution across the tribe indicated that the niche characteristics were conserved during the dispersal, with ancestrally dry Andean lineages establishing in dry regions of North America. Significant niche shifts only occurred within South America, where some species of *Brugmansia* expanded into more mesic lowland areas. Overall, these results suggest that long distance range expansions can trigger radical changes in morphology and physiology even when the environmental niche is conserved.

Keywords: Andes, BioGeoBEARS, biogeographic stochastic mapping, *Brugmansia*, *Datura*, environmental niche evolution, pPCA

*Speaker

Genetic-phenotypic intraspecific diversity covariation in structured landscapes: An empirical test of underlying determinants

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Intraspecific diversity plays a key role for evolutionary and ecological dynamics. It is the raw material on which acts selection, it improves species and communities resilience to disturbance and it affects the way species modulate their biotic and abiotic environment. Understanding patterns and underlying determinants of genetic and phenotypic intraspecific diversity is therefore of critical importance for ecological, evolutionary and conservation sciences. Here, focusing on two freshwater fish species (*Gobio occitaniae* and *Phoxinus phoxinus*) sampled across a large river basin (the Garonne-Dordogne river basin, France), we used causal analyses to test for genetic-phenotypic intraspecific diversity correlations (GPIDCs) and unravel the processes underlying intraspecific diversity patterns. Genetic diversity was assessed using microsatellite markers and phenotypic diversity was assessed through geometric morphometrics. We found disparities in the distribution of genetic and phenotypic diversity in the two species, suggesting higher level of local adaptation in *G. occitaniae*, and our results revealed common and contrasted processes shaping diversity at the α - and β -level. At the α -level, we found no GPIDC in both species despite common relations between isolation and genetic and phenotypic α -diversity in *G. occitaniae*. At the β -level, we found no GPIDC in *P. phoxinus* but we found a positive GPIDC in *G. occitaniae* that could originate from positive assortative mating. Studying neutral genetic diversity and phenotypic diversity within an integrative framework appears as a valuable way of deciphering the complex and diverse impacts of neutral and adaptive processes on intraspecific diversity patterns.

Keywords: Intraspecific diversity, neutral genetic diversity, phenotypic diversity, diversity patterns, causal analyses, freshwater fish

*Speaker

Linking wing shape and flight behaviour in *Morpho* butterflies

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Butterflies display an extreme variation in wing shape associated with a tremendous ecological diversity. Disentangling the role of neutral *vs.* adaptive processes in wing shape diversification is a great challenge for evolutionary biologists. In the Neotropical genus *Morpho*, wing shape divergence has been linked to the role of ecological differences between micro-habitats (understory *vs.* canopy). However, whether wing shape and flight behaviour have coevolved in response to contrasted selective pressures in these two micro-habitats remains to be investigated. Here we conducted a field study to quantify flight behaviour of 11 canopy and understory *Morpho* species using multi-camera three-dimensional videography in cages settled in their natural environment. We then precisely quantified wing shape variation of the filmed specimens using geometric morphometrics to investigate the association between wing shape and flight behaviour. Our study uncovers diversified flight behaviours among *Morpho* species, challenging the classical, binary opposition between understory and canopy species. This stresses the need to identify selective forces acting on flight performance.

Keywords: Nymphalidae, wing shape, habitat selection, flight, aerodynamics.

*Speaker

Phylogeography and population genetic structure of Snow Petrel populations in east Antarctica

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Seabirds have an extraordinary ability to travel long distances, disperse freely between populations and maintain high levels of gene flow. Ironically, they also exhibit strong philopatry which may lead to pronounced genetic differentiation within and between populations. In this study, we investigated the phylogeography (using mitochondrial cytochrome b sequences) and population genetic structure (using cross-species nuclear microsatellite markers) of the most southerly breeding bird, the snow petrel *Pagodroma nivea* in Antarctica. The genetic sampling was conducted during three austral summers (2013-14, 2014-15 & 2015-16) under the Indian Antarctic Program at Larsemann hills, Schirmacher oasis and Svarthamaren hills in east Antarctica. A total of 93 samples were sequenced at mitochondrial cytochrome b region for phylogeographic analysis whereas 142 samples were genotyped for microsatellites. A 792-bp long cytochrome b sequence was obtained from these samples and aligned using MEGA v.6.06. We identified 30 variable sites resulting in 33 haplotypes where three haplotypes were shared between the colonies furthest from each other, Larsemann hills and Svarthamaren hills. Haplotype diversity was higher at all three sites (> 0.85). We identified two populations ($K = 2$) from the bayesian individual clustering model in STRUCTURE 2.3. The F_{ST} values were found to be low (< 0.04) indicating high gene flow between all three colonies. High dispersal ability and long-time spent foraging at sea might be attributed to lower genetic differentiation between populations. This work entails first detailed genetic study on snow petrels in Antarctica and lays the foundation for undertaking pan-Antarctic sampling for understanding connectivity amongst spatially disjunct populations.

Keywords: Antarctica, Snow Petrel, Phylogeography, Population genetic structure

*Speaker

Transition from the Pebas system to the modern Amazon drainage is a key period in the diversification of the frog genus *Allobates* (Aromobatidae).

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Amazonian forests shelter around 40% of world's tropical rainforests. Hypotheses have been developed that ascribe the majority of Amazonian diversification to the Plio-Pleistocene. However, Amazonia underwent profound environmental and landscape changes during the Tertiary due to Andean orogeny and it is important to test the contribution of older diversification on extant diversity. Here we focus on the Neotropical frog genus *Allobates*, which is known to have diversified extensively within Amazonia during the Miocene. We built the largest ever DNA barcode database for this genus (625 16S amplicons from GeneBank, 307 new ones) obtained through the most complete taxonomic (74% of described species) and spatial sampling to date. An unsupervised DNA-based species delineation led to 50 Operational Taxonomic Units (OTUs; 45 described and 5 as-yet undescribed lineages). We subsequently obtained complete mitogenomes from 32 of the 50 delineated OTUs using shotgun sequencing, and reconstructed a robust time-calibrated phylogeny. Our results reveal an extensive diversification in western and Southern Amazonia between 20 and 10 MYA, with a peak of diversification around 10 MYA in Western Amazonia. This final peak of diversification is concomitant with the transition from the Pebas system, a vast flooded area located in western Amazonia, to the modern Amazon watershed. These results highlight that the bulk of the diversification of Amazonian frogs predates the quaternary and that the hydrological consequences of the Andean orogeny have had major impacts on these frogs during the Tertiary.

Keywords: Biogeography, Diversification, Neotropics, Amazonia, Pebas system, Tertiary, Anura

*Speaker

Rapid habitat-related genomic divergence in a songbird following the colonization of a small oceanic island

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Upon colonization of oceanic islands, organisms are subjected to strong selective pressures often related to dietary shifts. In islands with contrasting habitats and food resources, local adaptation has the potential to drive the formation of within-island independent evolutionary lineages, which should diverge in morphological traits related to feeding behaviour and the genomic regions associated with them. We test this hypothesis in the common chaffinch (*Fringilla coelebs*) on the small island of La Palma (Canary Islands), where the species occupies two drastically different habitats, pine forest and cloud forest. Phenotypic analyses of beak morphology and tarsus length revealed significant differences between both habitats that are consistent with ecomorphological predictions. A genome-wide survey of genetic variation using SNP (single nucleotide polymorphism) loci from a genotyping-by-sequencing approach, revealed marked structure among localities and among habitat types. Analysis of neutral SNP loci showed light structure between localities that was consistent with habitat type but also with geography. To disentangle the roles of drift and selection in driving population structure, we analysed loci under selection, which showed a marked structure strongly associated with habitat type. Preliminary analysis to identify genes associated with peaks of divergence among habitats revealed candidate genes related to bone morphogenesis and metabolism. Our results suggest a strong role for local adaptation in driving lineage divergence in the chaffinch of La Palma, an excellent model for studying the evolutionary mechanisms of phenotypic divergence and speciation.

Keywords: Population genomics, local adaptation, genotyping by sequencing

*Speaker

Covariation of genetic diversity in forest dwelling nocturnal lemurs

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Human-driven habitat loss and fragmentation are driving a major and unprecedented biodiversity crisis. This crisis is particularly striking in heavily pressured biodiversity hotspots such as Madagascar. However, deforestation is not ongoing at the same pace in all regions. In particular, the Loky-Manambato region (Daraina, North Madagascar) presents a low historical deforestation rate in contrast with most other regions. In addition, in the Loky-Manambato region, the relative impact of past climate changes and of humans since their recent early Holocene colonization of the island is still debated. To infer past forest dynamics and disentangle the relative effect of human activities and climate on forest cover, we generated restriction associated sequencing data (RAD-seq) for two forest-dwelling lemur genera *Microcebus* and *Lepilemur* (200 individuals each) spread across the Loky-Manambato region. Our analyses allowed identifying the major landscape features limiting or promoting gene flow among forests and highlighted a particularly striking co-variation of the genetic diversity of the two studied sympatric genera. Furthermore, we will present preliminary analyses of their demographic history shedding light on the processes that drove forest fragmentation in Northern Madagascar.

Keywords: Landscape genetics, demographic history, climate change, habitat loss and fragmentation

*Speaker

Social interactions and transmission

Experimenting with culture: tracking the spread and persistence of innovation in birds

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There is increasing evidence for social learning and culture in non-human animals. Recent work has also hypothesized that animal cultures could also exhibit some degree of cultural evolution, changing in form, patterning or function over time. However, we still have relatively little empirical evidence for how such processes may operate. In this talk, I discuss a series of studies of the within and across-generation transmission of foraging traditions in wild birds. I show that beneficial innovations can spread through social networks to form stable traditions, that cultural traits can be both inherited, refined and modified over time, and that such traditions can be flexible in the face of changing environments. More broadly, I use these case studies to explore the intersection between cognition, learning and social dynamics in wild populations.

Keywords: Cultural transmission in birds

*Speaker

Changing the Game: Evolution, Ethics, and Human Domination of the Planet

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Humans are an exceptionally successful species. Our success depends not just on our own traits - such as big brains and tool use - but also on our having recruited an expanding network of other species into mutualistic interactions. We have changed many interactions with other humans, and with other species, from zero-sum to positive-sum games. Compared to our evolutionary cousins, chimpanzees, we engage in far more mutually beneficial interactions with members of our own species, including collective foraging and trade. Considering our interactions with other species, we have changed many interactions from predatory hunting and gathering to more mutualistic herding and gardening. How and why humans evolved this capacity to transform the games we play remains debated. Since Darwin, many scholars have focused on intergroup aggression as the primary driver of within-group cooperation in humans. Considerations of data from chimpanzees and human hunter-gatherers suggest instead that within-group cooperation - particularly collective foraging, food exchange, and stable breeding bonds between males and females - drove the evolution of psychological traits necessary for human behavior to be guided by social norms such as ethical rules. Key challenges facing humans today include expanding the circle of players in positive-sum games to ensure the flourishing of global ecosystems.

Keywords: Behavior and ecology of non, human primates

*Speaker

Who is in my house? Territory defense in a steppe passerine responding to playback intrusion.

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Intensity of mate or territory defense in birds seems to be related to intrasexual competition, thus increasing with the density of competitors. We evaluated the response of a territorial species to the artificial intrusion according to co-specific density, habitat quality and male body condition. We used Dupont's lark (*Chersophilus duponti*), a strict insectivorous and monogamous steppe bird with active defence of the female, as species model. We selected five areas differing in male density, where males were captured and marked. Behavioural response to a species-specific playback was measured for five minutes since the male was visually located. Response rate, response time, number of songs or other vocalizations, and minimum distance to the playback were estimated. Habitat quality was measured using blue-NDVI extracted from drone images, and testing its relationship with arthropod biomass. When possible, body condition of males was used. Response rate was higher in areas with higher use intensity (measured with a Kernel Density Estimator on the male locations) and in areas with poorer quality habitat. On the contrary, response time was higher with lower use intensity. Inter-sex communication (singing rate) increased with habitat quality. Intra-specific communication (other vocalizations) increased in worst habitats and higher densities. Body condition was not related to response variables. Our results suggest that males concentrations, sometimes used as an indicator of well-conserved areas for the species, may be reflecting poor quality areas with satellite unpaired males, while territorial paired males could be occupying better areas, with lower intraspecific density.

Keywords: Defense behaviour, Dupont's lark, Habitat quality, Simulated territorial intrusion, Song rate, Territoriality.

*Speaker

Common eider (*Somateria mollissima*) behavioural shifts in response to the invasive American mink (*Neovison vison*) in West Iceland

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Iceland has been subjected to several biological invasions after human colonization, which constitute large-scale natural experiments in a relatively simple ecosystem. One example is the introduction of the American mink (*Neovison vison*) for pelt farming in the 1930s. Native avifauna has low eco-evolutionary experience with a mammalian nest predator that is able to reach the colonies on islands along the coast. Among the most threatened species are economically and culturally important species such as the common eider (*Somateria mollissima*, IUCN Red List of Endangered Species of Iceland status VU), Atlantic puffin (*Fratercula arctica*, CR) and black guillemot (*Cepphus grylle*, EN). We present findings on how the common eider managed to shift its breeding grounds to avoid mink predation in the Brokey archipelago in Breiafjörur in West Iceland. After the return of the native Arctic fox (*Vulpes lagopus*) into the Purkey archipelago, common eider moved their nest sites to fox-inaccessible islands. Atlantic puffins, however, usually remain in colonies - with dire consequences. This difference may be caused by the differing learning potential between the species after a mink attack on their nests: Eiders suffer the loss of their offspring, but adults survive, whereas the puffins commonly breed in burrows, and adults are trapped and killed in the case of a mink attack. Our agent based model explores how changes in nest choice can be facilitated through learning in the common eider and inhibited through conformity effects in the Atlantic puffin.

Keywords: invasion ecology, animal behaviour, learning, common eider, bird nesting

*Speaker

A spatiotemporal analysis of the food dissemination process and the trophallactic network in the ant *Lasius niger*

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The intranidal food dissemination through trophallactic exchanges is a fundamental issue in social insect colonies but their underlying mechanisms are far from being clear. We develop a framework to investigate the spatio-temporal dynamics of the trophallactic network starved *Lasius niger* ant colonies. Thanks to individual labelling and tracking methods, the individual and caste (foragers or non foragers) level contributions and their role (donor / recipient) as well as the spatial locations of the trophallactic interactions in the nest are recorded. At the colony level, while we highlight a strong heterogeneity of the individual participation to the trophallactic activity, the trophallactic network is not different from a random one. We show that the trophallactic behaviour of the two castes are markedly different at both spatial and social levels. A key result is that the foragers not only harvest food but also play a major role in the food dissemination. Moreover, our analysis reveals interindividual differences within both castes, this heterogeneity being more marked within non foragers. We discuss our results in the light of division of work, network theory and collective food management in insect societies.

Keywords: Ant, Trophallaxis, Network

*Speaker

Inter-group conflict, cooperation and social relationships in wild banded mongooses (*Mungos mungo*)

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Conflict between groups occurs in many social species that live in stable groups. Conflict can potentially shape the behaviour of individuals and influence the wider environment, through changes in foraging patterns and home ranges, or the take-over or destruction of groups. Inter-group conflicts have been suggested to promote cooperation within groups, as larger, more cooperative groups should be more effective in these conflicts, and may consequently gain valuable resources or territory. Some studies have revealed that affiliative behaviour between group members increases after inter-group encounters. Banded mongooses defend their territory from neighbouring groups and have frequent, and violent, inter-group encounters. I performed simulations of inter-group encounters, using playback techniques and stimuli presentations, to wild banded mongooses (*Mungos mungo*). After simulated intrusion presentations neither affiliative grooming interactions, nor aggressive interactions changed in frequency. However, there was an increase in group marking behaviour, which could be a marker of in-group identity. Additional social network analysis shows that despite overall grooming and aggression levels staying constant, relationships within the group are affected by simulated intrusions. Grooming increases between females, but not males. Aggression is suppressed between sexes, but there is no change within sexes. These sex differences in response to inter-group conflict may be due to conflict between the sexes over the cost of conflicts in this species. Males suffer higher mortality than females, and females can benefit from inter-group mating. These results suggest that inter-group conflict can affect social behaviour and social relationships.

Keywords: cooperation, inter, group conflict, social networks

*Speaker

Dishonesty in begging signals is shaped by colony kin structure in *Formica* ants

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Social insects live in highly complex societies that have developed efficient communication systems to coordinate complex tasks. Begging is one display commonly used by offspring to signal their nutritional state, but it has received very little attention in studies of social insects. Theory predicts that begging can be an honest (i.e., honest-signalling strategy) or a dishonest (i.e., scrambling competition) signal, with dishonesty predicted to be more likely when relatedness among nestmates is low. To assess the existence of chemical and behavioural hunger signals and of factors driving dishonesty, we used a comparative approach to investigate larval hunger signalling in *Formica* ants. Using two low-relatedness species (*F.aquilonia* and *F.pressilabris*), one intermediate-relatedness (*F.exsecta*) and one high-relatedness (*F.fusca*), we investigated the behaviour and the cuticular chemical profiles of fed and hungry larvae. We assessed the attraction of workers towards odours extracted from these two classes of larvae. We found that in high and intermediate-relatedness species, larvae swayed significantly more when hungry. While there was no significant difference in low-relatedness species, the data revealed a strong trend towards increased swaying by fed larvae in *F.aquilonia*. Our results furthermore show that workers were overall more attracted to the odour of hungry larvae than to the odour of fed larvae. Intriguingly, we did not detect any differences between the cuticular chemical profiles of fed and hungry larvae. Overall, this study provides the first evidence for the existence of dishonest hunger signals in social insects and demonstrates that larval hunger signalling varies with colony kin structure.

Keywords: social insects, begging, honest signalling strategy, scramble competition, relatedness, cuticular chemical compounds

*Speaker

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Comparison of the pulsed call repertoires of killer whales (*Orcinus orca*) in Iceland and Norway

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Killer whale (*Orcinus orca*) pulsed call repertoires can provide information on the relatedness of groups and populations. Killer whales in Iceland and Norway are presumed to belong to the same ecotype and to have been in contact prior to the collapse of the Atlanto-Scandian herring stock in the 1960s but the actual level of contact between the two populations is unknown. Using data collected between 2005 and 2016 this study provides a detailed description of the call repertoire of killer whales in Iceland and updates existing catalogues of the Norwegian population. 42 call types and 30 subtypes are described in Iceland and 32 call types and 21 subtypes in Norway. Measurements of time and frequency parameters of 5752 calls (nIceland = 4,037, nNorway = 1,715) showed significant differences for most parameters but a high overlap between the populations. A discriminant function analysis classified 57% of calls correctly, thus performing only slightly better than a by-chance classification. However, a visual and aural comparison of all call types did not yield any matches between Icelandic and Norwegian calls, indicating the two populations have different call repertoires. This stands in contrast with expectations of similarities in the repertoires due to the presumed past contact between the populations. The consistent difference in repertoires suggests that if the populations have been in contact before they were likely not one totally mixed population.

Keywords: Killer whale, *Orcinus orca*, acoustics, behaviour

*Speaker

Developmental and transgenerational carry-over effects on behavioural reaction norms of the freshwater snail *Physa acuta* in response to predation

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Behaviour is a labile and reversible trait allowing a rapid response to environmental changes. Evidence is accumulating that individuals differ in both personality and level of behavioural plasticity (respectively intercept and slope of the behavioural reaction norm), even within a same population. What is the role of past environmental conditions on between-individual differences in behavioural responses is still not well understood. Although previous environments experienced by animals themselves can play a role, less is known about the effect of ancestral environment. Ancestral environment can indeed have long-lasting effects on average behavioural responses through non-genetic processes. These transgenerational carry-over effects (called transgenerational plasticity) could also influence the between-individual variation in personality and behavioural plasticity. We investigated the behavioural reaction norms of the freshwater snail *Physa acuta* in response to predator cues according to past (intra- and transgenerational) experience of predation risk. This species is known to increase its survival by expressing anti-predator behaviours (especially crawling-out the water) when the predator is detected. Moreover, as this species has a short generation time, parental environment should be a good proxy of offspring environment in the wild, and transgenerational carry-over effects should have been selected. Two generations (parental and offspring generations) were raised in control or predator-cue environments. We then measured in all mature offspring two behavioural traits in control and in predator-cue environments: exploration (total distance crawled in the water) and escape behaviour (time to crawl out the water).

Keywords: behavioural reaction norm, transgenerational plasticity, nongenetic inheritance, anti-predator behavior, *Physa acuta*, personality

*Speaker

Cognition: learning and memory

Innovative tool use and manufacture in the Goffin's cockatoo

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Finding flexible tool use and manufacture in non-specialized animals, may contribute to our understanding of the origins of tool-related cognition. Goffin's cockatoos are Indonesian parrots that originate from a small archipelago in the Moluccas. They are highly opportunist generalists that forage on a large number of different and often patchily distributed or seasonal resources. Accordingly, they show high levels of flexibility and innovativeness during physical problem solving and extractive foraging. Nevertheless, they are not dependent on tool obtained resources and lack the two ecological predispositions for establishing complex object relationships (nest building, food caching) that have been proposed to promote the onset of tool use in birds. Nevertheless, a captive cockatoo reliably broke sticks out of a block of larch wood and used them to rake food into reach, while modifying their lengths when necessary. His tool using skills could be transmitted to other individuals in his group through goal emulation learning. Successful birds thereafter spontaneously manufactured probing tools from larch-wood and other materials that required active shaping (cardboard, leafed twigs) independently. In a test featuring different reward distances we further found that our subjects could flexibly adjust the length of their tools depending on the distance at hand. Additionally, we confronted birds with a task that required bending or unbending a piece of wire to use it as a hook or probing tool. 5/13 subjects succeeded in one condition, a single individual in both. Our findings indicate that innovative tool manufacture does not require an adaptive specialisation to tool use but may arise from domain general processes.

Keywords: Innovativeness and tool manufacture in birds

*Speaker

Simple form of learning in non neural organisms, evidence from slime molds

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Learning, defined as a change in behavior evoked by experience, has hitherto been investigated almost exclusively in multicellular neural organisms. Evidence for learning in non-neural multicellular organisms is scant and only a few unequivocal reports of learning have been described in single celled organisms. In this conference, in a first part, I will demonstrate habituation, an unmistakable form of learning, in the non-neural organism *Physarum polycephalum*. In a second part, I will show that learned behavior can be transferred from one cell to another via cell fusion. In the last part, I will propose a possible mechanism underlying habituation in slime moulds and reveal that this mechanism allows information to be preserved for a very long time. All these results point to the diversity of organisms lacking neurons, which likely display a hitherto unrecognized capacity for habituation, a simple form of learning. These results suggest that slime moulds may be an ideal model system in which to investigate fundamental mechanisms underlying the ground-floor of learning abilities.

Keywords: Cognition in ants and slime molds

*Speaker

Cognitive senescence correlates to age-related decline in reproductive success in wild great tit *Parus major*

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Behaviour is at the front of animal responses to environmental changes. Innovation, the ability to use novel or modified behaviours, can positively relate to reproductive success within species. Yet, whether this link is causal (i.e. higher cognitive capacities improves the finding of quality food, increasing condition) or a third variable is involved (i.e. a shift in the oxidative balance leads to a fast accumulation of oxidative damage in metabolically active tissues, thus to a decline in cognitive/physical performances) is currently unknown. We used a long-term studied population of wild great tits to test this hypothesis, which is a major gap in our understanding of the evolution of cognition.

Keywords: cognition, problem, solving, ageing, senescence, provisioning, great tit

*Speaker

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The Openfeeder: an automated RFID feeder to measure consistent individual differences in behaviour and cognition in wild birds

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To understand the evolution of personality and cognition, it is crucial to develop new approaches to measure consistent individual and species differences in behavioral or cognitive performances on large sample size. Here we present an open-source RFID-based feeder (Openfeeder) specially designed to test foraging, personality and cognitive abilities in wild animals. We demonstrate that this tool enables us to assess consistent individual differences in daily foraging strategy, neophobia and associative learning in wild birds. The large sample size (> 350) and the ability to test animals directly in their natural environment make of the Openfeeder an ideal tool to study evolutionary causes and consequences of individual differences in behaviour and cognition. Additional, comparing results for 3 species of tits we will also show that the Openfeeder could be an interesting method for people interested in comparative studies. Overall, the Openfeeder is a flexible tool that enable an integrative approach to study the evolution of behaviour and cognition since it could be used both to carry on research on contemporary selection (comparing individuals) and past evolution (comparing species).

Keywords: individual differences, new technology, cognition, personality, foraging

*Speaker

Basic arithmetic and use of symbolic rules by an insect

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Most animals benefit from using basic quantity discrimination in tasks such as resource management or aggressive interactions. However, complex numerical capacities such as labelling, arithmetic (addition or subtraction), or understanding complex numerical concepts have only been demonstrated in a limited number of vertebrates such as chimpanzees, orang-utans, vervet monkeys, rhesus monkeys, or parrots. We have now shown that an insect, the honeybee, can learn to use blue and yellow as symbols indicating whether to perform an addition or a subtraction calculation, respectively. Free-flying bees learnt that upon flying into a Y-maze, if they viewed objects which were blue, they needed to add one to the array of presented elements to receive a reward of sucrose, but if objects were yellow, they needed to subtract one from the array to receive the reward. The correct and incorrect options were presented in two arms of the Y-maze and the incorrect option could be greater, lesser, or the same as the original presented quantity. Bees mastered the dual task within a few hours and performed successfully in unrewarded tests when presented with a novel number of objects not previously experienced during training. Thus, honeybees demonstrated evidence of arithmetic using symbolic representations of numeric rules, suggesting that sophisticated numerical cognition is accessible to animals with comparatively small and simple brains.

Keywords: addition, *Apis mellifera*, arithmetic, honeybee, subtraction, symbolic

*Speaker

Neurobiology of Memory Facilitated by Social Context in *Drosophila melanogaster*

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Animals have the ability to establish associative links between distinct events, or between their own behavior and their consequences. By relying on multiple sources of information, they can quickly adapt their behavior by integrating their past experiences. Interactions between conspecifics are one of these information sources. *Drosophila* is recently become a model in neuroethology for the study of social behaviors and mechanisms governing learning and memory. Previous works have highlighted a long-lasting memory whose retrieval is facilitated by the presence of conspecifics in *Drosophila*. However, the neurobiological mechanisms underlying the enhancement of this memory are still unknown. What are the brain networks involved in this process? What is the cue responsible for improving the memory of group of flies? We identify using multiple experimental methodologies, such as neuro-genetic, *in vivo* neuro-imaging, gas chromatography and mass spectrometry and behavioral approaches, the social cue and the brain bio-aminergic neurons involved in this social context-dependent memory.

Keywords: memory, drosophila, neurobiology, social interaction

*Speaker

Causal Understanding of Stick and Stone Tool Use in Macaws

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Tool use tasks have often been used in cognition studies to see what animals understand about physical cause-effect relationships. Many of these tasks are given to species that are known to be tool users. It is thus unclear whether the studies show the specialist tool use skills of the species or their causal understanding of the task. We therefore gave two non-tool using species of macaws a battery of four different tool use tasks. In all tasks the birds had to make a causal intervention with either a stone or stick tool to obtain a reward. Many subjects showed some ability with stone tools, with some showing a higher proficiency level. But they were all very poor at using stick tools. Although we present evidence that these parrots are very good at rapidly learning cause-effect relationships, we discuss that this appears to have been without an understanding of how these relationships function. We also debate how useful tool-use tasks are for comparative cognition in general due to the dearth of species that can actually use tools.

Keywords: Cognition, Tool Use, Parrots, Causal Understanding, Comparative Cognition

*Speaker

High CO₂ impairs cleaner fish cognitive performance

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Species' cognition is tightly linked to their evolutionary history and ecology. The indo-pacific cleaner wrasse, *Labroides dimidiatus*, evolved a set of cognitive tools and sophisticated behaviour to engage in cooperative cleaning interactions with reef fish species¹. However, the ecological conditions where cleaners were able to evolve their cognitive abilities are changing due to human-induced environmental changes². Here we show a substantial decrease of cleaner wrasse cognitive performance after 30 days of acclimation to elevated CO₂. We found that acclimation to different pCO₂ levels, from pre-industrial (275 μ atm) to elevated CO₂ (980 μ atm, 2100 RCP 8.5 scenario), affected cleaner fish cognition, as their ability to solve a cognitive task-relevant for cooperative interactions under the higher CO₂ concentration dropped 55% relative to the lower concentration. This loss of cognitive performance has a crucial ecological cost, as learning allows animals to exploit environmental features, niches and behavioural repertoires that cannot be used otherwise. Our study provides substantial evidence for impairment of cognitive abilities under ocean acidification with possible implications for cooperative interactions.

Keywords: Cleaning mutualisms, ocean acidification, climate change, learning, market theory, *Labroides dimidiatus*, Coral reefs

*Speaker

Cognitive performance and seasonal changes in blood glucose levels in striped mice (*Rhabdomys pumilio*)

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In some species, cognition can change flexibly in response to environmental changes. These changes can be adaptive or can result from physiological constraints, such as when energy availability decreases seasonally. Here, we investigated: 1. how cognitive performance changes between seasons that differ significantly in food availability; 2. how these changes are related to environmentally induced physiological changes such as blood glucose levels; and 3. whether experimental increase of blood glucose levels during the dry season impacts cognitive performance. We studied 93 free-living African striped mice (*Rhabdomys pumilio*) in the Succulent Karoo, South Africa during the hot summer dry season, with low food availability, and the cold wet winter with high food availability. Striped mice had reduced blood glucose levels during the food-restricted dry season. We measured their spatial memory using the Barnes maze test. Spatial memory did not change seasonally. However, high basal and experimentally increased blood glucose levels impaired spatial memory performances. Even though food was restricted in the dry season and blood glucose levels were reduced, cognition was not affected by these changes, supporting the cognitive resilience hypothesis. The observed cognitive resilience in striped mice probably represents an evolved adaptation to cope with seasonally changing energy supply.

Keywords: Cognitive flexibility, Seasonality, Blood glucose, Spatial memory

*Speaker

Horses take into account whether a human has previously observed a food-hiding event to decide whom to beg from.

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Inferring what other individuals have witnessed or not provides important benefits in social contexts, but evidence is still scarce in nonhuman animals. We tested this ability in domestic horses (*Equus caballus*) by testing whether they could choose between two experimenters whom to solicit when confronted with an unreachable food source based on what they had previously observed. First, food was hidden in a closed bucket (impossible for horses to open by themselves) in front of the horses and in the presence of two experimenters who behaved identically but differed in their visual access to the hiding event (a "witness" experimenter was facing the bucket while a "nonwitness" was facing away). Horses were then let free in presence of both experimenters, and their interest towards each (durations of gaze and touch) was assessed. Horses gazed at ($n = 14$ horses, $p < 0.001$) and touched ($n = 14$, $p = 0.003$) the witness significantly more than the nonwitness. These results could suggest that the horses took into account the visual perspective of the experimenters during the baiting process to infer the knowledge state of the individuals and then adapt their later behavior. Hence, our study could be interpreted as evidence for perspective taking and knowledge state attribution in horses that might partly constitute at least a Minimal Theory of Mind.

Keywords: Horse, *Equus caballus*, Social cognition, Knowledge state, Theory of Mind, Horse, human relationship

*Speaker

Interspecific interactions

Rapid host and pathogen co-evolution following a severe emerging infectious outbreak

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In 1994, *Mycoplasma gallisepticum*, a common bacterial pathogen of poultry, jumped into house finches, rapidly spreading through their entire eastern North American range and causing the death of millions. This emerging infectious disease outbreak is one of the best documented natural epidemics to date and offers unique opportunities to test key questions regarding host-pathogen co-evolution. Host resistance was found to have spread from standing genetic variation within 12 years of disease exposure only, and was associated with parallel changes in pathogen virulence. Here I discuss the phenotypic changes that took place over the course of the epizootic in both the host and the pathogen, and show that these phenotypic changes gave rise to significant increases in host and pathogen fitness, as expected under an antagonistic co-evolution scenario.

Keywords: Evolutionary ecology of host, pathogen interactions

*Speaker

What about trophic interactions between native and non-native predatory fishes?

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Due to their strong association with human activities, freshwater ecosystems have been the recipients of numerous non-native species, with fishes being among the most frequently introduced freshwater organisms. Introductions of predatory fishes known to impact native fish populations and modify prey community and food web structure. Using different top-predators fish species as biological models we investigated trophic ecology (predation-competition), habitat use and behaviour of these species into their novel environments and consequences on recipient ecosystems.

Keywords: Interactions between indigenous and exotic predators, impact on aquatic food webs structure

*Speaker

Pollination network analysis by environmental metagenomics

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Plant-Pollinator interactions are organized in bipartite, mutualistic complex networks with two organism groups: for plants, pollinators are essential pollen vectors required for their reproduction, while plants provide vital food resources to pollinators. Studies of plant-pollinator networks are traditionally based either on field observations of pollinator visits to plant species or pollen identification by microscopy, both having strong limits. Recently, a new innovative approach has been developed; it consists to identify the pollen of the various plant species carried by insects or deposited on plant stigma by using DNA metabarcoding, high throughput sequencing and bioinformatics tools. Compared to traditional approaches, metabarcoding provides a striking different picture of pollination networks. Moreover, the approach allows investigating intraspecific networks and upscaling the impacts of individual behavior on species networks.

Keywords: Pollination networks, metabarcoding, Interspecific interaction, metagenomics

*Speaker

Mesopredator spatial and temporal response to large-predators and anthropogenic activities in a Central Indian Reserve

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Large predators play important role in shaping community structures and dynamics across diverse ecosystem. Decline in large predator occupancy and shift in activity can influence release of mesopredators from intraguild competition. Differential human activity in the landscape also affects the activity of both predator and prey species, depending on their degree of specialisation. This may result in change in community structure and impact other ecological processes. We hypothesized that temporal and spatial partitioning among meso and apex predators would be affected by different levels of human use. Motion-detecting camera traps were deployed throughout Tadoba-Andhari Tiger Reserve in Maharashtra, India following a systematic grid sampling. The study area spreads over an area of 1700 sq.km with a gradient of human use. Temporal activity overlap was calculated using non-parametric kernel density distribution of photo capture time. We found that the effect of apex-predators on mesopredators decreases spatially and temporally as their difference in body size increases. Species altered their activities temporally at sites with higher human activity. This change in activity was reflected in higher temporal overlap between predators in locations with high human use. Species centric conservation measures may help to conserve a species but overpopulation of predator may disturb the stability of an ecosystem. Absence or decline of some predators may trigger the increase in number of certain prey. Human movement should be restricted at areas with high intensity of predators.

Keywords: Anthropogenic gradient, Large carnivore, mesopredator release, spatio, temporal segregation, species interaction

*Speaker

Interactions between free-ranging dogs and humans in Morocco; do all dogs understand humans?

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Free-ranging dogs, although not under direct control by humans for reproduction or movement, still rely on humans for a great deal of resources including food and protection. Therefore, humans form a crucial component of the ecology of these dogs. Although it is known that pet dogs readily understand human communication, it is as yet unclear whether the different socialisation experience of free-ranging dogs affects their understanding of humans. We investigated the nature of interactions between free-ranging dogs and humans in Morocco via daily observations. Furthermore, we conducted two field experiments to assess 1) whether dogs discriminate human facial expressions and 2) how non-pet dogs respond to human commands. Of a total of 1466 observed dog-human interactions over 3 months, 901 were from humans towards dogs. 81% of these interactions were positive, demonstrating that i) free-ranging dogs do not appear to experience more negativity than pet dogs, and ii) humans and free-ranging dogs can positively co-exist. Furthermore, the dogs also showed different behaviours according to the facial expression demonstrated, for example, they showed significantly more gaze aversion after an angry face than after a happy or neutral face. Finally, despite not having formal training, all 23 dogs tested readily followed a human command forbidding them to take food. Overall, these results suggest that, like pet dogs, free-ranging dogs are adept at interspecific interactions with humans. These results have implications for both management of free-ranging populations and theories of dog domestication.

Keywords: canid, interspecific, observations, field experiment

*Speaker

The role of ecosystem engineers in shaping community patterns along spatial environmental gradients

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All species affect others, to a small or large extent, through modifications of their shared environment. When a species is identified as being responsible for a notable change in abiotic conditions, this species is referred to as an ecosystem engineer. Ecosystem engineers have been shown to greatly influence species composition and community patterns at different spatial scales. Nevertheless, the processes by which ecosystem engineers create such patterns, in particular along spatial gradients, remains unclear. In this study we use a dynamical model to identify conditions - such as engineering strength, engineer niche similarity, and the dynamics of environmental conditions - under which different community patterns emerge along an environmental gradient. Notably, we show that engineering actions of species can create strong discontinuities in community composition and environmental conditions across space due to the presence of alternative stable states. We also find that similarity between ecosystem engineers' niches can lead to different types of species interactions, from indirect competition to mutualism, resulting in distinct spatial patterns of species abundances. This study highlights the importance of considering species-environment feedbacks when studying community organization along environmental gradients.

Keywords: Species environment feedbacks, Lotka Volterra, Community pattern, Ecosystem engineers, Alternative Stable States

*Speaker

Microbial progression in the rhizosphere of *Coriandrum sativum* grown in an arid region like solapur

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The Rhizosphere of any plant is a dynamic environment with enormous number of microbial activities continuously going on in this particular region as a result of diversity of microorganisms. It is an active region of soil, often rich in organic matter and other nutrients. The microorganisms play an important role in the improvement of soil fertility and recycling of nutrients. The microbial diversity depends upon the type of plant, soil environment and other physical factors. However, the type and the number of microorganisms change with the time and also it is dependent upon the developmental stage of the plant. Each plant shows a peculiar rhizosphere microflora. Each and every microorganism of this region is carrying out some specific activity and the plant releases chemicals to attract microorganisms which can be beneficial to its growth. The present study is taken to determine the variation and progression of heterotrophic bacteria in the rhizosphere of *Coriandrum sativum*. The study not only reflected initial bacterial diversity but clearly indicated the progression in bacterial count throughout the developmental stages of plant and establishment of dominance over the plants growth indicating microbial ecological succession.

Keywords: Rhizosphere, microflora, *Coriandrum sativum*

*Speaker

How birds, bats and ants interact with arthropod herbivores and herbivory in a tropical rainforest understory and canopy

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Predators are known to have remarkable effects toward arthropods and plants by exerting a top-down cascading effect that directly alters arthropod herbivore communities and indirectly influences host plant herbivory. Birds, bats and ants are important arthropod predators in tropical systems, many studies have found they had significant cascading effects toward arthropod herbivores and corresponding herbivory through building specialized predator exclusions. However, most of these experiments were simplistic as they only excluded one single group of predators. Thus, the relative effects of these predators on arthropod herbivores and herbivory remain poorly known.

We conducted a 4-months long manipulative experiment factorially excluded vertebrate and ant predators in the canopy and understory of a tropical rainforest, and another 1-month long manipulative experiment factorially excluded birds and bats in the understory.

We found that in both canopy and understory, herbivore richness and abundance and corresponding herbivory increased the most in ant exclusions, which indicated ants have the strongest top-down effects among major predators. The top-down effects of vertebrate predator exclusions were not as strong as that of ants yet still significantly increased herbivore richness and abundance and herbivory in both canopy and understory. In understory, we found that only birds exclusion significantly increased herbivore richness and abundance while bats exclusion had no significant effects toward herbivore communities.

Our results suggest that both vertebrates and arthropod predators play important roles by regulating arthropod herbivores and their herbivory toward host plants, and highlight the high importance of ants in the tropical rainforest.

Keywords: trophic interactions, top down control, arthropod herbivore, predation, herbivory, Southeast Asia tropical rainforest

*Speaker

Smooth diet on smooth brome? Not so much of a generalist as considered.

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The study of host-parasite relationships is crucial for describing the mechanisms of host specialization. Generalists use a wide range of different host species and thus, this adaptation may lead to a potentially broad geographical distribution. A good example of this mechanism is observed in the eriophyoid mite *Aceria tosichella*, which is a complex of genetic lineages differing in its host specificity and distributions. The most widespread and polyphagous genetic lineage is MT-1, which commonly infests cultivated and wild grasses such as wheat or smooth brome. However, such a broad host range is quite unusual for eriophyoid mites. In our study, we brought into question the generalist status of MT-1 and investigated mite-host interactions in terms of host acceptance.

The mite acceptance of different hosts was tested in two experiments: (i) recording of the behaviour and aerial dispersal events; (ii) assessing the population growth rate on both hosts. General activity was higher on smooth brome than on wheat. On brome specifically, mites exhibited behaviours indicating non-host acceptance. When measuring population growth rate on wheat, the population size increased each week, whereas, on smooth brome it increased during the first two weeks and decreased thereafter. The results suggest that smooth brome functions as a host plant reservoir and is not a regular host for MT-1, as it was formerly considered. The investigation thereby implies a broader view of the predictable generalists' characteristics. The study was funded by National Science Centre grant no. 2016/21/B/NZ8/00786

Keywords: generalists, host and parasite interactions, host acceptance, mites

*Speaker

Asymmetric agonistic character displacement in fan-throated lizards

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When closely related species occur in sympatry, selection against hybridization and inter-specific aggression can lead to divergence in signaling traits. Two processes- reproductive and agonistic character displacement - are often invoked to describe such patterns of trait divergence. Though reproductive character displacement has been studied extensively, role of agonistic character displacement remains poorly explored. Two fan-throated lizards- *Sitana laticeps* and *Sarada darwini* have overlapping breeding seasons, similar sexual signaling behavior, and female morphologies. Across most of their ranges, these species are allopatric, except for a narrow sympatric zone in southern western India. In this sympatric zone, aggressive interactions between males of these species are common, despite there being significant differences in the color of their dewlaps- throat fans used for sexual signaling. We examined the consequences of these interspecific interactions by comparing morphology and sexual signaling of these species across their sympatric and allopatric populations. We found that males of both species respond to heterospecific males and females in sympatry and allopatry. However, *S. laticeps*, the smaller of the two species with a white dewlap, had smaller dewlaps and exhibited lower inter- and intra-specific male aggression in sympatry compared to allopatry. Furthermore, in sympatry, *S. laticeps* also showed reduction in intensity of inter- and intra-specific courtship displays. Interestingly, we did not find any differences in sexual signaling of *S. darwini*, the larger species with a tricoloured dewlap. These patterns are consistent with the predictions of agonistic character displacement and highlight the role of interspecific aggression in sexual signal divergence.

Keywords: sexual signaling, competitive asymmetries, sympatry, character displacement, fan, throated lizards, India

*Speaker

Conservation and global change ecology

Monitoring genetic erosion: why it matters and what are the prospects?

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Genetic diversity (GD) is one of the three key components of biological diversity that can be measured, and thirty years of population genetic (and now genomic) research have shown that GD estimators can provide sensitive indicators of changes in demographic processes manifested in population size, connectivity, inbreeding, introgression/hybridization among others. Yet, despite its proven record, GD is rarely incorporated into conservation planning, and we have to ask the question "why?" and examine the prospects for its more meaningful inclusion in conservation policy and management in the future. I will examine the reasons for the limited traction that genetic science has gained in conservation, exemplify some case studies from our own work where genetic and genomic data can fundamentally change conservation management action and discuss prospects for how this situation may improve as we transition into a new decade of conservation planning.

Keywords: Conservation genomics

*Speaker

Impacts of climate change on wild species: From global patterns to local processes

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Global and regional meta-analyses conclude that climate change has already impacted wild species and ecosystems and strengthen the attribution of those observed changes to anthropogenic climate change. While these broad trends are very powerful indicators, increasingly detailed studies reveal multiple levels of complexity. For example, we found that many species that appear to have no response to general warming (i.e. they are not shifting to earlier spring phenologies in spite of local warming) are, in fact, highly sensitive to changing temperatures but are responding in a more complex manner than simple expectations predict. Further, a century of long-term observations and detailed experiments reveals the disproportionate impact of severe weather events and extreme climatic periods on the ecology and general health of wild species. There is evidence that anthropogenic climate change has already altered the frequency and severity of certain extreme events. Although analyses of biological responses to climate change often use simple climate metrics, such as mean annual temperature, the true underlying drivers of biological responses are more likely to be changes in magnitude, timing and frequencies of climate extremes. This talk will explore some of the responses of wild species and natural systems to recent climate extremes, and discuss the implications for long-term impacts of anthropogenic climate change. Edith's checkerspot butterfly (*Euphydryas editha*) will be used as a case study to explore the complex relationships between the local micro-climate, impacts of single extreme climate events and long-term shifts climate on species' distributions. The science of observed changes in the natural world to relatively small levels of warming of the past century (0.6°C to 0.8°C), helped to shape the international declaration to keep anthropogenic warming below a 2°C limit (by 2100), and strive towards a 1.5°C limit, in order to prevent "dangerous" climate change. However, even if emissions reductions are successful, preservation of biodiversity in the face of anthropogenic climate change will require novel forms of management and unconventional measures of 'success'. Some conservation options bring up ethical issues that question the philosophical foundation of traditional conservation. Successful conservation will increasingly depend on trans-national cooperation, both in terms of research and policy applications. Creative conservation solutions are not without risk, but successful conservation in a time of rapid environmental change will be that which recognizes that doing nothing carries risk as well.

*Speaker

Keywords: Climate change impact

Best restaurant at sea: seabirds and humans sharing space and food

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Inter-specific competition is known to occur at sea between breeding seabirds in sympatry and is often mitigated by spatial segregation or niche partitioning. However, inter-specific competition is not restricted to wild animals - seabirds also compete with fisheries with variable impact on their populations. Indeed, both types of forager tend to exploit "hotspots", where oceanographic conditions lead to the concentration of levels of prey that are of interest to seabirds and fisheries alike. Interactions are also made more likely by the discarding, by vessels, of non-marketable species and offal that attract some seabird species. We examine the foraging grounds of multiple pelagic seabird species and of fishing vessels, moving in the same areas at sea, using novel fine-scale tracking datasets from both. Using behaviour identification and modelling methods, we quantify space use, as well as potential interactions among seabirds and fishing vessels in the Irish and Celtic Sea, a heavily used meeting place for all these foragers. Qualifying and quantifying these relationships adds the human dimension to our understanding of inter-specific competition in seabirds and is of crucial importance to inform marine policy management in the context of steady competition between seabirds and men and an ongoing ban on discards in the EU waters.

Keywords: fisheries, foraging, interactions, Irish Sea, Seabirds, spatial analyses

*Speaker

Genomic Relatedness Matrix allows to untangle genetic and environmental components of behaviour in non-model free ranging populations: a case study in roe deer

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Behaviour plays an essential role in adjustment to environmental changes since it allows individuals to respond quickly to natural or human-induced environmental fluctuations. Behavioural plasticity (within-individual variation) can generate short-term responses to environmental change while between-individual variation provides the raw material for rapid evolutionary adaptation assuming a genetic determinism. Therefore, to better understand the evolutionary implications of environmental change, a key issue is to quantify how variation in behavioural traits is distributed between- and within-individuals and determine whether these traits exhibit heritable variation. Measuring the heritability of a trait in wild populations require estimates of pairwise genetic relatedness between individuals which have been traditionally based on multi-generational pedigree. However, many species cannot be sampled at sufficient intensity for a successful pedigree reconstruction. We used RAD-sequencing data to assess pairwise genomic relatedness in a free-ranging roe deer population inhabiting a human-dominated landscape. These data allowed us to tease apart the genetic and environmental components of spatial and non-spatial behaviours implied in risk-avoidance and resources acquisition, two families of traits susceptible to vary with human activities.

Keywords: genomic relatedness matrix, heritability, SNPs, personality, quantitative genetics

*Speaker

Designing a network of Green Infrastructure to enhance the conservation value of protected areas and maintain ecosystem services

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Growing concern for the maintenance of ecosystem services (ESS) leads to the need of holistic landscape planning to enhance sustainable use of ESS and maintenance of biodiversity objectives. The EU is currently developing policy to regulate the maintenance of ESS and enhancing connectivity among protected areas (PAs). This is known as network of Green Infrastructure (GI). However, there is not a working framework defined yet to plan the spatial design of this network of GI.

Here, we use Marxan with Zones, to prioritize the spatial distribution of different management zones that resemble a potential network of GI, in Catalonia (NE Spain). These zones included a conservation zone, mainly devoted to protecting biodiversity; a GI zone, that aimed at connecting PAs and maintaining regulating and cultural ESS; and a management zone devoted to exploiting provisioning ESS.

We found out that there was a threshold on ESS targets over which trade-offs appeared between maintaining regulating and cultural ESS and biodiversity vs. getting access to provisioning ESS. This methodological approach could help designing a structural framework to integrate biodiversity and ESS management in holistic plans and decision making and at the same time meeting European mandates concerning the design of GI networks.

Keywords: co, benefits, connectivity, marxan with zones, multi, functionality, systematic conservation planning, trade, offs

*Speaker

Systematic conservation planning for intraspecific genetic diversity

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Intraspecific diversity informs the demographic and evolutionary histories of populations, and should be a main conservation target. Although approaches exist for identifying relevant biological conservation units, attempts to identify priority conservation areas for intraspecific diversity are scarce, especially within a multi-specific framework. We used neutral molecular data on six European freshwater fish species (*Squalius cephalus*, *Phoxinus phoxinus*, *Barbatula barbatula*, *Gobio occitaniae*, *Leuciscus burdigalensis* and *Parachondrostoma toxostoma*) sampled at the riverscape scale (i.e. the Garonne-Dordogne river basin, France) to determine hot- and coldspots of genetic diversity, and to identify priority conservation areas using a systematic conservation planning approach. We demonstrate that systematic conservation planning is efficient for identifying priority areas representing a predefined part of the total genetic diversity of a whole landscape. With the exception of private allelic richness (PA), classical genetic diversity indices (allelic richness, genetic uniqueness) were poor predictors for identifying priority areas. Moreover, we identified weak surrogacies among conservation solutions found for each species, implying that conservation solutions are highly species-specific. Nonetheless, we showed that priority areas identified using intraspecific genetic data from multiple species provide more effective conservation solutions than areas identified for single species or on the basis of traditional taxonomic criteria.

Keywords: conservation genetics, spatial biodiversity patterns, dendritic networks, multispecific, intraspecific genetic diversity, conservation prioritization

*Speaker

Resilience of tropical forests to cyclones: an individual-based model simulation approach

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Tropical cyclones have a major impact on tropical forests, and their intensity is believed to increase in the next decades. Moreover, these forests have high level of biodiversity and endemism and are exposed to anthropogenic activities. However, a comprehensive understanding of the long-term effects of tropical cyclones on the structure and dynamics of tropical and subtropical forests has yet to emerge. Here, we coupled an individual-based forest dynamic model, TROLL, with a global climatic boundary condition, the CRU-NCEP reanalysis climate data. We applied this model to a subtropical forest of Taiwan, in a region with high frequency of cyclone visits. We showed that the reanalysis data represented reasonably well climatic forcing at the local level. We also compared extreme wind data derived from reanalysis dataset with best-track data (IBTrACS), which specifically track tropical cyclone path and intensity around the world. Baseline simulation results showed adequate fit between simulated and observed forest structure metrics (such as maximum height, tree density, and aboveground biomass.) Wind regimes were related to treefall probability using a biomechanical model, accounting for tree allometry, wood density and local neighborhood. As extreme wind intensity increased, we observed a transition from a "forest" state to a "non-forest" state, suggesting non-linear behavior of the system. A cross-site comparison was performed including sites from the Caribbean region, and showed that the model was also able to capture the dynamics of these forests. Future work should explore the vulnerability of forests to cyclones at global scale and under climate change scenarios.

Keywords: climate change, cyclone, forest, tree allometry, treefall

*Speaker

No place like home? A test of the natal habitat-biased dispersal hypothesis in Scandinavian wolves

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Natal dispersal is an important mechanism for the viability of populations. The influence of local conditions or experience gained in the natal habitat could improve fitness if dispersing individuals settle in an area with similar habitat characteristics. This process, defined as ‘natal habitat-biased dispersal’ (NHBD), has been used to explain distribution patterns in large carnivores, but actual studies evaluating it are rare. We tested whether grey wolf *Canis lupus* territory establishment was influenced by the habitat characteristics of the natal territory using the long-term monitoring of the Scandinavian wolf population. We paired the locations of natal and established territories, accounted for available habitats along the dispersing route, and compared their habitat characteristics for 271 wolves during 1998–2012. Wolves with the shortest dispersal distances established in natal-like habitat types more than expected by chance, whereas wolves that dispersed longer distances did not show NHBD. The pattern was consistent for male and female wolves, with females showing more NHBD than males. Chances to detect NHBD increased with the size of habitat defined as available. This highlights the importance of considering the biological characteristics of the studied species when defining habitat availability. Our methodological approach can prove useful to inform conservation and management to identify habitats to be selected by reintroduced or naturally expanding populations.

Keywords: *Canis lupus*, natal habitat, biased dispersal, habitat availability, habitat selection, individual experience, Scandinavia

*Speaker

Unravelling the relative importance of top-down and bottom-up environmental effects driving vital rates according to sex, colony and experience in long lived species, the snow petrel

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Unprecedented climate change is expected to occur in the 21st century, with greater warming often reported for high latitudes. This should result in significant ecological impacts on ecosystems, from species to communities. Environmental factors and their ecological impacts on population dynamics need to be studied to understand the diversity of responses to climate change in living organisms. In this study, we used capture-recapture modelling based on a 36-year-long individual monitoring dataset to investigate bottom-up and top-down forcing on several demographic parameters according to the sex, the colony and the breeding status of individuals in a long-lived species, the snow petrel in Antarctica. Our results indicate that predation and sea ice concentration had a greater negative impact on the survival of inexperienced individuals. Interannual variations of breeding probability for inexperienced breeders were partly explained by sea ice concentration during the pre-laying period. Hatching probability was negatively related to the southern annular mode and the number of snowy days during the incubation period. Air temperature and wind strength during the incubation period mainly affected hatching probability of non-breeders of the previous year. Variations in fledging probability appeared to be better explained by local weather and breeding phenology. These results highlight the importance of top down and bottom up environmental factors on the demography of a long-lived species, and of taking into account multiple parameters to understand the impact of environmental changes on population dynamics.

Keywords: Demography, Sea ice, Capture, mark, Recapture, Antarctic, Seabirds

*Speaker

Putting the heat on insect reproduction: understanding how heatwaves impact male fertility

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The increase in mean temperatures, and risk of heatwave extremes, is a particularly ubiquitous and pernicious form of global change. Climate change is causing natural populations to shift their ranges and become locally extinct at warm margins. However, the proximate mechanisms behind such responses are poorly understood. Male sensitivity to heat is recognised in endotherms, but ectotherms have received limited attention, despite comprising most of biodiversity and being more influenced by temperature variation. Here, we examine how experimental heatwaves impact on reproduction in an insect system (Sales et al. 2018). Using a flour beetle model system, we find that heatwave conditions (5 to 7 °C above optimum for 5 days) damaged male, but not female, reproduction. Heatwaves reduce male fertility and sperm competitiveness, and successive heatwaves almost sterilise males. Heatwaves reduce sperm production, viability, and migration through the female. Inseminated sperm in female storage are also damaged by heatwaves. Finally, we discover transgenerational impacts, with reduced reproductive potential and lifespan of offspring when fathered by males, or sperm, that had experienced heatwaves. This male reproductive damage under heatwave conditions provides one potential driver behind biodiversity declines and contractions through global warming. Data produced in this experimental setting could help inform predictive models and conservation actions for species in the face of climate change. Sales, K., Vasudeva, R., Dickinson, D.E., Godwin, J.L., Lumley, A.J., Michalczyk, L., Hebberecht, L., Thomas, P., Franco, A., Gage, M.J.G. 2018. Experimental heatwaves compromise sperm function and cause transgenerational damage in a model insect. *Nature Comms*, 9:4771.

Keywords: Climate change, Heatwave, Reproduction, Fertility, *Tribolium castaneum*, Insect, Beetle, Experimental evolution, Transgenerational effect, Sperm, Egg

*Speaker

Posters

Once burned, twice shy: groups of experienced fish take fewer risks while foraging than do naïve ones

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Prior experience with predation risk can provide valuable information and influence how individuals decide to forage and trade-off food and safety. We examine foraging and refuge use behaviour among groups of social goldfish (*Carrasius auratus*) at risk of predation from little egrets (*Egretta garzetta*) for groups containing only individuals that previously experienced predators, only naïve individuals, or mixed groups containing both experienced and naïve fish. Groups of all-experienced fish consumed significantly less food than the all-naïve and mixed groups, and spent the least amount of time foraging outside of refuge. Furthermore, within the mixed treatment groups, naïve individuals spent more time foraging compared to experienced group members. In terms of survival, the groups containing all-naïve members experienced the highest mortality, and significantly more naïve fish were captured within the mixed groups. Interestingly, the mixed groups experienced overall mortality rates similar to the less active all-experienced groups, even though the mixed groups foraged more like the all-naïve groups. To explain this, we found that the mixed groups were able to detect the approaching predator significantly earlier than the all-naïve groups. Thus, we show that naïve individuals within mixed groups did not reduce foraging activity via social learning from experienced group members, but did benefit from enhanced collective predator detection. Overall, we demonstrate how prior experience with predation risk influences how individuals make foraging decisions and that recent encounters with a predator had a significant carry-over effect on individual and group prey behavior.

Keywords: predator, prey, learning, social experience, trade off, refuge use

*Speaker

Accelerating across the landscape: the energetic costs of natal dispersal in a large herbivore

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Dispersal is a key mechanism enabling species to adjust their geographic range to rapid global change. However, dispersal is costly and environmental modifications are likely to modify the cost-benefit balance of individual dispersal decisions, for example, by decreasing functional connectivity. Dispersal costs are predicted to occur during departure, transience and settlement, and are levied in terms of energy, risk, time and lost opportunity, potentially influencing individual fitness. However, to the best of our knowledge, no study has yet quantified the true energetic costs of dispersal across its three phases by comparing dispersing and philopatric individuals in the wild. Here, we employed animal-born bio-loggers on a large sample ($N = 105$) of juvenile roe deer *Capreolus capreolus* to estimate energy expenditure indexed using the vector of dynamic body acceleration (VeDBA) and mobility (distance travelled) in an intensively monitored population. Our results provide strong support for the hypothesis that natal dispersal is energetically costly due to higher levels of activity and mobility. We also showed that this energetic cost occur essentially during the transience phase at dawn time. Further work will permit to link dispersal costs with fitness components so as to understand the likely outcome of further environmental modifications on the evolution of dispersal behaviour.

Keywords: Roe deer, bio, logging, movement, transience, energy expenditure, philopatric, circadian rhythm

*Speaker

Diet analysis of *Nyctalus noctula* following a new hibernacula range using DNA metabarcoding

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During the last two decades the noctule bat *Nyctalus noctula*, has expanded its hibernacula range to the north in Eastern Europe. Climate change is considered as the main driver of northward expansion of species range. The higher temperatures at northern latitudes prolong the growing season and increase the activity of insects, which are a primary food source for bats. Our main objective was to investigate the diet of *N. noctula* in a new hibernacula range and understand which insects become an essential food source for prehibernation fattening. Previous studies report the diet of bats by examining the insect remains in fecal samples by eye. Such results limit our knowledge about the dietary choice because suggestions are made based on the size and structural integrity of undigested chitin parts. In the present study, the diversity of insects in the diet of *Nyctalus noctula* is identified using a DNA metabarcoding approach, targeting a 133 bp COI minibarcode. Preliminary analysis identified a total of 283 COI variants from arthropods, including 22 orders, 74 families, 131 genus and 138 species. Further analysis will reveal dietary preferences of *N. noctula* during breeding and prehibernation seasons in a recently expanded winter range.

Keywords: DNA metabarcoding, environmental DNA (eDNA), Arthropoda, Chiroptera, *Nyctalus noctula*

*Speaker

Links between oxidative stress and color polymorphism in an urban context

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Urbanization is associated with changes in the environment, impacting the structure and functioning of ecosystems. The urban environment is characterized by a modification of various factors: chemical pollution, artificial light, noise exposure, etc. Urban areas exert selective pressure on organisms, creating heterogeneity between urban and rural populations. For example, previous studies in feral pigeon (*Columba livia*) have found higher frequencies of dark morphs (with more melanin) in cities than in rural areas. Most studies suggest that the advantages and disadvantages of melanism are indirect and result from existing genetic links between melanin synthesis and many other biological parameters, such as oxidative stress. In this correlative study, we measured oxidative stress in 69 feral pigeons, caught in highly urbanized areas (Paris). Our initial prediction was that melanic individuals (with a darker morph) have a stronger ability to manage the oxidative stress generated by an urban environment. We measured oxidative stress as the ratio between the pro-oxidant concentration and antioxidant capacity of the plasma. In addition, we quantified individual's melanism from the percentage of dark feathers of the left wing. These results could partly explain the proportion of dark morphs in the pigeon seen in the city. To go further, we will test the influence of trace metals (zinc and lead) on the oxidative stress in the pigeon. Indeed, the identification of environmental factors responsible for measured differences between urban and rural populations appears essential for the characterization of the ecological impact of human activities.

Keywords: urbanization, melanism, oxidative stress

*Speaker

Do physiological needs determine movement initiation in horses?

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Gregarious species benefit from the advantages of group living by synchronizing their activities. Collective decision-making processes, that must have been selected during evolution, allow both maintaining group cohesion and satisfying the needs of all group members. In many species, even if the leadership is often distributed, only a few individuals of a group initiate the majority of collective movements. Previous studies showed that frequent initiators are the dominant or the boldest ones, but also that the reproductive state can influence leadership roles in movements. In this context, we explore in domestic horses whether the heterogeneity of physiological needs can explain the unequal distribution of initiation propensity and if the initiator of a collective behaviour has the highest physiological needs. We filmed three semi-free ranging groups of domestic horses for several weeks. We observed collective movements to determine the initiation propensity of group members, and we set an index to estimate their energetical needs. We also focused on activity switches in the same groups of horses. Actually, the analysis showed that the energetical needs were not correlated to the initiation propensity in the three groups we studied. Furthermore, we found that the frequent initiators are older and eat less, whatever the group studied and the purpose and arrival area of the movements. Indeed, fulfilling energetical needs is not the only reason for moving. More specific nutritional needs (depending on age), but also the need for rest or heat sensitivity, may motivate horses to move or change activity.

Keywords: collective movements, leadership, horses, physiology, group living, decision making

*Speaker

The foraging effort of the Wandering albatross (*Diomedea exulans*) during breeding and migration seasons

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Migration is common throughout the animal kingdom, while individuals often move to areas of high productivity, travelling long distances can be costly. Hence, the migration season can influence individual fitness as it is key in acquiring the energy required for reproduction. Recent studies have highlighted the important interaction between migration and breeding behaviour and identified so called "carry-over" effects where behaviour in one period affects the behaviour in the other. In this study, we examine the foraging effort of Wandering albatrosses (*Diomedea exulans*) during migration and breeding to determine their effect on fitness. Using seven years of tracking data from a population on the Crozet Islands we examined the importance of age and sex on foraging effort (i.e. flight duration and take-offs). We found the foraging effort was greater for females and decreased with age. Past reproductive successes had an influence on the foraging effort during migration, which subsequently had an effect on the reproductive successes in the next breeding season. Birds with lower energetic costs before the breeding season were more successful breeders. Overall, the breeding season was more costly. This study highlights the importance of linking both seasons when trying to understand the life-history of the wandering albatross.

Keywords: breeding, fitness, foraging effort, migration, seabird, Wandering albatross

*Speaker

Diversity patterns of tropical fish communities along disturbance gradients

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Amazonian freshwater ecosystems are facing intense human-induced pressures due to population's growth and economic activities. Those pressures were shown to affect more the species identity and the functional diversity of fish assemblages than species richness. Thus, disturbance effects should be assessed in a community based approach. In this study, freshwater fish diversity was considered through two diversity facets: taxonomic and functional diversity. The relationships between these facets can provide insights on the ecological processes shaping the structure of communities. The taxonomic diversity was assessed using environmental DNA sampling and the functional diversity was measured using morphological measures and ecological traits of tropical fishes. We filtered 68L of water in 40 river and 40 stream sites in French Guiana in order to collect fish DNA. Then, the DNA was assigned to fish species using metabarcoding techniques. Disturbance gradients of increasing gold-mining, deforestation and urbanization were defined using GIS data layers. For river sites, we observed a significant decrease of taxonomic and functional diversity through deforestation, gold mining and urbanization gradients. For streams sites, we only observed a decrease of the diversity thorough gold-mining gradients. Despite of the erosion of fish diversity through disturbance gradients, the effect of disturbance gradients on ecological processes was not significant.

Keywords: Taxonomic diversity, Functional diversity, environmental DNA, human impacts, fish

*Speaker

Secondary contact at the Sino-Japanese divide: geneflow and cultural transmission across a little-known biogeographical boundary

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Two major zoogeographical boundaries between the Palearctic and Sino-Japanese realms are recognized in East Asia: a continental boundary northeast of Beijing, China, and a maritime boundary between the Japanese Archipelago and the mainland. At the continental boundary, several taxon pairs of forest-dwelling birds exhibit secondary sympatry with variable levels of historical gene flow. The Blue-and-white Flycatcher genus *Cyanoptila* (Muscicapidae; subfamily Niltavinae) exhibits phenotypic divergence and two possible migratory divides congruent with the above continental and maritime boundaries. Using genome-wide SNP and morphological data to characterize population genomic structure of this migratory songbird, we explore the interaction between differential gene flow, phenotypic divergence, and migratory route in maintaining lineage integrity across two zoogeographical boundaries in East Asia. For the first time in an endemic East Asian species complex, we test for the presence of a continental divide with gene flow through secondary contact and a maritime divide precluding gene flow through secondary contact. We detected recent asymmetric introgression from *C. cyanomelana* into *C. cumatilis* individuals near the contact zone; a significant find given that the sister species were estimated to have diverged ca. 4 million years ago. The only known site of secondary sympatry was found 150 kilometers to the northeast from the breeding territories of introgressed individuals, where *C. cyanomelana* was also discovered to have learned the song of the locally more abundant *C. cumatilis*. This suggests that the hybrid zone has shifted a substantial distance in tandem with post-glacial expansion of the introgressed taxon, *C. cumatilis*.

*Speaker

Keywords: *Cyanoptila cumatilis*, *Cyanoptila cyanomelana*, Genetic Introgression, Hybridization, Cultural Transmission, Phylogenomics

Allofeeding of fledglings in a territorial breeding parrot: an interesting case of altruism

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Individuals in many vertebrate species may help raise offspring that are not their own, acting as helpers to the parents. The function of this behavior varies between species, but can often be explained because it increases the direct or indirect fitness of the helper. Unpaired males may increase their direct fitness by gaining extra-pair matings with females that they help, and offspring from previous broods may gain indirect fitness by helping their siblings to survive. Unrelated individuals may increase their own chances of survival, and thus the chances of producing offspring, if they "pay to stay" in a territory or social group by providing care to the offspring of the dominant group members. One aspect that links these cases of helping is the necessity for access to a high-quality territory to breed, which the helpers cannot maintain on their own. Here, we describe a case of helping in keas which does not obviously fit into previously-described scenarios. Kea maintain breeding territories and don't tolerate other individuals near the nest, but foraging is non-territorial and occurs in fission-fusion social groups with no strict hierarchy. Over five years, we observed the behavior of captive kea towards fledglings entering their social group. Both adult and juvenile allofed fledglings which were not their offspring. "Pay to stay" explanations for this behavior are ruled out due to the non-territorial nature of kea's feeding ecology. We tested whether genetic relatedness to the fledgling, affiliative relationship to the parents, and dominance rank of the feeder predict allofeedings.

Keywords: altruism, psittacids, *Nestor notabilis*, kin selection, social prestige, dominance

*Speaker

Predator prey interactions: Can a generalist outcompete a specialist?

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Predator-prey interactions often lead to the co-evolution of different tactics over time. These can be quite apparent in extreme environments such as the sulphur streams of southern Mexico. Sulphur mollies (*Poecilia sulphuraria*) inhabiting these streams have evolved specialized traits that allow them to withstand the otherwise toxic concentrations of hydrogen sulphide in the water, including behavioural adaptations such as aquatic surface respiration. Several fish eating birds take advantage of the resulting high number of fish at the surface to prey on. Following a bird attack fish schools produce a series of synchronized waves. In order to understand the function of these waves and how they affect bird predation we compared the hunting strategy of two species of fish-hunting birds, the green kingfisher (*Chloroceryle Americana*), a specialist fish-catcher and the great kiskadee (*Pitangus sulphuratus*), an opportunistic fish-catcher. Both these birds hunt by flying over and attacking the fish school from atop, but they differ significantly in the number of waves they produce and in their success probability. We experimentally induced repeat waves while kiskadees were hunting, and could show that consecutive attacks were significantly delayed after wave exposure. We concluded that waves prevent birds from attacking and thus significantly decrease their success rate. Despite being considered generalist feeders, it seems that kiskadees are able to attack fish aggregations frequently and thus compensate for their low probability of success by attacking many times, without inducing a strong response by the fish.

Keywords: collective behaviour, predator, prey interactions, Kingfisher, Kiskadee, Sulphur molly, fright wave

*Speaker

Epigenetics as a target of conservation: an empirical test in two sympatric fish species

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The current concept of Evolutionary Significant Units (ESUs) relies on genetic marks and takes into account the past evolutionary history related to long-term demography, but not the immediate adaptation of organisms to the surrounding environment. Epigenetics, because of its sensitivity to environmental conditions could provide access to this short-term eco-evolutionary history. By considering both genetics and epigenetics, new management entities could be defined: Evolutionary and Ecologically Significant Units (E²SUs). To empirically test the usefulness of the E²SU concept, we aim at comparing both genetic and epigenetic structures in populations of two sympatric -yet contrasted- freshwater fish species (*Phoxinus phoxinus* and *Gobio gobio*) sharing the same environment. The objective is to test the hypothesis that genetic structure mostly reflects the past colonization and demographic history of populations, whereas epigenetic structure would mostly reflect the current environmental heterogeneity of habitats in which populations are living. Both types of diversities could be estimated using microsatellites/SNP data and DNA methylation data (MS-AFLP method). It would permit to test whether or not there are genetic and/or epigenetic differentiations in populations inhabiting a same habitat, and then establish the spatial patterns for both facets of diversity. Moreover, by collecting pertinent information on the abiotic conditions of the environment, one could test the hypothesis that environmental characteristics better explain the epigenetic structure of populations than the genetic structure. If epigenetic marks better reflect environmental heterogeneity than genetic marks, it would constitute a good primary test for validating the E²SUs concept.

Keywords: Evolutionary Significant Unit, Genetic diversity, Epigenetic diversity, Conservation, DNA methylation

*Speaker

Better alone than in bad company: brown bear's social avoidance at feeding sites in southern Slovenia

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Brown bear females with cubs foraging decision requires taking into account both risk of humans and potentially infanticide males. In the present study, we analysed how intraspecific predation risk affects the social behaviour of brown bears in Slovenia, where hunters maintain numerous artificial feeding sites to diversionary feeding and hunting purposes. We monitored eighteen feeding sites with camera traps for 2 years (supplied interchangeably with corn/carrion of wild ungulates). All recorded pictures were analysed to get information on number and sex of the bears using feeding sites; date and time of the visit; type of used bait (carrion and corn vs. corn) and bear density in 1 km around the feeding site. The relationship between "female with cubs" vs. "others" use of feeding sites was analysed using generalized linear mixed models (GLMM) in which we considered as independent variables time, season, type of bait and bear local density. Our results indicate that females with cubs visited feeding sites relatively more often during daylight and less often during mating season and used carrion feeding sites less often than corn ones. All observed patterns are in agreement with predictions of sexually selected infanticide theory. Contrary to our expectations local density of the bears apparently did not affect relative use of feeding sites by females with cubs. Our results provide evidences to show that females with cubs are adapting their use of feeding sites to avoid intraspecific predation risk, having several implications also for monitoring and management of the species

Keywords: landscape of fear, avoidance, infanticide, brown bears, feeding sites

*Speaker

Coinfection and its Dynamics in *Drosophila melanogaster*

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In the natural environment, organisms are susceptible to a plethora of pathogens. A lot of research has been conducted to basically explore the single host-single parasite system. However very few studies address the interactions that occur when a single host is infected with multiple pathogens simultaneously. In this study, we wanted to explore the dynamics of the interactions between the pathogens and its effects on the hosts. We have done this by conducting coinfection experiments on baseline populations of *Drosophila melanogaster*. We hypothesized that the flies infected with combinations of bacteria will show characteristics intermediate between the flies infected individually with the respective members of the combinations. From the results obtained we can conclude that the effects are specific for the different bacteria and their combinations. However the relationship between the mortality proportions of the individual bacteria and their respective combinations is not linear, that is, our hypothesis is not true for all the combinations used in this study.

Keywords: Coinfection, Immunity, Survivorship, Tradeoff, *Drosophila melanogaster*

*Speaker

How does predation risk and physiological stress response explain energy budget balance in a free-ranging rodent?

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In order to survive, the energy cost of obtaining food cannot exceed energy intake. Prey species often must balance the cost of locomotion, foraging effort, and predation risk with high metabolic costs. In our work, we assessed how wood mice balances these costs by manipulating food access difficulty and predation risk. Live trapping was performed in Madrid where 80 live traps were set in 4 plots consisting of a 4x5 grid. All traps were subjected to a control period followed by four different treatments of three days duration in which food access difficulty was experimentally manipulated (free access; straw balls; straw balls wrapped in metal wire; opened plastic bottles; closed bottles). Predation risk was manipulated by exposing half of the traps to fox faeces. To quantify food intake, we weighed the remnants of food left by each mice. To evaluate physiological stress response, we collected mouse faecal samples from traps and quantify faecal corticosterone metabolites (FCM). Results showed that despite mice generally avoiding traps treated with fox faeces, predation risk did not modulate food intake or FCM levels. By contrast, food access difficulty determined the amount eaten and increased FCM levels, probably owing to the different energetic costs required to obtain the food. Moreover, recaptured individuals ate more, indicating that experience is crucial in the ability of wood mice to reduce the costs of accessing to food. In conclusion, we found that mice can modulate their energetic expenditure depending on food access difficulty in order to preserve their energy stores.

Keywords: food access difficulty, energy budget, risk of predation, small mammals, glucocorticoids

*Speaker

Do urban living Sulphur-crested cockatoos distinguish between individual humans?

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Cities built by humanity cause fundamental environmental changes. This, in turn, provoke not only destruction but also creation of habitats for animals. Some species are better at adapting and surviving in these new habitats than others. In cities for instance, animals have to cope with a warmer climate, more noise and light than they would have to in their natural environment. Cognitive skills could be advantageous in order to face those challenges. Animals in urban areas also live in close proximity to humans. However, people vary considerably in their behaviour towards animals. Therefore, it would be advantageous for urban living animals to distinguish between persons in order to response appropriately towards specific humans (e.g. flight or approach). The aim of my master project is to understand how animals in cities cope with living with people. Because the population of Sulphur-crested (S-C) cockatoos (*Cacatua galerita*) in Sydney approach people in order to get desirable food, I tested whether S-C cockatoos are able to distinguish between individual humans, in order benefit from interaction with specific human individuals. Do do so I conducted a behavioural experiment with wild living cockatoos, where I individually marked the birds, trained them to press a buzzer in order to receive a reward and then tested if they could learn to preferentially visit the buzzer of the person who actually provides a reward.

Keywords: individual human recognition. cognitive ecology, urban habitat, cockatoos

*Speaker

Trails to trash: Understanding animal behaviour at garbage dumps around forest edges of a protected area in India

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Inadequate solid waste management around natural reserves poses a serious threat to animal welfare. Garbage dumps act as attractive food resource for several wildlife species putting them at risk from consuming hazardous waste.

In the present study, we quantified the ecological impacts of garbage dumps located at forest edges on behaviour of wild species. This study was conducted around forested areas adjoining Rajaji National Park, a biodiversity rich protected area in north India. Garbage dumps of various sizes (< 100, 100-500 and > 500 m² area) situated at near (< 100 m) and far (> 100 m – 5000 m) distance from the forest edges were sampled, each along with a control site (i.e. adjoining area without garbage dump). We used scan-focal observation method and passive-infrared camera trapping to document the visitation patterns of vertebrate species at these monitored sites.

We conducted 200 hours of manual observations and 384 hours of camera trapping at 17 garbage dumps and equal number of control sites. We documented 20 mammalian (including Asian Elephant, Indian Jackal, Leopard, Rhesus macaque, Sambar, Striped Hyena etc.) and 6 avian species (including black kite, Indian jungle crow etc.). We observed higher visiting frequencies (9 visits / hour) of vertebrates at the larger garbage dumps close to human habitation as compared to small or medium-sized dumps. Sambar, Indian Jackal and Striped Hyena were recorded among the most frequent visitors at the garbage dumps. This study is the first attempt to understand human-mediated resource use at garbage dumps by terrestrial species in India.

Keywords: garbage dump, visitation patterns, foraging behaviour, terrestrial vertebrates

*Speaker

Brace yourself, winter is coming: winter budget requirements of *Nyctalus noctula* along latitudinal gradient.

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Some animals are particularly susceptible to human-induced changes. Bats belong to this group because they reproduce at a low rate, are long-lived or require specific pristine habitats. Among bats, migratory species are of specific concern, because they do not only depend on single habitats in which they spend the whole annual cycle but on a sequence of habitats for breeding, migrating and hibernating. The common noctule bat is a long-distant migratory species with a broad distribution range in Europe. However, it has been noted over the past three decades that this and some other bat species have expanded their distribution range and hibernation area towards the North. The primary suggested drivers of northward expansion are global climate change and urbanization. In order to understand the benefits and limitations of different ambient conditions for hibernating bats, we calculated winter energy budgets for bats along a latitudinal gradient. We used open-flow respirometry to measure basal, resting and torpor metabolic rate. This enables us to quantify the energetic costs of staying torpid and active at varying ambient temperatures and also to quantify the metabolic costs of arousal events. The length of torpor duration bouts was quantified by measuring skin temperature of torpid bats kept under three different thermal conditions. Finally, we projected hibernation costs into time slices using spatial maps of present and future global temperature forecast.

Keywords: global climate change, energetic costs, bats, winter ecology

*Speaker

Covariation of stoichiometry with functional traits within two global invaders, *Procambarus clarkii* and *Orconectes limosus*

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The functional importance of intraspecific variability in modulating the ecological impacts of invaders on recipient ecosystems has been recently demonstrated. It is now known that some phenotypic traits covariate at the individual level, in particular with physiological and history-life traits (e.g. Pace of Life Syndrome (Réale et al., 2010), Functional Syndrome (Raffard et al., 2018)). If the growth-mortality trade-off is well described (Biro et al., 2006), covariations between response and effect traits are still investigated. Stoichiometry, defined as elementary composition of individuals (e.g. C:N:P ratios), is increasingly studied as a pool of phenotypic traits (Leal et al., 2017). However, no study deal with the potential covariation of stoichiometry with other traits, despite the fact that it could improve our understanding of how individuals impact the ecosystem functioning, through trophic interactions, nutrients fluxes/limitations and transformation rates (Welti et al., 2017). In this study, we aimed to investigate the elementary composition of two highly invasive species (red-swamp crayfish, *Procambarus clarkii* and spiny-cheek crayfish *Orconectes limosus*), using a multi-traits approach. We conducted a 15-days experiment in aquaria to quantify multiple response traits (morphology, activity, boldness), effect traits (stable isotope analyses, excretion, ecosystem engineering, leaf consumption, voracity), metabolism (dioxygen consumption) and stoichiometry (C:N:P ratios) on individuals from the same population. We demonstrated that stoichiometry is an important source of intraspecific variability. Then, we tested in what extent stoichiometry covaried with other functional traits at individual scale, and we found significant positive covariations between elementary composition and response and effect syndromes (Raffard et al., 2018).

Keywords: intraspecific variability, functional syndrome, functional traits, stoichiometry

*Speaker

Interspecific and intraspecific competition for foraging space use in sympatric breeding chinstrap and gentoo penguins in two close habitats

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Theory predicts that predators which share the same prey have competitions with limited resources. It would occur not only between different species but also within the same species, among close populations. Intraspecific competition is often more intense due to the lack of niche partitioning and this may drive foraging segregation. Here we investigated foraging space use of sympatric breeding chinstrap and gentoo penguins in two close habitats, Ardley Island and Narebski Point, at King George Island, Antarctica, in the 2017-2018 breeding season. Using GPS and time-depth recorders, we found that the foraging areas of chinstrap and gentoo conspecifics in both habitats were highly segregated. Ardley Island birds used adjacent Maxwell Bay but Narebski Point birds had longer trips out of the bay and mostly went to Bransfield Strait. Interspecific comparisons showed that the foraging areas and depth were overlapped between the two species but stable isotope analysis with $\delta^{13}\text{C}$ in blood indicated that foraging niches were different. Our results support the hypothesis that intraspecific competition may lead to spatial segregation of the neighboring populations of the same species.

Keywords: foraging area, ecological niche, chinstrap penguin, gentoo penguin

*Speaker

General rules to predict the outcome of chemotaxis across species

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Many living beings navigate using chemical cues. This behavior, known as chemotaxis, is a key feature of life across several levels: It guides bacteria towards nutrients and suitable niches, it helps immune cells find the pathogenic ones, and steers animals away from predators and towards food, friends and mates.

The physiological and biophysical mechanisms that underlie chemotaxis have been extensively studied. It is however difficult to link the well-studied instantaneous behaviors of chemotacting individuals to the global features that determine the fate of the system, such as the distribution of foragers across food patches. Through a combination of theory and experiments, we aim to link these two levels of description.

Our theoretical work studies how sources of chemoattractants of different densities can be distinguished at a distance. We have obtained two interesting predictions on how this ability is limited by the physical properties of diffusion. First, we find that a difference of orders of magnitude in concentration between two sources may lead to only a small difference in the number of individuals choosing each one. Second, we find a counterintuitive trade-off: Being better at finding resources (i.e. having higher sensitivity to the chemoattractant) may lead to a lower ability to distinguish high-quality sources from low-quality ones.

We test our predictions experimentally using the nematode *Caenorhabditis elegans*, but we aim to develop a general theory to link individual properties to global outcomes, which we expect will be useful across species and contexts.

Keywords: Chemotaxis, *Caenorhabditis elegans*, Animal behavior, Foraging, Decision, making

*Speaker

Does sexually attractive facial colouration in rhesus macaques reflect their ability to cope with oxidative stress?

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Elevated oxidative stress (OS) can impair cellular function potentially affecting health, longevity and fitness. Studies of sexual selection have hypothesised that physical signals used in mate choice may indicate an individual's ability to cope with OS and therefore communicate information about their health status. Yet primate research on this topic is entirely lacking. Female rhesus macaques prefer mating with males with darker, redder faces and such males sire more offspring. However why females prefer this phenotype is unknown. Here we test the hypothesis that male facial colouration in rhesus macaques is associated with a putative measure of health and condition (oxidative stress). We predict that males with redder and/or darker faces exhibit lower oxidative damage and higher antioxidant protection. To quantify male face colour we measured redness and luminance in digital photographs from free-ranging adult male rhesus macaques (N=19) on Cayo Santiago, Puerto Rico. To measure OS, we assayed non-invasively collected urine samples for 8-OHdG (a marker of DNA oxidative damage) and Total Antioxidant Capacity (TAC). During peak mating season, male luminance and TAC were weakly negatively correlated suggesting that males with darker faces had higher antioxidant protection but this relationship was not statistically significant. Oxidative damage was unrelated to face luminance or redness.

Keywords: *Macaca mulatta*, ecophysiology, female mate choice

*Speaker

Effects of metallic trace elements on honeybee behavior: from the colony to the brain

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Pollinators, such as honeybees, provide a vital ecological and economical service. Given their importance, the reported widespread declines of bee population over the last decades are of particular concern for the maintenance of ecosystems and food security. A range of stressors has been identified as threats to pollinators (pesticides, parasites, malnutrition, etc) but there are still some fundamental gaps in our understanding of their effects, either alone or combined. Metallic trace elements are ubiquitous contaminants of the environment that bees collect when foraging for pollen, nectar or water, but also in the air during flight. These pollutants accumulate in the body of bees and in the hive products. Recent studies have shown that heavy metals contamination affects bee behavior and survival. We aim at studying the effects of heavy metals, in interaction with other stressors, at levels ranging from the colony to the individual. Our approach uses connected hives to identify relevant stressor combinations, and lab experiments to measure their possible impact on individual cognitive abilities and brain organization. Here we tested whether bees can detect metals in their food and avoid consuming contaminated food. Our first results suggest that lead (Pb), zinc (Zn) and arsenic (As) are indeed detected by sensory organs, and induce behavioural responses indicating that bees evaluated them negatively. Next, we will test whether these heavy metals impact on learning tasks that are important for foraging: if so, heavy metals could reduce foraging efficiency and eventually jeopardize the whole colony.

Keywords: honeybee, environmental stressors, combined effects, metallic trace elements, brain

*Speaker

What are you singing? The use of heterospecific song traits to assess habitat quality depends on the listener sex and aggressiveness

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Assessing local habitat quality via social cues provided by conspecific or heterospecific individuals sharing the same needs is a widespread strategy of social information use for breeding habitat selection. However, gathering information from competitors may involve agonistic costs. The use of cues allowing individuals to predict local habitat quality from a distance could therefore be favoured. Bird songs are conspicuous signals commonly assumed to reliably reflect producer quality, and thereby local site quality. Birds have been shown to be attracted to breeding sites by heterospecific songs in different species, but it is unknown whether they can use heterospecific fine song features as information on the producer- (and by extension habitat-) quality. Using a playback experiment in a wild population of collared flycatchers, a species known to eavesdrop on dominant great tit presence and performance, we tested whether flycatchers preferred to settle near broadcasts mimicking the presence of a high quality great tit (songs with large repertoire size, long strophes, high song rate), a low quality great tit or a chaffinch (control). Among old females, aggressive ones preferred to settle near broadcasts of high quality tit song, while less aggressive ones preferred to settle near broadcasts of low quality tit song. Male traits did not influence settlement decisions. Our results show that collared flycatcher females use great tit song quality features as information for settlement decisions, but differently depending on their own competitive ability. Our study enlightens the complex condition-dependent use of heterospecific social information for breeding habitat selection.

Keywords: *Ficedula albicollis*, social information, signal, eavesdropping, bird song, heterospecific competition, individual quality, personality, *Parus major*

*Speaker

Can we monitor Natura 2000 sites in a cost-effective way through citizen science?

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Natura 2000 is the central component of the European Union strategy to address the current alarming rate of biodiversity loss. However, a recent inquiry revealed that 70% of European citizens never heard about the network. This is worrisome since public awareness plays a critical role in the achievement of biological conservation goals. In addition, a recent report revealed that current management and monitoring efforts in Natura 2000 sites are insufficient to reach the targets of EU 2020 biodiversity strategy. Citizen science may be a valuable option to address the challenges currently faced by this network. For instance, it has the potential to decrease the costs associated with research and management. Besides, it can also improve knowledge and promote changes in attitudes towards biodiversity among participants. Hence, the main goal of this work is to assess whether citizen science can fill the gaps described above in a cost-effective manner. The first step was to compile historical data on two selected pilot sites, in order to identify species/parameters that best translate shifts in the ecosystem structure and functions as well as significant threatened and/or rare species. Then, new protocols were developed or adapted from the literature. Overall, 5 citizen science protocols were produced, which aim to monitor European otters (*Lutra lutra*), Chiropterans, litter pollution, soil quality and water quality & fish populations. With these protocols, we aim to raise awareness about Natura 2000, gather data needed to fulfil the mandatory Natura 2000 monitoring reports and provide relevant information to guide management decisions.

Keywords: protected areas, citizen science, biodiversity conservation

*Speaker

Physiological and transcriptomic responses to metal contamination and parasites in gudgeon: a multiple stress approach

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Freshwater fish are threatened by many abiotic and biotic stressors. Among them, trace metal contamination and parasite infections are the most frequent stressors in streams. Exposure to these stressors causes energy reallocation, oxidative stress, immune alterations and metabolic changes at different biological scales, especially at the transcriptomic level. However, there is a lack of knowledge about the interactions between pollution and parasites and their combined effects on physiological traits and gene expression (antagonism or synergism). In this study, we investigated the interactive effects of trace metals and parasites on several traits, from molecules to the whole individual. We also aimed at identifying which genes were involved, to understand the underlying mechanisms of fish defenses. To answer these questions, we compared several physiological traits and the level of expression of selected genes that are part of metabolism pathway, oxidative stress and immune responses in the gudgeon *Gobio gobio*. Fish were experimentally exposed to a realistic mix of trace metals and/or to an immune challenge simulating parasite infection. We expected interactive effects of metal contamination and immune challenge, especially on the immune, oxidative and metabolic responses of fish exposed to multiple stressors. Such combined effects of multiple stressors need to be taken into account to better predict the response of fish populations to present and future anthropogenic stressors and to improve the management of freshwater ecosystems.

Keywords: trace metal elements, immune challenge, stressors interaction, behaviour, transcriptomic

*Speaker

Testing condition, but not age, is the main determinant of social learning : a meta-analysis

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Theoretical modelling has suggested that social learning should be particularly adaptive during the juvenile phase of an individual's lifetime, and therefore selection should favour increased social learning abilities during this developmental period. Multiple empirical studies have tested this hypothesis, and evidence is equivocal and scattered in the literature. Therefore, we present here what we believe to be the first meta-analytic review of this body of research, aiming to elucidate the potential link between age and social learning across taxa. Collating 27 studies that tested for social learning with comparable experimental designs, we ran a twofold analysis. First, we examined if learning success was correlated with three variables: phylogeny, testing conditions (captive, wild animals in captivity, wild), or dispersal system (single or multiple dispersal events). In a second phase, we tested for interactions between these variables and age (14 studies). Our findings reveal that social learning success is best explained by testing condition, with a larger proportion of captive individuals learning compared to wild individuals. Interestingly, wild animals brought captivity performed similarly to captive animals, suggesting that it is context, not subject origin, that is important. Finally, there was an interaction between age and testing condition, with the social learning success of juveniles, but not adults, being strongly influenced by testing conditions. While these results are intriguing, only a low number of studies provide data for age-related differences in social learning abilities. Our study therefore underlines the need for future research to consolidate these findings.

Keywords: social learning, meta, analysis, age, difference

*Speaker

Phylogeography of large adaptive radiations in Madagascar: the Malagasy olive tree (*Noronhia* sp.) as a case study

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Large adaptive radiations hold strong potential for understanding evolutionary mechanisms such as speciation, adaptation, and specialization. This is particularly the case when occurring in geographic areas where evolutionary processes can be modeled, such as in Madagascar. In addition to its unique biota with a high level of endemism, this island houses many examples of adaptive radiations. To explain this unique biodiversity, several models of diversification have been proposed in Madagascar, considering the major ecological, geologic, geographic, and climatic features that may have driven radiations. However, most of these models were built and tested on the Malagasy fauna. To better understand the hyper-diversification of plants in Madagascar, we test alternative evolutionary mechanisms using the highly diversified Malagasy olive tree (genus *Noronhia*; Oleaceae) as a model. This genus is represented, to date, by 87 species of which 82 are endemic to Madagascar. In this study, we produce a robust phylogeny reconstruction based on restriction associated sequencing (RAD-Seq) from 180 individuals covering 100 lineages. The molecular analysis takes into account both plastid and nuclear DNAs to assess respectively maternal and bi-parental heredity representing seed versus pollen+seed gene dispersal. Combining phylogenies with species range data, we test putative speciation events to identify the major mechanisms that drove the adaptive radiation of Malagasy olive trees.

Keywords: Biogeography, diversification models, Model testing

*Speaker

Niche innerness: measuring a population's position to niche margins

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Populations located at species' range margins are expected to be particularly threatened e.g. by climate change. Generally, species margins are defined in the geographical space as the boundaries of a species' distributions, but one can also consider species margins as the boundaries of conditions in a multivariate environmental space. Tools have been developed to locate where a population lies with regards to the niche centroid. However, niche shapes can be highly asymmetric implying that the distance to the centroid might not be the best measure of niche matching. To overcome this limitation, a new metric - the innerness - was developed to assess populations' position with regards to species niche margins rather than to centroid. It measures the relative distance between the target population and the closest species niche margin. To test this new metric, we compared the innerness to the usual habitat suitability index (HS) for 50 invaders plant species. Niche innerness was calculated by estimating the native species' niche in a multivariate space and then by calculating distances of invasive populations to the margins defined by that space. HS was calculated by estimating the native species' niche using a generalized linear model and then by predicting the model to invasive populations. The innerness was expected to be particularly informative in cases of low or null values of habitat suitability, i.e. when invading populations fall outside the native niche. Our results suggest that the innerness metric could be used to improve our ability to detect changes affecting species ecology.

Keywords: Niche margins, invaders species, innerness, Habitat Suitability Model

*Speaker

Investigating patterns of human-bonnet macaque interaction in an anthropogenic landscape

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In the current scenario of rapid transformation of natural habitat into anthropogenic landscapes, wildlife species are exhibiting behavioral adaptations towards human presence. Frequent interactions are observed as commensal non-human primates share habitat and resources with humans. We studied two free-ranging groups of bonnet macaques (*Macaca radiata*) in an ecotourism site in Thenmala, Southern India between June 2017 and January 2018, using all occurrence sampling method to test if the macaque's sex and age influenced the initiation (and the response) of interaction with adult humans. We then explored whether the macaque behavior initiated was dependent on their prior tendency to interact with humans regularly (residents) or not (tourists), and the sex of the human. Our results show that humans initiated most aggressive interactions, whereas macaques initiated neutral interactions. We found sex-related variation in the initiation of the interaction for macaques: females 'begged' and 'approached' tourists more than males, while males 'followed' tourists more than females. Additionally we tested macaques' response to aggressive behavior initiated by humans, and we found that most macaques displayed submissive behaviour. Aggressive behaviour was rare from the monkeys' side, whether it was when initiating an interaction or as a response. Our study identifies the factors bonnet macaques gauge before initiating interactions with a person, and helps understand the strategies that monkeys use to interact with humans. In the light of growing intolerance of humans towards bonnet macaques, our findings might help inform conflict-management decisions in order to design awareness programs.

Keywords: Interaction, Initiation, Aggressive, Neutral, Bonnet Macaque

*Speaker

Mate-Copying : mechanistic bases of a social learning in *Drosophila melanogaster*

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Mate-copying is a form of social learning in which the mate-choice decision of an individual (often a female) is influenced by the mate-choice of conspecifics. *Drosophila melanogaster* females are known to perform such social learning, and in particular, to mate-copy after a single observation of one conspecific female mating with a male of one phenotype, while the other male phenotype is rejected. Despite some promising studies, research about the mechanisms of social learning are still at the beginning. With its mini yet highly structured brain (100,000 cells), the fruit fly *Drosophila melanogaster* is one of the most favorable model species to dissect the neuronal processes of learning. It was established that the formation of visual associative memory requires dopamine, while serotonin is required for aversive place memory. I recently showed that dopamine and serotonin are required in this social learning, using a pharmacological approach. I also found that the dopaminergic receptor DAMB is required in long-term memory of mate-copying but not in short-term memory, like in olfactory associative learning. This gives a first insight into the mechanistic pathways underlying observational social learning in fruit flies, and could help building bridges between the mechanisms underlying different types of learning.

Keywords: social learning, memory, drosophila, mate, copying

*Speaker

Where the wind blows: constraints on feeding habitat selection in herring gulls (*Larus argentatus*)

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As global climate change continues to alter environmental factors, most research is focusing on temperature and rainfall in terrestrial ecosystems. However, in marine ecosystems, wind is a large factor that is shifting not only in direction but in strength. For flying animals like birds, changing wind patterns affect flight costs and therefore may play an important role in determining where they can forage efficiently. Intertidal zones are crucial feeding habitats for herring gulls (*Larus argentatus*), which prey upon bivalves and crustaceans. This project aims to investigate how selection of intertidal feeding habitats is related to wind conditions and what alternative feeding sites are used under wind conditions unfavourable for intertidal foraging. GPS tracking data and wind data are being used to conduct (i) first passage time analysis, (ii) habitat association, and (iii) wind influence. We expect first passage time analysis will conclude the gull's furthest distance to be their primary foraging habitat. Habitat association will determine that intertidal zones are most frequently foraged. When wind speed increases, foraging duration will be negatively correlated but flight speed will be positively correlated. The angle at which individuals depart and return to the colony will be altered to move with wind direction. Lastly, we predict that if intertidal foraging is not optimal, individuals will choose habitats that benefit their flight costs. This research will give greater understanding on the interplay between resource availability and environmental conditions which is particularly important in understanding how individuals and populations respond to environmental change.

Keywords: seabird, wind, foraging selection, spatial ecology, marine ecosystem, tracking data, climate change

*Speaker

Impact of trace metals on the diversity of microbiota in a city dweller host, the feral pigeon

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Urbanization is one of the most radical human-induced transformations of terrestrial landscapes. Consequences of urbanization has been described from habitat loss to changes of abiotic factors such as increasing temperatures and pollutions. Those factors can have an impact on the health of city-dwellers, ranging from host's parasite exposure to immune responses. One important aspect of individual health is the interactions between the host and its gut microbiome, an assembly of bacteria involved in host digestion, nutrient synthesis and protection against pathogens. A study on house sparrows showed that diversity of gut microbiota was lower in urban environments, suggesting that negative effects of urbanization extend to individuals microbiome. One form of pollution is by trace metals. Here, we present an ongoing experimental study where we exposed hosts to two metals, Lead and Zinc, to pinpoint what factor of urbanization impacts gut microbiota diversity. We used 69 feral pigeons (*Columba livia*), caught in a highly urbanized area (Paris), and maintained them in aviaries for 13 weeks outside of Paris (CEREP Ecotron). Birds were feed *ad libitum* and their water was implemented with no metals, Zinc, Lead, or Zind and Lead. If metal traces are a determinant factor of gut microbiota composition, we expect an increase in microbiota diversity of individuals with no exposure to trace metals compared to treated individuals. This work will help understand the consequences of trace metals exposure on city-dwellers, and more generally the selective pressure wild animals have to cope with urbanization.

Keywords: gut microbiota, urbanization, experimental study, trace metals, ecophysiology

*Speaker

Genetic consequences of habitat loss and fragmentation: a spatial perspective from large to small scale

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Past natural climate change has affected ecosystems worldwide, also by influencing connectivity among populations. More recently, anthropogenic activities have strongly intensified such changes, leading to habitat loss and fragmentation (HL&F) at a fast rate. There is a need for understanding the genetic consequences of HL&F, including the rate at which populations lose genetic diversity and accumulate differences when connectivity is limited. Most species worldwide have a geographically restricted dispersal, which genetically translates into a positive relationship between genetic and geographic distances, known as "isolation-by-distance". However, relatively few studies have assessed the consequences of HL&F in space and time, in part because a general population genetic theory of spatio-temporal processes is still missing. In the present study, we used a spatially explicit individual-based model to assess 1) the time required for detecting genetic differences in spatially structured populations after HL&F; and 2) the distribution of genetic diversity within habitat fragments. Moreover, we tested 3) whether a recently developed statistic (Pfeifer et al. 2017), which quantifies edge effects on the basis of habitat information, would be a good predictor of edge-determined changes in genetic diversity. Using spatial simulations, several landscape topologies and varying population sizes and migration rates, we found that this statistic can predict up to 90% of the genetic variability affected by edges. However, these results require still a thorough validation and application to real data.

Keywords: habitat loss and fragmentation, genetic diversity, spatial, temporal processes

*Speaker

Individual and demographic consequences of extreme climatic variations in a cosmopolitan bird

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Although empirical evidence of animal adaptation to varying climatic conditions is increasingly reported in the literature, the individual and demographic consequences of natal exposure to extreme climatic variations within a life-history context remains less well understood. While many longitudinal studies of short-lived, seasonally breeding species have provided excellent evidence for the selection and adaptation to local climatic variation, the geospatial and taxonomic breadth of these studies may limit our ability to predict how current climate variations affect avian life-histories in more mobile and widely distributed species. Here, we examine the delayed effects of extreme climatic variation experienced during the natal year, in the recruitment patterns of male and female Glossy Ibises (*Plegadis falcinellus*) from a long-term study population in the South of France. Preliminary analyses suggest that experiencing climatic extremes (at least in terms of temperature, wind and rainfall) during the natal year can negatively affect the probability and the age of recruitment as a breeding adult, years later in life. The extent to which changes in local environmental variability and incidences of extreme climatic events are likely to aggravate these types of delayed responses can have broad implications for the threats posed by a changing climate.

Keywords: climatic variation, life, histories, long, term effects, recruitment

*Speaker

An Examination Of Neighbourhood Effects Driven By Invasive Plant Species In New Zealand

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The impact of invasive plants on native plant species is an area of keen interest in invasion ecology. Neighbourhood effects between invasive and native species can be either beneficial or detrimental to plant fitness. Pollination is one type of community interaction often altered through neighbourhood effects. Bright, showy invasive flowers may act as pollinator ‘magnets’, attracting more pollinators to the area and thus benefiting natives, or invasive flowers may compete with natives for a limited pool of pollinators, thus disadvantaging the natives. Such interactions may be key in understanding the regeneration of native communities in areas where invasive species are present.

In New Zealand, a high proportion of native plant species have small, inconspicuous flowers adapted for pollination by generalist pollinators. In the dryland Mackenzie Basin of Central South Island of New Zealand are several rare species in the legume genus *Carmichaelia*. A common invasive species in the area is the large, brightly flowered legume *Lupinus polyphyllus*, planted along roadsides for its aesthetic value. While the lupins do not physically compete with *Carmichaelia*, their indirect influence on the seed set of these rare plants through pollinator competition is of interest to conservation practitioners.

My research aims to determine active pollinators in the region and demonstrate the way in which neighbourhood effects of large flowering invasive plants directly and indirectly impact natives with small, inconspicuous flowers.

Keywords: ecology, invasive, plants, New Zealand, neighbourhood effects, pollination

*Speaker

Learning from fights: consequences of agonistic encounters in male *Drosophila melanogaster*

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In many animal species, learning and memory have been found to play important roles in regulating intra- and interspecific behavioral interactions in varying environments. In such contexts, aggression is commonly used to obtain desired resources. Previous defeats or victories during aggressive interactions have been shown to influence the outcome of later contests, revealing loser and winner effects.

In this study, we asked whether short- and/or long-term behavioral consequences accompany victories and defeats in dyadic pairings between male *Drosophila melanogaster* and how long those effects remain. The results demonstrated that single fights induced important behavioral changes in both combatants and resulted in the formation of short-term loser and winner effects. These decayed over several hours, with the duration depending on the level of familiarity of the opponents. Repeated defeats induced a long-lasting loser effect that was dependent on de novo protein synthesis whereas repeated victories had no long-term behavioral consequences. This suggests that separate mechanisms govern the formation of loser and winner effects.

This study aims to lay a foundation for future investigations exploring the molecular mechanisms and neuronal circuitry that participate in the development of these social memories.

Keywords: aggression, behavior, learning and memory, *Drosophila melanogaster*

*Speaker

Phylogeny and population variability of Hoolock gibbons in India

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India has a considerable population of the Western Hoolock gibbon (*Hoolock hoolock*), and reports suggest, based on coat colour, a small population of Eastern hoolock gibbons (*H. leuconedys*) is in Roing, India; towards the eastern side of Chindwin river. We hypothesized that this can be a unique population or a sub – species of *H. hoolock*. We also hypothesized that hunting and fragmentation can create small pockets of isolated populations of *H. hoolock* in parts of Northeast India, where erstwhile they were continuous.

We gathered 10 fecal and blood samples from the aforementioned distribution of *H. leuconedys*, from Roing, Arunachal Pradesh and 29 samples from 6 disparate populations of *H. hoolock* in other states with different natural or anthropogenic barriers between them. DNA was extracted, and mitochondrial and nuclear markers like D-loop and ND5, sequenced. To ascertain the place of the *H. leuconedys* found in India, SNPs were used for ML and Bayesian trees reconstruction. Whole mitochondrial sequencing was also done using blood samples and compared with NCBI referenced genomes. To address population level variation in India, we measured haplotype (h) and nucleotide diversity (π) and genotyped the individuals through microsatellite markers. This has thrown light on heterozygosity and inbreeding pressure within populations.

Preliminary results provide a clearer picture about the position of Hoolock gibbons in the phylogeny of hylobatids as a whole. Further our results suggest that this is a population of *H. hoolock*, can be considered as evolutionary conservation units and be given a separate conservation plan.

Keywords: Hoolock gibbon, phylogeny, population genetics, India, fragmentation

*Speaker

An investigation of the relationship between cognition and social behaviour in wild great tits (*Parus major*)

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There is considerable evidence for a relationship between sociality and cognition, across taxa. However, most of the data supporting this evidence comes from comparing cognitive performance in species of differing social systems. The aim of this study was to examine the relationship between cognition and sociality at an individual level. Using automatic feeders equipped with PIT tag readers, we assessed great tits' (*Parus major*) performance on a spatial learning task in the wild, and collected data on individual's social network. We found little evidence that undirected social network metrics affect individual's learning speed or participation. However, we did find that scrounging positively predicted whether an individual would learn, the individual's initial learning speed, as well as its reversal learning speed. Hence it seems that in this population of great tits, an individual's position in a social network was not a good predictor of that individual's learning performance. However, the presence of conspecifics, which would allow for scrounging opportunities, facilitated learning.

Keywords: cognition, social network, great tits

*Speaker

Predation and disruption of the egg-laying behaviour of the pest fly *Drosophila suzukii* by local macroinvertebrates

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Drosophila suzukii, the spotted wing drosophila, is an exotic pest of fruit crops which causes important damages especially to small soft fruits such as cherries, strawberries and raspberries. While intensively studied, no satisfactory mean of controlling its populations has emerged, which enlightens the need to find efficient and ecological methods of pest management. *D. suzukii* interactions with local fauna remain poorly studied, as well as the possibilities of biological control by using local predators. We compared the efficiency of 17 local macroinvertebrates at disrupting *D. suzukii* egg-laying behaviour and at preying upon it. We showed that some macroinvertebrate predatory species, mostly spiders and centipedes, were efficient at killing the flies before they could lay eggs. Besides, other species, such as ground-beetles or woodlice, led to a reduction of the egg-laying behaviour despite a relatively low predation rate. Additional behavioural experiments were carried out on the latter species to know if their sole presence could induce a decrease in egg laying by *D. suzukii*. To achieve this, a choice test was proposed to the flies which had the possibility to lay eggs either near or far from a caged invertebrate. One of the ground beetle species had a repellent effect on the flies which laid less eggs on the substrate near it. These results provide novel information about the interactions of *D. suzukii* with local invertebrate fauna and thus are a first step in the targeting of local fauna species that could be used in the biological control of this pest.

Keywords: spotted wing drosophila, integrated pest control, biological invasions, egg, laying behaviour, macroinvertebrates

*Speaker

From kitten to tiger: inferring ontogenic trophic behavior of the giant catfish (*Silurus glanis*) in a large French lake

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The giant catfish (*Silurus glanis*) is a recent invader in large Alpine lakes. Reliable assessment of its trophic interactions with native species is currently lacking that limits the ability to forecast its possible ecological impacts and implement adaptive management. We recently developed an empirical Niche Model that allows estimating consumer's feeding range and inferring their related preys in a large Alpine lake (Lake Bourget, France). This model was used to infer an array of prey characteristics (e.g. prey richness and size diversity, diet proportions of invertebrate and fish) for giant catfish sizes ranging from 0.1 m to 2 m. Our results suggest that giant catfish would experience a major diet change at size of \sim 0.6-0.7 m, shifting from invertebrate-based to fish-based diet. Prey richness and prey size diversity also drastically decreased for giant catfish larger than this size. A special focus on lake salmonids suggested that due to their relatively large mean adult sizes, those would be mostly vulnerable to large giant catfish (i.e. larger than 1.4 m) that remain currently rare in the lake, due to their recent arrival (i.e. mean giant catfish sizes harvested by fishermen \sim 0.8-1 m). Nonetheless, the threat of giant catfish on lake salmonids could increase in the future, as long as mean individual giant catfish sizes will increase. These results should be confirmed by traditional stomach content analyses yet highlight the powerful ecological insights that can be obtained by combining theoretical and empirical approaches.

Keywords: giant catfis, trophic behaviour, ontogeny, Alpine lakes

*Speaker