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Abstracts of Talks

Habitat Complexity and Its Use Correlate with Soil-Transmitted Helminthiasis in Two Social Groups of *Macaca maura* (H.R. Schinz, 1825), Endangered Primates Endemic to Sulawesi Island, Indonesia

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Sulawesi endemic *Macaca maura* is included in the IUCN Red List as Endangered due to anthropogenic disturbance and fragmentation of its habitat. Residual populations have a scattered distribution in the karst forests of south Sulawesi. Here the dissolution of limestone layers has created a multi-level landscape hardly accessible for ground predators and humans. In this study, we aimed to obtain better knowledge on the ecological flexibility of *M. maura* in the use of such a complex habitat, and its consequences on health status. Since all data published on *M. maura* were obtained from a single group (group B), an additional group (G) was habituated to human presence. We analysed 50 vegetation plots (10 × 20 metres) to discriminate structural features in terms of feeding options (e.g. key food species diversity, density and DBH) and anthropogenic disturbance (e.g. human trails and solid litter). We then correlated these data with habitat use and helminth infection. We collected 74 faecal samples from 18 different adult individuals belonging to both groups. Vegetation analysis suggested that there were 2 suitable habitats: a Ground Forest (e.g. higher abundance of key food species) and a Karst Tower Forest (e.g. lower presence of human trails and solid litter). Gastrointestinal investigation revealed a positive correlation between the prevalence of *Trichuris* sp. and time devoted to ground food-related activities in all individuals (Spearman correlation, $r_s = 0.665$, $p = 0.003$). Moreover, behavioural data confirmed that group B, the larger study group of the area, spent most of its activity time in the Ground Forest ($N_{\text{group B}} = 33 \pm 1$; $N_{\text{group G}} = 18 \pm 1$; $\chi^2 = 134.30$, d.f. = 1, $p < 0.001$). Since resource availability and predation risk can influence foraging decisions and, ultimately, space use, the “group size effect” might explain the significantly higher proportion of time spent by group B in the Ground Forest. Consequently, due to the *Trichuris* faecal-oral contamination life-cycle, the chance of infecting individuals based on their feeding habits might be described according to the “soil-transmitted helminthiasis hypothesis”.

The First Study on Enteric Parasites in Wild *Macaca maura* (H.R. Schinz, 1825), an Endangered Species Endemic to Sulawesi (Indonesia): a Contribution to the Global Mammal Parasite Database

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Wild primates host an amazing diversity of parasites and infectious diseases, which represent potential threats to both wildlife and humans. These include intestinal nematodes, protozoa, bacteria and viruses. Recent conservation work hypothesized that threatened primates, due to their spatial isolation and reduced population size, harboured fewer parasite species than non-threatened species. Despite the importance of georeferenced data, information on parasitism in wild primates is lacking and patchy, with some areas better represented than others. “The Global Mammal Parasite Database” (GMPD) is an outstanding archive including all major groups of parasites and pathogens found in 119 wild primate species. It contains over 400 parasite species including helminths (39%) and protozoa (20%), which represent over half of all parasites reported in primates. East Africa is the region with the highest sampling effort while large portions of South West Africa, South American Amazon, East and Southeast Asia, remain un-sampled. Among Old World primates, African species have received more than twice (61.3%) as much attention as Asian primates (28.8%). For the genus *Macaca* only 6 out of 22 species were reported and there were no records at all for Sulawesi primates. As part of a wider project on behavioural ecology, we collected data on enteric parasites in two wild groups of *Macaca maura* (Taman Nasional Bantimurung Bulusaraung, Sulawesi). Due to the high level of decline caused by habitat disturbance and fragmentation, *M. maura* is reported as Endangered (IUCN Red List). We collected, stored (in Ecofix preservative) and analysed 176 faecal samples. Three taxa of nematodes (*Trichuris* sp., hookworm and *Strongyloides* sp.) were identified. These parasites were also shared with the local human population whose forest use could cause cross-species transmissions and be a threat to all. Though modest, our data represent an important contribution to both GMPD and conservation management of *M. maura*.

Gut Homeostasis in Wild Tropical Non-Human Primates

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Abundance and diversity of microbial and helminth communities inhabiting the gastrointestinal tract are of critical importance to health in both humans and non-human animals. However, this micro-biodiversity has rarely been considered within a conservation framework. The Udzungwa red colobus monkey (*Procolobus gordonorum*) is an endangered and endemic primate species living in the Udzungwa Mountains of Tanzania, a global biodiversity hotspot. The monkeys are primarily arboreal and highly sensitive to hunting and habitat destruction. Therefore, they are an excellent model species for investigating the effect of habitat degradation on gut homeostasis. Two distinct studies have been conducted, separately, to understand both gut microbiota variability (31 faecal samples analysed) and helminth abundance and richness (251 faecal samples) across habitats with different levels of human disturbance, from either fragmented or unfragmented forests. The first study used barcoded 454 amplicon pyrosequencing of the 16S bacterial ribosomal RNA gene, while for the second study we recovered data via sodium nitrate

floatation and faecal sedimentation. Our results in closely related, yet distinct, populations of red colobus showed that gut microbiota diversity was lowest within groups, higher between groups and highest across habitats. There was an increase of gut microbiota biodiversity in individuals living in the largest and more undisturbed forest range. This increase may be correlated with the higher diversity of available food resources. Similarly, helminth richness and abundance were also higher in larger and intact forests than in smaller and degraded areas. Our results suggest that human disturbance and degradation effects gut microbial and helminth communities and indicate that strict environmental protection is needed to preserve global natural diversity.

Play and Sociality: A Comparative Study in Chimpanzees and Gorillas

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Great apes live in complex social groups and have evolved sophisticated systems to communicate emotions and intentions. During social play, individuals acquire information and inter-individual communication serves to regulate and balance the sessions. Communication modality varies in primate species and is influenced by many factors, such as social system, rank, relationship quality between players, age and gender. During play, animals use both gestures and facial expressions to communicate their motivations. Gestures are considered intentional signals, whereas facial expressions can also be the result of an internal emotional state. Therefore, play is a perfect field to explore the dichotomy between emotionality and intentionality. To understand how signals are produced and used during the play session and how they are influenced by the species, we carried out a comparative study on play dynamics in chimpanzees (*Pan troglodytes*) and gorillas (*Gorilla gorilla*). We investigated what parameters affect play modality in these two species that are characterized by strong differences in hierarchical organization and distribution of affiliative behaviours. Social play involving more than 2 players was more frequent in chimpanzees than in gorillas. The unbalanced play sessions characterized by a prevalence of one player over another occurred more often in chimpanzees than in gorillas, even though the probability of escalation was higher in gorillas than in chimpanzees. In gorillas, play asymmetry was positively affected by the number of players involved, which explains the low levels of polyadic play in this species. In conclusion, play dynamics seem to reflect social dynamics in the great apes showing different levels of cohesion and social support.

Capuchin Monkeys (*Sapajus* spp.) Take Advantage of Tactile Information to Visually Recognise Different Object Features

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Although diurnal primate species mainly rely on sight to gather information from the environment, touch is both the first sense to develop and by far the most extensive in Primates. Systematic studies investigating the integration of information coming from the sensory systems of sight and touch are sparse in non-human primates. To date, little is known about possible enhancement effects due to the synergy of these two sensory modalities. Here, we investigated in capuchin monkeys ($n = 12$) whether manipulating objects and retaining tactile memory en-

hanced visual discrimination learning for larger-scale (i.e. size, shape) and smaller-scale (i.e. surface) object features. A two-alternative forced choice task was used to train capuchins to visually select a rewarded stimulus between 2 wooden objects differing in size, shape or surface. Object pairs were presented in 2 conditions: the Sight condition prevented capuchins from haptically perceiving the object features; the Sight & Touch condition allowed them to gain tactile information about the object chosen by sight. Our results showed that the availability of tactile information (Sight & Touch condition) accelerated learning speeds for visual discrimination of object size, shape and surface. Overall, our data demonstrated that the acquisition of tactile information about an object's features allowed capuchins to achieve high levels of visual accuracy faster. These results suggest that information from touch influenced perceptual and/or attentional processes in visual modality and encouraged further investigation on how manual exploration affects object recognition.

Optimizing Field and Analytical Procedures for Estimating Densities of Arboreal and Threatened Primates in Tropical Rainforest

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Accurate estimation of abundance and distribution of threatened animal populations is a necessity for conservation. For primates, which are among the most threatened mammals, distance sampling from line transects, especially for arboreal species, is the method of choice. Yet the application of distance sampling to primate density estimation is challenging and susceptible to estimation biases. This difficulty is mainly due to problems of properly accounting for variation in species detectability and of accurately sampling the spread of the social groups. Here we use a novel dataset from the Udzungwa Mountains, a primate hotspot in south-central Tanzania, to propose an application of hierarchical distance sampling to arboreal primates. The sampling method comprehensively considered habitat covariates, including tree height, which is a potentially important habitat feature not considered in previous studies. Target species included the threatened and endemic Udzungwa red colobus *Procolobus gordonorum*, Peters' Angola colobus *Colobus angolensis palliatus*, and Tanzania Sykes' monkey *Cercopithecus mitis monoides*. We counted animals along 26 linear transects, 2 km in length across 1 of the major moist forest blocks of the mountain range. We obtained 35 repetitions in a total of 100 primate group encounters. We collected vegetation covariates at plots of 25 × 25 m, placed every 500 m along each transect ($n = 104$). Our results from hierarchical modelling, based on the AIC scores of competing models, show that the inclusion of the effect of tree height in the analysis enhanced the accuracy of our final models. We also proposed a field procedure to measure primate group spread while simultaneously conducting line transects to obtain observation-specific measurements. This method also significantly improved the precision of density estimates. We found that measurements taken at different locations and/or in different seasons introduce biases. Moreover, we found that group size had a positive effect on the detectability of all species. We thus confirmed the potential of this approach for obtaining more accurate estimates of primate density.

Genes, Songs, and Melodies: Phrase Dissimilarity in the Indris in the Light of Genetic and Social Factors

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The increasing interest in the origin and evolution of vocal communication has led to investigations of the link between genetic and behavioural components. A very limited number of primate taxa use “songs” (sequences of vocal emissions) to communicate. Among the few “singing primates”, *Indri indri* produces highly complex sequences of emissions, mainly consisting of distinctive “descending phrases” of 2–5 units. Indris live in family groups and have a rich vocal repertoire, making them a good model species to investigate the relationship between genetic relatedness and song similarity. To understand whether species-specific song traits might be inherited across generations, we examined how the acoustic structure of phrases significantly differed when analysed within closely and distantly related indris in the population. We also tested whether song features could provide conspecifics with acoustic cues about individual identity and group membership. Phrase dissimilarity and genetic distance showed significant results for both sexes. When analysing each sex alone, we found that genetics had a stronger effect in shaping the features of some male songs compared to female songs. Furthermore, we found that indri song possessed features specific to individuals with no potential for indicating group membership. While the genetic component appeared to shape male acoustic features, social factors could play a role in the acoustic plasticity of female indris. Our findings open new perspectives for future investigations on the possibility of vocal learning in this species.

The Great Chain of Being Will Not Die: Climbing Up and Down the Phylogenetic Trees Moving Sideways

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Phylogenetic trees are used extensively as frameworks for evolutionary studies as well as being effective images for communicating evolutionary concepts to wider sectors of society. How phylogenetic reconstructions are interpreted has critical consequences for our understanding of evolution and evolutionary processes. More than 150 years after the publication of Darwin's theory of common descent with modification, ideas and assumptions derived from the deeply rooted Aristotelian notion of the *scala naturae* are still pervasive in the interpretation of phylogenetic reconstructions, not only among non-professionals but also in the scientific literature. Data mining of papers with an anthropological or primatological focus published in the last 10 years confirms that the “primitive lineage fallacy” and its nested pre-evolutionary conjectures of a hierarchical order in nature are surprisingly widespread. Terms such as “higher/lower”, “basal”, “primitive/derived”, are often used to define entire groups, species or lineages, instead of specific characters. As a consequence, some extant species are viewed as ancestral to other living ones, and used as models to describe the emergence of „more evolved” ones. Tricks played by ladderised thinking of tree topologies can thus produce erroneous interpretations and misconceptions about evolutionary patterns and processes. Strepshirhines have long suffered this bias, and the most emblematic depiction of the archaic nature of this group is the widely-held view of cheirogaleids as model primate ancestors. We discuss the misleading role they have played as living models of ancestral primates and its impact on theories about primate origins and evolution.

Communication Meets Morphology: Modelling Individual and Species Vocal Differences in Group-Living Lemurs

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Species-specificity and individual variation in vocalisations are a prerequisite for recognition of conspecifics and group mates. Accordingly, modelling these vocal abilities in non-human primates may provide insights into the biological mechanisms underlying the evolution of their social organisation. To accomplish this, computer simulation of physio-anatomical processes is becoming an attractive and useful technique in primatology. We built a computing system that provides functionality for generating the acoustic response of a vocal tract, allows random modification of vocal tract models and simulation of vocalisations. We focused attention on lemurs because they live in relatively large social groups, have conspicuous vocal repertoires and their utterances can be interpreted in light of the source-filter theory of vocal production. Lemur calls allow specific and individual discrimination thanks to the resonance frequencies of the vocal tract. In this study, we aimed to determine how the distinctive vocal features can be derived from the morphology of the supra-laryngeal vocal tract. We used computational models derived from anatomical measurements to generate simulated vocalisations of *Lemur catta* and *Eulemur* spp. We then compared the results with the spectrographic output of vocalisations recorded from live lemurs. Our results demonstrate that the morphological variation of the vocal tract explains species specificity and individual distinctiveness of the lemur utterances. We also provided further evidence that vocal tract modelling is a powerful tool for studying the vocal output of non-human primates.

Molecular Cytogenetics of Callitrichinae

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It is generally accepted that chromosome rearrangements are rare genomic events that can provide useful markers for reconstructing the evolutionary history of primates. Here we used both chromosome banding and painting to compare the karyotypes of five species of Neotropical primates belonging to the subfamily Callitrichinae: *Saguinus midas*, *Leontopithecus rosalia*, *Callithrix geoffroyi*, *Callithrix penicillata* and *Mico argentatus*. All species were studied first with G-banding. Subsequently, we used human chromosome paints to map, for the first time, comprehensive homologies between *S. midas* and human chromosomes. Four human chromosome probes (1, 2, 10 and 16) were then hybridized to metaphases of *C. penicillata* and *M. argentatus*. We identified the chromosome translocations that differentiate the karyotypes of these species and identified 3 different karyotypes. In particular, these 3 karyotypes differ from each other in diploid number and/or presence or absence of the chromosomal associations 1/10 and 2/16. On the basis of our data and those from the literature, we were able to propose an ancestral Callitrichinae karyotype. The genera *Saguinus* and *Leontopithecus* (tamarins) conserve the ancestral karyotype of Callitrichinae, while *Mico* and *Callithrix* show a more derived karyotype due to chromosome translocations in human chromosomes 1, 2, 10 and 16, which occurred during the phylogenetic history of these taxa.

Human-Primate Conflict and Strategies for Mitigation: A Field Study on *Cercopithecus albogularis* in Hogsback, South Africa

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Sharing living space is never easy; sharing your garden with wild animals, especially primates, is a major cause of irritation among human residents in South Africa, who may respond aggressively. In Hogsback, a village in the Eastern Cape Amathole Mountains, people share their gardens with domestic animals, baboons, bushbuck, civets, mole rats and samango monkeys. Samangos (*Cercopithecus albogularis*) are protected in South Africa and a population of about 400 individuals occupies this forested, but transformed area. In a preliminary survey, I observed a high percentage of animals in certain troops with serious injuries, which impaired locomotion and foraging behaviour. By direct observations (200 h), still photography and videos, I aimed to further investigate habitat use by 2 troops occupying human modified and natural habitats to identify the causes of such mutilations. I counted 10 individuals with serious, debilitating injuries within a troop of 33 individuals. This troop lived in an area divided unequally into transformed land and natural forest. Regardless of their attitude to wildlife, most residents surround their properties with high fences often topped with electric or razor wire. The victims of such powerful barriers against intruders are juvenile and subadult monkeys. These individuals incur severe lacerations to the hands, arms, legs and tails while crossing the fence, resulting in the loss of extremities and tails. During the study, local residents were encouraged to install safe crossing points, both over the roads and between the forested and human-modified habitat. Small changes to fencing can prevent permanent mutilations: razor wire should be removed at crucial crossing points, and information panels near the protected forest can advise visitors regarding the issue. If monkeys are not fed or allowed to forage in garbage cans, they may not find human settlements so interesting.

Do Geladas Console Their Victims? Testing the Anxiety Reduction Hypothesis

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Triadic affiliation is defined as the first post-conflict affiliative contact directed by third parties to one of the two opponents. It can be spontaneously offered by the bystander to the victim or can be provided on request of the victim (solicited affiliation). Such affiliative contacts have a consolatory function if they are spontaneously directed towards friends or kin and reduce anxiety (measured via scratching) in the victim. Up to now, within the order Primates, consolation has been demonstrated in only humans, chimpanzees, bonobos and Tonkean macaques. Here, we tested specific hypotheses on the potential functions of triadic affiliation in geladas (*Theropithecus gelada*), a species living in complex multi-level societies. Geladas engaged in spontaneous triadic affiliation towards the victim, but we failed to find any evidence for the presence of solicited triadic affiliation in our study group. Playing, touching and lip-smacking/vocalization were the most frequent affiliative patterns directed by bystanders towards the victims. Third-party affiliation also occurred more frequently in the absence of reconciliation, defined as the first affiliative contact between the former opponents immediately after a fight. Even though spontaneous triadic affiliation was not mainly directed towards kin or friends, it significantly improved the emotional state of the victims

by lowering their levels of anxiety, especially when the conflict was not resolved through reconciliation. It remains to be understood if the improvement of the affective state of the victim is linked to the physical closeness and protection provided by the bystander; a situation that lowers the probability for the victim to be re-attacked by the former opponent. The improvement of the emotional state of the victim could also be due to the activation of a victim-bystander emotional attunement, which translates into the activation of the prosocial behaviour named consolation.

Conservation of Stone Tool Use in Primates: Development of a Landscape Suitability Model to Evaluate Anthropogenic Influence on Nut-Cracking Behaviour in a Wild Population of Capuchin Monkeys (*Sapajus libidinosus*)

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Stone tool use is observed in wild primates, which often live in areas characterized by increasing anthropogenic pressure. However, the influence of human activities on tool use in primates has not yet been properly addressed. In this pilot study, we developed a landscape suitability model to investigate nut-cracking behaviour in a wild population of capuchin monkeys (*Sapajus libidinosus*). These monkeys live in a Brazilian semi-arid habitat where human activities have recently increased. The model considered behavioural data collected at anvil sites where tool use behaviour was indirectly recorded. The site was characterized by both natural variables (i.e. minimum distance between anvil sites and palm trees, Normalized Difference Vegetation Index, NDVI) and anthropogenic variables (i.e. minimum distance between anvils and houses or sandy roads). Results showed a positive relation between NDVI and landscape suitability for nut-cracking behaviour. High NDVI was most likely related to a persistent and healthy vegetation cover, which provided protection from predators, as well as a steady fruit supply. Anthropogenic variables seemed less important in the model. However, anvil sites were found at short distances from anthropogenic elements (i.e. houses and roads), thereby supporting the hypothesis that capuchin monkeys in the study area have developed a remarkable adaptability to moderate (i.e. low human and housing/traffic density) anthropogenic disturbance. The accuracy of the model will need to be improved in order to understand better the relation between anthropogenic disturbance and capuchin nut-cracking behaviour and also to develop conservation strategies to preserve such a unique behaviour.

How do Capuchin Monkeys (*Sapajus* spp.) Innovate in a Tool-Manufacturing Task?

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Innovation has been defined as the ability either to find a solution to a novel problem by using motor and cognitive strategies already acquired, or to find a novel solution to an old problem through new motor and cognitive strategies. Innovation can improve fitness by allowing animals to adapt flexibly to social and ecological changes, but it could also be detrimental by exposing animals to potential risks and costs. Little is known about how this capacity emerges and whether/

how innovators differ from non-innovators. The major aim of the study was to investigate the innovation capabilities of capuchin monkeys and 4-year-old children in a task requiring tool-manufacturing. Here we report on the results of 16 capuchins presented with an innovative tool-manufacturing task in which they had to modify a tool to obtain a reward from a transparent apparatus. Each individual was given 3 trials: in each trial a different material set was presented to the subject. Each set consisted of 4 potential tools; if appropriately modified and put into a different opening in the apparatus, each tool provided the opportunity to reach the reward. Thirteen out of 16 capuchin monkeys successfully modified objects and used them as tools to obtain the reward. Detaching the tool from a substrate was the most common type of modification. Successful innovators differed from unsuccessful innovators in the amount of interaction with the apparatus and the tools, but not in the latencies to approach the task stimuli. Moreover, previous experience in tool-use tasks affected success and time needed to solve the task. These results are discussed in light of the cognitive and motor skills potentially affecting innovative tool behaviour in primates.

Play Behaviour in Wild Juvenile Chimpanzee (*Pan troglodytes*)

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Many primates live in social groups in which members coordinate their activities, communicate and interact in affiliative and agonistic ways. Play behaviours are an effective means to integrate social life. Play serves as a universal “engine” to learn social rules and acquire knowledge of other individuals. Play also contributes to social cohesion and helps develop cognitive skills for social life. The aim of this research was to test a number of sociobiological assumptions about play behaviour in juvenile chimpanzees. Chimpanzees coordinate their activities and form strong social bonds by a variety of social interactions. These complex interactions are often expressed in adulthood as dominance, cooperation, coalition and grooming. In terms of evolutionary adaptations, they could be related to juvenile social play development. Here, we focused on a community of 50 wild chimpanzees in the Kibale Forest National Park, Uganda. Observations were video recorded using “behavioural sampling” with a focus on play behaviour. Only juveniles (<15 years old) were included as initiators of play behaviour. Time budgets of social play were calculated as the proportion of social play duration relative to total playtime. An intensity value was assigned to each episode relative to the type of play. Play session intensities were scored by combining the intensity values of observed behaviours. The intensity of play sessions differed relative to gender and age of the player and partners. Male games were on average more intense. Play also increased in intensity with age, especially when directed toward females. Males dedicated more time to social play activities than females, who spent more time in solitary and mothering games. Finally, we observed the emergence of preferences in the choice of specific playing partners.

Post-Conflict Emotional Variation in Bystanders: The Case of Tonkean Macaques

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The perception of emotions in others regulates many aspects of social life. Consolation, a post-conflict mechanism aimed at reducing distress of the victim, relies on the victim and the consoler sharing emotions. One hypothesis is that consolation depends on a mirroring effect.

Mirroring permits an exchange of representations between the victim, who experiences an emotional variation, and the consoler, who is affected by the emotional variation of the victim. From this perspective, consolation is considered an empathy-rooted phenomenon, activated by a perception-action mechanism. If consolation relies on the perception of the victim's distress, the occurrence of a conflict and the following consolatory contact should produce an emotional variation in the consoler as well as in the victim. As a model species we selected *Macaca tonkeana*, a primate characterized by high levels of tolerance, which allows individuals to reveal their social relationships through many different behaviours including consolation. Data were collected on a colony of 54 macaques housed at the Parc zoologique de Thoiry (France). Behaviour of both the victim and the bystander was recorded at the same time with a video camera. Our results showed that victims and bystanders increased their anxiety rate after the end of a conflict. Consolation decreased anxiety in the receiver and in the actor of the affiliative contact, but not in bystanders who did not actively participate in the consolatory event. Moreover, in the absence of consolation, a correlation between the anxiety rate of the victim and the bystander was found. These findings, taken together, strongly indicate the sensitivity of the subjects to react empathically according to the affective state variation of the victims.

Sharing Emotions or Intentions? A Comparison of Rapid Facial Mimicry during Play in Lowland Gorillas and Chimpanzees

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In primates, playful facial expressions can disclose both emotions and intentions. By employing a comparative approach, we investigated the use of these facial displays and mimicry in chimpanzees (*Pan troglodytes*) and lowland gorillas (*Gorilla gorilla gorilla*). Even though the two great ape species are phylogenetically close, they strongly differ in their social cohesiveness and cooperative propensity, a “social fork” which also translates into differences in playful communication. Contrarily to chimpanzees, gorillas mainly performed Full Play Face (FPF: both upper and lower teeth are exposed in a relaxed way). This FPF was maintained for a longer period than the less evident Play Face (PF: only lower teeth exposed). PFs reveal unambiguous, positive emotions and can elicit in the observer the same emotional state as that of the performer, which is expressed through Rapid Facial Mimicry (RFM). RFM is a rapid and automatic response by which a subject reproduces the facial expression of a fellow within 1 second. We confirmed the occurrence of RFM in both species. Intriguingly, in gorillas the frequency of facial matching response (PF→PF; FPF→FPF) was particularly high. For both chimpanzees and gorillas RFM, and not the mere presence of PF/FPF, exerted a positive effect on play by promoting a longer bout duration. Therefore, in both species, RFM communicated to the performer that the stimulus was perceived and accurately processed, thus it reduced the ambiguity of communication. In conclusion, despite their social diversity, emotional rapid mimicry in gorillas and chimpanzees seems to share a similar function even though some differences in the sphere of intentional play communication also apparently exist.

Global Primate Conservation Issues and a Case Study from Tanzania

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A recent review of global primate conservation revealed that out of 504 species in 79 genera across the tropics, alarmingly, about 60% of species are threatened with extinction and about 75% have declining populations. This situation is the result of escalating anthropogenic pressures on primates and their habitats, leading to extensive habitat loss through the expansion of industrial agriculture, large-scale cattle ranching, logging, oil and gas drilling, mining, dam building and the construction of new road networks in primate range regions. Other important drivers include increased bushmeat hunting and the illegal trade of primates. Addressing primate conservation requires a diversity of strategies, from improving human conditions in range countries and strengthening the coverage and efficiency of protected areas, to mitigating illegal trade, restoring habitat and reintroducing species. For many of these strategies to be properly designed, and their success evaluated, efficient monitoring of threatened primate populations is advocated as a critical prerequisite. We build on this background to present a case study from a long-term monitoring and conservation programme in the Udzungwa Mountains of Tanzania, which is a global hotspot for primate endemism and conservation. Arboreal primates were monitored using counts from line transects established in 2 large moist montane forest blocks collected for over 10 years, cumulating in nearly 1,400 transect repetitions for over 5,200 km walked overall. The two forests differ in protection status, one being relatively well protected and one unprotected. Results of temporal trends in abundance show clearly how hunting and habitat degradation drove the most vulnerable primate species to near extinction in the unprotected forests. We elaborate on field and analytical routines related to comparability of data from multiple years. Results were used to lobby for conservation with relevant authorities, which contributed to the upgrading of the protection status of the unprotected forests.

Four Chimpanzees (*Pan troglodytes verus*): From a Human-Like Life to a Good Captive Chimp-Like Life

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Subjects of this study were 4 females (3 adults and 1 juvenile) who grew up in a strongly biased human environment, both living in the owner's house (connected to a 50 m² outdoor cage) and experiencing invasive human interventions into their intra-group social behaviours. In collaboration with the Safari Ravenna (Italy), this project intended to assist these chimpanzees in regaining their "non-humanity". The chimpanzees were provided with various opportunities and choices. They could move in an appropriate space (a 1,100 m² indoor-outdoor enclosure). This space was enriched with multiple and varied structures, such as branched dead trees equipped with elevated platforms covered by leafy-branch roofs, a Tibetan bridge, a wooden gazebo, a pond and a small creek. They were provided with an assorted diet composed of about 100 different items (e.g. green vegetables, fruits, roots, seeds, nuts, spices, animal products, honey). The food itself was provided using 20 different modalities (e.g. cooked/raw/frozen, intact/sliced/diced, scattered on the substrate, hidden in boxes, wrapped in jute) on an unpredictable schedule. The chimpanzees had the freedom to express intra-group social behaviours. We monitored their behaviour (feeding/foraging, locomotion, social, self-directed, resting and abnormal behaviours) at

the Safari Ravenna over a 6-month period ($n = 953$ focal animal sampling, $n = 238$ h) during which this strictly planned environmental enrichment programme was carried out. Pre- (control condition) vs. post-enrichment (PRE-E; POST-E) and indoor vs. outdoor (IN vs. OUT) conditions were compared. Multivariate statistics showed that chimpanzee behaviour was overall strongly affected by the combination of IN/OUT and PRE-E/POST-E conditions (e.g. scratching-SCR, $p = 0.0001$; yawning-Y, $p = 0.00001$; self-grooming-SGR, $p = 0.0015$; pro-social behaviours, $p = 0.0007$). In particular, Y, SGR, and abnormal behaviours decreased just by the effect of the OUT condition (independently of any environmental/feeding enrichment; $p < 0.005$; $p = 0.0001$; $p = 0.00001$, respectively). While the SCR behaviour – the most informative anxiety related activity – also significantly decreased by the effect of POST-E condition ($p < 0.025$).

Disclosing 3D Shape of Ossa Genitalia in Primates

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Selection pressures on copulatory systems rapidly shape the anatomy of external genitals, affecting both the occurrence and form (size+shape) of baculum (os penis) and baubellum (os clitoridis) in primates. These heterotopic bones are usually located within the distal end of the penis and clitoris. However, the pattern of occurrence within the primate phylogenetic tree and the multitude of forms shown cannot be easily merged into a univocal functional interpretation. This study aims to develop a methodological protocol to supply a suitable dataset of bone virtual volumes. These data are useful in morphological approaches exploiting both traditional and geometric morphometric techniques. We provide results on samples from both captive individuals (i.e. fresh samples from corpses coming from zoos or research laboratories) and museum samples (i.e. the primate collection of "La Specola" Natural History Museum, Florence, IT). We followed a three-step protocol which entails progressive sophistication: (1) manual palpation (efficient for fresh tissues, much less so for museum tissues made stiff by either alcohol or formalin); (2) X-rays (confirming or not the palpation); (3a) if absence is confirmed, histological analysis is performed focused on hypothetical traces of cartilage or osteocytes; (3b) if presence is confirmed, high resolution 3D images are obtained by using a non-invasive microtomography system which allows the exploration of both the external and internal structure of bones. The main objectives of the research were (1) completing the primate genital bone occurrence matrix at the specific level, and (2) providing morphological data to test evolutionary hypotheses by overlapping form variation to reproductive and ecological correlates.

Investigating Singing Behaviour and Territoriality in Wild Indris (*Indri indri*): Responsiveness and Song Contagion

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Long-term intergroup relationships are most likely established through regular vocal exchanges, random encounters and direct confrontations. These interactions allow the reciprocal assessment of resource holding potential through vocal and physical fights. If aggressiveness is consistently less intense towards neighbouring groups, as opposed to strangers, a phenomenon

referred to as “dear enemy effect” is involved. Group-living lemurs occupy relatively stable territories over years, and indris represent a perfect model species to study whether such an effect exists. Through two types of investigations, playback experiments and natural observations, we aimed to reveal whether dear-enemy effects are involved and whether natural features affect the song of indris. We tested the response parameters of neighbour *versus* stranger differences in aggressiveness during simulated intrusions. Only one parameter (i.e. proportion of songs overlapping the stimulus) yielded a robust result in favour of the dear enemy effect. Based on data derived from natural observations, we found that non-random associations between subsequent songs exist and environmental humidity, temperature and rainfall affect both singing rate and degree of contagion. While some results are relevant for the development of future vocalisation-based surveys, more research is needed to expand theoretical debate over the role of vocal displays.

How do Indris Cope with the Noisy, Dense Rainforest?

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The rainforest of Madagascar is home to a diverse array of animal species. The sounds that these animals produce can serve as proxies for understanding species behaviour, as well as for evaluating ecosystem health affected by various anthropogenic and environmental factors. Among the lemurs, the indri (*Indri indri*) is most notable for its impressive howling cries, commonly known as “songs”. Additionally the indri is considered diurnal but no quantitative study on its daily and seasonal activity cycle has been conducted to date. To simultaneously study the singing behaviour of the indri and the acoustic behaviour of other animals in the community across different forest types, we installed two passive acoustic recorders (Wildlife Acoustics SM4) at locations differing in disturbance level (pristine vs. secondary forest) in Maromizaha Protected Area. The recorders were programmed to record daily at fixed intervals: every hour for 10 min during the 24-hour cycle. Here we report our preliminary findings based on 1,496 sound recordings collected during 33 days in March–April 2017. We analysed the spectrograms (a) qualitatively by describing the indri song patterns, and (b) quantitatively by calculating the acoustic activity occurring at each location. We found that both locations possessed a great diversity of sounds, with the pristine forest showing higher H values than the secondary forest (H-index range: 0.504–0.657 vs. 0.448–0.605), and that an increase in species calling activity was observed during 18:00–04:00 and 11:00–14:00. Indri songs, on the contrary, were mainly emitted during 06:00–09:00 and 12:00–14:00. Our study shows that the passive acoustic monitoring technique can provide useful information for inferring indri activity pattern and analysing the spatial and temporal variations in its singing patterns as influenced by habitat and climatic factors, thereby contributing to our knowledge of the animal community dynamics and structure in Madagascar’s rainforest.

Sex and Age Influences on Singing Coordination and Rhythmic Abilities of the Indris (*Indri indri*)

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An essential feature of both speech and music is their non-random structure over time. It is still debated as to what extent other primates share rhythmic abilities with humans. Indris are the only “singing” lemurs: their howling cries are organized vocal displays with a coordinated pattern. First, we examined the temporal structure of the individual vocalizations to test whether overlapping and turn-taking during the songs had a regular pattern. Overlapping between singers was not random: males and females, indeed, influenced each other's onset timing. The breeding pair also overlapped each other's call more frequently than they did with non-dominants. We then focused on the spectral and temporal structure of particular phrases which occurred during the song. We found sexual dimorphism in both the inter-onset intervals and the median frequencies of the units emitted during these phrases. Males showed longer intervals and higher frequencies compared to females. We found no effect of age on the temporal and spectral structure of the phrases. The structure of the phrases given in the song showed that potential for sex recognition was due to both spectral and rhythmic features. Moreover, the high flexibility of singing behaviour may underlie perceptual abilities still unknown in other non-human primates.

Triadic Post-Conflict Behaviour in Wild and Captive Ring-Tailed Lemurs

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The escalation of conflicts may reduce the benefits of group living. To reduce such risks, social species have developed mechanisms to repair the damage caused by aggression (post-conflict strategies). Affiliation between former opponents of a conflict (reconciliation) and triadic affiliation (defined as a friendly gesture provided by a bystander to the victim) can function as post-conflict strategies. Triadic contacts spontaneously offered to the victim by a bystander seem to lower victims' distress (measured by self-directed behaviours, e.g. scratching). This phenomenon has been found in hominoids, monkeys and in some non-primate mammals, but it has never been described in lemurs. Here, for the first time, we investigated the post-conflict strategies used by *Lemur catta* by analysing data collected in the wild (383.5 h of observation; Berenty Reserve, Madagascar) and in captivity (1,138 h of observation; Pistoia Zoo, Italy). The data analysis revealed the presence of unsolicited post-conflict triadic affiliation in both settings, but failed to reveal solicited affiliation. Our analyses also showed that whenever social conditions do not favour reconciliation, unsolicited triadic contacts can substitute for it, thus lowering the risk of further aggression. The anxiety levels experienced by the victims after an aggressive event and in the absence of any kind of post-conflict affiliation did not vary compared to controls. Therefore, triadic spontaneous affiliation does not have a key role in buffering distress after conflicts. GLMM analyses revealed that the tendency of a bystander to approach and interact with a victim was affected by the sex of the aggressor. When the previous aggressor was a female, the probability of spontaneous triadic post-conflict affiliation was higher. This is an interesting result for a despotic species characterized by a strict dominance hierarchy led by females, which frequently re-iterate aggression, not only towards the previous victim, but also towards other group members.

Abstracts of Posters

Structure and Usage Flexibility of the Alarm Calls of Diademed Sifaka

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One current research horizon for understanding the evolution of language is to investigate the flexibility in structure and usage of non-human primate vocalizations. In primates, different call types may occur in the same socio-ecological context. Conversely, a given call type may be used in various contexts. However, in several cases, signals such as alarm calls have a high context-specificity. In some species, call types may even have acoustic variants depending on the context. We studied the acoustic and usage call flexibility in the diademed sifaka (*Propithecus diadema*), a group-living strepsirrhine species, whose vocal behaviour is poorly known. From April to August 2014 we investigated 3 wild, habituated groups in the Maromizaha rainforest, eastern Madagascar. We focused on alarm calls. We found that the long-range Zzuss and Zzuss-Tsk calls, described in other eastern and northern sifakas, have similar, multi-contextual patterns of emission. These vocalizations are mostly produced when a lost group member is calling, during vigilance, inter-group encounters, or terrestrial and aerial disturbance. Using the Mantel test, we found that the acoustic structure of the Zzuss and the Zzuss-Tsk varied significantly according to the context. The MMM, one of the most common calls of the repertoire, was performed mostly during aerial disturbance and vigilance, and we found a significant contextual variation using the Mantel test. Sifakas produced the loud and contagious Roar call only when the presence of a raptor was detected. These results suggest a higher context-specificity for the alarm call given during aerial disturbance than for those used for terrestrial disturbance, a pattern already described in the western species *Propithecus verreauxi*. However, terrestrial disturbance calls had acoustic variants that occurred in distinct contexts.

Distribution and Habitat Preferences of the Critically Endangered Yellow-Tailed Woolly Monkey in the Utcubamba Province, Peru

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The yellow-tailed woolly monkey (*Lagothrix flavicauda*) is an aboreal primate listed by IUCN as Critically Endangered. It is endemic to a small belt of cloud forest in the northern Peruvian Andes, between the regions of Amazonas and San Martín. In recent years, the area has undergone increasing pressure due to population growth, inducing widespread deforestation to clear land for pastures and crops. These threats, combined with the extremely high level of endemism, qualify the area as part of the Tropical Andes Biodiversity Hotspot. This study was conducted within and around the private conservation area “Bosque Berlin”, in the Utcubamba province, Amazonas region. Four forest fragments were surveyed for the presence of *L. flavicauda*, to determine its distribution and abundance and assess habitat association. Data were collected through counts of primate groups, conducted along 9 transect lines of 500–700 m in length, and distributed across 4 discrete forest patches. Transects were each repeated 5 times during March–May 2017. Results indicated that the species occurred in 3 of the 4 patches and was difficult to detect visually, with a mean encounter rate of 0.55 (SD = 0.64) groups per km walked. Repeated detection/non-detection along 100 m segments of transects were used to estimate the probability

of presence (i.e. occupancy). Occupancy was estimated to be 0.39 (SE = 0.62), with a relatively low detection probability (0.23, SE = 0.60). Preliminary results of modelling counts and estimated occupancy with potential habitat predictors indicated that these metrics varied with a range of covariates. The habitat variability, and hence the gradient of the covariates, appeared relatively small to determine clear habitat association patterns. Considering the critical conservation status of *L. flavicauda* and the increasing human pressure and deforestation in the area, these results are useful to identify targeted conservation measures and call for further investigations.

Heterozygous Evolutionary New Centromeres in the 20/21 Association Synteny in Two Closely Related Cercopithecini Species

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The Cercopithecini tribe of the Old World monkeys has experienced rapid chromosome evolution and taxa vary in diploid number from $2n = 48$ to 72. However, all Cercopithecini have a syntenic association of chromosomes homologous to human 20 and 21. Chromosome painting and G-banding suggested that 2 isoforms of this chromosome exist with different centromere positions. In one form, the centromere occurs at the fusion point of the 20/21 association while in the other it is located in the segment homologous to chromosome 20. In this study, we used a range of molecular cytogenetic methods, including BAC-FISH, to examine the 20/21 association in a number of Cercopithecini species. We discovered that individuals from 2 closely related species *Cercopithecus mitis* (CMI) and *Cercopithecus petaurista* (CPE) were heterozygous for centromere location. The centromere within the segment homologous to HSA20 is a neocentromere. In CMI this centromere appears completely devoid of satellite DNA, while in CPE it appears to have a repeat structure more similar to a normal, mature centromere. Taken together, our data allowed us to speculate on the evolutionary process related to Cercopithecini phylogenomics as well as to neocentromere formation and maturation. One hypothesis is that neocentromeres had a common origin and survived at least one speciation event, but this explanation is contradicted by their different degrees of maturation. These heterozygous neocentromeres represent a unique opportunity to understand the phenomena of neocentromere formation and maturation.

First Report of Leaf Swallowing and Parasite Expulsion in an Asian Small Ape

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Leaf swallowing behaviour, known as a form of self-medication for the control of nematode and tapeworm infection, occurs widely in all the African great apes. It is also reported to occur in a similar context across a wide array of other animal taxa including, domestic dogs, wolves, brown bears and civets. Despite long-term research on Asian great and small apes, this is the first report of leaf swallowing in an Asian species, the white-handed gibbon (*Hylobates lar*) in Khao Yai National Park, central Thailand. We present the first evidence of leaf swallowing (*Gironniera nervosa* Planch CANNABACEA) behaviour ($n = 5$ cases) and parasite (*Streptopharagus pigmenta-*

tus) expulsion (n = 4 cases), recorded during 4,300 h of direct animal observations during 2 distinct research projects. We recovered 4 – 18 rough, hairy and hispid surfaced leaves from each sample, undigested and folded, from the freshly evacuated faeces of 5 different individuals (2 males, 3 females, 5~34+ years old) living in 3 different social groups. Based on close inspection of the leaves, as observed in chimpanzees, it was clear that leaves were taken into the mouth, one at a time, folded and detached from the stem with the teeth before swallowing them whole. All instances occurred during the rainy season, the time when nematode worms were also found in the faeces. These striking similarities in the details of leaf swallowing between white-handed gibbons and African great apes, and other animal species, suggest a similar anti-parasitic function.

Does Ageing Impair Decision-Making in Tufted Capuchin Monkeys (*Sapajus* spp.)?

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In everyday life, considered choices must be made, but it is not yet clear if rational choices are consistently made throughout the entire lifespan. Recent studies have found that people over 65 years of age show more inconsistent choices than younger individuals. However, human cross-sectional studies have a major drawback because inter-individual differences may stem from personal attitudes and different experiences. The aim of this study is to overcome these drawbacks by longitudinally investigating whether decision-making ability declines with age in the tufted capuchin monkey. This New World monkey species, despite 35 million years of independent evolution, shows many behavioural, cognitive and life-history convergences with humans. In a previous study, capuchins presented with binary choices between 2 types of food in variable amounts showed very consistent preferences. They combined the relative value assigned to 3 different foods according to transitivity, a hallmark of rational choice behaviour. Here, we assessed again the rational choice of capuchins 15 years after the original study by testing the same subjects with the same protocol. We then made within-subject comparisons with previous data. The protocol involved 3 phases: Familiarization with each food, Food Choice between different quantities of high-preferred and low-preferred foods, and Transitivity, in which subjects faced binary choices between different quantities of 3 differently preferred foods. If aging has similar effects on human and non-human primate decision-making, we expect a decrease in preference consistency and transitivity.

Ribosomal DNA 18S-28S Sequence Probe Mapping on Primate Genomes: Evolutionary Insights

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Ribosomal DNA (rDNA) is a repetitive DNA which encodes for ribosomal RNA, essential for cell function. Nuclear rDNA is organized in two families. One family consists of genes for the 5S (minor) and 45S (major) subunits. The second family comprises the 18S, 5.8S and 28S genes corresponding to the Nucleolar Organizer Regions (NORs). Data derived from rDNA gene mapping have been used as markers for comparative cytogenetic studies. Their number may vary among species, thus facilitating studies of evolutionary relationships. Dif-

ferent numbers and locations of rDNA genes are hypothesized to result from chromosomal rearrangements or transposition events. We mapped, using fluorescence in situ hybridization (FISH), 18S and 28S probes on karyotypes of 14 species representing the main groups of Primates as well as in *Tupaia minor* (Scandentia), which often serves as an outgroup for primate phylogenetic reconstructions. The aim of our study was to establish the chromosomal distribution of rDNA gene sequences in primate genomes. In the species analysed, we found that the rDNA probe provided signals on 1 to 6 pairs of chromosomes, including acrocentric and metacentric elements. For each species, inverted DAPI banding allowed us to identify the chromosomes hybridized by the rDNA probe and, on the basis of previous painting data, to analyse human syntenic homologies. Our results showed rDNA probes provided signals on both homologous and non-homologous chromosome segments. From an evolutionary perspective, our results support the hypothesis that different mechanisms are responsible for rDNA distribution in primates. Further, the many synapomorphies found could be useful phylogenetic markers. Future research on more species, coupling classic and molecular cytogenetics approaches, could provide useful information on chromosomal and species evolution.

Habitat Use in Capuchin Monkeys (*Sapajus* spp.): A Preliminary Study in the Caatinga of Rio São Francisco Natural Monument (Bahia, Brazil)

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Sapajus flavius is an endemic Neotropical primate living in northeastern Brazil, listed as Critically Endangered by IUCN due to its small population size. This species inhabits Atlantic Forest in the states of Paraíba, Pernambuco and Alagoas, but its western distribution limit is poorly defined because of the lack of data in the Caatinga dry forest. Recent studies reported the presence of a population of *S. flavius* in the Caatinga of São Francisco Natural Monument between Bahia and Alagoas. Genetic studies are in place to identify the species. The aim of the present study was to estimate the abundance of this population and to evaluate its habitat use with respect to areas of different human disturbance. Preliminary data were collected from November 2016 to February 2017. We used direct counts by walking 32 km on 2 linear transects in the dry forest. During a total of 16 h of observations, we identified along the transects at least 2 groups of monkeys for a total of 51 individuals (encounter rate: 0.12 per km). Most of the monkeys (79.5%) were encountered in areas where anthropogenic disturbance was occasional (e.g. dirt roads, abandoned buildings and electric pylons) and 20.5% in areas where anthropogenic disturbance was constant (infrastructures, establishments and main roads). Our results showed that capuchin monkeys were adapted to the human-induced environment. Moreover, during the surveys we detected 40 anvil sites used by capuchins to process foods, principally fruits of cacti (*Tacinga inamoena*). Anvil sites are indirect signs of the presence of capuchins and can provide important information on how the areas are used by them. Further surveys are needed to establish habitat preference, area of occupancy and population numbers of the threatened tool-using capuchin monkey.

Hand Preference in Callitrichids: A Study on Emperor Tamarins

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Humans show a consistent right-hand preference for manual actions. This asymmetry could be related to a lateralisation of brain functions. Despite extensive studies, its origin in the evolution of primates is still unclear. Little is known about hand use in New World monkeys, although various handedness studies have been conducted in callitrichids and *Cebus*. Many studies of handedness revealed that different factors could affect hand preference, including posture, individual experience and task complexity. The aim of this study was to investigate manual lateralisation in food reaching in 9 emperor tamarins (*Saguinus imperator*) housed at Parco Natura Viva – Garda Zoological Park (Bussolengo, Verona). Subjects were provided with cone-shaped enrichment devices containing a food reward. Ten 30-minute sessions were video-recorded to collect data on hand use during the interactions with the enrichments within the social context of the subjects. Through video-recorded sessions, data on hand use of each subject were collected using the focal animal continuous sampling method. Results indicated that emperor tamarins, at the group level, showed no hand preference during the interaction with the target. However, hand preference varied across individuals. These results seem to suggest that, at the group level, hand preference in emperor tamarins does not appear for simple and familiar actions, such as reaching for food. Further research on callitrichid species is necessary to add new evidence on the evolution of this puzzling trait in primates.

Measuring Behaviour to Assess the Welfare of the All-Male Group of Zoo Gelada Baboons

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Behavioural diversity is an important parameter of an animal's well-being and should be considered in welfare assessment. The use of environmental enrichment is widespread among modern zoological gardens, aiming at promoting natural behaviour and improving welfare. However, evaluating environmental enrichments is essential to verify whether they provide welfare benefits and do not have detrimental effects. The aim of this study was to investigate the daily activities of a group of 6 male gelada baboons (*Theropithecus gelada*) transferred from NaturZoo Rheine (Germany) to Parco Natura Viva (Italy), focusing on the effect of an environmental enrichment programme on their behaviour. The research consisted of 2 different study periods: during the first period, carried out one month after the animals were in their new enclosure, no enrichment was provided. During the second period, carried out one month after the first one, animals were provided with the environmental enrichment programme (e.g. leafy branches, barks, bamboo sticks, straw). For each period, 12 15-minute sessions per subject were conducted. Duration of individual and social behaviours was collected; data were analysed using nonparametric tests. Results highlighted that both in the first and in the second period the subjects performed species-specific individual and social behaviours. Moreover, alert, locomotion and inactive behaviours were performed more in the first than in the second period, whereas food-related behaviours were performed more in the second period than in the first. Results of this study show that when provided with an enrichment programme, gelada baboons seem to cope better with the novelty, being more active and performing less anxiety-related behaviours. This study suggests the positive effects of an enrichment programme on the welfare of zoo ani-

mals, promoting the performance of natural behaviour and helping them to manage the novel environment. To plan a good enrichment programme for grass-eating geladas it is important to consider that they are nutritional specialists with grass blades making up to about 80% of their diet.

Quantity Discrimination in Prosimians: The Case of the Ring-Tailed Lemur (*Lemur catta*)

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Quantity discrimination, defined as the capacity to discriminate the larger/smaller quantity of objects, has been reported in several taxa, ranging from invertebrates to vertebrates, including fish, amphibians, birds and mammals. The precision in quantity discrimination is known to be affected by the ratio between quantities. The aim of this study was to investigate whether 9 ring-tailed lemurs (*Lemur catta*) were able to distinguish between two continuous quantities with two different ratios, specifically 0.66, which is commonly used in spontaneous quantity discrimination of non-primate species, and 0.47. Lemurs were presented with 2 food amounts on 2 identical plates. In particular, lemurs were randomly presented with either two 3.66 cm or two 8 cm plates. In the first period, the ratio between food amounts was 0.66 whereas in the second period the ratio was 0.47. For each period, a total of 12 trials per lemur was carried out. In the first period, results revealed no significant group- and individual-level discrimination of the larger food amount, whereas in the second period a significant discrimination of the larger quantity was found. Our findings suggest that ring-tailed lemurs do not seem capable of detecting physical differences between food amounts in the presence of a 0.66 ratio, whereas they can detect the larger food when the ratio is 0.47. Results of this study add to previous literature on prosimians and improve our knowledge on quantity discrimination in these species. Moreover, our findings might be useful to design future experimental settings aiming to test cognitive abilities or similar features in these species.

To Chop or Not to Chop? Effect of Whole Food Provision on the Welfare of Zoo Barbary Macaques (*Macaca sylvanus*)

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In zoos, food is chopped to facilitate access by all individuals in a group, to prevent aggression during feeding, to reduce wastage and to promote foraging behaviour. However, scientific evidence-based research is needed to assess the effects of different food provision strategies on animal welfare. This study aimed to investigate the effects of whole food provision on the behaviour of 13 Barbary macaques (*Macaca sylvanus*) in Parco Natura Viva, Italy. The study consisted of 3 different conditions: Baseline – chopped food was provided; Whole Food I – at least 2 pieces per subject of whole fruit and vegetables; Whole Food II – at least 1 piece per subject of whole fruit and vegetables. Per subject and per condition, two daily 10-minute sessions were done. Durations of individual and social behaviours were collected using a continuous focal animal sampling method. In addition, we recorded the frequency of female agonistic interactions to calculate

the Clutton-Brock index (CBI) to construct dominance hierarchies. Non-parametric tests were used to analyse the data. Species-specific behaviours and no stress-related behaviours were reported in all conditions. Foraging and attentive behaviours as well as grooming were performed more in the whole food conditions than in the baseline, suggesting a positive effect of this feeding strategy on macaque welfare. Over the study conditions, the frequency of female aggressive behaviour decreased. Further, no significant differences between conditions in the hierarchy of female macaques were reported. Therefore, whole food provision seems to positively affect group cohesion and stability of zoo Barbary macaques. Providing food in a more natural way – whole fruit and vegetables – seems to be a good strategy to guarantee welfare and improve social stability of zoo non-human primates.

Temporal Stability and Inter-Individual Variability of Personality Traits in the Common Marmoset (*Callithrix jacchus*)

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The most widely used approaches in personality research on non-human primates (NHP) explore components and dimensions used in human studies. However, more comprehensive approaches, integrating methods and theories from both psychological and ethological research, are available. The present study applied 1 of these integrated approaches, that is, the Behavioural Repertoire x Environmental Situations Approach, to a colony of common marmosets (*Callithrix jacchus*). Data on 56 different behaviours were collected in 10 different tests, during observations under social conditions. Observations were repeated after 15 days, to evaluate temporal stability. Behaviours were standardized and aggregated to obtain measures of specific personality traits. Traits were then analysed to investigate temporal stability and individual differences, as well as gender and age effects. Principal component analysis (PCA) was also performed on temporal stable traits to obtain components for comparative purposes. Significant differences in the expression of traits between subjects were confirmed. Temporal stability was found for most personality traits and individual personality profiles; no significant effects of age or sex on the temporal or individual stability of personality profiles were evident. PCA identified 3 major components, which together explained 60% of the total variance. Present findings, obtained through an objective assessment method, support previous literature by confirming that the common marmoset is characterized by a complex personality structure, which satisfies the criteria of temporal stability.