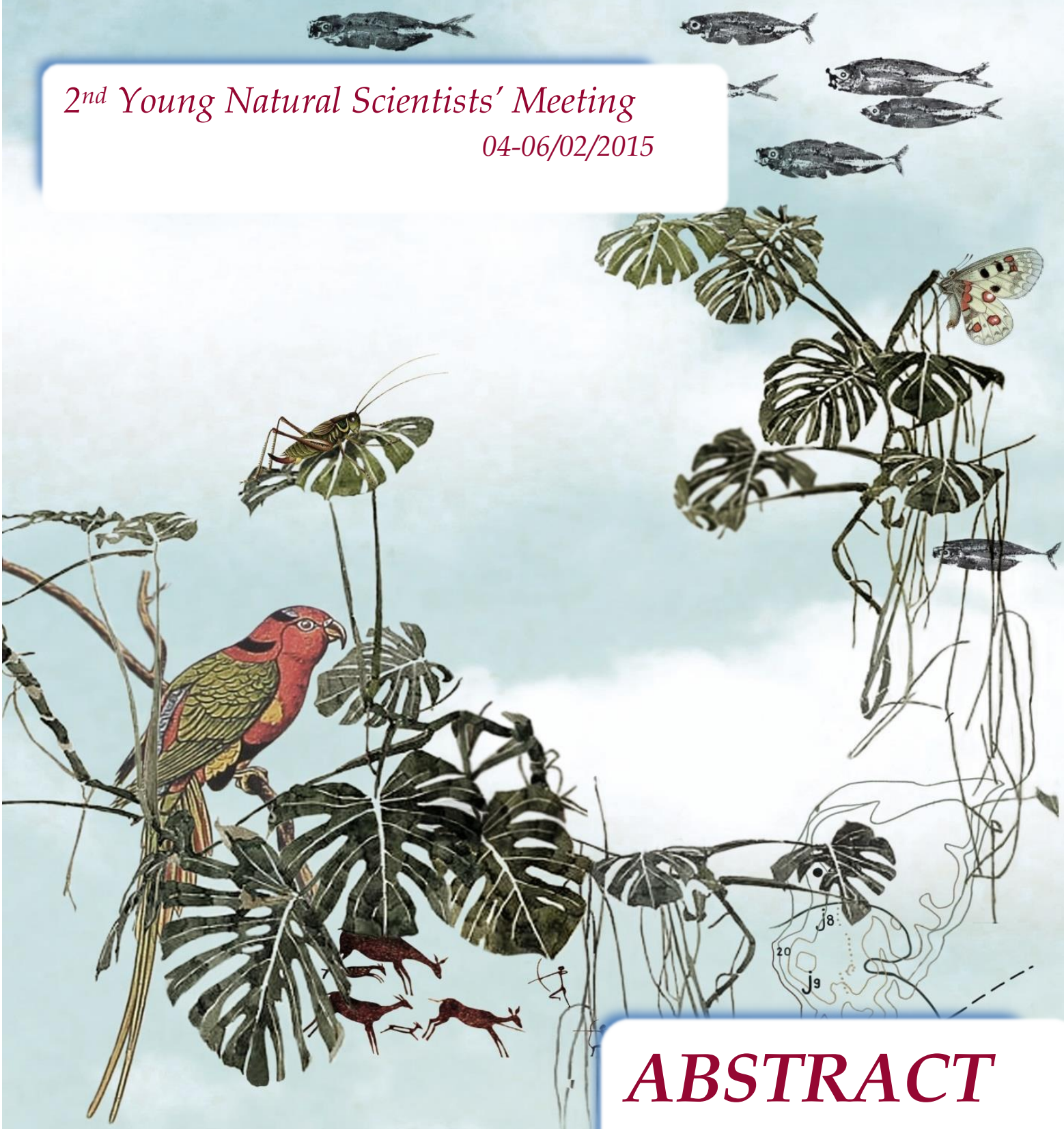
2nd Young Natural Scientists' Meeting

04-06/02/2015



ABSTRACT BOOK

GRAPHISME : SOPHIE FERNANDEZ

The BDEM (Bureau des Etudiants et Doctorants du Muséum), Doc'up and Timarcha are pleased to welcome you to the **2nd Young Natural History scientists' Meeting** at the Muséum national d'Histoire naturelle, in Paris. We hope this congress for young researchers will provide you the opportunity to present, possibly for the first time, your research in a relaxed but studious atmosphere. We believe that the YNHM is a great chance for us to have a first congress experience.

Our program is varied, covering several aspects of Natural History with a keynote speaker for each session and several oral and poster presentations by young researchers, distributed in four sessions. We thank you for coming so numerous and hope you will enjoy the conference and get opportunities for networking.

Faithfully yours,
The Organizing Committee:

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Acknowledgements

We would like to thank the **Chairpersons and Jury members** for kindly accepting our invitation to present their session as well as lead the discussion and designating the winners for the oral and poster awards.

Session	Chairperson	Jury
Biodiversity, dynamics and conservation	Laurent Palka (MNHN)	Nathalie Machon (MNHN) Cedric Hubas (MNHN) Christie Lecoeur (MNHN)
Earth and planetary sciences	Emmanuel Jacquet (MNHN)	Grégoire Egoroff (MNHN) Pierre Guerriau (IPANEMA)
Mankind, prehistory, nature and societies	Jean Denis Vigne (MNHN)	Aurélie Salavert (MNHN) Florence Revelin (MNHN)
Systematics, evolution and comparative anatomy	Mario de Pinna (MZUSP)	Romain Natier (MNHN) Damien Germain (MNHN)

We also wish to thank for their financial and logistic support:

→our **sponsors and hosting institutions**:

→the **organizing associations**:

Biodiversity, Dynamics and Conservation

INVITED CHAIRMAN

A natural history of the Guam island
Laurent Palka, EGB, MNHN

My presentation will focus on ecology and biodiversity on the island of Guam (Western Pacific Ocean), through two short stories. The first describes the high consumption of bats by the locals (Chamorro people) that led the species *Pteropus mariannus* to decline dramatically. Today the population is about 100 individuals according to the red list of IUCN and expected to be extinct in the Guam island within 10 years. In parallel, a peak in incidence of a mysterious neurological disease occurred among the Chamorros thought to be caused by a cyanobacterial toxin. The biomagnification hypothesis offers a link between both phenomena. The second story is about an invasive species of snake, the brown tree snake *Boiga irregularis*, likely carried along as stowaway in ship cargos or aircrafts. The snake is responsible for devastating the majority of native bird population and bats as well.

ORAL PRESENTATIONS

Mitigating the impact of light pollution on biodiversity: Is part-night lighting an efficient way to reduce the impact of artificial light on bats?

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The effect of Artificial Light At Night (ALAN) on biodiversity is of growing concern in conservation biology as it may cause nightscape fragmentation and impede wildlife movements. Currently, many local administrations have started part-night lighting schemes by turning off streetlights from midnight to 5AM. This measure first aims at reducing energetic costs but it may also influence the effect of light pollution on biodiversity. However, the effect of this measure on biodiversity has never been addressed. Bats appear to respond differently to ALAN and are good candidates to determine the effectiveness of this measure. We set up a field experiment on bats during two summers 60 km south of Paris. We selected 45 pairs of two sites presenting similar habitat characteristics but exposed to different streetlight treatment (lit/unlit). 25 pairs were located in areas where streetlights were turned off from midnight to 05 AM, and 20 sites in areas where streetlight were on all night. Bat activity was surveyed simultaneously on the two sites of each pair for one night using two ultrasound automatic recorder SM2 bat. Using Generalized Additive Mixed Models, we analyzed part-night lighting on the activity of the common pipistrelle *Pipistrellus pipistrellus* and the guild *Myotis sp*. As expected, the preliminary results show that the common pipistrelles present higher level of activity and *Myotis sp*. lower level of activity in illuminated areas. The common pipistrelles also appear to be negatively affected by part-night lighting, whereas *Myotis sp*. benefit from it. Interestingly, it appears that unlit sites are also more exploited by this group when they are located in an area with part-night lighting. This suggests that this measure ameliorate the accessibility of suitable foraging sites for the *Myotis sp*. group. Part-night lighting of cities and surrounding infrastructures may hence ameliorate landscape connectivity for light-sensitive bat species.

Spatial structure of micronekton closely related to oceanographic fronts in the South-West Indian Ocean

Behagle Nolwenn

Intitut de Recherche pour le Développement (France)

Collecting information on the distribution of micronekton is essential to increase our knowledge on their predator dynamics and is a unique opportunity to monitor fisheries resources before its future exploitation. Hydroacoustics were used to investigate the vertical distribution of micronekton according to a horizontal latitudinal gradient (i.e. water masses delineated by fronts) discriminated by analyzing spatial remote sensing data. Acoustic data were collected continuously at 38 kHz frequency during eighteen transits carried out in the South-West Indian Ocean (20-60°S, 50-80°E) between 2010 and 2014 including scientific (source: MyctO-3D-MAP French project) and opportunistic fishing surveys (source: Integrated Marine Observing System 'IMOS' Australian project). A structure in three main depth layers (surface, intermediate and deep) has been found continuously along the latitudinal gradient 20-60°S. Changes of micronektonic spatial structure in the vertical plane and in terms of thickness and density were investigated along this gradient. Considering our whole dataset gathering all seasons and years, the surface layer acoustic density and thickness decrease by going southward. The intermediate

layer is generally almost empty except between 30 and 40°S where it is well-defined. Moreover, the deep layer acoustic density increases from North to South but its thickness does not change significantly. A spatially constrained clustering was applied on acoustic data to assess the importance of vertical changes in acoustic structure along the latitudinal gradient. For the whole dataset, analogous horizontal groups were observed with obvious latitudinal limits along seasons and years as well as distinct profiles. A positive correlation is established between vertical acoustic organization and fronts' position which explain the stable latitudinal structure reported in this study. We conclude that spatial organization of micronekton is structured depending on water masses and confirm the interest of collecting acoustic data from fishery vessels to complete scientific surveys that are often restricted in time and space.

Vulnerability of two marine gastropods *Stramonita haemastoma* and *Conus ventricosus* to organostanic pollution along the coast of the Gulf of Tunis and the Cap Bon

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Unité de Recherche Biologie Intégrative et Ecologie fonctionnelle et évolutive des milieux aquatiques (Tunisia)

This work is a comparative study of the eco-toxicology of two gastropods bioindicators living in the coast of the Gulf of Tunis and the Cap Bon: *Stramonita haemastoma* and *Conus ventricosus*. A total of 13 stations were prospected along these shores. Vertical distributions were estimated for all stations using 4 transects of 10 x 5 m each, separated by 10 x 10 m. Imposex degree was evaluated in females using four indices: Imposex rate, Index of penis relative length, Index of relative penis size and Index of vas deferens sequence. Vertical distribution analysis revealed that the majority of *Stramonita haemastoma* individuals' were concentrated at the bedrock of the mediolittoral. As for *Conus ventricosus*, it was subservient to the soft substrate of the upper part of the infralittoral. Females' masculinisation was reported in both species with different degrees depending on the stations. *Stramonita haemastoma* showed the anomaly in all the studied sites and the highest rates were observed near the major harbours of Sidi Bou Said (82.35%) and La Goulette (86.36%). This phenomenon was only signalled at 3 stations in *Conus ventricosus* with an advanced stage in La Marsa (45.45%) and early stages in Kelibia (27.27%) and Sidi Bou Said (11.11%). The difference in the sensitivity of these species to organotins could be attributed to their habitat conditions. Indeed, the constant immersion of *Conus ventricosus* at the infralittoral could be at the origin of a regular metabolism and continuous vital functions. At the mediolittoral, the occasional supplying with oxygen would lead *Stramonita haemastoma* to a slowing metabolism during desiccation period. This could cause a weakening of the physiological state and an autointoxication by organotins' accumulation. In conclusion, the affection of intertidal organisms', in the Gulf of Tunis and the Cap Bon, by organotins seems to be narrowly related to species' eco-physiology.

The seasonal change in Antarctic sea-ice cover influences the structure of invertebrate food web at Terra Nova Bay (Ross Sea)

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Seasonal-related changes in the dynamics of Antarctic sea ice strongly affect primary production patterns during spring. Such changes can impact benthic communities fuelled by sympagic algae and plankton, propagating throughout the food web. Thus, the study of the effects of changes in resources availability in benthic habitats could be a key for understanding the effects of the climatic change on the ecosystem functioning in Antarctica. In this study, we addressed the trophic organisation of benthic communities at Terra Nova Bay (Ross Sea), by sampling five locations showing different sea-ice cover dynamics during the Antarctic spring. Trophic niche descriptors and trophic links were obtained both at community and population level by mean of C and N isotopic analyses and Bayesian mixing models. We hypothesised an increased contribution of sea-ice algae to benthic food web in the absence of sea-ice cover and a predominance of detritus consumption and intraguild predation in ice-covered locations due to conditions of resource shortage. According to our hypothesis, sea-ice algae fuelled benthic communities only in those locations poorly subjected to sea-ice cover. As a consequence of increased quality range of available resources, we observed that trophic niche broadened at the community level and narrowed at the population one, in according to foraging optimisation strategies. On the contrary, both intraguild predation and niche overlap between populations increased in ice-covered locations. These results suggest that macroinvertebrates were able to shift their diet on alternative resources when available, mediating the re-distribution of different nutrient inputs along food chains following changes in sea-ice cover. Although future changes in sea-ice dynamic in the Ross Sea are still difficult to predict, trophic-functional responses of macrobenthonic taxa can be crucial in explaining the effect of climatic changes on the functioning of Antarctic coastal ecosystems.

Effect of habitat structure and reproductive activity on the condition of a small teleost

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In lagoons and estuaries, small brackish-water creeks represent important habitats for many fish species, in particular for the small lagoon residents. Aim of this study is to determine the influence of habitat structure and reproductive activity on the body condition of a small teleost, the South European Toothcarp *Aphanius fasciatus* (Valenciennes, 1821) (Actinopterygii, Cyprinodontidae). Fish were sampled from March to September in four sites of the Venice lagoon: two natural salt marshes and two artificial creeks. For both sexes, condition factor was calculated for each specimen, according to the relative weight methods, using the length-weight median regression estimated on all the sampled specimens. Comparisons among habitats were carried out by means of quantile regression analyses, considering also the reproductive effort and the resource availability. Results showed a significant effect of habitat type, resource level and reproductive activity on fish body condition, with different patterns between sexes. On the whole, analysis of body condition detected variations, even on a small spatio-temporal scale, of the status of fish populations. Further studies may unravel more specific cause-effect relationships, suggesting condition factor as a useful tool in the management and conservation of fish populations.

Do malaria parasites manipulate the host preference of their mosquitoes vectors?

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Many parasites have evolved the ability to manipulate the behavior of their host in a way that increases their transmission. One such manipulative parasite is *Plasmodium falciparum*, a species transmitted by the bites of mosquito vectors and responsible for the most severe form of human malaria. Several studies have shown that *Plasmodium sporozoites* (transmissible stage) can induce increased mosquito aggressiveness and biting rate, thereby increasing parasite's transmission potential. However, despite its medical importance, no study has yet explored whether this parasite can not only bite more but also better. *P. falciparum* is a specialist parasite species that only infects human as vertebrate hosts. However, the mosquito species responsible for the transmission are diverse and show varying level of anthropophily (some species feed almost exclusively on human while other are mostly zoophilic). It is currently unknown whether malaria parasites could affect mosquito decisions on feeding between species and whether this ability can depend on the degree of vector's anthropophily. To address the question, we used field isolates of P. falciparum and two natural vectors: *A. gambiae* (considered antropophilic) and *A. arabiensis* (considered zoophilic) in Burkina Faso. Female mosquitoes were fed through membranes on gametocyte-infected blood. Control mosquitoes were fed on the same blood in which gametocytes were heat-inactivated. We explored differential behavioural responses to human and calf odours between infected and uninfected mosquitoes. The behavioural responses (i.e. degree of activation and preference) were investigated using a wind tunnel designed to accommodate whole hosts as a source of odour stimuli. We predicted increased preference for human odour in sporozoite-infected mosquitoes compared to uninfected counterparts.

Search for active compounds against dengue virus from Diospyros and their associated endophytes

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2. Architecture et fonction des macromolécules biologiques (France),
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Dengue fever is the most prevalent mosquito-borne viral disease of humans. In 50 years, the incidence of dengue has been multiplied by 30 (1). Efforts to decrease transmission by vector control have failed, and no effective antiviral treatment is available.

In 2009, a screening using a dengue replicon virus-cell-based assay (2) led to the selection of species from the genus *Diospyros* (Ebenaceae). Among this genus, 20 species, distributed in tropical areas showed significant inhibitory activity on dengue virus replication.

The aim of the study is to isolate and characterize active compounds from *Diospyros* species and/or their associated endophytes. Initially, metabolic proximity analysis was conducted from the UPLC-HRMS profiles of 33 plant extracts. The metabolic proximity is presented in the form of a dendrogram using the software MZmine 2 (3). The results of this study showed that the chemical similarity is not related to the plant species or plant organs. Overall,

metabolomic profiling allowed us to define large groups of extracts, both comprising active and inactive ones. Closely related profiles from active extract might indicate that the common major components of these extracts are responsible for the antiviral activity, while the comparison of chemically similar active and inactive extracts, will permit to and compounds of interest. For example, the only obvious difference between *D. fasciculosa* leaf extract and *D. glans* and *D. vieillardii* bark extracts is the presence of a peak at tR 23.50 min with m/z 499.3867(MH+). This compound will be isolated and characterized in priority. To conclude, this methodology combining UPLC-HRMS and the data processing toolbox MZmine 2 proves to be a powerfull tool in dereplication.

(1) Messina JP. *et al*. (2014), Trends in Microbiol. 22: 138-146
(2) Massé N. *et al*. (2007), Virologie; 2: 121-33
(3) Pluskal T. *et al*. (2010), BMC Bioinformatics 11: 395-406

Impact analyses of riverscapes fragmentation on the conservation of bryophyte communities

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Biodiversity conservation planning and the impact of human activities on biodiversity and landscapes are some of the most pressing issues in ecology nowadays. Freshwater biodiversity is among the most threatened worldwide, hence conservation planning is an urgent need. The objective of this work was to provide an integrated assessment of anthropogenic impact and its implications for conservation planning and riverscapes' bryophyte diversity, in Northern Portugal. To accomplish the sought integration and overcome the lack of spatial chorological data for fluvial bryophytes a community-level modelling approach was employed. We obtained a set of four community types that constituted useful surrogates of regional bryophyte species presence for conservation planning and management. The distribution of the four community types was modelled and projected for the study area using biomod2. In order to assess the impact of energy production schemes and transportation networks, on fluvial bryophyte communities, spatial data on these elements and on respective areas of influence and magnitudes of impact was superimposed to the communities' potential distribution. A spatial conservation prioritization analysis using Zonation software was conducted to spatialize priority conservation areas chosen based on three bryophyte communities rich in conservation interest species and different combinations of fragmentation restrictions. We found that a considerable part of impact is located within protected areas of the study area, which undermines their efficiency for the protection of fluvial bryophytes. Main roads were found to be the leading cause of impact across all communities. Zonation analyses further reinforced the necessity of effective management strategies in protected areas This work, using fluvial bryophytic communities as a biological model for conservation studies, demonstrated that constraining protection of biodiversity to protected areas is not necessarily an effective strategy and that a more integrated management approach of a region and fragmentation elements should be considered in the overall conservation policies.

Unable to hide: Behavioural changes in the brown shrimp due to heavy metal pollution.

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Understanding the effects of heavy metal contamination in estuaries is becoming an increasingly important topic in conservation biology. Heavy metals show a high bioavailability and some bioaccumulate, making them a threat to a wide range of animals. Benthic invertebrates are extra sensitive to them since heavy metal concentrations in the sediment are higher than in the water column. Exposure to heavy metal pollution can cause a variety of effects, including behavioural impairment, endocrine disruption and, in the most extreme circumstances, death. Many studies on the effects of heavy metal pollutants in invertebrates focus on the lethal concentration at which 50% of the population dies (LC50). Although LC50 is a well-established method, recent studies indicate that behavioural endpoints are more sensitive than LC50 trails and provide more ecologically relevant results. The number of studies focusing on the behavioural effects of heavy metals on marine crustaceans is nonetheless still very limited. This project focuses on the effects of heavy metal pollution on the behaviour of the brown shrimp (*Crangon crangon*). This is an ecologically and commercially important species distributed from North-West Russia to Morocco, the Mediterranean and the Black Sea. Results will be presented to discuss whether heavy metal pollution can indirectly influence the shrimp's fitness by changing its behaviour.

Dimorphism, performance, and personality in the Grey mouse lemur (*Microcebus murinus*)

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Sexual dimorphism is common in animals, including mammals. Sexual dimorphism has been suggested to be the result of sexual selection for traits that provide a mating advantage (often traits important in male-male competition). However, competition for access to food, or the differentiation of ecological niche avoiding competition between the sexes, may also play a role in driving phenotypic differences between the sexes. In most primates, sexual dimorphism is marked, often in connection with a social system involving polygyny. However, prosimians have an exceptionally low degree of dimorphism compared to other primates. The grey mouse lemur (*Microcebus murinus*) is an exception, and female mouse lemurs are known to be larger than males. However, whether other traits also differ between the sexes remains largely unknown. Here we studied a colony of captive lemurs and measured the dimensions of the head and limbs. Moreover we measured ecologically relevant performance traits including grip force and bite force. We also measured personality traits including the latency to start exploring an open-field test chamber and the latency to exit a box. Our results show that females are larger than males in accordance with previously published data. Moreover, females have larger heads and bite harder than males. For grip force performance and exploration, we did not find any significant difference between males and females. However, males and females differed in the latency to exit the box with males taking less time than females. Taken together, our data show sexual dimorphism in performance and tend to support the theory of niche differentiation between males and females in the grey mouse lemur.

How does mammal species diversity respond to landuse intensity and does it impact the poor in Mozambican Miombo?

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Miombo, colloquial Swahili term for trees belonging to the Genus *Brachystegia* is also largely used to represent the deciduous woodland in Southern Africa. Miombo ecoregion being centre for endemism for many species groups is important in terms of biodiversity and human well-being as about billion people, majority of which are poor, depend on it for their basic needs. The ecology of Miombo is largely determined by the unique set of geomorphological, environmental and anthropogenic factors making it one of the prominent and complex socio-ecological systems. Like other ecosystems Miombo is being altered by changing landuse and it is important to understand the consequences of such a transformation on biodiversity and related ecosystem services. The woodland loss in the Gaza province of Mozambique due to changing and complex landuse dominated by charcoal production represents the complexity of a typical Miombo. We selected a charcoal landuse gradient comprising of 6 villages and documented terrestrial mammal, insect and tree assemblages. We undertook a multiscale assessment- multispecies, multitrophic and multi trait perspective to aptly accommodate the complex nature of biodiversity-landuse dynamics and to understand more about the underlying process and interactions that pre-determine species response to change. The preliminary results suggest loss of species and trait richness and that species converge in trophic and trait space in high charcoal landuse. Does this affect the poorest in the Mozambican Miombo? Can we predict species winners and loosers based on traits? These are re some questions that we are trying to answer.

Invertebrate community resistance and resilience to river drying

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One important goal in community ecology is to understand patterns of species diversity, notably in disturbed ecosystems. Flow intermittence (i.e., the periodic loss of water) represents a disturbance that affects ~50% of rivers worldwide; yet, its effects on communities in many river systems remain unknown and thus impede our ability to predict future changes in biodiversity. We examined the response of invertebrate communities to flow intermittence in one such system, alluvial rivers, using a combination of field surveys, in situ flow manipulations, and laboratory experiments. First, we explored the effects of drying events of different durations (14–105 days) on invertebrate communities in 8 alluvial rivers in southeastern France. Surprisingly, communities were similar to control (no drying) reaches, regardless of drying duration, after as few as 19 days of flow resumption; indicating high resilience (i.e., capacity to recover from disturbance). Second, we used a flow manipulation experiment to quantify the importance of invertebrate drift, which is thought to be the main source

contributing to resilience in previously dry channels. After drying 6 river channels for 7 days, we prevented colonization by invertebrate drift in half of the dry channels. Despite reducing abundance and diversity by up to 100% during drying, recovery of communities occurred within 2 weeks of rewetting; including in the channels where drift was prevented, indicating that recovery was supported by other sources of colonists. Third, laboratory mesocosm experiments showed that invertebrates actively seek refuge in the hyporheic zone (i.e., saturated interstitial areas beneath the riverbed) to escape the increasingly harsh abiotic (temperature) and biotic (intraspecific competition) conditions that occur in drying rivers. These results suggest that the hyporheic zone plays a key role in maintaining resilient biological communities in alluvial rivers and improve our understanding of how communities respond to flow intermittence.

POSTERS

Assessing the geographical distribution of Sorghum bicolor in Africa

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The general objective of our study is to describe how social, environmental and genetic factors have interacted to shape the modern distribution and diversity of sorghum and millet in Africa. So far, environmental factors influencing sorghum distribution have only been studied at the regional or country levels. I address this question at the continental level through an Ecological Niche Modeling approach (based on climate and soil), using the Maxent machine learning software. Distribution models were developed from georeferenced data, obtained from GBIF, Genesys and IRD, for cultivated sorghum (2632 occurrences) and spontaneous forms (84 occurrences) Geographic coordinates were systematically checked with gazetteers. Associated bioclimatic data were extracted from the WorldClim database, allowing the characterization of climatic envelopes of cultivated and spontaneous sorghum with a Principal Component Analysis (PCA). The cultivated sorghum model well describes its quite continuous distribution, as documented in the literature, with wide presence in the sub-Saharan regions and in eastern Africa. In contrast, the distribution predicted for spontaneous forms is dispersed and even disjunct. Both models were validated by literature data. They are not explained by the same bioclimatic variables: temperature and precipitation during the dry season appear less important for cultivated populations than for spontaneous ones. According to the PCA, the climatic envelope of spontaneous forms is contained in that of cultivated sorghum. However, both envelopes appear to be similarly constrained by the same variable combinations, related to high temperatures and low precipitation during the dry season. In a first approach to identify soil parameters for a better model of sorghum distribution, carbon content and silt percentage appeared to be good candidates. Soil acidity is also important, but only for cultivated sorghum. Texture components may be important to buffer climate aridity.

Deciphering the role of the anthropogenic disturbances in ecological processes: the role and impact of two predators in changing environments.

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Urban areas strongly alter ecosystems through land use change, multiplication of anthropogenic barriers or accumulation of pollutants and heterogeneous distribution of resources. In "île de France" region these disturbances are well known but their consequences on predator-prey interactions are poorly studied. In this study we look at different degree of anthropogenic disturbances in three contrasted areas: forests, agro- ecosystems and urban parks. These three ecosystems will allow us to study how the nature and intensity of anthropogenic disturbances can alter predator presence and their subsequent impact on prey populations. We will focus on two predators that are among the most abundant in urban environments: the domestic cat *Felis silvestris catus* and the red fox *Vulpes vulpes*. These two predators are particularly interesting to study simultaneously due to their potential interactions like competition for food and/or habitat or their potential exclusion behavior. We aim to determine the difference of these two predators for their (i) diets, (ii) movement and territory behaviors, and (iii) seed dispersal function. We will study their diet according to main prey abundances, habitat and seasons. If possible, we will use molecular technics to understand their diet at individual scale. These data will be coupled with those obtain for their movement and territory habits thanks to GPS tracking and hair traps. Finally, to have an overview of these predator impacts on the whole ecosystem, seeds ingested by cats and foxes will be studied through viability analysis and seed germination protocol. This research work is just beginning but we strongly think that the results obtained through this study will make outstanding results appeared. We expected to discover a

large panel of predator individual and population behavior depending on their range of prey specialization, habitat use and different anthropogenic disturbances.

Acoustic data assimilation for estimating energy transfert parameters of a micronekton model

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2. Centre d'Études Biologiques de Chizé (France)

SEAPODYM Forage is a micronekton model used to simulate foraging fields of top predators (tunas, swordfishes, turtles, seals...). In this framework, micronektonic organisms are divided into 6 functionnal groups according to their diel vertical migration. Their dynamics is driven by temperature and oceanic currents. Micronekton production is modeled as a percentage of energy transfer from primary production to mid-trophic level. This amount of energy is allocated to each group with transfert energy coefficients which are not reachable throught direct observations: this work uses data assimilation to assess them. Data assimilated into the model are ratios of biomass over the water column – calculated from 38kHz-acoustic density used as a proxy of micronekton biomass. A negative log-likelihood function (mainly distance between observations and model estimations) is minimized with help of a gradient descent method (Quasi-Newton algorithm). Gradients are estimated with an adjoint code. We present an illustration of assimilation experiments with multiple transects in various environments.

Citizen science: a tool for the study of the ecology of French ladybirds

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Studying ecology and evolution of taxa requires an adequate level of data, both in terms of quantity and diversity of geographical origins. Thanks to the general public and non-professional scientists, citizen science programs allow to obtain an adequate sampling according to standardized protocols. Here, we used data from the citizen science Spipoll program (Vigie-Nature, MNHN) to bring out the links between habitat settings, distribution and density of some ladybird (Coleoptera: Coccinellidae) species in metropolitan France. We will present and discuss the results related to some environmental settings such as latitude, altitude and intensity of human activities.

ClimTaille Project: Body size decline and climate change, from theory to data

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Climate change are acknowledged for altering geographic range and phenology of species. Shrinking body size was recently suggested as the third universal ecological response to warming. As predicted by Bergmann's rule, species living under warmer climatic conditions trend to be smaller. This size pattern is well supported for endotherms along a spatial gradient (i.e., latitude or altitude). So far, weak evidence was found for changes of body size through time and few studies investigated their adaptive nature. This project aims at stating (1) which species experienced body size changes through time in France; (2) which ecological or phenotypic trait is associated with these changes; (3) if body size variation is due to climate change and whether it is associated to temperature variation or food availability; and (4) whether body size decrease is adaptive or not. To achieve this, we will explore body size variation of 35 common bird species monitored during a 25 year survey in France (STOC-Capture program, 1989-2014). We will test which environmental variables best explain body size variation with a modelling approach that includes climate, land use and primary production variables. Finally, we will use mark-recapture models to estimate the dependence of survival rates on body size change. Hence we will attempt to predict body size clines in response to climate change and provide guide lines for future conservation actions.

Females collared flycatchers choose close and more ornamented extra-pair partners from a pool of males around their nests

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Females of many bird species often raise chicks from better males than their social mates. They may avoid mate guarding and travel across the breeding area to assess males' quality and choose their extra-pair partners. In this way, females may obtain some indirect benefits for their offspring. In collared flycatchers (*Ficedula albicollis*), females prefer males with larger wing and forehead patches and extra-pair paternity is common. We were interested on females' abilities to assess males' quality in a given area and

which traits they selected males as extra-pairs partners. During the field season, males were measured and their blood was sampled. Comparisons between chick and father genotypes allowed the determination of within and extra-pair paternity, and in some cases to determine the identity of the extra-pair father. GIS enabled us to estimate distances between the mother and extra-pair males' nests and determined the potential extra-pair males available in the area around the females' nests. Firstly, we compared the ornaments and morphological traits of cuckolded and non-cuckolded males, as well as those of social mates, potential mates, and extra-pair mates. Interestingly, we found that more ornamented males lose more paternity in their nests. Extra-pair males were more ornamented than potential males, and generally had longer wings than social males. Females also choose males closer than all their possibilities but not the closest and no traits influenced the distance. These results may be explained in the context of mate guarding behavior: less attractive males may guard their mates more intensively to avoid losing paternity. On the other hand, more ornamented males may spend more time attracting extra-pair females, and this lack of guarding could lead females to seek more attractive extra-pair mates around their nests. In conclusion, females gain extra-pair paternity with larger males among a pool of males around their nests.

Birds demographic answers to global changes in space: from national trends to local management

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Disruption of natural habitats and climate change affect birds populations (distribution, size) at national scale. However, demographic changes behind these variations are not well known. In addition, too few studies have looked at which spatial scale these changes take place (national? regional? local?). The french Constant-Effort-Site (STOC-Capture) is a national banding program began in 1989. It aims to sample common bird species with a standardized protocol. This program is applied to more than 200 sites in France, and has allowed to capture 120 000 adult individuals from 30 different species. Two demographic parameters are suffisant to describe birds demography: the local survival and the recruitment. The local survival, is the probability for an adult present in a given site to be present in the same site next year. The recruitment is the probability for a site to recruit new adult individuals. These demographic parameters are estimated with the software of Capture-Mark-Recapture E-Surge. The first objective of this thesis is to estimate at which spatial scale demographic parameters vary. These results will permit to study at which spatial scale climatic variations force on demographic parameters.

Temporal variability of carbonate biogenic dissolution by microborers and response to environmental factors in coral reefs (New Caledonia)

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Biogenic dissolution of carbonates by microborers (or microbioerosion) is one of the main destructive forces in coral reefs. This process seems to be enhanced by eutrophication and ocean acidification and the chlorophyte *Ostreobium sp.*, the main agent of this process, appears as the most responsive microboring species to those environmental factors. *Ostreobium sp.* recruitment period, its development along community successions, the impact of its dynamics on rates of biogenic dissolution and how it is affected by environmental factors remain however, poorly known. An experiment was thus carried out on a reef in New Caledonia to study with a monthly resolution, *Ostreobium*'s ecology, microboring community successions and biogenic dissolution dynamics over time. Blocks of dead coral were used and exposed to colonization by microborers over six periods of one year, 3 starting in summer and 3 starting in winter, allowing the determination of the seasonal and interannual variability of the biogenic dissolution process. In parallel, environmental parameters (T°C, pH, chla, etc...) and biotic factors (grazing pressure and epilithic cover) were recorded every month and/or continuously. Results showed that (a) microboring communities at their early developmental stage (1-3 months) were dominated by large chlorophytes and induced low rates of biogenic dissolution whatever the studied year, (b) between 3 and 6 months, the chlorophyte *Ostreobium sp.* started dominating communities which consequently increased rates of carbonate dissolution more or less exponentially depending on the studied year, and (c) after 6 months of exposure, *Ostreobium* was finally well settled and biogenic dissolution rates slowed down to reach a 'plateau' with some variations probably correlated to biotic factors. At a larger temporal scale, biogenic dissolution dynamics and rates varied greatly among studied years and seasons. Multivariate analyses were carried out to determine the main factors (biotic and abiotic) which could explain those temporal differences.

Testing the impact of habitat-driven swimming movements on the dispersal of juvenile Western Pacific leatherback turtles (*Dermochelys coriacea*)

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The implementation of targeted conservation measures for threatened species requires an accurate knowledge of the spatial distribution at all life stages. For the leatherback turtle (*Dermochelys Coriacea*), a vulnerable species (IUCN, 2013), satellite-tracking provides adequate data on the migration routes and distribution of adults, but observations of newborns and juveniles are largely missing. In an attempt to solve this problem, several authors have hypothesized that leatherback hatchlings drift almost passively with the oceanic currents so that their distribution at sea can be deduced from numerical simulations of the dispersal of Lagrangian (i.e. passive) particles drifting with simulated ocean currents. While the passive drift hypothesis certainly holds for the very first months of life, it becomes less and less valid as individuals grow and become more powerful swimmers. The results of passive drift simulations are thus questionable for individuals older than 1 year or so. As an example, Gaspar et al (2012) showed that, assuming a purely passive drift, 5- to 6-year old juvenile leatherbacks from New Guinea rookeries should reach the eastern part of the North Pacific (east of 150°W), a prediction in contradiction with bycatch and sighting data which indicate that only large individuals, certainly older than six, are present in this area. In this paper we present a simple model of the swimming activity of leatherback turtles in which we only assume that (1) swimming is directed towards more favorable habitats (in terms of food concentration and water temperature) and (2) swimming speed increases with age (and thus size). We show that adding such a simply-modeled swimming activity to current-induced drift, significantly reduces the eastward movement of simulated New Guinea-born leatherback juveniles headed towards California. As a consequence, the simulated size/age spectrum of individuals approaching the Hawaiian archipelago and then California better matches observations.

Accelerated seasonal rhythm leads to accelerated aging in a primate species

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Senescence is a deterioration of physiological functions leading to an increase of mortality hazard with advancing age. At the intra-specific level, individual differences in pace of aging may arise from differences in frailty and environmental conditions. However, the effect of intrinsic functioning on individual mortality is still largely unknown. The grey mouse lemur *Microcebus murinus* is a primate adapted to drastic seasonal fluctuations and undergoes physiological and behavioral changes induced by photoperiod. This characteristic allowed us to experimentally accelerate the photoperiodic seasonal rhythm of individuals and to study the effect of this acceleration on individual mortality hazard. 1619 captive grey mouse lemurs were raised under seasonal rhythms ranging from 2 (observed in natura) to 5 seasons/year and various disequilibrium between dry and wet seasons. All individuals were kept under the same captive conditions (temperature, humidity, resources availability). Survival analyses showed that accelerated seasonal rhythm leads to accelerated aging. Individuals experiencing four seasons per year instead of two die 1.24 times more at a given age. They also die faster with mortality levels and derivatives of mortality hazard respectively equal to those of control individuals 1.17 and 1.75 times their age. Moreover, the less time the grey mouse lemurs spend in dry season (period of resources shortage), the faster they age. Torpor use for energy saving may therefore induce body repair and protect organisms from aging. The differences in mortality hazard according to the seasonal rhythm imply an intrinsic response since all individuals are exposed to the same environmental conditions. Further studies will investigate the physiological mechanisms underlying this aging pattern variation.

No coherence between spatial gradients and temporal trends in bio-indication by vegetation for forest soil chemical properties

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Bio-indication by plant communities is widely used in both research and forestry to predict the value of environmental parameters. Plant indicator values (IV) are derived from niche modeling, and allow estimating parameters of a site by averaging the IVs of the species from the local community. The reliability of bio-indication through spatial gradients is verified. Bio-indication is often employed to study temporal trends, supposing that the correlation between IVs and soil properties remains valid through time. IVs are notably used to assess plant community evolution in response to soil

eutrophication and acidification. However, the relevance of this transposition was not clearly proven. We tested to which extend plant community dynamics reflect changes in soil composition. We used 15 years of monitoring data on 100 permanent plots from the French RENECOFOR network to compare spatial and temporal relationships between plant bio-indication and measured soil variables. Plant IVs for pH and C/N ratio varied significantly among plots and through time, as did the soil properties (pH, carbon and nitrogen content). The strong spatial correlation between IVs and soil parameters at each monitored date confirmed the relevance of vegetation bio-indication. However, the significant temporal changes observed in soil parameters were not correlated to the evolution of IVs. We also examined bio-geographical factors that might influence the plant bio-indication/ soil composition relationship through time. Temporal changes in IVs inferred by vegetation were not reflecting the substantial measured changes in soil composition over a 15-years period. As understorey species are mainly perennials, it might be due to a delayed response of vegetation. Yet, the correlation between soil and bio-indication might be not strong enough to bring out such subtle changes. To predict the impact of environmental changes on vegetation, models should thus take into account this weak reactivity of understorey vegetation to soil composition changes.

Site-specific height-diameter allometry of Central African moist forests

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In this study we aimed to identify the variation in height-diameter allometry between forest types and among species in Central African moist forests. We also examined the consequences on biomass estimation. Two forest sites in southern Cameroon with contrasting levels of deciduousness. Height and diameter were measured for a total of 521 trees belonging to 12 timber species over a large range of diameter, 10-240 cm for the Ma'an site and 11-182 cm for the Mindourou site. Commercial forest inventory data (n=7253 0.5ha plots) were gathered for the Ma'an (n=34 samples and 2101 plots) and Mindourou (n=117 samples and 5152 plots) sites. A total of nine allometric models (including polynomial, asymptotic and non-asymptotic models) were fitted to the height-diameter data at species (n=12) and site (n=2) level. Site-specific height-diameter allometric equations were compared to a set of global and/or regional published equations. Biomass estimates were computed based on forest inventory data and general allometric models using both site-specific and published height-diameter equations. The height measurements performed over a wide range of diameters, 10-240 cm, tended to support an asymptotic shape for the height-diameter allometry either at species and site level. We identified a significant difference in height-diameter allometry between the two study sites. For a given diameter, trees tended to be taller in the more semi-deciduous Mindourou site than in the more evergreen Ma'an site. Similar trends were reported within species for the three species shared by both sites (*Cylicodiscus gabunensis* and *Pterocarpus soyauxii*, and *Lophira alata* to a lesser extent) suggesting an environmental control on tree allometry, although local adaptation cannot be excluded. Consequences on the estimation of biomass and carbon stock. Height-diameter allometry strongly varies between sites and site-specific height-diameter allometric equations should be developed to further improve the estimation of biomass and carbon stock contained in tropical forests.

Influence of environmental conditions on the distribution and foraging behaviour of seabirds in a tropical pelagic ecosystem

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While resource acquisition strategies of marine predators are well studied in polar and temperate environments, far less is known in tropical marine environments that are, in comparison, less productive. Resources are more dispersed in the tropics, with low seasonality and high interannual variability due to climatic events such as El Niño and La Niña. Due to these conditions, tropical seabirds may use different foraging strategies than polar or temperate seabirds to minimize costs associated with large but low-quality foraging area. Additionally, tropical seabirds can associate with subsurface predators like tuna and marine mammals. Here we study the influence of various environmental variables on the habitat and foraging behaviour of a pan-tropical species: the red-footed booby, on Europa Island in the Mozambique Channel. Adult individuals were fitted with GPS tags during incubation and/or brooding in 2003 (n = 17), 2011 (n = 33), 2012 (n = 31), 2013 (n = 41) and during fledging in 2014 (n = 8). Duration of foraging trip (h), total distance covered (km), maximum range from the colony (km), proportion of time on the water (%) and area-restricted search (ARS) behaviour were compared between years and

breeding stage. In order to explore links with environmental conditions, tracks were superimposed on maps of Sea Surface Temperature (SST), Chlorophyll A concentration, and submesoscale filaments produced by the stirring and straining by mesoscale eddies.

Development and sex determination sensitive to temperature under climate change constraints

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Environmental sex determination is a widespread phenomenon in many taxonomic groups but its most spectacular development is observed in chelonians for which most species have a sex determination dependent on the temperature of eggs. However, the consequences and ecological constraints of this kind of sex determination have so far been studied only from eggs incubated at constant temperatures. Development by the laboratory for new methods of analysis under natural conditions is promising since we have access to huge data sets that have never been analysed correctly. From the temperature recorded in the nest or in the ground, we are now able to predict the sex ratio of clutches. The thesis work aims to put this phenomenon in the context of climate change to assess sea turtles viability.

Effects of temperature on the density of *Gracilaria gracilis* in the salted pond of Ganzirri (NE Sicily): Global changes?

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Gracilaria gracilis (Rhodophyta) is an Agarophyta algae. From its thallus is extracted agar, a polysaccharide with many uses; it is widely used in food, chemical, pharmaceutical and microbiological sectors. The natural population of *G. gracilis* found in the salted pond of Ganzirri (NE Sicily) is an important economic resource in relation to the quantity and quality of the agar product. With the support of the INNOVAQUA project is being tested a cultivation of *G. gracilis* in Ganzirri's pond, with excellent results. Since several years the population of this alga is constantly monitored, in particular, by analyzing the chemical and physical parameters of the water. The most important parameter for its growth is the temperature; its increase, in addition to slow the growth of the alga, promotes the development of other competitive species, such as *Chaetomorpha linum*. The data collected in 2006 showed that during the summer the *G. gracilis* has a very poor density. The alga starts to grow when the average temperature of the water is below 25.5°C (September). In December (15°C) the growth increases, but the highest peak is observed in February (13°C). The density is highest during the month of May (T about 22°C), above which the density of the alga collapses drastically. In 2011 and 2013 the average temperatures, higher of about 0.5°C, have produced a staggered growth curve, with a peak of growth in January and a maximum density in April. It is observed as a small overall increase in temperature corresponds to a drastic reduction of the optimum period of growth of the alga. In 2014 (research in progress) the continuing high temperatures (September to November) led to a significant general delay in growth of the alga. This could involve a considerable change in the balance of the delicate ecosystem of the salted pond.

Botanic Gardens: a powerful instrument for the biodiversity conservation

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The ability to predict which and through what mechanisms the loss of biodiversity will impact on human well-being is due to our still incomplete and fragmentary understanding of the ecosystems complexity. While some processes are well documented on a global scale, as species loss, degradation of many ecosystems and an undeniable climate change, on a regional scale we have a few fragmentary and non-homogeneous data, that do not allow us to draw sufficient reliability trends of processes. Hence the need to implement at the local level strategies for biodiversity conservation, which would hinder the trend and make effective and efficient policies and strategies for biodiversity conservation, both in situ and ex situ. The "Global Strategy for the Conservation of Biological Resources of the Planet" identifies the Botanic Gardens the most appropriate instrument for the protection and conservation of biodiversity. The vegetal landscape of Lazio region is one of the most biodiverse in Italy. Latial vegetation includes about 3000 entities, rare species make the 29% of the total. The aim of this work is the reconstruction at the Botanic Gardens an ex situ native mixed deciduous forest and the conservation of some recalcitrant species included in this ecosystem. The forest comprehend an area of 2.5 ha in the Botanic Gardens of University of Rome "Tor Vergata". It was planted in 2010 even through citizen science campaigns. The mixed deciduous forest contains over 400 plants, representing the main consortia forest components of Latial mountain ranges. The selection of plant species was carried out using

syntaxonomical scheme according to Braun-Blanquet. The project final goal is the ex situ conservation of some Lazio region vegetational consortia in the arboretum of "Tor Vergata" Botanic Gardens and the cold storage of some hardness species through synthetic seeds.

Sabellaria alveolata (Annelida: Sabellariidae) reefs in the Mediterranean Sea (Southern Sicily)

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Sabellaria alveolata (Linnaeus, 1767), commonly named "sandcastle worm" or "honeycomb worm", is a gregarious tube-dwelling polychaete building tubes by assembling sand grains and shell fragments with a proteinaceous adesive. The tubes are closely aggregated to form large reefs. These bio-constructions, providing shelter and food to several reef-dwelling species, represent a valuable habitat for benthic invertebrates. For this reason, *Sabellaria* reefs are listed under Annex I of the EC Habitats Directive as a marine habitat to be protected by the designation of Special Areas of Conservation. *Sabellaria alveolata* reefs are usually intertidal, and sometimes subtidal, at temperate latitudes and they are commonly recorded in the NE Atlantic coast, from Bristol Channel to the Portuguese coast. Reefs are also found in the Mediterranean Sea, where they are usually smaller and less studied than the Atlantic ones. The aim of this study is to improve the knowledge of *S. alveolata* structures and associated fauna in the Mediterranean area. Reef samples were collected at three Sicilian sites (Sicily Channel), photographed and stored in absolute ethanol. After sorting, the collected specimens were identified at species level and counted. The morphological analysis was integrated by molecular analyses (DNA Barcoding) aimed at confirming the identity of some species of particular interest. Both analyses confirm the presence of two congeneric species in the reefs: *S. alveolata*, the dominant species, and *S. spinulosa*. The rest of the associated fauna was mainly composed by other polychaetes and crustacean amphipods. Among the most abundant polychaetes, *Eulalia ornata* Saint-Joseph, 1888 (Phyllodocidae) resulted new for the Mediterranean Sea. The Mediterranean Sabellaria reefs are a peculiar habitat not yet properly known. Further study would help to better understand the role of *S. alveolata* as ecosystem engineer and the factors influencing the dynamics of the biogenic reefs in order to promote their conservation.

Distribution and assemblages of the aquatic Hemiptera (Gerromorpha & Nepomorpha) in hydrographic basins of north-western Tunisia

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Different ecological - models are increasingly used to show spatial distribution of species in relation with the heterogeneous environmental conditions. We analyzed here, the assemblage of aquatic Hemiptera (Nepomorpha and Gerromorpha) in relation with the abiotic parameters in the hydrographic basins of north-western Tunisia. The composition of species assemblages vary in time, in relation to habitat quality, that determines the distribution of species, by the interplay among several structuring factors. In 2013, nine sampling stations were chosen to reflect the large variety of aquatic habitats present in the area. 30 species of Hemiptera Nepomorpha and Gerromorpha were sampled, totalizing 397adults. Several environmental variables (pH, conductivity, salinity, dissolved oxygen, water temperature and air, substrate type, current velocity, turbidity, major cations (Ca, Na, Mg, K) and anions (SO4, Cl, NO3), BOD, COD) were measured for each sampling site. Relationships between community structure and environmental variables were evaluated using multivariate analyses, including principal components analysis (PCA) and partial triadic analysis (PTA). Results revealed that the spatial distribution of aquatic Hemiptera was influenced firstly by an environmental gradient from lotic / lentic which are showing high correlation with morphological gradient (in this case altitude).

How threatened are Andean bears in Ecuador?

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From a total of eight bear species worldwide, the Andean bear (*Tremarctos ornatus*) is the only bear species of the Neotropic and the only living member of its genus. Andean bears are Vulnerable and their habitat has decreased to 42% of the range. In Ecuador this species is Endangered and only 32% of bear habitat is protected under the national law. In the last ten years, bears are increasingly killed by farmers and cattle ranchers because habitat is decreasing, and Andean bears are approaching farmland and eating crops

and cattle more frequently. Conflicts are increasing and new policies are needed to support the authorities and to protect Andean bears and people livelihoods in conflicted areas. Researchers, local non-governmental organizations, environmental institutions and people from mestizo and indigenous communities that live near Andean bear habitat have participated on conservation efforts but their impact is local, and not enough to cope with the high loss rate on bears and habitat. Andean bears are disappearing with a lack of attention from the world. We need support from the scientific community and a combination of techniques and efforts adapted to the local reality (human and environmental) to prioritize research and actions if we aim to conserve this species from extinction in the next decades. I will present a national assessment on the status, distribution and state of knowledge; including new scientific data on Andean bear density and genetic diversity and structure, plus the identification of key challenges and opportunities for conserving Andean bears in Ecuador.

Distribution, biomass, and meadow structure of *Caulerpa prolifera* (Chlorophyta) in a Mediterranean lagoon

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The Southern lagoon of Tunis is a coastal Mediterranean lagoon located in the Southwest of the Gulf of Tunis. It was one of the most eutrophicated lagoons of the Tunisian coast. Its phytobenthic communities were dominated by a high density of nitrophilous algae (Ulva and Cladophora) whose decomposition caused a severe ecological imbalance leading to a serious dystrophic crisis. However, after the restoration project, the situation in the lagoon has dramatically changed with a decline of pollution-tolerant species and of free-living macrophytes. In the present work, based on macrophyte density and biomass analysis, *Caulerpa prolifera* is the most dominant macrophyte species in the lagoon. It forms an extended dense meadow with coverage of nearly 100% at many sites. Furthermore, the phenological study describes the characteristics of C. prolifera and explains the ecological importance of this specie. Indeed, the stolons which make up an intricate network reach up to a mean length of 26.52 m/m² ± 13.41 and carry a high density of rhizoid bundles that attain a mean value of 2621 bundles/m² ± 1320. This ensemble (stolon + rhizoids), whose mean value of dry biomass is 48.24 g d.w /m² ± 32.66, has a large capacity to retain sediment, favoring its stabilization and a humification of the environment. The length of the primary and secondary fronds attains mean values of 5.9 cm ± 1.9 and 4.3 cm ± 1.5, respectively. Finally, the macrofaunal communities associated to *Caulerpa prolifera* were more important in the Center of the lagoon, where the highest biomass of this Chlorophyta has recorded, in terms of species richness and abundance. This result may elucidate the importance of *Caulerpa prolifera* as a key species in the Southern lagoon of Tunis.

Contribution to the evaluation of the biodiversity of Copepods parasite of Teleost and Chondrichtyan fishes from Tunisian coasts

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Copepods are an ecologically and economically important group with high species richness and abundance. In this study, 420 Teleost fishes belonging to 12 different species and 339 Chondrichtyan fishes belonging to 7 different species were examined for copepod fauna. The copepod collected from those hosts was studied morphologically for systematic comparison. The morphological criteria allowed us to identify 10 different species of copepods infesting the commercially exploited fish species in tunisian coasts. For the first time, we report the occurrence of *Lernaeopoda galei* on *Scyliorhinus canicula*, *Mustelus mustelus* and *Mustelus punctalatus* on the southern banks of the Mediterranean and in tunisian waters. Since parasitic sea lice represent a major sanitary threat to marine fishes, we checked tunisian ichthyofauna for ectoparasites copepods of the Caligidae family. This allowed us to assign *Caligus elongatus* as parasite of *Raja clavata* in Tunisia. This study enabled us to analyze the diversity and the specificity of copepods parasites. The description of these parasites species combined to their host affinities present a major and easy tool for fishes' sanitary surveys.

Earth and Planetary Sciences

INVITED CHAIRMAN

Meteorites and the building blocks of the Earth
Emmanuel Jacquet, MdC MNHN

The formation of the Earth occurred a few tens of million years after the formation of the solar system, 4.57 billion years ago. While terrestrial rocks have essentially lost all memory of their protoplanetary heritage due to intense geological activity, meteorites represent pristine samples from the earliest solids of the solar system. I will introduce meteorites (in

particular chondrites) and discuss to what extent they inform us on the makeup of our planet.

ORAL PRESENTATIONS

Change in dust and fluvial deposition variability in the Peruvian central continental coast during the last millennium: Response of the ocean atmospheric systems.

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We present record of laminated sediments core retrieved in the Peruvian continental shelf that covers the last ~700yr from Medieval Climate Anomaly (MCA), Little Ice Age (LIA) and the current warm period (CWP) at centennial to decadal resolution. The aim of the study is reconstructing sedimentation patterns in order to determine the most important processes that control the input of terrigenous material and understand how these components reflect climate variability during the last millennium. We determined the size distribution of the terrigenous fraction using an image-based analysis system. Among the four identified grain size modes, three of them were linked to aeolian inputs (M1: 2,6 µm; M3: 54,2 µm, M4: 88,3 µm on average) and the last one to runoff entries (M2: 9,1 µm on average). Variations of the amplitude of all these modes are closely related to the principal climate periods of the last millennium. The coarsest components (M3, M4) which contribution remains weak during the LIA, becomes the most important mode during CWP. On the other hand, M2 displays an opposite behavior, exhibiting a strong contribution during the LIA. We interpreted these variations as a consequence of domination of input of fluvial material during LIA periods whereas aeolian processes were dominating modern inputs. Intensification in wind strength or increase in frequency of strong winds (related with local transport events – Paracas dust storm) could be responsible of such a trend. Comparison with others South American records indicate that those changes are linked to displacement of the Intertropical convergence zone (ITCZ) and South Pacific Sub-tropical High (SPSH) at a centennial time resolution. Finally the great increase of the fluvial transport within the transition between the LIA and the CWP is synchronous to severe drought recorded in the indo-Pacific region, which are related to higher frequency of El Niño events.

Spatial and seasonal variability of the silicon biochemical cycle in the naturally iron-fertilized Kerguelen region (Keops-2, Southern Ocean)

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The Kerguelen Plateau, in the Indian Sector of the Southern Ocean (SO), supports a large and recurrent diatom bloom related to natural iron fertilization from the Plateau. This bloom is among the largest observed in the SO and is probably strongly influenced by mesoscale activity. Considering that diatoms, a siliceous phytoplankton group, are the main contributors to SO primary production, the study of the Si-biogeochemical cycle is crucial to assess both carbon and silicon pump efficiency in this ocean. Here, we investigate the Si-biogeochemical cycle in this particular area through 2 isotopic approaches that allow us to combine different spatial and time scales. Measurements of natural isotopic composition (δ30Si) of dissolved and biogenic silicon (DSi and BSi) were carried out in contrasted regions (iron-fertilized and HNLC stations, open-ocean Polar-Front zone, and in a mesoscale structure of the Polar-Front). These analyses were combined with daily measurements of silica production-dissolution fluxes in the mixed-layer using 30Si isotope dilution method to determine the environmental factors that control the Si-biogeochemistry. Preliminary results show homogeneous δ30Si signatures of DSi and BSi below 500m whatever the station considered and confirm that these deep waters (originated from the south) could be considered as the Si-source for all stations located above the Plateau. In these latter, the winter and summer silicon supplies in the mixed-layer seem to be well balanced by the combination of BSi accumulation in surface waters and late summer BSi export. The seasonal evolution of δ30Si is thus mainly driven by the balance between the dissolution/production and Si-uptake/Si-supply ratios, and the Si-production is alternatively based on regenerated sources and "new" Si-sources. Other features could be also identified such as a small production event and remineralization in the HNLC area or Si-supply via vertical mixing and cross-frontal exchanges in stations associated to the Polar-Front.

Lichen-induced geochemical weathering of schist surfaces in Côa Valley Archaeological Park (NE Portugal)

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The Côa Valley Archaeological Park (Vila Nova de Foz Côa, northeast Portugal) was classified by UNESCO as World Heritage in 1998 and is where it is located one of the most important sites of open-air rock-art on schist surfaces in the world. Engraved surfaces are spread mainly facing two orientations, north-west and south-east. This kind of surfaces suffer from different pressures and threats such as temperature fluctuaction, wind abrasion or biological colonization. To assess the risk of deterioration of engraved surfaces and need of implementing conservation techniques and prevent future damages seems necessary to minimize the impact of such deteriorative agents. Previous studies proved that lichens are the most abundant colonizers of schist surfaces in the Park and the assessment of their impact on a geochemical point of view is lacking. To evaluate the role of lichenological colonization in schist surfaces, four locally dominant species were selected to perform the study (*Aspicilia contorta* subsp. *hoffmanniana*, *Caloplaca subsoluta*, *Lecanora pseudistera* and *Peltula euploca*). Colonized rock samples and respective controls (non-colonized samples) were collected from non-engraved surfaces to assess the potential effect on major element mobility. Preliminary results aspect related geochemical weathering revealed that this phenomenon occurs in the south-east facing surfaces and it is very reduced or potentially absent in the north-west facing surfaces, affected by physical weathering in a higher extent. Results evidence significant differences between colonized and non-colonized rocks in the south-facing surface where *Caloplaca subsoluta* is the species that affects the highest number of the assessed elements. These results associated with prior knowledge obtained from other recent studies constitute an important insight in the relationship between lichen action and colonization of schist surfaces, especially those with cultural interest.

The genome and diet of an ancient canine specimen from the Chauvet cave

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In order to characterize the genome and diet of a Pleistocene canid, we analyzed coprolites from the Paleolithic painted cave of Chauvet-Pont d'Arc (Ardèche, France). We selected coprolites in the deep cave sector and constructed libraries of DNA fragments suitable for Illumina sequencing. The DNA sequence data indicated that two coprolites were devoid of animal DNA, whereas a well-preserved sample contained 10% of canine DNA. For this sample, radiocarbon dated to 35,000 calBP, we performed high-throughput sequencing and obtained one billion DNA reads. The sequence dataset allowed us to reconstruct the complete mitochondrial genome sequence of an ancient *Canis lupus* specimen with a 90X coverage. Phylogenetic analyses revealed that the genome of the Chauvet specimen falls outside the diversity recorded among extant dogs and wolves. This mitochondrial genome therefore highlights an extinct *Canis lupus* maternal lineage that diverged from the extant dog/Holarctic wolf lineage approximately 70,000 years ago. Analysis of the nuclear DNA fragments provided a draft nuclear genome sequence with a 0.7X coverage. The similar coverage for the X-chromosome and the autosomes demonstrates that the specimen is a female. Analysis of specific genes involved in starch digestion (MGAM, AMY2B, SGLT1) revealed that, in contrast to dogs, the Chauvet specimen was not adapted to an omnivorous diet. This finding is supported by the information on the diet provided by the coprolite DNA content. The DNA data indeed showed that the Chauvet wolf ate cave bear (*Ursus spelaeus*). This result helps to explain wolf intrusion into the deep cave sector, where bear carcasses were abundant some 35,000 years ago. Thus, with the genomic characterization of a Pleistocene wolf and wolf-cave bear interaction, this study provides new insights into the evolution of Canidae and the paleoecology of a reference archaeological site.

POSTERS

Holocene climate reconstructions and paleoupwelling along the southeastern Brazilian coast

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In the southeastern of Brazil seasonal Coastal upwelling is a consequence of cold-water mass ascension as a consequence of intense NE trade winds, affecting the regional climate. However, the impact of contiguous coastal upwelling and the Holocene paleoenvironment on the coast is not thoroughly characterized. Fish bones and otoliths are utilized in this work because they are exceptional archives for depth-time analysis of climate reconstruction and radiocarbon dating. Diffractogram for crystallographic and quantitative multi-element geochemistry analysis were carried out on a set of whitemound croakers fish otolith (Sciaenidae, *Micropogonias furnieri*), because these fishes represent the main species target in the pre-historic fisheries in the coastal lagoons region of Rio de Janeiro state. Radiocarbon and stable isotope analysis for paleothemperature based on otolith samples from the same species were performed. Fish otoliths were found to be a reliable material for paleoenvironmental analyses. Two different regions were studied: The first located in Rio das Ostras region, north of Cabo Frio (Tarioba shellmound: 3,400 to 4,000 cal BP), showed north upwelling plume displacement alongshore to reach the mixture with the Brazilian Current (paleothermometer range: 15 to 24 C), and the second located in the Saquarema coastal lagoon, southwestern of Cabo Frio (Manitiba, Beirada and Ponte do Girau shellmounds: 3,600 to 4,100 cal BP) showed extremely intense upwelling (paleothermometer range: 8 to 19 C). The general context of multy-proxies analyses suggests exceptional Holocene seasonal upwelling in the Cabo Frio region and differential climate condition between Rio das Ostras and Saquarema region.

Characterization of forms and origins of nitrogen in the water of an agricultural watershed: The case of watershed Kamech (CapBon, Tunisia)

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Among all the changes affecting the natural hydro-systems, changes engendered by anthropological actions have the biggest influence, on the regimes as well as on the quality of water resources. In this way, the problem of enrichment of waters by nitrogen has been addressed by several studies. Indeed, the nitrite (NO2-), the nitrate (NO3-) and the ammonium (NH4) are nutrient salts the most used in modern agriculture in spite of the fact that the excess of these salts provokes severe environmental problems.

In this study, the quality of surface and subterranean water was monitoring in Kamech catchment in Northern Tunisia by the research for various nitrogenous forms and the chlorides. Campaigns of in-situ measurements and water sampling were conducted in order to monitor the spatial-temporal evolution of concentrations of nitrites, nitrates, ammonium and chloride. Subsequently, and using the software Statistica (ver. 8), a Principal Component Analysis (PCA) was therefore performed on nitrates, chlorides and conductivity in the first place. Going further in this analysis, specific functions based on the original elements (major elements, nitrates, chlorides and conductivity) were re-projected. Thus for each of the sites studied, the distribution of proportions of variances based on original items could be elaborated.

Holocene climate variability in the North-Western Mediterranean Sea (Gulf of Lions)

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A high-resolution SST-alkenone and n-alkanes time-series over the past 10000 years was established from marine sediment core in the Gulf of Lions (N-W Mediterranean Sea). A Sea surface temperature reconstruction shows Early and Middle Holocene warmth followed by a cooling trend through the late Holocene. On multi-decadal to multi-century scale, SSTs show strong fluctuations between 15 to 20 °C. Six rapid climate changes (RCC) were identified during this time periods: 6500-5600, 5300-5000, 4300-3900, 2500-2250, 1800-1200, and 650-150 cal yr BP. During these periods, the SSTs are lower and show a decrease of ~0.5 ° C. A clear cyclicity was not found, but these RCC show a periodicity of ~1100 years and an average duration of 400 years. Several RCC seem coeval with a high flood periods likely due to intense cyclones of the North European/Mediterranean region.

The molluscs of the "Falunière" of Grignon (Middle Lutetian, France): quantification of lithification bias and its impact on the biodiversity assessment of the Middle Eocene of Western Europe

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Lithification is stressed as a major bias for the palaeobiodiversity evaluation. Although this bias is often discussed in the literature, it has rarely been quantified. This

work offers a first estimation of diagenesis impact over mollusc diversity record for a single bed of the "Falunière" of Grignon (middle Lutetian, France). This bed possesses the particularity of displaying two lithological facies: one lithified and the other unlithified, both from a same taphocenosis. Mollusc diversities of three unlithified and three lithified samples have been compared (1453 specimens among 131 species). The comparison was made possible by the construction of rarefaction curves extrapolated for 30 samples and the introduction of two indexes: the eDGmean (mean extrapolated Diagenesis Gap) that gives a value of diversity loss between two facies and the STD (sampling/diagenesis bias threshold) that gives the threshold (in number of samples) after which eDGmean can be estimated. The analysis reveals that nearly 80% of species richness is not recorded in the lithified facies, and that loss can reach 100% for species smaller than 2 mm. The bias linked to specimen sizes is discussed, both for large and small shells. The differences of biodiversity recorded among litholofacies have also been approached at regional level by the comparison of taxon associations from lithified and unlithified lithologies from the middle Eocene of Paris Basin (Lutetian: Vanves, Nanterre, Damery, Ferme de l'Orme, Chaussy, Grignon and Villiers-Saint–Frédéric; Bartonian: Baron), Aquitaine Basin (Bartonian: Blaye and Gironde) and Italy (Lutetian: San Giovanni Ilarione, Verona). A revaluation of biodiversity estimates that consider lithification bias suggests that the Tethyian regions (San Giovanni Ilarione) housed similar or higher species richness than theParisBasinduring the Lutetian. Any future comparisons of the biodiversity from distinct regions or time intervals have to consider the conditions of preservation and the lithification bias.

Organic carbon in the brackish environments of the Oriented Natural Reserve of Capo Peloro (Sicily, Italy)

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Transitional waters are environments that are the natural transition between land and sea and are considered very productive and unique ecosystems around which revolve many human activities. The primary objective of this investigation was to study the distribution and the cycle of organic carbon in the natural reserve of Capo Peloro (Eastern Sicily; 38°15'57" N; 15° 37' 50" E). This is to make a significant contribution on the knowledge and the productive potential of the waters in question, even and especially in connection with the exploitation of biological resources (culture of molluscs and algae). The distribution of carbon was investigated to better understand the dynamics of productivity in the two salted ponds and the "sustainability" of the environment. The carbon in particular, in fact, plays a vital role as vector of matter and energy in the lagoon ecosystem. Sampling was carried seasonally, in the ponds of Ganzirri and Faro (that form the Capo Peloro reserve) and in the sea surrounding (Tyrrhenian Sea and Strait of Messina), mainly in order to assess the changes in organic carbon and parameters related to it, in an entire annual cycle. Were also carried out all the other chemical-physical and biological determinations to support the environmental survey. The trend of organic carbon, shows especially during the summer, a substantial differentiation between the two lagoon environments, with a greater abundance of NPOC in the pond of Ganzirri (difference of about 4 mg/l), probably due to the absence of consumers (shellfish filter feeders and algae), which are present in greatest abundance in Faro's pond. The data obtained from this study represent a sure possibility of exploitation also of Ganzirri's biotope for culture of clams and experimental culture of *Gracilaria gracilis*. This could be good for the environment and for local economic resources.

Mankind, Prehistory, Nature and Societies

INVITED CHAIRMAN

Early animal domestication and husbandry

Jean-Denis Vigne, CNRS-MNHN-Sus (UMR 7209)

This presentation will first review the conceptual aspects of the researches which developed during the last 15 years about the beginnings of animal domestication and husbandry. It will especially develop the ecological approach of animal domestication, in the framework of the anthroposystem, which integrates both socio-cultural and ecological functions. The presentation will then develop some reflections about the process and reasons of the beginning of animal domestication and husbandry, based on several examples mostly taken in South-West and East Asia.

ORAL PRESENTATIONS

The convenience of water in a Pre-agricultural community: Using Archaeobotanical and Stable carbon isotopes to understand water stress at the Epipalaeolithic hunter-gather site of Kharaneh IV, Azraq Basin, Jordan.

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dThis paper presents a discussion of the preliminary results of a multi-proxy study examining the relationship between archaeobotanical data, including stable carbon isotopic values, with existing archaeological and palaeoenvironmental evidence to investigate changing water stress during occupation at the Epipalaeolithic, hunter-gatherer site of Kharaneh IV, located in the Azraq Basin, Jordan. Stable carbon isotopes can be used as a direct means of inferring water conditions from archaeological crop remains. However, here, we have applied this method to pre-agricultural wild plant remains. This paper discusses the rationale of this approach and our initial results in light of our preliminary hypothesis of increasing water-stress throughout the site's occupation history. The implications for regional vegetation reconstructions and the patterns of subsistence and movement of the inhabitants of Kharaneh IV both on site and within the Azraq Basin are also addressed. Our results allow us to comment with increasing confidence on the complex interplay of early communities and environmental factors that the hunter-gatherers in this area may have experienced and on how they may have adapted and responded to micro ecological changes.

Genealogical trees, a metaphor for science from Ancient Greece

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Although "metaphors" are usually associated with the frills of literary writing, they feature extensively in our everyday language, and play a significant role in shaping our thought processes. In fact, we use concrete concepts to grasp of more abstract ideas (Lakoff and Johnson 1980; Kövecses 2010). For example, our understanding of time is partly structured by our cognition of space (Casasanto 2010). As historians of science have repeatedly pointed out, metaphors play an important role in natural sciences as well, not only in the context of scientific divulgation, but also by shaping scientific research (Kuhn 1979; Keller 2002). For example, Brandt (2005) showed how the metaphor of the genetic code – the idea that DNA could be "read" as a written text of sorts – reshaped experimental practises in the 1950s and 1960s' biology. However, metaphors are not "neutral" tools. They often embody cultural tenets that transcend science, and they can be value laden. I propose a case study from the field I specialize in, the representation of kinship in Ancient Greece. I focus on a metaphor depicting genealogical relations in vegetal terms: the "family tree". Geneticists, for example, are familiar with the usage of tree-like figures as tools for classifying family members; they translate quite easily into language (e.g. when we speak of the "branch" of a lineage). However natural this may seem, vegetal images of genealogical relations in Greece worked on quite a different register. Furthermore, although they played a role in the development of medical thought, they were at least partly underpinned by widespread cultural tenets on what society should be like. By comparison, the case of ancient vegetal images draws our attention to the ways that metaphors we use in science today are equally liable to shape our thought in unnoticed and non-neutral ways.

Human – climate - vegetation relationships in Vanuatu: palynological studies of holocene deposits

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Human populations settled in Oceania only recently: the first settlers (Lapita) reached Remote Oceania (southeast Solomon to Samoa) around 3000 cal BP. These human groups suffered clearly from climate changes, but also impacted the natural environment of pristine islands. The interaction between human societies and environment remains still unclear, despite an increase number of palaeoecological studies. We present a reconstruction of late Holocene vegetation on Efate Island (central Vanuatu) during the Late Holocene based on a high-resolution palynological analysis. The study, still underway, concerns two palustrine sediment cores, collected from Emaotfer Swamp (south Efate) and Lake Otas (east Efate). The aim of this work is to distinguish the effect of climate and the effect of human settlement on vegetation dynamics. The rainforest taxa significantly decrease between 3700-3500 cal BP, illustrates drier conditions, which could be linked to ENSO variations and is coeval with the first population eastward departures from Papua New Guinea. The palynological data support the hypothesis that Lapita settlement on Efate Island could have been favoured by sustained El Niño conditions. Until 1100 cal BP, there is no evidence of human activities. Generally speaking, in order to stimulate tuber growth of some introduced taxa (yam, taro ...), flowers were consistently cut. Hence, such pollen taxa are scarce in palynological record. After 1100 cal BP, the human pressure

is clearly seen in the pollen data, buy a significant rise in Musaceae content and decline in vegetation diversity, but it remains difficult to explain why Musaceae, introduced by the first settlers, are only cultivated after this date. The ongoing phytolith analysis of the Emaotfer swamp core – can determine tuber cultivation –, and the pollen study of Lake Otas, without human influence, may help discriminate climatic change and human activities.

First data on ethnobotany of Yezidis and Kurds of Armenia

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Yezidis and Kurds of Armenia are typically settled in rural or suburban areas, which is largely preconditioned by their economic activity. The public opinion as well as the professional and media circles see Yezidis and Kurds as nomadic pastoralists, devoid of plant cultivation-gathering culture. However, the ethnobotanical studies carried out in 2013-2014 suggest that the aforementioned opinion is rather a stereotype. In fact, the Yezidis and Kurds do practice plant cultivation and can be characterized by distinct gathering traditions along with consequent culinary and folk medicine practices. Due to seminomadic pastoral economy plant cultivation among the Yezidis and Kurds wasn't diverse until recent decades and was often limited to cultivation of cereals. Plant cultivation practices of this sunworshiper people factually repeat those of the Christians living in the same region, specifically the Armenians. There are a few peculiarities in plant cultivation of the Yezidis that stem from their belief and caste system but these are not widely spread. Contrary to plant cultivation, gathering has been a traditional and essential aspect of Yezidis livelihood. The areas of plant gathering mostly cover middle (villages, stationary settlements, 1000/1200-2000 m above sea level) and high mountainous areas (temporary livestock stations, more than 2000 m a.s.l.). The plants gathered and used by the Yezidis and Kurds in Armenia fall into the following categories according to their purpose - nutritional (e.g. *Rumex crispus*, *Malva neglecta*, *Chenopodium spp*., *Amaranthus spp*., *Spinacia oleracea*, *Tragopogon spp*., etc), spices (e.g. *Thymus spp*., *Mentha spp*., *Allium spp*.), medical (e.g. *Tanacetum punctatum*, *Echium spp*., *Hypericum perforatum*, *Plantago major*, *Matricaria spp*.), technical (e.g. *Cerasus avium*, *Verbascum sp*.), cosmetic (e.g. *Taraxacum spp*.) and so on.

Biometrical analyses in Zooarchaeology. A case-study from the late Roman to early medieval transition in England

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Biometrical analyses of faunal remains recovered from archaeological sites can provide a wide range of information on the exploitation of animal resources by past societies. The different biological responses of teeth and post-cranial bones to external stimuli allow pursuing different, though complementary lines of investigation. In the case of domesticates, for example, it becomes possible to detect successful attempts of size improvement as well as opposite developments, and to shed light on how this occurred. Similarly, the sexual dimorphism displayed by several domestic species can highlight diachronic differences in the sex-ratio, reflecting a changed interest in the economic outputs of animals. The comparison between a late Roman context from Pakenham and early Anglo-Saxon deposits from West Stow (Suffolk, UK) provides a useful case-study for biometrical examination. Results from several zooarchaeological analyses underline the different nature and functions of the two sites: the material from Pakenham is the result of specialised butchery practices centred on beef production, while animal management at West Stow was characterised by a more generalised husbandry strategy. The biometrical evidence reinforces such results by highlighting the smaller size of Anglo-Saxon cattle relatively to the Roman animals from Pakenham. Comparisons with a range of other late Roman and early medieval sites suggest that this size difference was not restricted to the case-study under consideration. An interpretation is attempted on the basis of local environmental conditions, of the nature of cattle husbandry in Roman Britain and of the needs and possibilities of Anglo-Saxon settlers. At the same time, some evidence for size increase between the 5th and early 6th century at West Stow has been detected, providing an alternative view of animal management during the earliest phase of Anglo-Saxon establishment.

Biodiversity of the late Holocene ichthyofauna: what can tell us fish bones from archaeological sites?

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A research of species richness and biodiversity of fish assembladges from past ages is an essential part of common understanding of the formation and development of modern ichtiocenosis. A result of fish bone remains from 17 archaeological sites 4-18 centuries AD from Middle Volga region (Russia). A total of 10,156 fish bones NISP belonged

to 36 species. According to the constructed model of taxonomic relationships limit the determination of a number of types of Log NISP (R2=0,835), 10,000 fish remains can be considered as themaximum for describing taxonomic pattern of studied region in the late Holocene. Shannon and Brillouin indexes (> 2) allowed to reveal collections with identical information burden and to determine the representativeness for 7 collections. \Archaeobiodiversity" index (aD) of current collections ranged 5.87-15.24. A cluster analysis of relationship Ln (acipensioridae/cyprinidae) and Ln (pike/sander), along with aD led to unification of the various collections in two main clusters. To evaluate of fish resources Fish exploitation index (the ratio of large-scale and medium-small-sized species) ranged 0.32-0.96. Mann-Whitney U and the Kruskal-Wallis H tests in most cases revealed significant differences (p< 0,05) in fish sizes. Assessing species structure was found that during the late Holocene in the reservoirs of studied region, Whittaker (bw) index raised from the middle of the first millennium AD to 16-18 centuries AD. At the same time Jaccard index decreased slightly. The results showed the consistency of the selected parameters for testing subfossil fish assembladges. Indexes, relationships, and comparative analysis of fish sizes in conjunction with the data on the geographical position and social status of the settlements allows fully assess the biodiversity of fish fauna and the use of fish in the past. They are also necessary for ecological classification Holocene river systems with intense human activity and exploitation of fishery resources.

The sharing of plant knowledge in Mbendjele Bayaka hunter-gatherers of the Northern Republic of Congo

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The use of plants has historically been an essential function of culture. The intergenerational transmission of plant knowledge is especially important for health and nutrition in small-scale populations. The wide sharing of adaptive knowledge, which contributes to an individual's chance of survival and reproductive success, may explain the resilience of some indigenous populations such as current day hunter-gatherers. Some extant hunter-gatherers are characterized by their highly mobile and egalitarian social structure along with multi-local co-residence patterns where both sexes disperse. Together these factors result in large interaction networks where the knowledge can be easily transmitted, however cultural and economic transitions associated with globalisation may weaken this extensive sharing of knowledge. Here, we investigate the knowledge and use of 35 plant species in over 150 Mbendjele BaYaka hunter-gatherers living in the northern rainforests of the Republic of Congo. We conducted fieldwork in four different camps, three of which were located in the forest, and one of which was located in a logging town. We recorded the participant's knowledge and use of each plant on the list and investigated whether the social structure of the camp (in terms of mobility, market integration and group size) affected the sharing of plant knowledge. We hypothesize that in highly mobile groups where there are frequent visits between camps, the knowledge and use of plants will be higher and shared more widely. However, in more sedentary camps (often as a result of market integration) the sharing of plant knowledge will be more limited. Moreover, information on the frequency and the extent of the use of certain plant species, regardless of the camp membership, may inform us about the adaptive value of the knowledge. For instance, knowledge about the highly toxic or medicinal plants may be shared more widely because of its influence on an individual's fitness.

The relationship between humans and nature. An interpretative reading through the history of gardens in France

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Human and nature relations have persisted over time at different social, personal or even functional levels. Over time, the characterization of the nature, it has changed, especially with the recent emergence of environmental issues. Since the Earth Summit in Rio 1992, several global calls have been made to acknowledge the role that humans have with shaping nature and several initiatives have been proposed in order to mitigate such impacts and generate awareness of different paths in which the interaction between humans and nature could become more sustainable. Such initiatives have the potential to generate a profound change in human and nature relations. The classification of human and nature relations has been the focus in many empirical and mono-disciplinary research areas: ecology, psychology, sociology, management, ethics, conservation, anthropology, environmental education. The purpose of our research was to make a theoretical and diachronic analysis, to deepen in the combination of elements from different approaches. Our research investigated how human-kind reports had evolved over the

centuries in the French society [1], throughout the gardens. We used the garden as the key element to reading the positioning of French people towards nature throughout history because in France gardens are the preferred "natural areas": more than nine out of ten French feel the need to have daily contact with the plants and gardens; and one out of three French dream to have an orchard. We made an interpretive reading of historical texts speaking of gardens and gardening through the centuries to propose a typology powered by previous researches but also by current thinking. Starting from the fact that Western societies have a dualistic thinking which opposes nature and humans, we propose a different typology in relation to the function.

[1] Here, gardeners, gardens users or gardening lovers.

POSTERS

Marine reservoir corrections on the Southeastern coast of Brazil: paired samples from the Saquarema Shellmound

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The coast of Rio de Janeiro presents a great density of archaeological sites built by hunter-fisher-gatherers during the Holocene. These sites are shellmounds also called sambaqui and have a great potential for radiocarbon dating studies since they are usually rich in human cultural remains such as shells, charcoal from replaces and bones. In such sites, the presence of both terrestrial and marine remains within the same archaeological context enables the comparison of different carbon reservoirs. The focus of this work is the study of charcoal, otoliths and shells found in a shellmound at the Southern Brazilian coast, the Sambaqui de Saquarema. The Saquarema archaeological site, located in Rio de Janeiro State, on the Atlantic coast, was investigated with the aim of evaluating the marine reservoir effect (MRE) in this region. Radiocarbon ages of 45 marine samples and 6 terrestrial samples from this shellmound provided data for accessing MRE and the influences of freshwater and seasonal coastal marine upwelling in this specific locality. Samples of charcoal, fish otolith and mollusk shells were analyzed and the radiocarbon dates were modelled in the OxCal software to determine the marine reservoir correction. The result obtained was R = 265 70 14C yr. and the offset R was found to be -140 66 14C yr. In order to support the accuracy of this value for correcting conventional 14C marine ages, taxonomic assays of the samples were accomplished.

Turkish and Persian Lexical Borrowing in Tlemcen[1] Dialect

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The linguistic situation in Algeria is very complex. Standard Arabic is the official and national language, Berber is the second national language, English and French have the status of foreign languages, though the latter is much expanded. In addition to these languages, there are various Arabic and Berber dialects which may differ from one region to another, however, they are all characterized by loan words or lexical borrowing from different origins; French, Spanish, Italian , Turkish, and English. The Turkish occupation in Algeria, especially in Tlemcen for more than three centuries, had left great sociocultural and linguistic impact, such as Turkish and Persian words which are always present in Tlemcen dialect. The objective of this study is to check up the usage frequency of these words. The data was collected mainly, from the thesis of Mohamed Ben Cheneb[2] and many contributors were required to fill in a questionnaire which contained a list of Turkish and Persian borrowing taking into account several factors, like age, gender, and occupation. The results reveal that Turkish and Persian borrowing is decreasing especially within the young speech community for many reasons which will be detailed throughout the participation.

[1] A city located in the North West of Algeria, and capital of Islamic culture in 2011.

[2] Mohamed Ben Cheneb, 2012, Mots Turks et Persans conservés dans le parler Algérien, Publications du cinquantenaire de l'Université d'Alger, 1962-2012.

Woodworking at an archaeological site from the Levantine Middle Palaeolithic?

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The purpose of this research is to explore prehistoric wood and plant use for hunting, domestic or symbolic activities. Wood remains have rarely reported from Middle Palaeolithic sites in the Middle East and the identification of wood working was never achieved in the past. The site of Nahal Mahanayeem Outlet (NMO) is located on the east bank of the Jordan River (Israel) and OSL dated to around 60 000 BP. NMO site is defined as a short-term hunting locality and was excavated during eight field seasons under the direction of Dr. Gonen Sharon. The site has yielded a unique collection of botanical remains including wood, bark, seeds and fruits. The site sediments were waterlogged since their accumulation creating unique condition of anaerobic environment that enabled the exceptional preservation of these remains in the dry Levant. The botanical remains from NMO provide a unique opportunity to explore the association between a prehistoric human activity and wood elements. Before exploring the question of human utility we face some more basic questions: What is the origin of the wood in the site and what are the agents (human, natural or both) that brought it into the NMO? What taxa of wood are represented in the assemblage? Can we identify evidences for wood utilizations on these very old remains? Analysis of a sample of this collection provides preliminary data that will enable us to answer some of these questions and contribute to a better understanding of the environmental background. In addition, experimental work, aiming to mimic woodworking applying Mousterian stone tools to work the wood species identified at NMO, are will be done. The aim is to gain better understanding of the typical use marks resulting from such work and to use this data set to identify woodworking on the NMO's wood remains.

The prehistoric fauna from the archaeologial site of "Lu Brandali", Sardinia

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"Lu Brandali" is a prehistoric archaeological complex located in Santa Teresa di Gallura (OT), northeast of Sardinia, Italy. It is composed of a central tower (nuraghe), surronding walls with secondary towers, a village of huts and two different kind of burial mouments. The faunal remains analyzed come from some huts of the nuragic village and they date at the Recent Bronze Age and first Iron Age (XIV – IX century BC). The reason of the analysis was to get a picture of the fauna in the territory around the settlement at the period of occupation and its use for food and as technological resource. The results present many different species therefore a great variety in the diet. The habitants of the village used to breed domestic animals like sheep, goats, cattle and pigs, and used to hunt deers, wild boars and mouflon. Fragments of *Prolagus Sardus*, an endemic extinct mammal, were identified,. Furthermore some occasional species like marine gastropod and bivalve as well as big fish were found. But the best discovery is the most ancient fragment of cetacean found in the island until now.

Two millenaries of morphological evolution of domestic equids in Western Europe: a new study project using 3D geometric morphometrics

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Equids and humans share a long history of interactions from the first domestication of wild horses in the Eurasian steppe about 5,500 years ago, to the diversity of breeds of modern domesticated horses. Standardized during the XVIIIth-XIXth centuries, these breeds present a large morphological diversity and reveal a strong specialization for different functions (like draft or racing performance). But our knowledge about past horses prior to standardized modern breeds is limited to texts or iconographic sources, and archaeological data did not yet provide their full potential with regard to this question. The main objective of this project is to obtain information about the morphological diversity of past horses and to know if specialized morphotypes linked with functions, can be found in archaeological records. Thanks to their special status for human population, horses are often found as complete skeletons in archaeological contexts so they can be the support of detailed analyses of their morphology. Complete skeletons found in several French and Belgian archaeological sites of Roman, Medieval and Modern periods will be studied. Using 3D geometric morphometric on limb bones, girdles and skulls, we will try to distinguish different archaeological morphotypes. Meanwhile, modern skeletons of various known breed will be studied to understand which factors impact on their variability and to relate it with animal function, especially by a study of the shape co-variation between bones. By applying this approach to archaeological specimens, we will try to assign to them a potential function. The results could have many applications

in regards of the understanding of each archaeological site containing horse remains. They will also be confronted to historical sources in order to contribute to horse history in Western Europe. At last, we will seek to describe the evolution of horse morphology from Roman period until their standardization in the form of breeds.

On the Gumelnița Chalcolithic period agriculture of Tell Hârşova (Romania)

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Numerous remains of cultivated plant existing in archaeological sediments of Tell Hârşova, a Chalcolithic settlement situated on the bank of Danube River, are evidencing that the agriculture was important direction of agrarian economy of the local population. Charred and in some cases mineralized archaeocarpological material recovered and investigated by the authors in different excavation seasons (1993-1996 - R. Buxó, 2008-2014 - R. Hovsepyan) attesting cultivation of several cereals and pulses: einkorn (*Triticum monococcum*), emmer (*Triticum dicoccum*), naked wheat (*Triticum aestivum/durum*), naked barley (*Hordeum vulgare* var. *nudum*), lentil (*Lens culinaris*), bitter vetch (*Vicia ervilia*). This assemblage of cultivated cereals and pulses, where hulled wheats, particularly einkorn, and naked barley prevail is typical for the Chalcolithic period of the South-Eastern Europe. Regular abundance of pulses is notable as pulses cultivation somewhat drop in this period in Near East and Caucasus. In addition to the cultivation of cereals and pulses, viticulture was practiced. We suggest that the grape was cultivated there, because many of recent grape landraces have similar pip morphology as the archaeological ones (shorter, rounder and with short beak). However, we accept possibility that the grape was collected also from the wild as wild grape grows in the investigated area.

Influence of Heat Index on economic productivity

Lee Daniel
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The changing climate is influencing the flow of heat and moisture in the atmosphere in a global scale. In this presentation, I show first results of a study evaluating the influence of the perceived temperature, measured using the Heat Index, on worker productivity. The changing distribution of Heat Index is shown for two reference periods, 1979-1999 and 2000-2013. Additionally, these changes are localized to countries using population-weighted per-country averaging. These localized heat index data are used to measure whether changes to Heat Index that are observable for an entire country have an effect on that country's economic productivity.

Quaternary squamata reptiles from the Columbretes Islands (Castellon, Spain)

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The Columbretes Islands are a small volcanic archipelago originated between 0, 27 to 1, 09 Ma; It is located close to the continental coast (50 Km) in the north-western Mediterranean Sea. The name of the island is referred to the abundant snakes that inhabited there. Nevertheles, the only non-flying recent vertebrate on Columbretes Island is the lizard Podarcis atrata The paleontological site named COLT was localized in 2005, in a large loess deposit on the south on Grossa Island. Unfortunately, the exact age of the site is still not confirmed. Squamata reptiles' remains are the most abundant in the site. In this study, three taxa are described: *Chalcides bedriagai*, *Podarcis sp*. and a member of the *Vipera aspis* complex (*Vipera sp*.). A likely Upper Plesitocene origin (probably Mast Glacial Maximum or Tardiglacial) is postulated for this fauna. A recent human action is suggested for the extinction of the *Ch. bedriagae* and *Vipera sp*. taxa in the island.

Understanding factors of deterioration for proper conservation and management of cultural heritage; the case of *Olduvai gorge* (Arusha, Tanzania)

Mosena Winne
Muséum national d'histoire naturelle (France)

Olduvai Gorge is a household name not only to palaeoanthropologists but to anybody interested in human origins and reading National Geographic magazine. Over the years, the continued preservation of most of the sites that Louis and Mary Leakey (British Archeologists discover this site in 1930)so painstakingly worked at, such as FLK Zinj, FLKN, MNK, BK, HWK, JK, DK, EF-HR t(he sites where named after his family members names), to mention a few, have been threatened by both natural and anthropogenic factors. Preservation of the palaeoanthropological remains in all these localities has constantly been threatened mainly by

slope wash erosion and trampling by animals, especially after they have been exposed by rain and destruction by domestic herds. The neighboring Maasai, oblivious of the destruction that herds can cause and the absence of community oriented educational programmes for awareness, graze their herds on the exposed sites and accelerate the destruction of sites and the trace fossils on the surface. While the factors have been mentioned in past, no efforts have been made to assess the level of damage each factor causes. Following three years of consecutive field work at Olduvai as part of the University of Dar es Salaam Field school, the author intended to monitor the impact of these factors. I would like to present in poster communication try to summarize, albeit tentatively, the level of damage resulting from the geological and anthropogenic factors and suggest ways of minimizing the problem.

Man-Environment relations and paleovegetation reconstruction during the prehistory in the Temiscouata (Lower Saint Lawrence region, Quebec, Canada)

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Université du Québec à Rimouski-Laboratoire d'archéologie et de patrimoine (Canada)

This research is part of the field of environmental archaeology. It concerns the prehistoric societies relations with their vegetal environment in the Nordic environments, especially within the Parc national du Lac- Témiscouata (PNLT)(Lower Saint Lawrence region, Quebec, Canada), the latest addition to Quebec's national park network opened in June 2013. The PNLT stands out for the importance given to its cultural dimension and for its mission that combines public education, research and the preservation of both its archaeological and natural heritage: 32 of the 51 known prehistoric sites in the Temiscouata region are located within the park's boundaries and are part of a monitoring program. Since its planning and creation, the development of the park's infrastructures has led to new discoveries. These have driven research and the development of a public archaeology program that includes archaeobotanical sampling. This research aims at documenting the use of plant resources during the prehistory in the Temiscouata. Its specific objectives are 1) to recognize and 2) to characterize the use and the exploitation of plant resources by prehistoric populations and 3) to measure the human impact over time, along with its heritage in today's landscapes. The recommended approach comes from palaeobotany and ethnobotany. The methodology consists in 1) extracting macrobotanical remains from soil samples taken from archaeological sites in the PNLT during the 2013-2014 summer public excavations, 2) identifying macrobotanical remains by comparative anatomy using reference collections and 3) quantifying macrobotanical remains. 4) These results will be compared with those of other studies concerning a) archaeological prehistoric sites of the northeastern part of North America and b) of paleoenvironmental reconstructions based on palynological and geomorphological studies available for the Temiscouata region. 5) Ethnographic sources will provide an insight on possible plant use (food, medicinal, ritual, etc.), preparation and transformation methods, along with taphonomic processes.

Systematics, Evolution and Comparative Anatomy

INVITED CHAIRMAN

Temporal processes and inferences in evolutionary patterns

Mario de Pinna, Zoology Museum, São Paulo University, Brazil

This presentation will critically review the fundamental concepts, premises and methods used to determine the time orientation of phylogenetic diagrams and their associated evolutionary inferences. The central argument will focus on the conceptual parallel between time arrow in biological processes and their application in phylogenetic inference. A poorly-understood ramification of such parallel is the causal connection between process-time and pattern-time, or the absence thereof. A theoretical solution to this conundrum is proposed. Processes related to the unfolding of complexity in phenotypic expression are considered as particularly informative sources of phylogenetic time. This reinforces the importance of comparative anatomy and ontogeny in understanding evolutionary patterns.

ORAL PRESENTATIONS

Biogeographic evidence and the evolution of exudativory in primates

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The consumption of gum or gummivory has been described as a primitive, fallback diet that is exhibited when other food sources become scarce, in particular during dry periods. Indeed gummivory is often observed in nocturnal strepsirhines believed to have retained many primitive features. However, gums (soluble exudates rich in complex carbohydrates) are also known to be particularly difficult to digest and require specific adaptations. The hypothesis of a primitive diet predicts that gummivorous strepsirhines should use homologous digestive strategies. Alternatively, different digestive adaptations would mean that gummivory evolved convergently. This study compared the digestive adaptations to gummivory observed in two small gummivorous strepsirhines, the African lesser bush-baby (*Galago moholi*) and the Malagasy reddish-grey mouse lemur (*Microcebus griseorufus*). We used a method of phylogenetic reconstruction and compared the distribution patterns of *G. moholi* and *M. griseorufus* with climatic parameters, to confirm that this peculiar diet evolved convergently in many primate lineages, all found in hypervariable regions; both study taxa inhabit regions in which the dry season is characterised by little to no rainfall, a drought that may persist for months. Similar climatic regions are occupied by other gum-feeders, including the marsupial gliders (Petauridae) of Australia. Our results support the hypothesis that gummivory evolved convergently in several primate lineages, apparently in response to environmental hypervariability.

Are polymorphic mimetic species less toxic?

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Müllerian mimicry is an evolutionary convergence of several toxic species toward common warning signals. Sharing a common signal among toxic species indeed allows sharing the cost of predator learning, leading most toxic mimetic species to be monomorphic within population. However, some toxic species like the Amazonian butterfly *H. numata*, presents polymorphism of warning patterns at local scale. Each of the *H. numata* patterns is highly similar to several different species of the distantly related aposematic genus *Melinaea* (Ithominii tribe). To explain such local polymorphism, it has been hypothesized that *H. numata* might be less defended than its co-mimic species. Therefore, the local polymorphism of *H. numata* would decrease the rate of individuals with low toxicity within each shared warning pattern group, maintaining protection against predators. Using insectivorous wild caught birds (Great Tits Parus major), we compared the predation rate on the polymorphic species *H.numata*, two Heliconius species locally monomorphic (*H. melpomene* and *H. erato*) and a species from the Ithomiini tribe (*Mechanitis polymnia*). The tested birds highly rejected both the monomorphic and the polymorphic *Heliconius* species. However, a significantly weaker reaction was found towards *M. polymnia*, which rely on different toxic compounds than *Heliconius*. This study confirms that the origin of polymorphic mimicry in *H. numata* is unlikely to stem from relaxed toxicity and raise new questions on birds' sensitivity to different chemicals.

Software packages for sliding semi-landmarks - same method, new tools

Botton-Divet Léo
Mécanismes adaptatifs : des organismes aux communautés (France)

The challenging complexity of biological structures has led to the development of several methods for quantitative analyses of form. Geometric morphometrics is now commonly used for the study of bones. As anatomical landmarks only cannot describe the whole complexity of bone form, the use of 3D semi-landmarks to describe curves and surfaces is becoming increasingly used. In this approach, semi-landmarks sliding on curves are used to describe crests and edges, and semi-landmarks sliding on surfaces to assess geometry of areas such as articular surfaces or the diaphysis of long bones. These semi-landmarks are allowed to slide with respect to a common reference according to the minimum bending energy criterion. Therefore in absence of biological homology, a geometric homology is used to construct comparable landmarks.

Because the first step, specimen digitization, is a time-consuming step that cannot be easily shortened, it could be of great interest to reduce the duration of the second step: the sliding procedure. Consequently, we compare two

softwares for the same sliding task in matter of ergonomics, repeatability, variability and the time required when using two software packages that are Edgewarp and Morpho, an R software library. To do so we use 3D scans of five mustelid species (Mammalia, Carnivora) humeri and a template composed of 27 anatomical landmarks and 790 semi-landmarks sliding on curves and surfaces. Sliding points are projected onto specimens using thin plate spline deformation and then slided against the template and procust meanshape iteratively. The global differences in geometries, as well as individual particularities are investigated. Faced problems are debated. Finally we highlight the relative comfort offered by new geometric morphometrics tools.

Is Eusociality a Major Evolutionary Transition?

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William Morton Wheeler is often said to have introduced the superorganism hypothesis to the social insect literature in 1911, and according to most accounts, his reasoning was initially embraced by the profession. This honeymoon period was short-lived, however. By the 1950s, few were willing to declare that colonies are superorgnaims. Yet, just two decades later, calls for the revival of the superorganism hypothesis began to appear. Although it is difficult to identify a single piece of work which catalyzed the resurrection of the superorganism, there is no doubt that the revivalist efforts have been successful. The claim that colonies are superorganisms has once again become a fixture in the literature. Although it is common to refer to colonies as superorganisms, the question of how, or even if the hypothesis is testable has rarely been discussed. In this talk, I describe a protocol for testing the superorganism hypothesis, and discuss the results that are obtained when it is applied. I suggest that some, but not all, eusocial organisms can be regarded as superorganisms, or alternatively, that only a small percentage of eusocial organisms represent a major evolutionary transition above the level of multicellularity.

A new species or just a new phenotype? Phenotypic plasticity in taxonomic traits of the tardigrade *Hypsibius dujardini* (Doyère, 1840)

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Phenotypic plasticity is the ability of a single genome to produce more than one form of morphological, physiological condition or behaviour in response to environmental conditions. However, the role of phenotypic plasticity in evolutionary processes is a controversial, and so far very poorly understood, issue. In the presented study, I examined the effects of temperature, one of the basic and variable environmental factors, on morphometric taxonomic traits of a clonal population of the tardigrade *Hypsibius dujardini* (Doyère, 1840), a representative of one of the largest families within Eutardigrada and a potential candidate for a new model organism in biology. Tardigrada are a phylum of invertebrates that belong to the mega-clade of moulting animals (Ecdysozoa). The taxonomy of these microscopic animals is based largely on morphology and morphometry, and tardigradologists struggle with difficulties resulting from a small number of available taxonomic traits and the lack of their evaluation in terms of phenotypic plasticity. The results presented in this study are an experimental test of the traditional taxonomy. They are hoped to aid an identification of taxonomically useful traits. The study should also allow a stronger inference about the validity of morphometric methods in the taxonomy of Tardigrada.

Jaw bone constraints during cusp pattern development in rodent molars

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The tooth crown pattern, and especially the crown complexity, was shown to be functionally related with the animal diet. However, the crown morphogenesis is only determined during embryonic stages. Developmental biology and computational modeling have shown that the cusp pattern of teeth can be self-regulated by signaling molecules associated with physical properties of the cells, independently from the surrounding tissues. This idea of self-regulation of the crown pattern formation is reinforced by the fact that molecular perturbations in the tooth system can reproduce crown phenotypes that appeared during evolution. During rodent evolution, the alternated cusp pattern appeared several time in their molar crown. Voles show an extreme case within rodents. In 2002, Salazar-Ciudad and Jernvall introduced a lateral bias parameter in their morphodynamic model of molar development. Together with anterior elongation, these biases influenced whether cusp patterns were alternate or confluent. The nature of these biases has not been tested experimentally, and here we examined for the first time the possible role of the jawbone as a mechanical constraint in fine-tuning of cusp

patterns. The cusp offset of the first lower molar (m1) in vole is lost when the tooth is cultured out from the jaw. Laterally constrained mouse and vole m1 in vitro recovers the vole-like cusp pattern offset. In voles, the thickness of the jawbone is larger than in mouse and shows a bucco-lingual asymmetry from 3D reconstructions of m1 and jawbone development in vivo showed. Therefore, the bucco-lingual constrain of the jawbone during the in vivo development can generate the alternate cusp pattern of voles. In conclusion, we show how the cusp pattern morphogenesis in molars can be influenced by a lateral constraint of the jawbone. This lateral constraint of the jawbone, may explain the variability of the crown patterns of molars in the evolution of rodents.

What's up with the opossum of Cuvier? New discoveries on Comparative Anatomy, Phylogeny and Paleobiology

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Three-dimensional reconstruction of the petrosal bone and osseous labyrinth of the opossum of Cuvier (*Peratherium cuvieri*, Herpetotheriidae, Metatheria) from the late Eocene of Montmartre: Comparative Anatomy, Phylogeny, Paleobiology With State-of-the-art technologies of X-ray microtomography (CT-Scan), it is now possible to pursue the investigation of one of the most emblematic specimen of the MNHN, the opossum of Cuvier. From three dimensional models of the petrosal bone and osseous labyrinth of *Peratherium cuvieri*, an anatomical description completed by comparisons with three other herpetotheriids reveals new features that clarify the ambigous definitions of these taxa, based on very variable dental characters. A cladistic analysis of petrosal characters in 14 metatherians (extant and fossils, among which the four herpetotheriids of the study) confirms the highly informative value of this bone for phylogenetic reconstructions. The results indicate the monophyly of *P. cuvieri*, *P. elegans* and *A. minutum*, but the other herpetotheriid of the analysis, *Herpetotherium* cf. *fugax*, is sister taxon to Peradectidae. Peradectids and herpetotheriids, traditionally considered as opossum-like, are here stem-metatherian. Hypothesis in favor of an ancient origin of opossums (Didelphidae) is therefore questioned. A preliminary study of ecological inference shows a link between the semicircular canals anatomy and the type of locomotion, but the inference remains difficult to apply to fossils as long as the sample is not subsantial.

Genetic population structure of the finescale four-eyed fish, *Anableps microlepis*, in North and Northeast Brazil N

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To determine how historical vicariance, environmental features and life history promote genetic divergence of marine species, the genetic population structure of the fine-scale four-eyed fish *Anableps microlepis* was investigated. Sequences of a 747 bp segment of mitochondrial DNA control region (D-loop) were compared among populations sampled in 6 localities along north and northeast Brazilian coast. 22 haplotypes were resolved from 223 individuals. Relatively high haplotype diversity ($h = 0.883 \pm 0.010$) and low nucleotide diversity ($\pi = 0.00493 \pm 0.00023$) were detected. Analyses of molecular variance and the population statistic FST indicated significant genetic structure among populations and five distinct groups were revealed. Pairwise mismatch distributions suggested rapid population growth for three populations while provided no evidence of rapid expansion for the rest populations. The hypothesis of population size reduction events related to sea level changes during the Pleistocene glaciations was purposed to explain the geographic distribution pattern, together with the historical demography of the populations studied. The Amazon River is a strong barrier for *A. microlepis*, nevertheless gene flow between each side of the estuary should ever occur during the sea level lowstand. Additionally, low degree of dispersal ability mainly caused by viviparous reproduction mode and sedentary behaviour of the species also contribute to the observed population structure.

POSTERS

The Molluscs of the Gulf of Gabès (Tunisia), endemism or ecophenotypic variations in extreme conditions?

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The Gulf of Gabès is a shallow gulf on the south Tunisian coast of North Africa, characterized by a major tidal

amplitude. It is host to very large meadows of *Posidonia oceanica*. Since the latter half of the 19th century, marine biologists have recognized that many molluscs living in the Gulf of Gabès exhibit a number of morphological characters that set them apart from the "typical form" that occurs in the rest of their Mediterranean distribution area. This is particularly remarkable in gastropods, and a number of Gabès populations are considered to represent species endemic to the Gulf (7% of the total molluscan fauna). The objective of the study is to compare the species that are supposed to be endemic of Gabes with their closest relatives in the rest of the Mediterranean sea and to confirm or reject this presumed endemism. The use of integrative approach combining shell morphology and DNA sequences in a modern oceanographic and phylogenetic framework permitted to evaluate their species-level status and test some hypotheses for each distinct presumed endemic species. The molecular results on the group Muricidae confirmed that *Ocinebrina corallinoides* is endemic to the Gabés. It also revealed cryptic lineages within the Mediterranean *Ocinebrina edwardsii* and *Muricopsis cristata* complexes. Similarly, The *Trochidae Jujubinus fraterculus* from the Gabés is distinct from the other Mediterranean species, and molecular data also revealed cryptic lineages within this group. Within the Buccinidae, two new species of Aplus (formerly Pollia), never described so far, were found in Gabes andBizerte. Our results thus confirm that the level of endemism in Gabes is important, raising the question of their origin: because the gulf is very young (6-8ka), it is suspected that these species originated elsewhere. To formally test this hypothesis, more data are needed, from other localities other species groups.

Genera as surrogates of bryophyte species richness and composition

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Surrogates offer quick and cost-efficient solutions to assess and monitor biodiversity, and their coarse classification often distinguishes between environmental and taxonomic surrogates. In the context of the latter type, the higher taxa approach consists in using higher taxonomic levels (i.e. genera and families) as surrogates of species. In this study we tested the higher taxa surrogates, particularly genera, for bryophyte species richness and composition, in two different habitats – exposed rock outcrops and watercourses, and across two scales – local and micro-scale, in the center and northern Portugal. Furthermore, we tested the influence of environmental variables on richness and composition of species and genera. Our results showed significant and positive correlations between species and genera, for both habitats, and also richness and composition parameters. Also, for both scales analyzed, correlations between species and genera were found to be positive and significant. Moreover, the environmental variables tested seem to influence species and genera richness and composition in the same way. In conclusion, the higher taxa approach could be an effective method for a rapid assessment and monitoring of bryophytes in the studied area, for the habitats and scales considered.

Diversity of digenean species in teleost fish from the Bizerte bay and lagoon, Tunisia

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Animal Bio-Ecology and Systematic Evolutionary (Tunisia)

Parasites are a vital and necessary component of biodiversity; they play a major role in ecosystem function and represent a factor that can influence the composition and structure of natural animal communities. Digenea is probably the largest group of internal metazoan parasites. They are an extraordinarily ubiquitous group characterized by complex life-cycles usually involving three hosts in their development and depending on the local availability of a variety of invertebrate and vertebrate hosts. In the present study, we focused on the digenean fauna of marine teleosts from the Bizerte bay and lagoon. Over a five-year period (2008-2012), a total of 45 digenean species were collected from 17 fish species; 10 new host records were found. With the aid of molecular evidence, two new species of the genus *Macvicaria* (Opecoelidae) were signalled and the life-cycle stages of *Proctoeces maculatus* (Fellodistomidae) were identified. The diversity of digenean fauna of each biotope is compared with that in the gulf of Gabès and in the nature reserve off Corsica. The importance of all these findings will be discussed.

Ecology of Early Pleistocene fossil cervids from the Balkans inferred from dental microwear texture analyses

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Cervids are usually considered as forest inhabitants. The reality is much more complex. The environmental affinities depend on taxa, and some of them occupy a wide range of feeding ecology and habitats. For instance, the red deer (*Cervus elaphus*) is plastic in its habitat spectrum. Tracking ecological behavior of such species is essential to assess variations in environmental conditions. Among the proxies

available for paleontologists, dental wear is a key-tool to infer diets of extinct species. During my PhD, I set up a model combining dental wear pattern and food habits of European species of cervids from many populations ranging from Scandinavia to Southern Spain and from Scotland to Poland. Dental wear patterns will be quantified through an innovative tool: 3D dental microwear texture analysis coupled with an automatic Scale Sensitive Fractal Analysis. Dental microwear textures reflect what a given animal has eaten during its last few days or weeks. This powerfull proxy allows not only to identify grazing and browsing habits, but also to differentiate feeding behavior at the intra-population scale, i.e., sexual and seasonal variations. Such information can be linked to vegetal resources availabilities. When applied on fossil cervids, such ecological proxies may also provide evidence to reconstruct environment. This will be the second aim of my PhD thesis. I will integrate Early Pleistocene fossil cervids (mostly from the Balkans) into the modern model. Niche partitioning between species in a given site, variations in diet through geological time will be explored to assess tree cover dynamic in the context of hominid dispersal into Europe between 2 and 1 Ma.

Neurotransmitter localization in the airway putative oxygen-sensitive chemoreceptor cells of air breathing fishes with particular reference to nitric oxide

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The concept that non-respiratory gases such as nitric oxide (NO) and other ones (CO, H2S) function as signaling moieties is a relatively recent development. NO affects respiration by functioning as a neurotransmitter in the peripheral and central nervous system. In the periphery NO is a parasympathetic component of autonomic nervous system and a cotransmitter with acetylcholine and the neuropeptide vasoactive intestinal peptide. In the gill of teleost fishes nitrergic nerves are broadly distributed in the gill filaments in close association with vascular smooth muscle and mitochondria-rich cells, indicating that NO may be involved in the control of blood flow and in ion regulation. Nitrergic nerves expressing nNOS are distributed on the efferent side of teleost gill filament and are associated with the chemoreceptive NECs, which suggest that NO could be involved in regulating NECs by local paracrine signaling or as transmitter in sensory afferents (Zaccone et al., 2006). This paper focuses on the immunohistochemical detection of nNOS/NO in the NECs of the swimbladder epithelium of the basal actinopterygian *Lepisosteus oculatus* by confocal immunofluorescence. The NECs in the epithelium are both of the closed and the open type and are found in the mucociliated epithelium. NECs contain either nNOS and 5-HT. ChAT has been not shown to occur in these cells at any site by colocalization with nNOS. The NECs containing NO may have a complementary receptor present on the nitrergic nerves (vagal afferents) innervating these cells as well as a cotransmitter role.

Molecules, morphology, and geometric morphometrics inform the evolutionary history of the Pincer Wasps (Dryinidae: Chrysidoidea)

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Dryinidae, parasitoids of Auchenorrhyncha, are found worldwide and are recorded as naturally attacking numerous agricultural pests. Despite their potential as biocontrol agents, these wasps are understudied and little is known of their evolutionary history. Using the novel incorporation of geometric morphometrics (as described in Catalano et al. 2010), combined with morphological and molecular data, I present a phylogeny that tests the proposed relationships within this family. Five shapes are analyzed – three configurations from the head and two from the chela- the pincer like structure that dryinids use to grapple with hosts and prey. The structures of the chela have shown significant variance throughout Dryinidae, but traditional morphological coding has failed to capture the subtle variations of curved edges and sculpturing. Additionally, I sequenced DNA from over 75 taxa of dryinids throughout the family using COI, CYTB, 18S and 28S markers and coded traditional morphological codes for these specimens. Using the generated phylogeny, I test hypothesis of host-choice and host-specificity throughout the lineages of Dryinidae.

Nuclear and chloroplast DNA phylogeography for the endangered species: *Arenaria grandiflora* L.

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The goal of conservation genetics is to understand the spatial distribution of the genetic variation of endangered species in

order to take the best decision for their preservation. Phylogeography is a discipline which infers the evolutionary history of populations and species; and it thus provides information for identifying the evolutionary significant units (ESU), i.e. the groups of populations that constitute units for conservation. In our study, we focus on a species whose lowland populations are rare and endangered: the large flowered sandwort (*Arenaria grandiflora*). This species comprises many ecotypes in widely separated areas of Western Europe. Its taxonomic status is still in discussion. To define the potential ESUs of this species, we first quantified the genomic size of individuals from populations. We found that populations can have various ploïdy levels. We then assessed the genetic variation of 25 natural populations using 13 nuclear microsatellite loci. We also have undertaken the study of the variation of chloroplast DNA (cpDNA) fragments. The aim of these three types of genetic analyses is to develop the best conservation programs for the endangered populations of the species.

A phylogenetic systematics approach to lichenicolous fungi

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Lichenicolous fungi are a group which grow obligately on lichens, with lichenicolous species appearing across many fungal genera. Despite fairly extensive morphological studies in recent decades, they remain little understood. This is partially due to the difficulty of isolating these inconspicuous, slow-growing organisms in axenic culture, meaning investigations into the life strategy and associations between the fungus and its lichen host are a rarity. Molecular data on the majority of lichenicolous fungi is also significantly lacking, making them a rich source for novel phylogenetic analysis. In an ongoing study, we have started using direct sequencing to obtain sequences of the ITS region, the nuclear large subunit (nucLSU) and the mitochondrial small subunit (mitSSU) to create a multilocus phylogeny for a broad overview covering many of the lichenicolous containing genera. We aim to elucidate questions about where the lichenicolous habit has repeatedly arisen and the nature of host specificity, as well as assess the practical approaches to working with these organisms in a molecular context.

Integrative taxonomy used for clustering instead of delimiting: the case of the intra-species morphological variation in crustacean amphipods

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Natural history research depends upon species identification though it is often problematic using by only morphological approach; thus, several authors have argued for an 'integrative taxonomy', combining molecular, morphological and any other available data to delineate and identify species. To date only the 10% of the amphipod species was sequenced for DNA barcode, since the identification of the species needs robust dichotomous keys, which unfortunately deal often with characters of adult specimens. Under this condition, the species thought to be moderately variable are not easy to discriminate and identify when they show a pronounced morphological variation. Such difficulty can results from two kinds of morphological variability: the polymorphism detected in eco-morphotypes within a range of a species or the morpho-ontogenetic variability during growth. Here, we present two study-cases from Mediterranean endemic amphipod species: 1. the hyalid *Parhyale plumicornis* (Heller, 1866), where the arrangement of spines in the third uropods and the setae in the second antennae, considered discriminating taxonomic characters, vary with body-size and 2. the talitrid *Orchestia stephenseni* Cecchini, 1928, where the shape of the second gnathopods in males, character used in dichotomous keys, vary with body-size. For both species, the COI barcoding marker was sequenced and confirmed the co-specificity of morphologically diverse specimens; statistical analysis confirmed that these are ontogenetic variations resulted by a series of moults. The two examples show how the integrative approach is not useful only to discriminate but also to cluster different shapes under a single species, and to limit mis-identification in the crustacean amphipods.

Structural response of the musculo-skeletal system of birds to different mechanical constraints

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The traits of the organisms are compromise between the phylogenetical (inherited factors) structural factors (properties of the biological material) and functional factors. The functional factors depend on the habits and habitats of the species. The functional demand on the skeleto-muscular system corresponds to the mechanical exchanges between the animal and its physical environment. It will be different depending if the animal moves on the ground or in the water. Our project is to quantify the impact of contrasted (but natural) functional constraints during the growth, on the structure of the skeleto-muscular system. We raised pure

breed ducks (*Anas platyrhynchos*) during 50 days, under four conditions: 1/limited moving area, 2/normal area (control), 3/large area and stimulation for walking, 4/large area, swimming pool and stimulation for swimming. The areas were filmed all day long in order to quantify the exercise done by the ducks during their life. Five birds of each condition were sampled at 7 stages during the period. All the birds sampled run in special track and filmed to detect the maximum speed. The muscles of the hindlimb will be measured (length +weight +fiber length) and the bone shape and structure will be compared using µctscans. The comparison between the 50 old ducks muscles will be presented here.

Locomotion and bony labyrinth morphology in hominoids

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The labyrinth comprises two functional parts. The cochlea detects sounds whereas the vestibular system is essential to keep balance and stabilize gaze during locomotion. Thus, semicircular canals and otolithic organs detect rotational and linear accelerations respectively. Perception sharpness, hence adaptation to a specific locomotion pattern, depends on canal morphology. In this study, a reference setting is established on five extant hominoid species. The bony labyrinth is virtually extracted from CT-scans. Comparisons are realized by geometric morphometrics. Interspecific and intraspecific shape variations are quantified. The relative contributions of locomotion, phylogeny and allometry in the signal are estimated. The aim is to use this reference framework for comparisons with fossil hominids, in order to precise their phylogenetic position and locomotion pattern.

Effectiveness of COI sequence variation in detecting genetic structuring in *Engraulis encrasicolus* (Linnaeus, 1758) of the Mediterranean Sea.

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The degree of genetic population structure of *Engraulis encrasicolus* has been studied in the last twenty years based on the analysis of different molecular markers. In the Atlantic Ocean and the Mediterranean basin, most of the authors supported the presence of two co-occurring lineages with different proportions in each population, resolved with different class of molecular markers (mtDNA, microsatellites, SNP, nuclear intron) (Magoulas et al., 1996; 2006; Borsa et al., 2004; Grant, 1985; Zarraonaindia et al., 2012, Vinas et al., 2014, Karahan et al., 2014). In this work the sequence variation of 655 bp of Cytochrome Oxidase I (COI) mitochondrial gene in 74 adult individuals collected from 2012 to 2013 from Tyrrhenian, Sicilian Channel and Ionian Sea, around Sicily, and from Adriatic Sea has been used for the first time to detect the genetic structure of *E. encrasicolus*. The sequences of the hyper-variable fragment of the mitochondrial control region (CR) were also used to validate the efficacy of COI as a population marker. Both Maximum Likelihood tree and Median Joining Network based on COI and CR haplotypes, showed the clear splitting of the sequences in two lineages including sample from all populations. There was a strong agreement between both markers in the assignment of the same specimen to the same lineage with the exception of 17% of the samples in which CR and COI sequences of the same specimen belonged to different lineages. Data from literature indicate that these two lineages correspond to two morphologically differentiated entities, one coastal corresponding to the so-called "white anchovies" , described as a separate species, *E. albidus*, and a more offshore one, corresponding to the "blue anchovy" both occurring also simpatrically. In this context, COI sequence variation could result a useful molecular tool to solve the complex status of the European anchovy.

A new large basal sauropodomorph from the early Jurassic upper Elliot formation of Lesotho

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Recent fieldwork in the Upper Elliot Formation exposed near the village of Ha Noosi in the Qacha's Nek District in Lesotho has yielded the sub-complete and articulated skeleton of a new basal sauropodomorph. The only missing elements are the caudal vertebrae, most of the pelvic girdle and the distal part of the right hindlimb. An isolated femur of another individual and two partial disarticulated skeletons of the small *Massospondylus carinatus* have been found associated with this new specimen. Ha Noosi locality is also known to have yielded the type specimen of the heterodontosaurid *Abrictosaurus consors*. A detailed analysis of the skull combined with the large dimensions of the skeleton is sufficient to assume that we describe here a new species. The taxon displays the most elongated and dorsoventrally compressed skull known among basal sauropodomorphs from the Late Triassic and Early Jurassic. It can be distinguished from the other sauropodomorph genera of the Upper Elliot Formation based on several autapomorphies, including a bifid anterior process of the

jugal. Regarding the dimensions of the new specimen, it is closer to Late Triassic forms such as Antetonitrus, Melanorosaurus, Plateosaurus or Riojasaurus. Only two other basal sauropodomorphs from the Early Jurassic have reached a large size: Aardonyx from South Africa and Jingshanosaurus from China. However, these two genera exhibit anatomical features which are not shared with the newly discovered Lesotho specimen. In a preliminary phylogenetic study, the specimen was recovered in the basal part of the tree, close to the basal sauropodomorphs Plateosaurus, Riojasaurus, Coloradisaurus, Lufengosaurus and Massospondylus. Moreover, when looking at discriminating characters among sauropodomorphs, the specimen appears to be closer to the basal condition. The new species described here is the first recovered so complete, well-preserved and articulated and could be a clue to understanding the evolution of basal sauropodomorphs.

Craniometric variation of Saiga tatarica (Linnaeus, 1766) from Emine Bair Koshar (Crimea)

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The cave Emine Bair Kohsar (Crimea) is located on the Chatyrdagh plateau (1527 m a.s.l.). The bone remains of the saiga Saiga tatarica (Linnaeus, 1766) obtained during the excavations in Emine Bair Khosar include all parts of the skeleton; at present they constitute one of the largest collections of saiga bones, with more than 330 specimens. Most of the remains represent post-cranial skeleton. The state of preservation varies from bone fragments to entire bones. The species was present in the site in all the studied profiles from the Holocene through the Bug glaciation (LGM, MIS 2) to various periods of the Vytachiv interglacial (MIS 3) (Ridush et al. 2013). In the analysis we used skull measurements from Emine Bair Khosar according to Baryshnikov and Tikohonov 1994. We canalysed also the measurements from Russia, Azerbajdhan, Polland and western Europe (Baryshnikov & Tikhonov 1990, Lasota-Moskalewska 1985). In Poland the saiga occurred in the caves Komarowa, Stajnia, Jasna Strzegowska, Maszycka, Mamutowa Ciemna and Słupianka. Nearly complete skulls were found in the caves Jasna Strzegowska, Maszycka and Słupianka. The analysis and comparion with literature data show that the skull measurements from Emine Bair Khosar were smaller than those from western Siberia. The specimens from the Middle Pleistocene of the Volga River were within the range of variation of the Late Pleistocene saiga from Poland and Belgium. The skull measurements from Eurasia were similar. The saiga is associated with steppe; such species migrated from Asia and eastern Europe into central and western Europe during glacial periods. The migrations were numerous but short-lasting, especially at the end of the Pleistocene. Because of the climate warming and forest expansion, at the end of the Pleistocene the saiga ultimately retreated from western and central Europe (Nadachowski et al. 2014).

First *Gondwanan caseid* (Amniota: synapsida) from the lower-middle permian of Madagascar: anatomy, phylogeny and paleobiogeographical implications

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Caseids are a "pelycosaurian" synapsid family that includes some of the first large plantivorous amniotes and are very important for understanding the late Paleozoic terrestrial ecosystems. To date, this family was only known in Laurussia, in North America and Europa. Although it has been discovered by Henri Bésairie probably in 1954, in the south-west of Madagascar, a well preserved, near-complete, and articulated skeleton of a new species of caseid (MNHN.F.MAP676) has been recently identified in the collections of the Muséum National d'Histoire Naturelle, Paris. This unique caseid from Gondwana has been found in the Lower Red Beds Formation, dated from Asselian (early Lower Permian) - Roadian (early Middle Permian), in the south of the Morondava Basin. A preliminary phylogenetic analysis based on cranial characters places the *Malagasian caseid* as the sister taxon of the most geographically distant caseid: the Russian *Ennatosaurus tecton*. This indicates that caseids were considerably more diversified and widely distributed than previously thought. The *Malagasian caseid* presents many autapomorphies, often related to an advanced adaptation to plantivory. The large adductor chamber volume and the deep lower jaw enabled stronger adductor muscle insertions, thus increasing masticatory force. The medially closed and posteriorly extended palate with the development of denticles on the palate and the medial surface of the mandible (including the prearticular) increased considerably the available surface for grinding plant matter. On the contrary, the postcranium shows no indication of the typically barrel-shaped rib cage of large plantivorous amniotes, specifically caseids. The *Malagasian caseid* represents also the oldest known occurrence of a terrestrial Gondwanan amniote. It pushes back in time the date of Permian amniote expansion from the Paleoequatorial belt (South of Laurussia) to higher southern latitudes of

Gondwanan areas, allowed by the deglaciation of the Gondwanan polar ice cap during the Lower Permian.

The dental toolkit of primates

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The teeth of primates have been extensively compared to tools. This "dental tool" concept echoes in the vocabulary used to describe the tooth (e.g. "blades", "pestle") and how it works (e.g. "shearing crests"). One aim of dental morphology is to assess whether and how the shape of these "dental tools" can inform on the diet of a species. Indeed, the actual diet of a species sometimes contrasts with the diet it seems to be adapted to (Liem's paradox). Moreover this approach can help to infer the diet of fossil species. To tackle these questions, dietary categories relevant to the teeth and the way they are used are needed. However, the commonly used categories, i.e. folivore, frugivore, insectivore and their derivatives, focus on the food origin and may not reflect the "dental tool" concept. Dietary categories that emphasize the mechanical properties of the food (for instance, "hard-food crushers") seem more relevant to the morphological features and the operating modes of these tools. Here is suggested a first synthesis of what is known about the diet of extant primates from a dental tool perspective. The concept of dental tool is precisely defined, and some of the dental tools of primates are characterized. Renewed dietary categories are defined from the literature, owing to the physical properties of food (e.g. hardness, toughness, strength, stickiness or abrasiveness). This will constitute a theoretical framework for future research aiming to interpret the dental morphology of primates.

Substrate use and grasping strategies in *Microcebus murinus*: insights for understanding primate grasping origins?

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Grasping is a widespread behavior among Tetrapod vertebrates. In primates, the hands and feet are involved in many grasping tasks including arboreal locomotion and food acquisition. Yet, the origin and the evolution of prehensile capacities, which are highly diversified across this group, remain poorly understood. Some suggest that grasping evolved in an arboreal habitat consisting of fine branches associated with insect predation and/or fruit and flower exploitation. However, few studies have tested the importance of arboreal conditions and diet (e.g. frugivorous, omnivorous) on the use of the hands in food grasping. The aim of this study was to quantitatively link substrate use and food grasping strategies in order to inform hypothesis concerning primate grasping origins. We studied a model often described as representative of the earliest primates: *Microcebus murinus*, quantifying its spontaneous substrate use (differing in diameter and orientation) in an unconstrained environment while presenting them with different food types. We show that 1) *M. murinus* appears to be an opportunistic rather than a specialist of a fine branch milieu as previously suggested, 2) the food properties, particularly the mobility of the prey, had an impact on the use of the hands versus the mouth, and 3) the notion of "fine-branch specialist" may need to be redefined.

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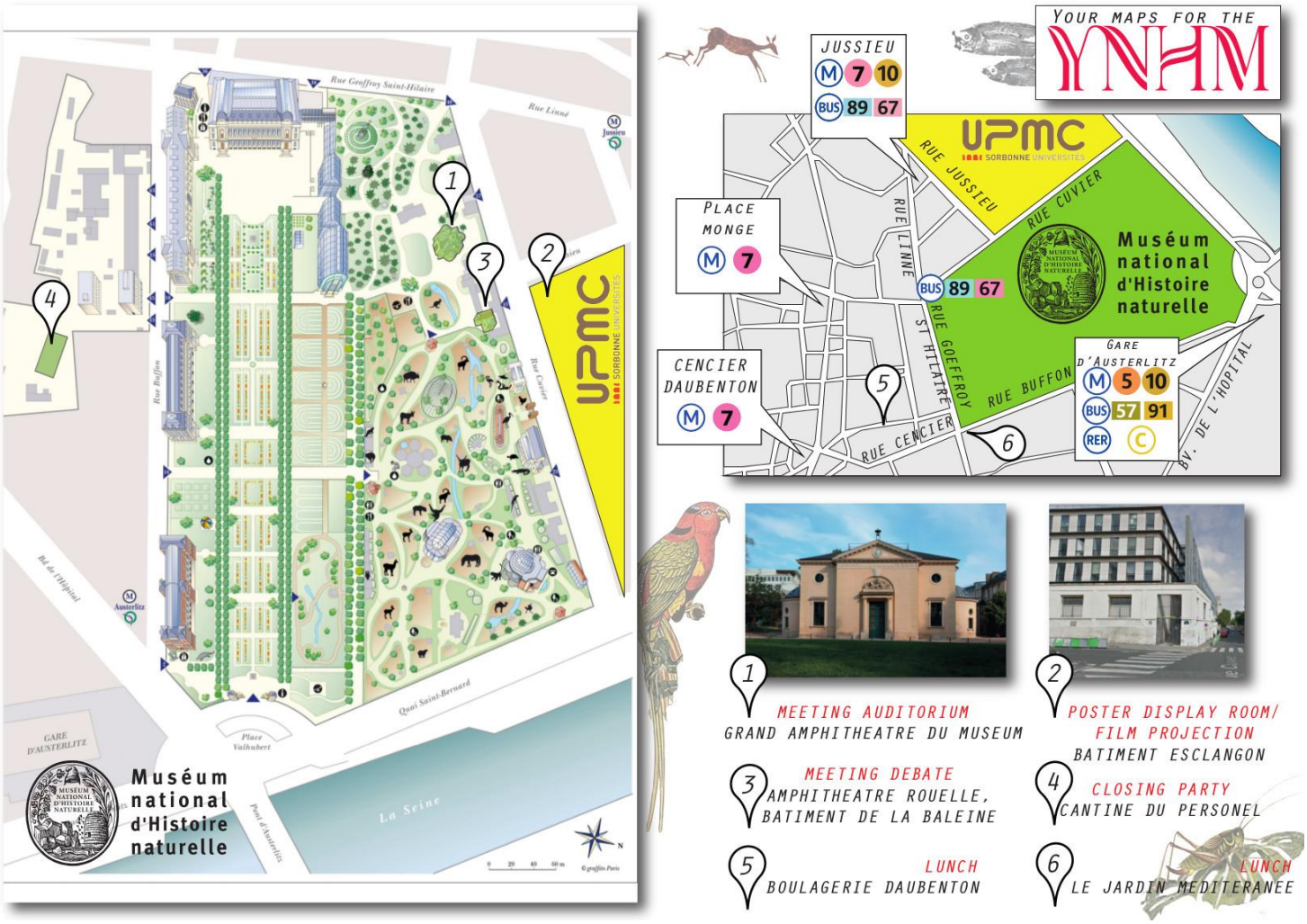
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Rue Linné
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Quai Saint-Bernard
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RUE JUSSIEU
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RUE BUFFON
GARE D'AUSTERLITZ
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M 7
RUE CENCIER
BV. DE L'HOPITAL
1 MEETING AUDITORIUM
GRAND AMPHITHEATRE DU MUSEUM
2 POSTER DISPLAY ROOM/ FILM PROJECTION
BATIMENT ESCLANGON
3 MEETING DEBATE
AMPHITHEATRE ROUELLE, BATIMENT DE LA BALEINE
4 CLOSING PARTY
CANTINE DU PERSONEL
5 LUNCH
BOULAGERIE DAUBENTON
6 LUNCH
LE JARDIN MEDITERANEE

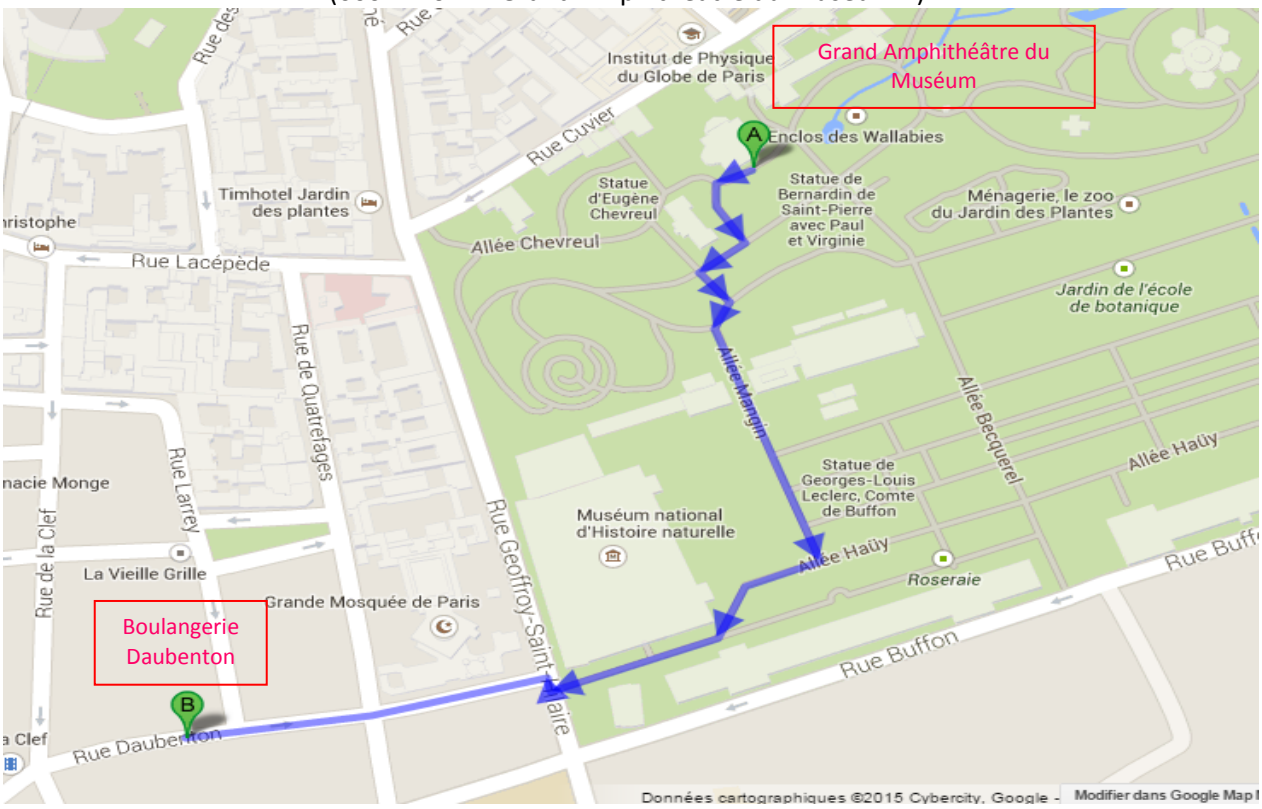
YNHM - February, 6th 2015

Meeting points for the Scientific debate and excursions :

- Amphitheater Rouelle (Scientific debate) (10:00-12:00)
- Geological and historical sites of the Jardin des plantes (1:30-2:30)
- Menagerie (1:30-2:30)
- Graineterie (1:30-2:30)
- Herbarium (1:30-2:30 or 3:00-4:00)
- Mineralogy Gallery (3:00-4:00)
- Greenhouses (3:00-4:00)

🍽 LUNCH TIME 🍽

Address : « Boulangerie Daubenton »
19 Rue Daubenton – 75005 Paris
(600m from « Grand Amphithéâtre du Muséum »)



Discount ticket for a meal
«Sandwich + drink + dessert» to 5€ instead of 5,50€.

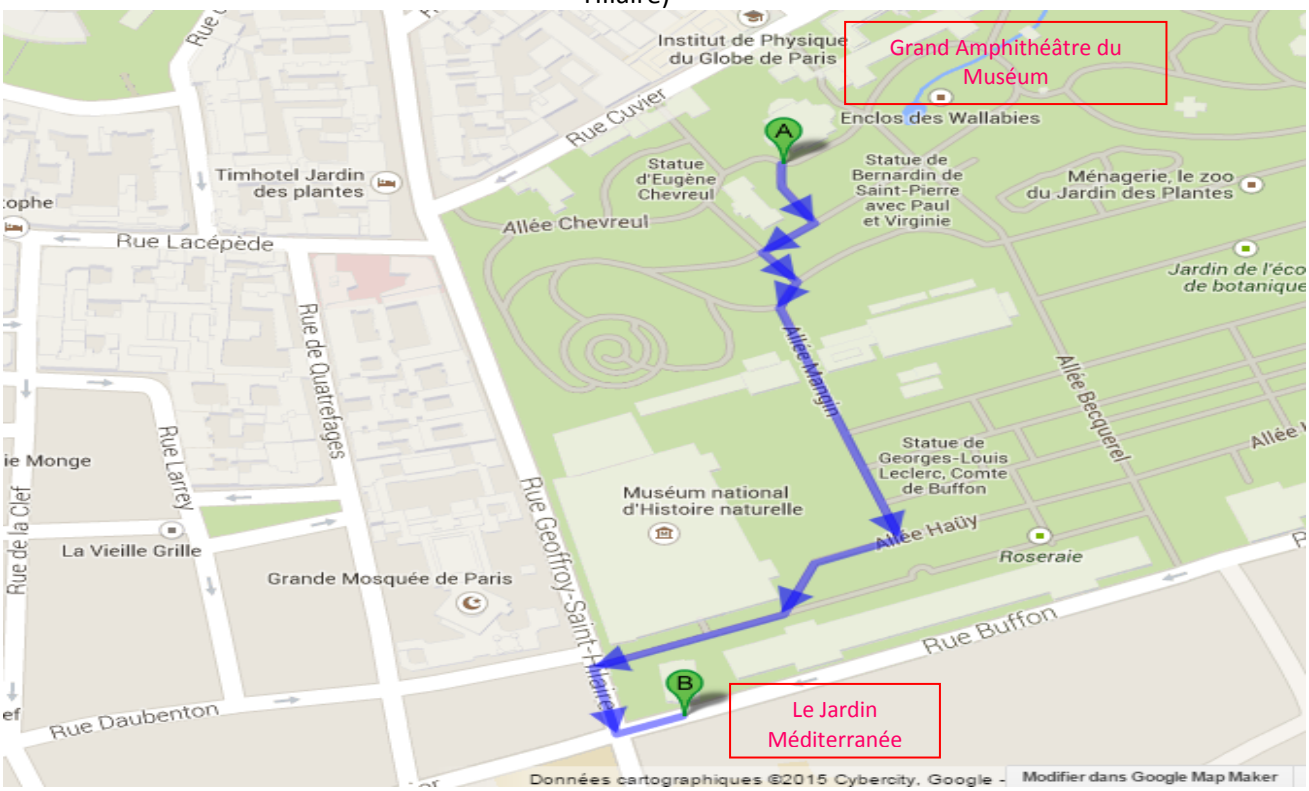
✂----------

Discount

Ticket

🍽 LUNCH TIME 🍽

Address : «Le Jardin Méditerranée »
75 Rue Buffon – 75005 Paris
(450m from « Grand Amphithéâtre du Muséum », at the corner of Rue Buffon and Rue Geoffroy Saint-Hilaire)



Discount tickets for «Menu Panini» to 8€ instead of 8,70€
or «Menu Galette Sarrasin» to 5€ instead of 5,50€.

✂----------

Discount

Tickets