

behavioural
ecology

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BOOK OF ABSTRACTS

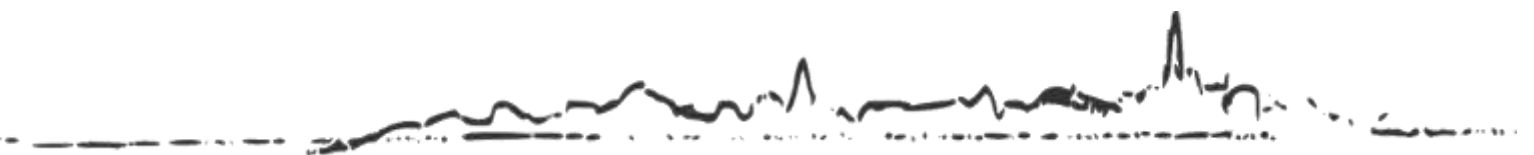


*In memory of
Matteo Griggio*

The organizing committee:

Alessandro Devigili, Alessandro Grapputo, Andrea Pilastro, Beniamino
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*All graphics present in this booklet
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Matteo Griggio, 2001

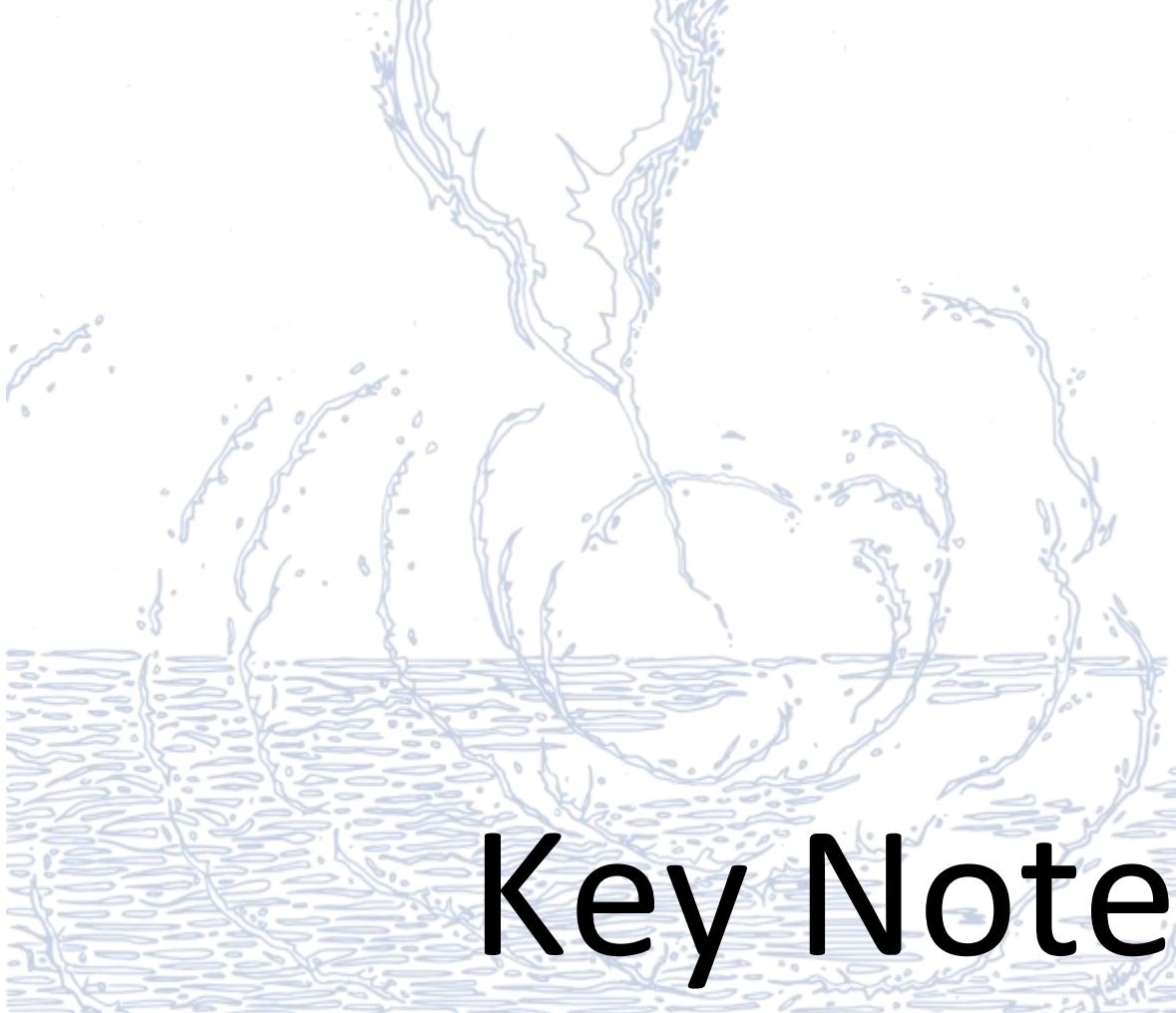
Evolutionary ecology of Ageing: how demographic and ecological constraints condition lifehistory trait evolution

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Killifishes have emerged over the past few years as a powerful model system to answer open questions in biology of aging, developmental and evolutionary biology. Killifish evolved in a range of environments, from rainforest to savannah water holes that desiccate seasonally. Annual killifish survive periodic desiccation by evolving an annual life cycle, characterized by a specialized embryonic adaptation (embryonic diapause), where embryos suspend development in the dry mud until the external conditions are safe for them to hatch. Annual killifish that evolved in dry environments often display short natural lifespan and a wide range of age-related changes, including neurodegeneration, inflammation, fibrosis, immune decline and dysbiosis. In my talk, I will share how studying killifish ecology and evolution has opened new perspectives to understanding that species' lifespan and aging evolve as a function of past demographic constraints. We further generalize our findings using a numerical model and show that limited population size, combined with contingent ecological constraints (e.g. non overlapping generations and intermittent water availability) conditions phenotype evolution.



Talks



Mate choice after spawning, mating, and pollination

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To procure a comprehensive view of reproduction, we are required to study processes happening at the microscopic scale of pollen grains, spermatozoa, and ova, namely gametic interactions. These interactions can both expand the scope of sexual selection and serve as reproductive barriers between species. In situations where a female is simultaneously pollinated by or mated with both a conspecific male and a heterospecific male, analogous process to male-male competition and female choice can favour the fertilisation of the ova by gametes from the conspecific male. This phenomenon is known as conspecific gamete precedence (CGP) and has been documented in multiple plants and animals. I will 1) offer a historical perspective of the study of CGP, 2) catalogue the occurrence and mechanisms of CGP in marine invertebrates, fishes, insects, mammals, fungi, and plants, and 3) share the latest findings of the evolution of CGP in the Australian wildflower *Senecio latus*.

Early coordination of care predicts cooperative parental strategies

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Family life is one of the most common forms of social behavior, yet we are still far from a complete understanding of the selection pressures shaping parental care. In particular, little is known about how parents cooperate to raise offspring despite an evolutionary conflict of interests ('sexual conflict') between them. Recent theory suggest that coordination of care can alleviate the cost of sexual conflict and promote cooperation between parents. In a previous study on rock sparrows (*Petronia petronia*) we found that the degree of coordination of parental visits at the nest during the early chick provisioning period was positively associated with parental strategies (biparental vs uniparental care). In this study, we use individual based models to explore the causal link between coordination of care and the resulting evolutionary strategy of care. We found that coordination models predict two distinct evolutionary outcomes, biparental and uniparental care, depending on the initial level of coordination between the parents. These theoretical results thus support empirical findings and shed lights on the evolution of parental care strategies.

Male aggressiveness during the female fertile phase in relation to extra-pair paternity, plumage ornaments and female traits

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In many bird species, physical aggression between males become more frequent during the female's fertile period, as female encounters with extra-pair males are more frequent and can entail paternity losses. Male aggressiveness during this stage has been proposed as crucial for ensuring male reproductive success. Thus, plumage ornaments could represent honest signals of individual quality that could reflect the aggressiveness of paired territorial males. Furthermore, male aggressiveness could be related to mate quality or defensive capacity. We quantified extra-pair paternity in the broods and investigated the association of male and female traits with the aggressive behaviour of territorial paired males in a Spanish population of Pied Flycatchers (*Ficedula hypoleuca*), where territorial intrusions were simulated during the female fertile period by placing a taxidermic male mount close to the nest. We predicted that (1) more aggressive males should better protect their mates from intruding males and thereby reduce their paternity losses, (2) males with larger white patches and higher UV reflectance of wing patches should respond more strongly to intrusions, and (3) that males should be more aggressive when mated with higher quality females. We found evidence that males that responded less intensely to a territorial intrusion suffered a higher paternity loss, which offers strong support to the basic tenet of the theory of territoriality as paternity defence. Moreover, both the level of male aggressiveness and control of the territory increased with male UV reflectance of wing patches. Finally, we found, contrary to our prediction, that males were less aggressive when mated with more ornamented females.

Does directional trail-following of spider trails depend on female body condition?

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Mate search is challenging and often involves both advertisement and mate choice from the sexes. Trails represent a particularly potent, target-oriented means for both finding and assessing mates: trail-following greatly increases encounter rates in comparison to random search and the trail-depositing animal often adds information on e.g. their body condition or mating state allowing for mate choice. Upon encountering a trail, individuals have to choose a direction in which to proceed, potentially halving the chances of finding a mate. Embedding directionality information in a trail, allows individuals to orientate themselves on it. Yet, the mechanisms of embedding such directionality information remain poorly understood. Many spiders release silk lines during locomotion (draglines) and many female spiders add information on their body condition, allowing males to exert mate choice before encountering the female. In the spider *Pisaura mirabilis*, males display a tendency to follow trails in the direction they were deposited by a female of high body mass. Additionally, males preferentially choose trails of females in high body condition (i.e. high-mass) over low body condition (i.e. low-mass) when given the choice

between them. We tested for condition-dependent directionality information in trails of the spider *P. mirabilis* by exposing males to unidirectionally deposited trails of females in high and low body condition and scoring the direction of the subsequent trail-following. Results will deepen our understanding of male mate choice strategies in a system characterized by costly mating via nuptial food gifts.

Talk

The effect of Geomagnetic Field on the foraging activity and orientation black garden ants

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The geomagnetic field (GMF) can affect a wide range of animal behaviors in various habitats, primarily providing orientation cues for homing or migratory events. Patterns of foraging activities, such as those implemented by *Lasius niger* (black garden ant), are excellent models to delve into the effects of GMF on orientation abilities. In this work, we assessed the role of GMF by comparing the *L. niger* foraging and orientation performance, brain biogenic amines (BAs) contents, and the expression of genes related to the magnetosensory complex and reactive oxygen species (ROS) of workers exposed to near null magnetic fields (NNMF, ~40 nT) and GMF (~43 μ T). NNMF affected workers' orientation by increasing the time needed to find the food source and return to the nest. Moreover, under NNMF condition, a general drop in BAs, but not melatonin, suggested that the lower foraging performance might be correlated to a decrease in locomotory and chemical perception abilities, potentially driven by dopaminergic and serotonergic regulations, respectively. The variation in the regulation of genes related to the magnetosensory complex in NNMF shed light on the mechanism of GMF perception in ants. Overall, our work provides evidence that the GMF, along with chemical and visual cues, is necessary for *L. niger* orientation process.

Talk

The origins of acoustic variation in the songs of Neotropical singing mice

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Advertisement vocalizations can attract mates, deter rivals, and drive reproductive isolation. Because adaptation relies on heritable variation, examining the heritability of acoustic variation is critical to understanding the evolution of vocalizations and the species that make them. Here, we investigate the processes underlying acoustic variation in the songs of Alston's singing mouse (*Scotinomys teguina*), a small and diurnal species living in Neotropical cloud forests. Unlike their distant and close relatives, which produce short and ultrasonic (>20 kHz) vocalizations, singing mice produce long and human-audible vocalizations. We used a combination of breeding studies and genomics-based methods to test for heritable variation in song structure among these mice both in the lab and field. We first took advantage of geographic variation in song to experimentally examine whether heritable variation contributes to intraspecific differences in song. We caught animals from Costa Rica and Panama, populations that

naturally differ in song length, then reared animals from these sites in captivity, recording songs from ensuing offspring. Population differences in song elaboration were maintained in lab-reared animals, suggesting a heritable basis to population differences. We then estimated the heritability of song within a Costa Rican population. We recorded songs and sampled genome-wide SNPs from wild-caught mice, then fitted generalized linear mixed models to calculate heritability of song. We found that energetic aspects of song (e.g., length, trill rate) had low h^2 while spectral characteristics (e.g., dominant frequency, bandwidth) had high h^2 . Finally, we conducted a biogeographical study to examine the evolutionary processes underlying phenotypic divergence between populations, finding evidence that different dimensions of acoustic variation may evolve under different processes. Together, our results enrich our understanding of the evolution of an elaborate acoustic signal.

Talk

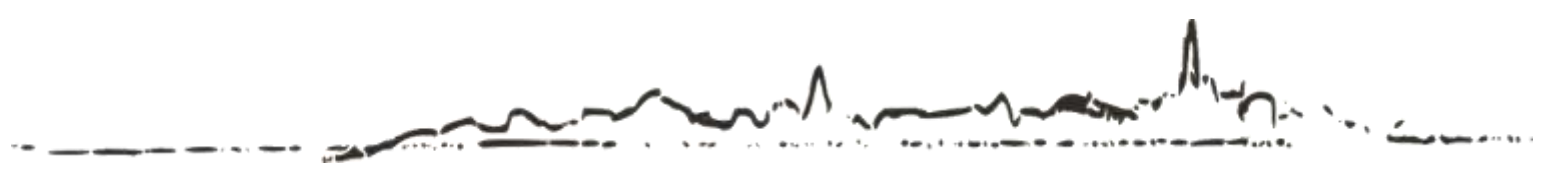
The dawn of social bonds: friendship in domestic dogs

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Social animals live in groups and interact with each other, creating social bonds. Social bonds with conspecifics bring many advantages, also in terms of direct fitness. A characteristic of social bonds is that they need time to develop. Several studies on human species emphasized the fact that not only time per se, but how it is spent, can affect the strength of social bonds. Thus, which is the role of shared experiences? In humans, sharing not only positive experiences (e.g. singing, dancing or laughing together) but also negative experiences (e.g. the strong bonds developed by soldiers during warfare) are known to affect the strength of social bonds (or friendship). A similar trend can be spotted in non-human species. For example, a recent experiment showed that if chimpanzees watched a video together, they spent more time in proximity compared with conspecifics with whom, although in proximity, they did not actively watch a video together. This trend is not limited to primates. Another experiment on guppies, a fish species, showed that individuals who experienced together a high predation risk showed preference for each other compared with those who did not. Using domestic dogs ($N=12$) as study species, I explored the role that shared experiences and activity synchronization may have on dog's social bonds. Since July 2022 I collected data on 32 dyads, for a total of about 125 hours of observations. I used pack membership (i.e., ownership to the same person) and the frequency of joint attention (i.e. same glance direction) as a proxy for "shared experiences" (passive shared experiences, in case of joint attention). Then, I tested dog's social preferences, and analyzed whether the preference towards one individual over another was affected by pack membership (shared experiences, H1) and by the frequency of joint attention (passive shared experience, H2). As activity synchronization is linked to the strength of social bonds in several species, I verified whether it applied also in dogs, testing whether dog's social preferences was affected by the level of activity synchronization (H3). A future step will be to present positive (e.g. hiking together), negative (e.g. unpleasant food) or neutral (i.e. time spent together) shared experiences to each dyad and verify whether repeated shared experience could modify dog's social preferences.



Multilevel social structure predicts individual helping responses to conspecifics distress calls in a cooperatively breeding songbird

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Multilevel societies are formed when stable groups of individuals spatially overlap and associate preferentially with other groups, producing a hierarchical social structure. Once thought to be exclusive to humans and large mammals, these complex societies have recently been described in birds. However, it remains largely unclear what benefits individuals gain by forming multilevel societies. One hypothesis—based on food sharing in hunter-gatherers—is that multilevel societies facilitate access to a range of cooperative relationships, with individual investment varying across the hierarchical levels of the society. We tested experimentally if such graded cooperation occurs in the multilevel society of a songbird, the superb fairy-wren (*Malurus cyaneus*). Specifically, we measured whether responses to playbacks of distress calls—used to recruit help when in extreme danger—varied according to the social level at which the focal individual is connected with the caller. We predicted that anti-predator responses should be highest within breeding groups (the core social unit), intermediate between groups from the same community, and lowest across groups from different communities. Our results confirm that birds exhibit the predicted hierarchical pattern of helping, and that, within breeding groups, this pattern was independent of kinship. This pattern of graded helping responses supports the hypothesis that multilevel social structures can sustain stratified cooperative relationships, and reveals similarity in cooperation in qualitatively different behaviours—anti-predator behaviour and food sharing—in the multilevel societies of songbirds and humans.

Host nest abundance and common cuckoo courtship, a potential visual signal to females

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In the sexual selection framework, nuptial gifts are defined as materials functional to improve the donor's fitness by increasing its chances of being selected for reproduction by the receiver. In specific cases, sharing crucial information may be an immaterial nuptial gift. To investigate this hypothesis, we focused on the common cuckoo (*Cuculus canorus*), an avian brood parasite whose female reproduction costs are mainly related to finding host nests to parasitize. To date, nest searching is assumed to be a task conducted by females only. We hypothesized a contribution by males who would transfer information on nest locations to females. Within a broader investigation aimed to verify the presence of a signal involved in sexual selection dynamics, here, we show the results of a first step in this direction, thus, whether cuckoo males' behaviour varies with the abundance of host nests. This study occurred in May-June 2022 in marshland areas in the Valli di Mortizzuolo (Mirandola, MO). We conducted behavioural observations of cuckoos at perching sites using camera traps and searched surrounding reed beds looking

for reed warbler (*Acrocephalus scirpaceus*) and great reed warbler (*Acrocephalus arundinaceus*) nests, common host species. We applied a series of GLMMs to link behavioural frequencies to the abundance or availability of host nests in subareas of our study site, focusing on potential visual displays. Cuckoo abundance at perches increased with the surrounding nest density, although we could not find any significant correlation. A peculiar cuckoo posture, the lax posture (keeping wings relaxed, with wingtips pointing down), was more common in males in the presence of both other potential male competitors and high host nest densities. Furthermore, the tail-swinging frequency increased with nest density and with the increase of parasitizable nests. In other words, these results are consistent with these behaviours as potential signals codifying information on the nest abundance or availability. Further studies are needed to understand whether these displays affect female choices, which may, in turn, play a role in sexual selection dynamics.

Talk

Spatial perception and memory without a hippocampus: GPS Deconstruction of the flight paths of hippocampal-lesioned homing pigeons near home

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Relying on detailed analyses of GPS-recorded tracks, we have been able to offer detailed and unprecedented insight into the impact of hippocampal (HF) lesion on spatial memory and possibly perception. We do so in the context of homing pigeon navigation when reliant on familiar landscape features near the home loft following repeated exposure from the same release sites. As we have reported previously, HF lesioned homing pigeons fly less direct paths home once near the loft. We now further show that although HF-lesioned pigeons modestly improve their navigational performance with repeated training, HF-lesioned pigeons 1) never reach the level of path efficiency within the home area displayed by control pigeons, 2) are persistently less likely than intact pigeons to display fidelity to a particular path home even after multiple homing flights, 3) intact pigeons are more likely to exploit leading-line landscape features, e.g., a road or the border of a woodlot, in developing flight-path fidelity and 4) even when flying a generally straight path HF-lesioned homing pigeons are more likely to display relatively rapid, oscillatory heading changes as if casting about for sensory, presumably visual information. Taken together, the GPS-track data offer a detailed characterization of the effects of HF lesion on landscape/landmark-based, homing pigeon navigation, offering new insight into the role of the hippocampal formation in supporting memory-related, e.g., fidelity to a familiar route home, and perhaps perceptual-related, e.g., oscillating headings, navigational processes.

Cognitive abilities of migrating European eels

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European eels (*Anguilla anguilla*) are catadromous fish that undergo an astonishing 1-year migration at the larval stage, from the Sargasso Sea to the European coasts, followed by an upstream migration in the freshwater environment. Evidence suggests that eels exploit 'simple' sensory mechanisms such as rheotaxis and salinity preference to migrate during their oceanic phase. Yet, to deal with the freshwater environment, they might arguably require a much more complex behavioural repertoire. To explore this possibility, we analysed the cognitive abilities of glass eels at the beginning of their freshwater journey. We collected migrating eels in the estuary of the river Po in Italy and we assessed their spatial learning, problem solving, and quantity discrimination abilities. In the spatial learning task, eels learned the route of a T-maze spatial task relatively quickly, although not at the level of the other teleosts previously subjected to the same task. When presented with a motor problem solving task (i.e., removing an obstacle to reach a prey), eels showed an excellent performance, much greater to that observed in other teleost species. Last, when presented with the choice between two different-sized prey, eels selected the larger prey, suggesting efficient quantity discrimination abilities. Interestingly, we observed a certain degree of interindividual variation in performance in the problem solving and in the spatial learning tasks. A correlation analysis indicated that individuals' performance in these two tasks covaried positively, which might be due to the presence of a cognitive syndrome. Overall, our findings suggest that glass eels are 'cognitively ready' for the demands of freshwater habitats as soon as they entered them. Moreover, eels display cognitive variability that is likely relevant for individuals' fitness and the conservation of the species.

Individual variation in an ectoparasite-host system: life history, fitness and evolutionary potential

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Tick-host systems are characterized by dynamic interactions that facilitate reciprocal adaptations and counter-adaptations affecting the life history, ecology and ultimately the evolution of both the host and parasite. To comprehend these systems it is thus essential to estimate the intraspecific trait variation and evolutionary potential, the genetic and phenotypic covariance between traits across life stages, and the effects that individual host characteristics have on ticks (host quality). Nevertheless, parasites have mainly been studied as agents of selection and pathogen vectors rather than as evolving species in their own right. Moreover, host-mediated effects on parasite traits and performance have mostly been neglected. To shed light on parasite individual variation and evolutionary potential we collected a wild

CORALIA CLAUDIO'S HOUSE

- MANY SWALLOWS
- MANY PRINCE SPEIROPS (ENDEMIC PRINITE)
(Peito-branca, Zosterops leucophaea)



population of a hematophagous ectoparasite, the tree-hole tick *Ixodes arboricola*, and raised two consecutive generations in semi-natural conditions. Ticks were individually marked and fed on wild great tits *Parus major*. Relatedness between individuals was known for both ticks and great tits. For larval, nymphal, and adult stages we measured on-host and off-host performance (attachment, feeding, moulting, survival, and hatching success) as well as life-history traits (feeding time, engorgement weight, moulting time, and clutch size) at the individual level. Furthermore, we investigated individual variation and heritability of host quality through variation in tick performance and life-history traits. Heritability estimates of tick life-history traits were generally higher in nymphs than in larvae and estimates for engorgement weight and moulting time were consistently higher than those for feeding time. Higher engorgement weights were correlated with shorter moulting and feeding times in larvae and nymphs but not in engorged females. As regards host quality, our findings suggests consistent among-host variation for attachment success. We also found a strong heritable signal for host quality as measured through tick feeding time, and lower but substantial estimates for other performance variables. Feeding success and survival of larvae was lower on female birds, and nymphal survival was higher on older birds. We discuss the implications of our results for tick evolutionary ecology, co-evolutionary dynamics, acaricide resistance, and disease spread.

An integrated approach to evaluate the effects of environmental contaminants on great tit population from Veneto Region areas

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The aim of this study was to evaluate anthropogenic contaminants' effects on great tit (*Parus major*), a ubiquitous species that can provide accurate information about a specific area, due to its territoriality. An integrated and non-destructive approach that combines biochemical and cellular responses, behavioural traits, reproductive success data and chemical analysis was applied. From an initial idea of Prof. Matteo Griggio, in the Veneto region several nest boxes for great tit are located in areas with different anthropogenic impact (agricultural, urban and wooded). Blood and excreta were collected from each animal to test different toxicological responses. Oxidative stress (TAS assay and respiratory burst) genotoxicity (ENA and comet assay), immunotoxicity (complement system and differential WBCs count) and neurotoxicity (esterases inhibition) effects were evaluated in great tit' nestlings sampled in the different areas. At higher biological levels, behavioural traits, reactivity performances and reproductive success were also evaluated. Feathers and eggs were used to assess respectively heavy metals and per- and polyfluoroalkyl substances (PFAS) levels. The results showed a strong increase of the total antioxidant status in nestlings from agricultural areas and DNA damage in specimens from agricultural and urban areas. The developed protocol was proved to be a useful tool for monitoring bird species. This integrated approach is fundamental to obtain a complete picture of the ecotoxicological health status of avian species, therefore the interlinkages between responses at different biological levels will be evaluated.

Let's get physical: frequency-dependent viscosity of salmon ovarian fluid has biophysical implications for sperm-egg interactions

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Gamete-level sexual selection of externally fertilising species is usually achieved by modifying sperm behaviour with mechanisms thought to alter the chemical environment in which gametes perform. In fish this can be accomplished through the ovarian fluid, a substance released with the eggs at spawning. While its biochemical effects in relation to sperm energetics have been investigated, the influence of the physical environment in which sperm compete remains poorly explored. Our objective was therefore to gain insights on the physical structure of this fluid and potential impacts on reproduction. Using soft-matter physics approaches of steady-state and oscillatory viscosity measurements, we subjected salmon ovarian fluids to variable shear stresses and frequencies resembling those exerted by sperm swimming through the fluid near eggs. We show that this fluid, which in its relaxed state is a gel-like substance, displays a non-Newtonian viscoelastic and shear-thinning profile, where the viscosity decreases with

increasing shear rates. We concurrently find that this fluid obeys the Cox-Merz rule below 7.6 Hz and infringes it above, thus indicating a shear-thickening phase where viscosity increases provided it is probed gently enough. This suggests the presence of a unique frequency-dependant structural network with relevant implications on sexual selection and fertilisation dynamics.

Talk

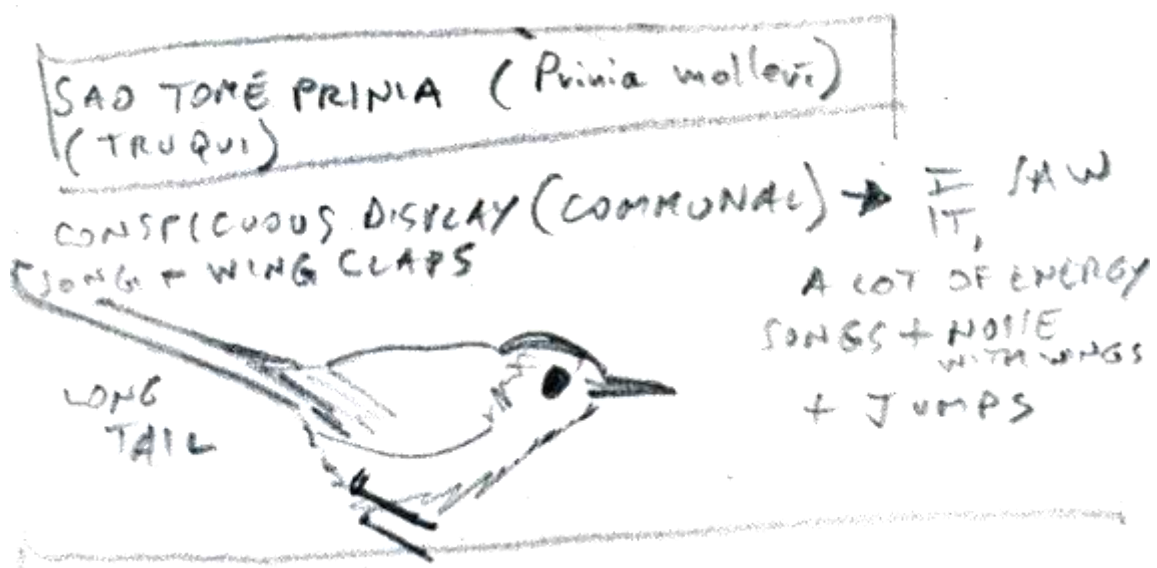
Early-life environment affects growth and development of ecologically-relevant behaviors in juvenile European lobsters (*Homarus gammarus*)

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The ability of individuals to switch between alternative behaviors is considered a key feature to a successful adaptation to changing environments, with important ecological and evolutionary implications. Behavioral plasticity may itself be developmentally plastic: individual differences in a type of plasticity that is expressed at a given age may be affected by environmental conditions experienced at earlier stages in life. However, for animals held under captive conditions, the frequent absence of important environmental stimuli tends to reduce plasticity, leading to deficient coping mechanisms and the development of maladaptive behaviours. From a conservation perspective, it is therefore crucial to identify environmental stimuli triggering plasticity, on which temporal scale they operate and what responses ecologically relevant into the wild they elicit. Here we focus on the European lobster (*Homarus gammarus*), an economically and ecologically important decapod species that has been subjected to conservation aquaculture programs for decades. We investigated to what extent different rearing conditions might affect growth and the development of competent behavioural repertoires of juvenile lobsters during their early benthic stages. Individual lobsters were tested for the effect on growth and behavioral development of alternative rearing conditions in terms of substrate, shelter, predator cues, and size of the rearing compartments. We found that juveniles reared under poorly enriched conditions showed reduced growth and impaired exploratory, sheltering and space-use behaviours. Our results offer sound evidence that sensory, structural or spatial stimuli in the rearing environment can dramatically affect growth and, interestingly, development of ecologically-relevant behaviors, with significant implications for conservation aquaculture programs.



Smarts in the city: innovation in rural and urban small mammals

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The expansion of human-altered environments presents wildlife with multiple novel situations in which the ability to produce innovative behaviour could be beneficial. Innovativeness is generally considered crucial for survival, particularly in novel, complex, and dynamic environments. In fact, species that do not display high innovation propensity might be forced out of anthropogenic environments. However, current research is heavily biased towards species with high dispersal abilities, namely birds and larger mammals. The potential role of innovation in coping with anthropogenic environments in animals that cannot easily elude anthropogenic disturbances remains relatively uninvestigated. Additionally, different behavioural innovations may not be functionally equivalent. Here, we focused on ground-dwelling rodents, which are often found in urban areas, partly as synanthropic. Using standardized tests in the field, we compared behavioural innovations of several urban and rural populations of free-living small mammals in a battery of repeated tests, including four foraging extraction tasks, an escape test, and dietary innovation assessments. We investigated the consistency of the innovative performance within and across tests. In addition, we tested the link between innovativeness and personality traits exploration and boldness. Results support the hypothesis that living in human-altered environments favours increased innovativeness, and that personality mediates innovative performance. Among-individual variation in innovativeness might thus play a key role in individuals' successful coping with the rapid and recent expansion of human-altered environments.

Talk

Telomere dynamics and lifetime fitness in a migratory passerine bird

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Telomeres are nucleoprotein complexes located at the ends of eukaryotic chromosomes which ensure stability to the entire genome. Due to the inability of DNA polymerase to fully replicate linear DNA, they shorten at each cell division. In addition, this shortening is enhanced by detrimental environmental conditions and/or high metabolic activities through an increase of oxidative stress. When telomeres reach a threshold length, they lose their functionality causing either cell senescence or apoptosis, with negative consequences for organismal functions and performances. Therefore, an age-related decrease in telomere length is expected, as it has already shown in several vertebrates, but an increase in telomeres length with age has been also seldom documented. However, most studies have been conducted in laboratory conditions, and those realized on natural populations are few, based on small samples and provide contrasting results. This study relied on a large dataset, resulting from a multi-year data collection, which include information of the entire life of free-living adult barn swallows (*Hirundo rustica*) under natural and sexual selection regimes. Relative telomere length (RTL) has been estimated following a well-established protocol which involves DNA extraction from red blood cells and subsequent qPCR. Firstly, the study aimed at evaluating the telomere dynamics over the entire life of these birds. Another purpose was to investigate how telomere dynamics are related to individual lifetime fitness (i.e. reproductive success and individual survival/longevity). Furthermore, the study tested the relation between telomere dynamics and the expression of secondary sexual traits under directional selection in

the study population (outermost tail feathers) to better understand the potential role of telomeres in sexual selection processes. Finally, we also evaluated some possible environmental effects on RTL and its inter-annual, inter-individual and inter-colony variation. These invaluable data gave us the extraordinary opportunity to test the eco-evolutionary role of telomeres in natural populations.

Talk

Female reproductive fluid and male seminal fluid: the non-gametic conflict for post-mating control

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Growing evidence shows that non-gametic components released by both males and females can play a major role in influencing sperm competition outcomes. Seminal fluid was shown to influence paternity success by affecting rival males' sperm performance, and in some species with male alternative reproductive tactics was reported to selectively decrease the fertilization success of males of the opposite tactic. Female reproductive fluid has been proven to differentially influence ejaculates of different males and bias fertilization towards specific partners. Whether, and with what outcome, these two processes can interact with each other to influence sperm competition is still unknown. In the study I will present we explored this scenario in the grass goby (*Zosterisessor ophiocephalus*), a fish with territorial-sneaker reproductive tactics, where sneaker males can exploit the territorials' seminal fluid while penalizing territorial sperm performance with their own fluid. To test whether female reproductive fluid can rebalance the ejaculate competition in favour of territorial males, we used in vitro fertilization with a seminal fluid mixture (territorial + sneaker), using increasing concentrations of female reproductive fluid, to simulate the natural conditions that ejaculates encounter towards the eggs. Our findings revealed a differential effect of female reproductive fluid, mediated by the interaction with seminal fluid, on the fertilization success of the different tactics, reinforcing the pre-mating preference of grass goby females for territorial males. Such a process seems to allow females to discriminate among ejaculates of the different male phenotypes and control the sperm competition outcome, attenuating the detrimental effect of sneaker seminal fluid on territorials' sperm performance.

Do individual differences in body size drive variation in aggressiveness in field crickets?

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Competitive interactions among members of the same species can have major effects on the reproductive success and survival of organisms. Interacting competitors often engage in costly fights to gain access to limited territories, food resources, and sexual partners. Within a population, individual decisions to engage and escalate in fights are crucial in explaining variation in competitive success and, thus, the extent to which competitive interactions affect reproduction and survival. There is, however, limited understanding of the mechanisms maintaining behavioural variation in competitive interactions at both the within- and between-individual levels. An important trait that might contribute to maintaining variation in competitive behaviour is body size. This is because body size is a key determinant of the fight outcome and individual competitors should decide whether to fight based on the difference between their own body size relative to that of their opponents. Here, we used the southern field cricket *Gryllus bimaculatus* to test how variation in body size in competing males affects both their average aggressiveness towards opponents and level of social plasticity in response to variation in the phenotype of opponents. We found that males reduced their own aggressiveness in response to increasing opponent's aggressiveness, which was partly explained by body size variation. Although individual males differed in both average aggressiveness and level of the plastic response, our results indicate that body size only explains a small proportion of the variation in the average and plasticity. Overall our findings suggest that body size might not be the main mechanism maintaining behavioural variation within and between individual competitors.

Talk

In the “nose of the beholder”: Major histocompatibility complex and mate choice in the zebrafish, *Danio rerio*

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Research on mate choice has mainly focused on the role of morphological traits, but other sensory modes may play an important role. Since olfactory cues are likely related to compatibility among the partner at major histocompatibility complex (MHC), they could strongly affect female mate choice in a macrosmatic species such as the zebrafish (*Danio rerio*). To investigate this aspect, we used a recently developed experimental set-up that allows the separate manipulation of olfactory and visual information. We assessed the role of visual and olfactory cues on precopulatory mating preference and, subsequently, we investigated the genetic similarity of the tested fish to understand the contribution of the compatibility at MHC loci during mate choice. To do so, we presented the same two males to the same female in two consecutive days, but in one day the female could rely only on vision to choose between males whereas in the other day also olfactory cues were provided. Once completed the trials, both females and males were genotyped to determine their MHC similarity. Our results revealed that olfactory cues changed not only the strength but also the direction of mate choice in the zebrafish. Moreover, when olfactory cues were provided, females preferred males with a higher number of MHC unshared alleles and also males that were more genetically different at those loci. No preference for a higher MHC compatibility was

instead found when females could rely only on visual cues to choose between males. Thus, olfactory cues convey information about MHC compatibility that influences social and reproductive behaviors in the zebrafish with females willing to maximize the resistance of offspring towards potential infections. Indeed, the MHC is a multigene family important in controlling the vertebrate immune system by presentation of self and foreign peptides to T cells.

Talk

Can stripes dazzle? The hunting display of the broadclub cuttlefish

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High contrast stripes are renowned for generating motion illusions in humans by altering the estimation of trajectory and speed of targets (Stevens and Merilaita, 2009, Merilaita et al., 2017, How and Zanker, 2014). Striped patterns are also widespread in nature, from insects to mammals. Yet, there is still little experimental evidence about whether, and how, animals evolved such patterns to dazzle, jam, or disrupt target visual systems. We research the use of motion dazzle in nature by investigating the effects of high contrast stripes in a real biological predator-prey interaction, the broadclub cuttlefish hunting crabs. This cuttlefish has a unique hunting technique. After spotting a potential prey, the cuttlefish changes the appearance of the skin on its forward-facing head to a homogenous white colour, stretches six of its arms forward into a tight cone, and the remaining two out sideways with their broad flat surface pointing forward. Then, it passes contrasting dark stripes in a downward direction across the head and arms until it strikes its prey (How et al., 2017). By tethering shore crabs over a Styrofoam treadmill in front of an LCD monitor (Smithers et al., 2019), we showed that an expanding predator stimulus with moving stripes - representing the approaching cuttlefish - is less likely to elicit a response in prey crabs than control stimuli with stationary stripes or with no stripes. Furthermore, crabs raised their claws for a longer time when exposed to control stimuli, showing that moving stripes seem to also affect prey post detection defensive behaviour. To start to investigate the underlying mechanism responsible for these effects, we implemented motion detection algorithms that suggest that crab responses may be altered by an overlaid downward motion cue very different from that expected by an approaching predator.

Social interactions generate complex selection patterns in virtual ecosystems

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Through social interactions, individuals affect each other's fitness. A key challenge in ecology and evolution is quantifying the components of selection generated by social interactions on traits. This requires measuring phenotypes and fitness of individuals across interactions, which is difficult in nature. We capitalize on an online multiplayer videogame as a source of extensive data describing interactions in realistic ecological settings, where prey interact and cooperate to escape a predator. We estimate non-social and social selection and their contribution to total selection in traits mediating competition, cooperation, and predator-prey interactions. Behaviours of partners have a large impact on survival. Depending on whether selection pressures on behaviours are synergic or conflicting, social interactions enhance or counter the strength of natural selection. Selection is thus shaped by a prey's behaviour, its partners' behaviour, and traits correlations. Our study emphasizes that interactions generate complex selective regimes even in a simple environment.

What are the consequences of living in a city? A bird's point of view

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The process of urbanization is marked by a transformation of natural habitats, leading to a patchwork of landscape with altered surfaces and vegetation composition. Moreover, animals living in urbanized areas are chronically exposed to human-induced pollution such as artificial light, noise, low quality foods and heavy metals from car traffic. This may increase oxidative stress, triggering also a premature shortening of the telomere, a DNA region at the end of chromosomes involved in aging. This change in telomere dynamics may lead to premature senescence of the individual, and affect not only its current health status, but also its fitness. In this way, chemicals from human activities may deeply modify the life of wild birds, and the field studies conducted on model organisms such as great tits (*Parus major*) can help the researchers to better understand the repercussions of city life on animals and humans as well.

Environmental constraints dictate the timing for hierarchy establishment in male Alpine ibex

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In ungulates, agonistic interactions among males lead to the organisation of dominance hierarchies that are often associated with access to females.

The peak of agonistic interactions usually occurs during the rutting period, where the competition for females is highest, but this does not apply to the Alpine ibex (*Capra ibex*) whose mating season occurs at the beginning of the winter when males rarely engage in agonistic interactions. The Alpine ibex is a mountain dweller and experience the most diverse environmental conditions during the year. In summer, the restoration and maintenance of body conditions are made possible by high food availability, while during winter food sparseness, deep snow and freezing temperatures represent a threat to survival. The reduction of fights during the rutting season has been interpreted as a behavioural adaptation that allows saving energies during the harsh season and increasing survival. Against this background, we hypothesised that in male Alpine ibex, dominance relationships are established when food availability is high and little variations in ranks occur until the rut, where dominance is an important attribute for ensuring reproduction. To investigate this hypothesis we collected 10426 hours of focal animal sampling observations on 74 marked male Alpine ibex in Gran Paradiso National Park, from 2014 to 2019. We also collected ad libitum data on agonistic interactions of marked males in the same study area from 2011 to 2022. We used a Generalised Additive Mixed Model (GAMM) to investigate the effect of the Julian date and other environmental variables on the frequency of interaction. The resulting model highlights a peak of interaction between late spring and early summer and a marked reduction in interaction rate during the hottest part of the summer. We then used the Elo-Rating system to estimate individual scores and we compared summer scores with autumn scores, obtaining high correlation coefficients for each year of observation. Environmental constraints might have acted as drivers in the evolution of agonistic behaviour in male Alpine ibex, leading to a mismatch between hierarchy establishment and reproduction. Indeed, hierarchy establishment occurs in early summer, when food availability is high and engaging in physical interactions is less costly than in winter. Accordingly, access to females during the rutting season must rely on early on established hierarchies.

Pre- and post-copulatory sexual selection benefit female fitness but impose survival costs in the field cricket

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Whether sexual selection increases or decreases fitness is under ongoing debate. Sexual selection operates before and after mating. Yet, the effects of each episode of selection on individual reproductive success remain largely unexplored. We ask how disentangled pre- and post-copulatory sexual selection contribute to fitness of field crickets *Gryllus bimaculatus*. Treatments allowed exclusively for i) pre-copulatory selection, with males fighting and courting one female, and the resulting pair breeding monogamously, ii) post-copulatory selection, with females mating consecutively to multiple males, and iii) relaxed selection, with enforced pair monogamy. While standardising the number of matings, we estimated a number of fitness traits across treatments and show that females experiencing sexual selection were more likely to reproduce, their offspring hatched sooner, developed faster and had higher body mass at adulthood, but females suffered survival costs. Interestingly, we found no differences in fitness of females or their offspring from pre- and post-copulatory sexual selection treatments. Our findings highlight the potential for sexual selection in enhancing indirect female fitness while concurrently imposing direct survival costs. By potentially outweighing these costs, increased offspring quality could lead to beneficial population-level consequences of sexual selection.

Do captive fish need cognitive enrichment?

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Some animal species might be hardwired to perform certain cognitive tasks and solve foraging problems due to their evolutionary history. Providing housing conditions with cognitive enrichments that reflect natural tasks might increase captive animals' welfare. Accordingly, studies in mammals and birds indicated that captive individuals displayed a marked preference towards problems and complex foraging tasks versus freely available food. We currently do not know whether this preference is also present in the group of vertebrates with the highest number of individuals in captivity, the teleost fish. In the first experiment of our study, we exposed two teleost fish, the zebrafish and the guppy, to the choice between freely available food (as in normal housing conditions) and food that could be obtained by solving a problem, i.e., removing a small obstacle that hid the food. In most trials, the fish consumed first the freely available food. However, in a statistically significant number of trials, they spontaneously tackled the foraging problem before consuming the free food. This suggested that fish displayed at least a modest interest in cognitive enrichment. Interestingly, male guppies displayed a much lower propensity to first solve the foraging problem (males: 11%; females: 24%). Moreover, female guppies usually solved the foraging problem even after consuming the freely available food whereas males did not. We speculate that female guppies (but not males) might have been selected to 'go the extra mile' to obtain additional food. To further evaluate the need for cognitive enrichment, we performed a second experiment to directly analyze its welfare consequences. We exposed naïve zebrafish to one of two treatments: housing in control conditions with freely available food or housing with food that could be accessed by solving

the problem. We then compared the welfare of the two experimental groups using standard behavioral indexes. Results indicated a decreased anxiety in the subjects from the treatment with the cognitive enrichment compared to the control subjects. Overall, our study indicates that captive fish respond positively to cognitive enrichments, although with differences between the two sexes, and that providing this type of enrichment might improve their welfare.

Talk

Strength of acoustic identity coding in territorial bird species

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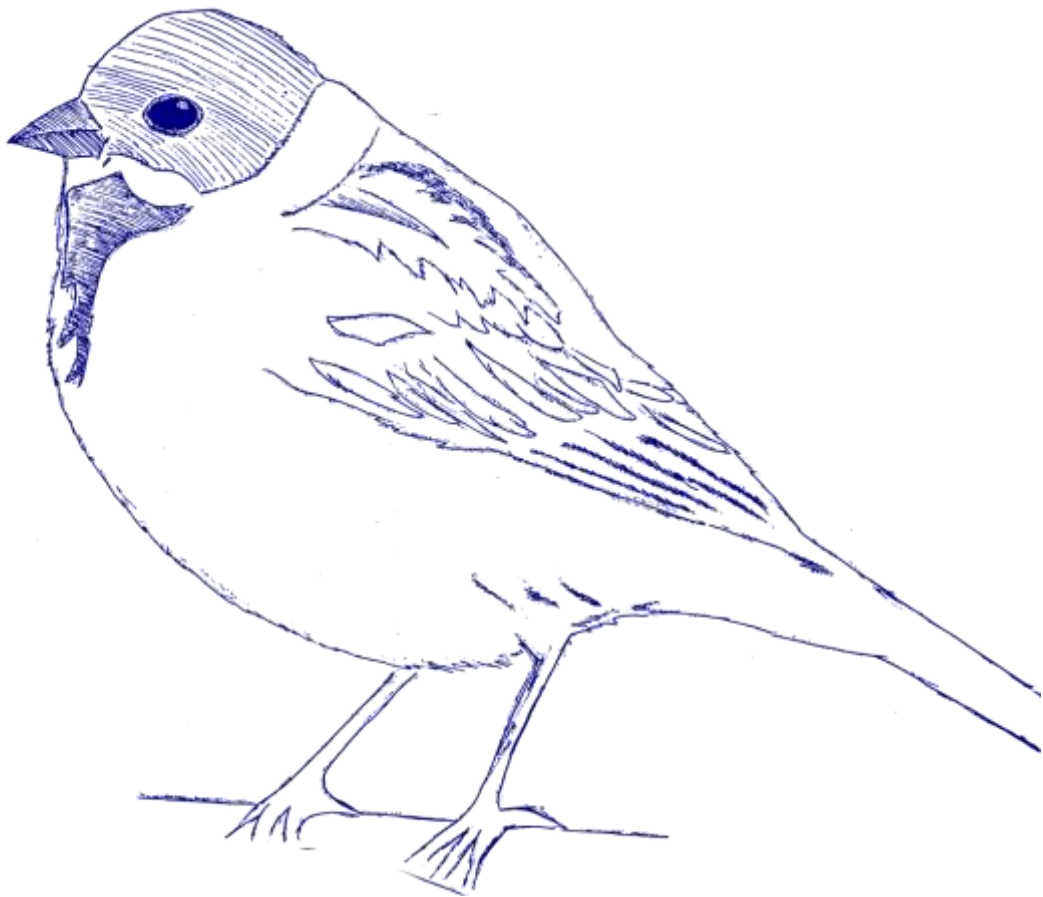
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The presence of individual signatures expressed in different sensory modalities has been widely studied across many species. Nevertheless, what evolutionary mechanisms and how they act on distinctiveness are still unclear. So far, researchers look for high individuality, especially in large and complex groups where the need to be distinct is more evident. However, identity signals are present even in territorial animals, especially in advertisement signals used during territorial defence and mate attraction. A correct identification between rivals may be decisive to prevent costly aggressions and to promote partner's choice. In this project we want to explore how proxies of intra-sexual selection, such as population density and spatial patterns, affect vocal identity in birds. We are collecting acoustic, spatial, and genetic data about one-learning, Ortolan bunting (*Emberiza hortolana*), and one non-learning species, Emerald-spotted wood dove (*Turtur chalcospilos*). We expected a positive relation between vocal identity and breeding density because when the pool of potential competitors is high, greater should be the need to sound different from the others. This type of data will allow us to measure reproducibility, social determination and plasticity of acoustic traits, advancing our understanding of identity signals evolution in animal communication.



Posters



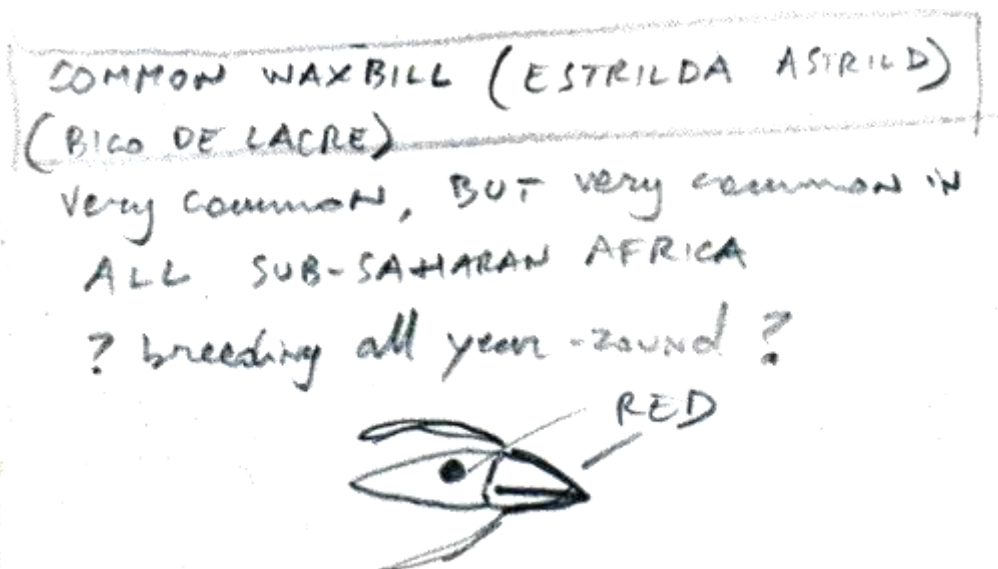
Outline of 'Good vibes' project: insect vibroacoustic behaviour and plant responses

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A finely tuned communication is crucial for maintaining plant-pollinator interactions. So far, this complex association has been studied primarily by focusing on visual and olfactory cues. Recent studies have suggested vibroacoustic (VA) signals as an additional communication channel eliciting plant response, however, the extent and ultimate roles of VAs in plant interactions are largely unexplored. In the context of plant-pollinator associations, VA signalling has only been scantily addressed, mainly in buzz-pollinated species, neglecting airborne components and without delving into the underlying molecular mechanisms involved. Our project aims at dissecting the molecular and physiological mechanisms of plant responses to distinct VAs emitted by approaching insects, using snapdragon as a model. Since *Antirrhinum* flower visitors have unequal efficiency as pollinators and emit characteristic VAs, we hypothesise that plants are able to recognise effective pollinators by sensing their specific VA signatures. We also postulate that VA-elicited snapdragon responses affect pollinator behaviours, with effects on pollen transfer, and consequently on plant reproductive fitness. This poster illustrates the research plan of the “insect behaviour unit” within this multidisciplinary project, that involves also a “plant physiology” and a “modelling” unit, combining ethology, plant molecular biology, and physics-informed data science. We will establish the network of flower-visiting insects of selected species of *Antirrhinum* as well as the pollination efficiency of the various taxa identified. VAs of legitimate and illegitimate flower visitors will be recorded and played back to test plant early and late electrophysiological, metabolic and transcriptomic responses. Behavioural assays will be carried out to test flower visitors’ preferences and to assess if plant responses triggered by VAs can be considered adaptive in the context of pollination. Multidisciplinary data will be interwoven tracing a roadmap to help understanding the origins of phyto-vibroacoustics: why vibroacoustic communication has evolved in plants. By tackling complex dynamics in plant-pollinator systems from a totally new angle, we endeavour to revolutionise our understanding of how plants interact with the biotic and abiotic components of the environment.



Study of shark swimming behaviour: can it contribute to the development of management strategies?

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The two species of smooth-hound sharks, *Mustelus mustelus* and *M. punctulatus*, represent an important resource in the Mediterranean Sea, and although they are evaluated as Vulnerable within the IUCN Red List, until now their harvest is not subject to any regulation. Given the low commercial value, smaller individuals of smooth-hound are sometimes discarded. However, this is not a guarantee of survival. Physical damages and capture-induced stress can have lethal consequences even several days after the capture or may reduce the fitness of individuals with serious consequences for their population. Therefore, studying whether and how individuals recover after capture is of fundamental importance to implement regulation that allow effective management strategy such as the release of juvenile individuals. With the aim of estimating the survival of discarded juvenile individuals of *M. mustelus* and *M. punctulatus*, in the frame of the European Marine Strategy Framework Directive (MSFD, 2008/56/EC), samplings on board of bottom trawl and gillnet were conducted in the northern Adriatic Sea. To simulate the discard and assess the survival over the following 72 hours, sharks were transported to laboratory tanks where water temperature and photoperiod were regulated according to seasonal environmental conditions. During this period, for each specimen three videos were recorded daily (1 hour after sunrise, at midday and 1 hour before the sunset). Through behavioural analysis, the present work aims to (i) evaluate if individuals differ in the swimming behaviour depending on sex and type of fishing gear; (ii) contribute to delineate a protocol for the maintenance of these species in captivity for post-release studies. Four different swimming behaviours were analysed: swimming in the water column, swimming on the surface, absence of swimming, and changes in the swimming direction. Preliminary results showed that (i) animals caught with different fishing gears differed in swimming activity, as possible indication of a different impact of the two gears; (ii) in some cases, males and females showed certain degree of variability in their swimming behaviours (iii) water changes, necessary to avoid the accumulation of dangerous levels of ammonia and nitrite, do not influence the swimming behaviours of sharks. This study indicates that animals can have different reactions to capture which need to be further investigated in order to better study the long-term consequences of post-catch release.

Parental age and offspring lifespan: mechanisms and consequences

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Aging is a multi-factorial process resulting in the age-dependent decline in functions across scales of biological complexity, from the molecular to the organismal level. The reproductive success – mainly quantified as the number of offspring per reproductive event – is a typical trait that shows deterioration during aging. However, parental age can impact fitness beyond fertilization by altering offspring performance from early stage to late life. The age-dependent accumulation of novel germline mutations (Gage-load) in the parents is likely the main route whereby old parents can negatively impact the fitness of their offspring. Hence, we expect that offspring from older parents should be of lower quality than offspring from younger parents, a phenomenon known as the Lansing effect. Despite this prediction, old parents have been shown to produce high quality offspring (Inverse Lansing effect) in several species. The occurrence of the Inverse Lansing effect suggests that current evolutionary models for parental age effects, are probably insufficient to explain the diversity of the effects observed in nature. In this project we develop an experimental strategy to address this seeming paradox. Genetic heterogeneity in the parental generation (Gload) could lead to parents of higher quality to survive longer, hence contributing to the next generation with longer-lived offspring. We thus propose to integrate the age-dependent deterioration of germ cells (Gage-load) and the genetic heterogeneity (Gload) in the parental generation in the same experimental model in order to interpret correctly the observed parental age effects, which is extremely relevant for predicting the consequences on offspring. To assess how variations in Gage-load and Gload interact to generate parental age effects on offspring lifespan, we will use the budding yeast (*Saccharomyces cerevisiae*), a highly versatile experimental model for lifespan studies, and the African turquoise killifish (*Nothobranchius furzeri*), which is characterized by one of the shortest lifespans among vertebrates.

The impact of climate change on fertility and behaviour in an insect species (*Gromphadorhina portentosa*): PhD's project

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Heatwaves (i.e. brief period of higher than normal temperature) are increasing both in intensity and frequency due to climate change. The impact of the heatwaves on animals is likely to be large and heatwaves have recently been associated with different (mainly negative) effects on, for example, behaviour, sociality, and reproduction of animals. Insects, as ectotherms, are especially sensitive to heat stress and because of their important ecological role, the impact of the heatwaves on these animals may also have direct ramifications on ecosystems and biodiversity. The overarching aim of my Phd project is to study the sublethal effects of heatwaves on animal, and specifically on reproduction, from fertility to sexual selection, using an insect species, the hissing cockroach (*Gromphadorhina portentosa*), as model

organism. Shedding light on how heatwaves affect reproduction will ultimately help our understanding of evolutionary trajectories and population viability in response to climate change.

Poster

Food availability reverses sperm precedence in the guppy

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In polyandrous species, male fertilization success is influenced by the number of competitors and by the temporal mating pattern which in turn modify the variance in paternity. Male fertilization success is typically studied under standardized conditions (e.g. a female mated with two males at a fixed time interval), which do not necessarily reflect natural conditions, where the level of polyandry and the interval between successive matings are variable. We investigated how male sexual traits, level of polyandry and temporal mating pattern affect the variance and the probability of male fertilization success in two sets of replicate populations of guppies (*Poecilia reticulata*) subjected to different levels of food availability. We found that i) the within-female variance in male postcopulatory success increased as mating interval increases, ii) mating interval significantly predicted male fertilization success in both diet treatments, but iii) last male precedence, typical of this species, was reversed under restricted diet, and iv) courtship rate was positively correlated with fertilization success only in the low-food populations. Our results demonstrated that sperm precedence, previously thought to be merely species-specific, may be instead influenced by environmental conditions. This finding highlights the importance of using more natural settings to quantify the contribution of multiple players in total sexual selection and their environmental-dependent variation.

Poster

Parental activities of a song thrush *Turdus philomelos* population breeding in Northern Italy

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Nesting birds carry out a series of tasks aimed at preserving the health state of their chicks, keeping the nest clean and hide from predators. In this study, we investigated the parental activities of a song thrush (*Turdus philomelos*) population nesting in apple orchards in Val di Non (Trento, Northern Italy). Data about the parental behaviour have been collected using gopro cameras temporarily installed near the nests in various stages of the raising period, from hatching to day 10-12. Subsequently, all the recordings have been analysed and the following behaviours of both parents have been noted: number of visits, total time on the nest, time spent feeding chicks, number of faecal sacs produced by chicks, number of faecal sacs eaten by parents, number of faecal sacs carried away from nest. Interestingly and unlike other thrush species and populations, in this song thrush populations both parents swallowed the faecal sacs most of the times, and rarely carried them away from nest. Our finding can be explained by the anti-predatory hypothesis, i.e. parents prefer to eat the faecal sacs and staying on the nest longer to i) increase

chicks surveillance and ii) avoid moving back and forth from the nest, thereby reducing the probability of being detected by predators.

Poster

Invasive Blue vs Local Green analysis of substrate preference of two species of crabs (*Callinectes sapidus* and *Carcinus aestuarii*) in the Venice Lagoon

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Invasive Alien Species have strong ecological and, often, economic impacts, by modifying the local food web and the diversity of the invaded habitat. The Atlantic blue crab *Callinectes sapidus* is an euryhaline species which inhabits both marine and brackish habitats. The species appeared in 1947 in the Mediterranean Sea, and it is considered invasive due to its biological characteristics such as rapid growth rates, opportunist diet, high reproductive rates, generalist habitat use, and aggressive behaviour. Thus, the spread of *C. sapidus* can potentially affect local ecosystems and the services they provide, with significant economic and social consequences. The Atlantic blue crab started to spread in the Venice Lagoon recently. Indeed, due to the heavy anthropogenic impacts over the past decades, this ecosystem seems to be an ideal place for the spreading of IAS and non-indigenous species. Moreover, as concerned by local fishers, *C. sapidus* could damage the smaller local green crab *Carcinus aestuarii* population, which is an important commercial resource for local lagoon fisheries. The aim of this preliminary study was to investigate if *C. sapidus* and *C. aestuarii* show any preference for different types of substrates (artificial vs natural), to identify possible areas of presence of this animal inside the Venice Lagoon and to understand if anthropic ecomorphological variations can differently affect the two species. Four different types of substrates were selected: sand, bottom sediments occurring near natural saltmarshes, bottom sediments occurring near artificial saltmarshes, and the control with no sediment. The experiment of substrate choice was performed on juveniles of blue crab and adults of local green crab, to keep comparable sizes. All the animals were taken from the catch of local small-scale fishery. Behavioural experiments were performed in tanks with a plastic support divided in four equal areas placed on the bottom, in which the different types of sediment were put in a random order. Each crab was placed in the middle of the plastic support surrounded by a plastic cylinder surrounding it. After three minutes of acclimatation the cylinder was removed, and the crab movement was recorded with a camera for the next 10 minutes. In total 26 videos were taken: 9 on *C. sapidus* and 17 on *C. aestuarii* individuals. Results shown a significant preference of *C. sapidus* for the sand and artificial saltmarsh sediments, while *C. aestuarii* had no specific preference for sediment. Moreover, behavioural observations have shown that *C. sapidus* not only stayed on sandy sediments but also, tended to burrow themselves in them. In conclusion, the preliminary results of this experiments suggest limited competition for space. Nevertheless, observation on other type of competitions such as food availability deserve further exploration.

If it stinks, I sit. The influence of conspecific faeces odour on exploration and occupation behaviour in *Myotis bechsteinii*

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Obtaining information about the environment is crucial for the survival of all organisms and, especially in social animals, being able to detect and recognize conspecifics plays a fundamental role in their everyday life. Most bat species are highly gregarious and display a wide variety of social structures, making them intriguing systems for studying sociality. Being mainly nocturnal, they rely mostly on hearing and olfaction to navigate the social world. The causes and consequences of bats' complex social structures have been studied for years, but the mechanisms mediating their maintenance are not well understood, especially when it comes to the role of odour in such processes. We performed a pairwise-choice experiment aimed at understanding the role of odour in bats' sociality. We focused on a maternity colony of Bechstein's bat (*Myotis bechsteinii*), a European tree-dwelling bat species. Female Bechstein's bats are highly philopatric, gathering in maternity colonies with inner fission-fusion structure but with virtually no exchange of individuals between neighbouring colonies. We placed pairs of experimental bat-boxes, each receiving either of two treatments (i.e. same- or different-colony faeces), that were continuously monitored through automatic RFID readers to allow for quantification of exploration behaviour and occupation events. We found that odour does influence bats' exploration behaviour, leading to earlier discovery and higher amount of visits to boxes with the odour of their own colony. Additionally, our data seem to suggest that bats' interest in boxes with their own odour quickly decreases over time, while that towards boxes with foreigners' faeces gets higher the older the odour gets. Despite this effect on exploration behaviour, however, we observed no influence of our treatment on boxes' occupation, suggesting that other factors might play a more important role when it comes to roost choice.

Associations between boldness, life history and body shape in guppies subjected to crude-oil pollution

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Oil pollution is an important threat to aquatic ecosystems, impacting biodiversity at a global scale, and is also one of the main drivers of contemporary evolution. Trinidadian guppies, *Poecilia reticulata*, are among the few freshwater fish species that have been able to colonise oil-polluted environments and are found in several polluted habitats across the southern regions of Trinidad. In a previous study, we found suggestive evidence for indirect, positive effects of the presence of oil pollution, in the form of increased body and offspring size in polluted environments, possibly mediated by reduced parasite presence and predation. However, how does oil pollution affect guppy behavior? To address this, we measured boldness and swimming activity in six populations of guppies (3 from polluted and 3 from non-polluted sites). We further analysed the relationship between boldness, life history and body shape. Overall, we

found that females were bolder in polluted habitats, while the opposite was true for males. Moreover, boldness in males was inversely correlated with reproductive investment. Our results shed further light on the impacts that polluted habitats have on the organisms inhabiting them. They also help us understand the phenotypic consequences of pollution, and how guppies are able to exploit degraded habitats, both in their native range and as an invasive species.

Poster

Nest site and diet differences in the pygmy owl: investigating the preferences of smallest European owl

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In this work, I investigated the preferences of Eurasian pygmy owl *Glaucidium passerinum* in nest and diet choice during the breeding period. The study area is located in the Aosta Valley, in the western Italian Alps. Prey samples and data about breeding success and nests characteristics have been collected on 11 nest sites, 7 from 2022 and 4 from 2021. The analysis of those data aims to recognize possible preferences of the pygmy owl on the choice of prey and nesting site, and if these choices have an influence on the breeding success. This was firstly possible analysing different variables regarding diet, like total number of prey, diversity of prey and prey weight. Afterwards I searched for trophic factors that had an influence on breeding success through statistical analyses: with generalized linear models I looked for a relation between the breeding success and the diet variables. Similar analyses were performed to investigate the influence of habitat types, in particular forest cover and forest typology, on breeding success. The findings suggest that the pygmy owl is a generalist predator, nearly opportunistic. Indeed, there isn't a real evidence of preferences of the species. It chooses the most available and detectable prey. To summarise, the data from this work prove that differences in reproductive success are not related to diet or habitat variations. The results have been compared with other studies from Germany and North Europe to better understand them. From this comparison it emerges that the pygmy owl needs a habitat that can support its ecological demand (food and territory) without causing competition with other similar predator, in particular with its intraspecifics.

Poster

Do spotted bowerbirds (*Ptilonorhynchus maculatus*) exhibit patterns of local similarities in their motor courtship components?

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Patterns of local variation are a common feature of communication signals in a number of species. Yet, evidence for social learning as an explanation for the origin and maintenance of dialects is for the most part restricted to acoustic signals. Postural components of courtship are widespread and prominent, and may also undergo social transmission. In this study, we focused on motor courtship components in wild spotted bowerbirds (*Ptilonorhynchus maculatus*). We investigated whether courtship movements vary

within a single population, and asked in particular whether social proximity can predict similarities in dance display patterns among individuals, in order to draw indirect inference about learning. We used video recordings of courtship behaviour to examine whether bowerbirds (i) exhibit consistent inter-individual variation in their motor displays – i.e., individual signatures; (ii) exhibit patterns of geographical similarities, such that courtship behaviour differs in distant locations within the same study site; (iii) are more similar in their courtship to conspecifics with stronger social bonds. We found evidence for geographical patterns of variation in the sequences of courtship elements, which did not co-vary with kinship. However, our results show that differences in visual courtship signals were not explained by social proximity. We discuss the implications of our findings in light of the literature on visual learning and motor imitation.

Poster

Male mate choice based on female body condition in a spider with nuptial gifts

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Animals of both sexes may exert preferences for mates varying in their reproductive potential and, especially in arthropods, mate assessment is often based on chemical information. For males, which are traditionally considered the least choosy among the sexes, mate choice is predicted when the costs associated to mating are high. Males of the nuptial gift-giving spider *Pisaura mirabilis* for example, court females with energetically demanding nuptial gifts: they hunt for prey, wrap it and carry it while searching for a mating partner. Despite being web less, these spiders deposit silk lines (draglines) during movement, which have the potential to vehicle chemical information. Previous studies show that males that contact female silk respond behaviourally, by initiating gift construction and performing courtship behaviours. In our study we ask if males i) are able to discriminate silk of females varying in their body condition – a correlate of female fecundity – and ii) allocate more time and energy to matings with those in higher body condition. We collected juvenile spiders, raised them to adulthood in laboratory conditions, and assigned females to differential feeding conditions (high and low food treatments) to experimentally manipulate their body mass and hence condition. We then staged two experiments. In the first, males were exposed simultaneously to the two different females and their movement and/or courtship behaviour towards one or the other were scored. In the second, male were exposed first only to the silk and then to the female, giving him the possibility to court, wrap a gift and copulate. We exposed males to one female at a time, randomizing the order. Selection may favour males that bear a high investment in nuptial gifts to discriminate more fecund females. Therefore, if female chemical signalling co-varies with individual state, we expect males to choose silk of females in higher body condition, and to allocate more to courtship of these females (longer silk wrapping, higher intensity of behavioural display). Our findings will contribute important knowledge on the evolution of male mate choice and allow testing condition-dependent chemical signalling and its potential role as a reliable indicator of individual quality.

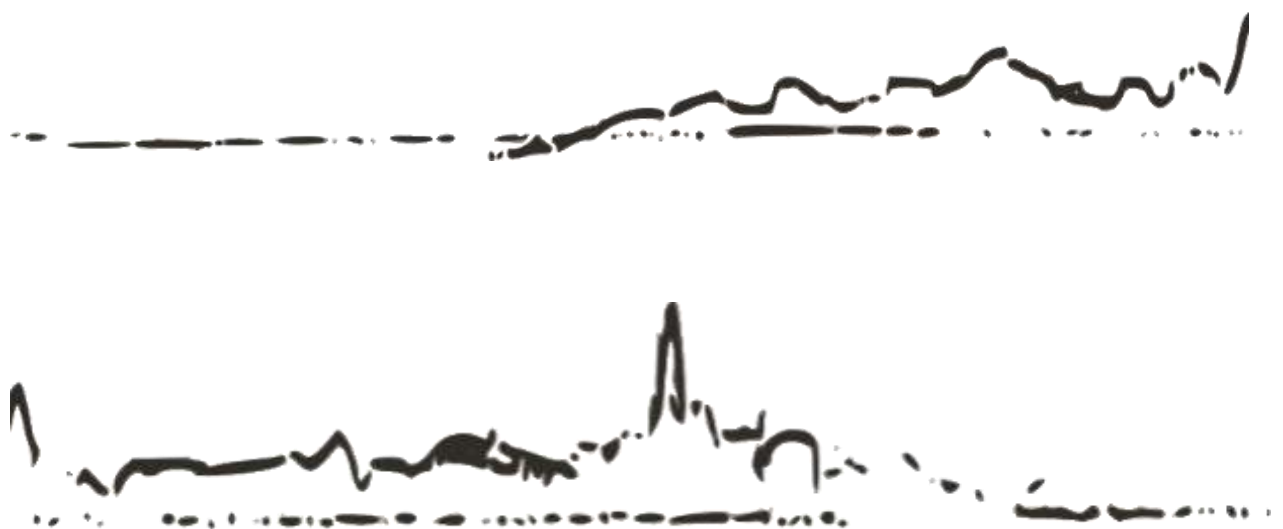
The effects of heatwaves on agonistic interactions in field crickets

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Heatwaves are predicted to become more frequent and intense due to the impact of anthropogenic activities. It is therefore crucial to understand how organisms will respond to or be affected by heatwaves, especially ectotherms which are more sensitive to changes in the ambient temperature. Although heatwaves clearly affect the physiology and metabolism of ectotherms, we currently have a limited understanding of these effects might cascade on behavioural traits. We addressed this missing gap in our knowledge focusing on two behaviours that determine foraging and reproductive success: exploration behaviour and aggressiveness during intrasexual competitive contests. We used southern field crickets (*Gryllus bimaculatus*) as study system and video recorded over 800 behavioural trials to assess the level of exploration and aggressiveness of males that were either previously exposed to a heatwave treatment (i.e. kept at 33°C for 5 days) or kept at control temperature (28°C). Given that heat stresses generally increase activity, we anticipate that the heatwave treatment will increase exploration behaviour. Likewise, given that in this species aggressiveness is positively linked to exploration behaviour, we expect that males that have experienced the heatwave treatment will show greater aggressiveness relative to control males. We also expect males from the heatwave treatment to elicit more aggressiveness in their opponents as a result of being more active and, consequently, being more likely to encounter and confront a potential opponent. Our findings will reveal the extent to which heatwaves can affect the expression of behaviours that are important for fitness. They will also provide insights into the environmental mechanisms driving behavioural variation.



List of (most of the) the Participants

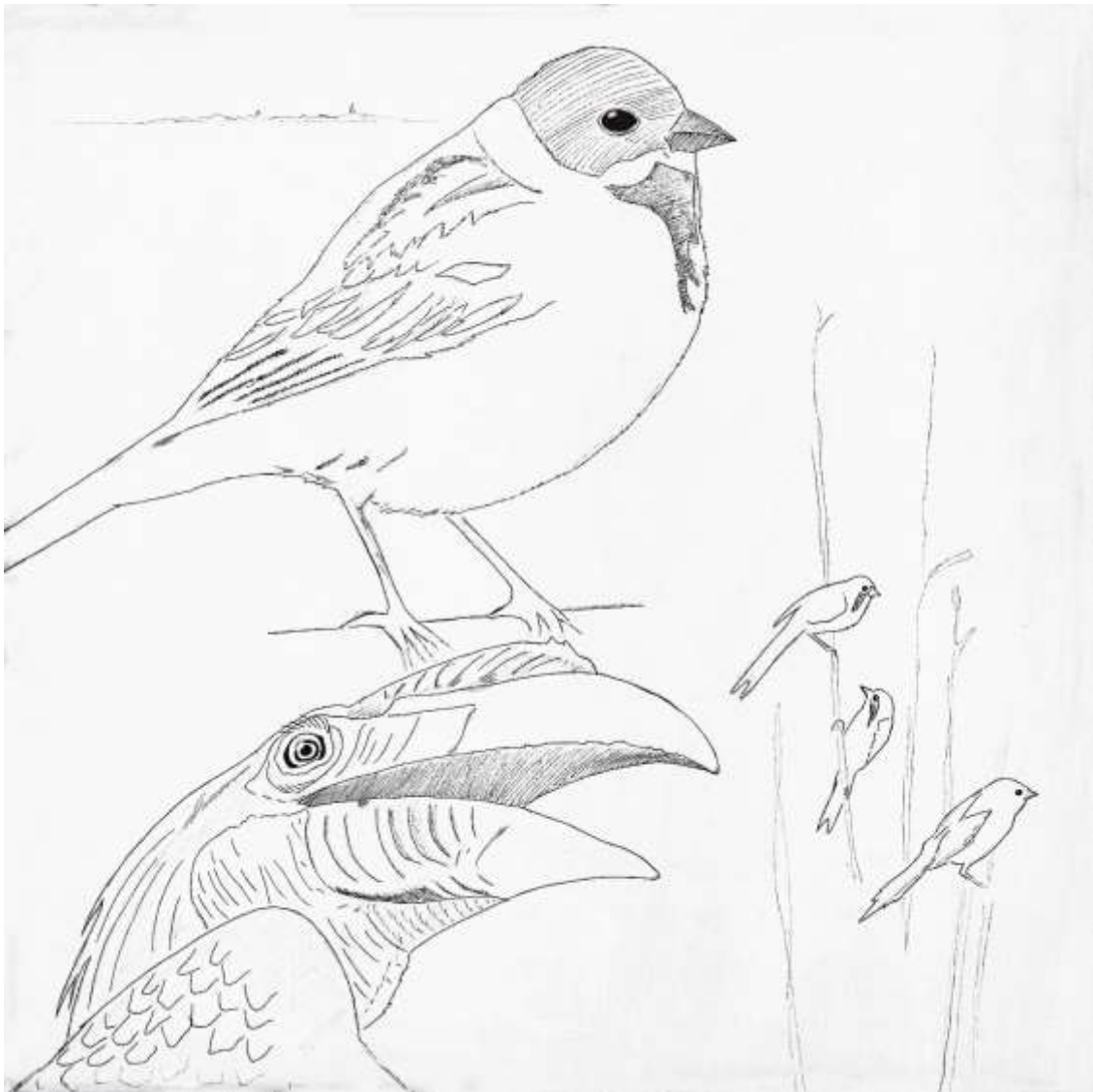
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In memory of Matteo Griggio

<https://sites.google.com/view/in-memory-of-matteo>



Matteo Griggio

