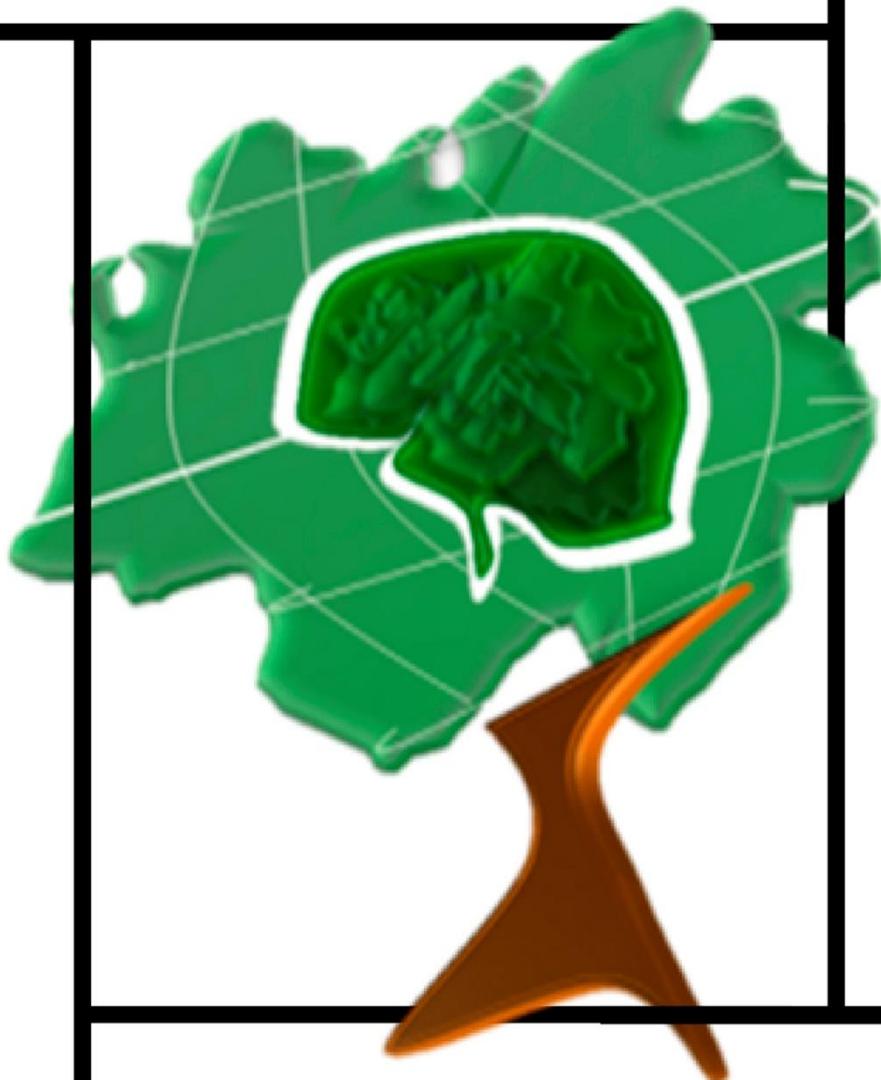


XIITH YOUNG RESEARCHERS MEETING ON CONSERVATION AND SUSTAINABLE USE OF FOREST SYSTEMS

VALSAÍN, SEGOVIA (SPAIN)
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University of Valladolid



Instituto
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PREFACE

This year we are celebrating the XIIth Edition of our Annual Conference of Young Researchers on Conservation and Sustainable Use of Forest Systems. As in previous editions, our first year graduated students organize and manage this event where graduated students from different master and PhD programs share their research objectives and outcomes. In this edition 47 students from 21 countries around the world (for the first time Asia, America, Asia, Europe and Oceania) will be represented! By conducting on a yearly basis this event we want to show the academic and scientific excellence of our students. This meeting, one of ours landmarks every year, is not only a reference for the dissemination of scientific work of our students but also in the forest community in Mediterranean basin. During our time in Valsain young and senior scientists will found time and space to establish new synergies that will help their personal and scientific development. This year, one invited lecture and 47 papers will be presented as oral communications covering different topics such as Ecology, Management, Policy, Protection and Conservation of forest ecosystems.

During the last years, and again this edition, we have had the cooperation of the Director and staff of the National Environmental Education Centre (CENEAM) in Valsain which hosted us in their facilities. The University of Valladolid, the Spanish National Institute for Agricultural and Food Research and Technology (INIA), and the Erasmus Mundus Action 1 (through the MEDFOR consortium) of European Commission have collaborated to make possible this event.

Last but not least, it is important to stress the hard work of students and professors who coordinated and managed the meeting and the presentations with a high standard both in organization and scientific quality.

I hope that this conference once again serves to our students (current and future) to acquire skills and knowledge useful for their own research projects.

Prof. Dr. Felipe Bravo
Director of Sustainable Forest Management Research Institute

PREFACE

One more time, and on behalf of the Organization Committee, we are proud to present you the Abstracts Book of The XIIth Young Foresters Meeting, to be held in Valsaín, Spain.

The aim of this meeting is, as usual, to share and to show a large sample of the research carried out in our Institute by our Masters and PhD students. Also, it represents an opportunity for our students to interact with senior researchers of different scientific areas and to establish important networks with colleagues all over the world, through the participation of students of the Master MEDFOR. The experience of presenting and discussing scientific results in English, and to practice and to improve communications skills will greatly contribute to their general training.

One important mark of this meeting is that the Organization Committee is mainly composed of some of our Master Students who have been responsible of all tasks related with the coordination and organization of an International Scientific Meeting: registration, communication, selection of communications or edition of the Abstract book, but also all logistic aspects as accommodation or travel issues. This is an important complement to their scientific training, making them aware of the importance of being precise and tidy in all aspects of research, including the respect of directions as deadlines, or formats, among others. We are grateful for their hard work, effort, time and availability.

Last, but not least, we also want to emphasize the active and enriching participation in the Meeting of all students, in particular those accepting to be Chairpersons and helping in hall tasks and the Professors of the different Masters for their guidance and supervision of the presentations and abstracts and for their direct participation in the Meeting, through questions and comments.

Prof. Dr. Elena Hidalgo
Coordinator of the Organization Committee
XIIth Young Forest Researchers Meeting

WELCOME CONFERENCE

FOREST FUNCTIONING, STRUCTURE AND ECOSYSTEM SERVICES TRADE-OFFS. ADAPTIVE MANAGEMENT OF COMPLEX FORESTS

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Enhancement and conservation of forest structure and functioning in the context of Global Change calls for increasing complexity of forest stands. However, the knowledge on the feedback loop between structure and functioning is incomplete because of the interplay between bio-geophysical conditions, species interactions (niche complementarity, facilitation, competition) and the species-specific effect on site conditions (presence of a nitrogen fixing or nutrient-rich species). The management of complex forest structures is further complicated when drivers of global change (land-use change, biodiversity loss and climate change) affects policy and stand-level management decisions aimed to meet societal demands (e.g. delivery of ecosystem services). This presentation shows how research on the mechanisms behind the trade-offs between structure/functioning and the consequences of management in the delivery of forest ecosystem services can play a role in the implementation of adaptive management in complex forests. Future research lines on complex forest structures and funding opportunities for young researchers are outlined.

Keywords: *complex forests, research gaps, adaptive forest management, research funding, young researchers.*

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URBAN FORESTRY GOVERNANCE: THE IMPORTANCE OF PUBLIC PARTICIPATION

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With the increasing popularity of urban forestry, most of the attention is taken by economic, social and environmental benefits. However, the interactions between actors, institutions, decision processes and public debates are not considered as much as the advantages of green areas in the cities. As a result, despite of a plethora of research that has focused on either urban forestry or governance, the topic 'urban forest governance' is not sufficiently studied. It is challenging to encounter studies about urban forestry governance. This study is an analyzation and discussion on the paper from Anna Lawrence et al. entitled, 'Urban forest governance: Towards a framework for comparing approaches', and aims to provide a source to lighten up the obscure topic of urban forestry governance. The paper builds a wide description of governance, then creates a framework that can be applied to diverse contexts in urban forestry governance research and management plans. Thereafter, it illustrates the implementation of the framework in five case studies chosen from various locations within Europe. The diversity of the locations shows how urban forestry is affected by various cultures, mentalities, sense of identities and geographies. After the five case studies, the paper discusses the advantages and disadvantages of using this framework to analyse urban forestry governance in different contexts. Finally, it proposes usage and improvement of this framework to create well-rounded approaches. It is clear from the paper analysed that governance is not static; actors, discourses, resources and rules are changing rapidly. Urban forest includes plenty of actors, the interests of these stakeholders are different, thus in the urban forest decision process conflicts are experiences. In each case study, with the influence of cultures, perceptions, public identities, different dynamics are seen, which demonstrates that every case is unique. The key to achieve improvements in urban forestry, governance with government with a holistic approach is necessary.

Keywords: *urbanization, reforestation, decision-making, conservation, public participation.*

FUNGAL AND BACTERIAL COMMUNITIES ASSOCIATED TO *B. EDULIS* PRODUCTIVE AREAS

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Cistus ladanifer scrublands are particularly interesting for their production of *Boletus edulis*. *B. edulis* is one of the most economically and gastronomically valuable fungi worldwide. A drastic decrease in the presence and productivity of *B. edulis* has been reported in several parts of Europe. Considering that currently, *B. edulis* is only collected from wild, there is a high interest in achieving a controlled production of this fungus. This triggers the search of deeper knowledge on the natural factors influencing *B. edulis* fructifications in order to try to reproduce them in laboratory. Biotic and abiotic environmental factors are likely involved in sporocarp productions, thus, the study of soil microbiomes will likely shed some light. The aim of this study was to determine the influence of bacterial and fungal communities on *B. edulis* productions. For that, we tested bacterial and fungal communities resident in *C. ladanifer* shrubs producing *B. edulis* versus adjacent non-productive sites. We carried out Ion Torrent sequencing fungal and bacterial gene fragments from soil samples taken at 27 sites. Data obtained are being analysed to confirm our hypothesis.

Keywords: *Porcini, Microbial Interactions, Symbiont communities, Controlled production, Ion Torrent.*

EFFORTS OF SOIL CONSERVATION THROUGH AGROFORESTRY IN SUB-SAHARAN REGION, GHANA

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Agroforestry practices have widely been used as an approach to improving soil conditions in many countries of the world. In the context of soil conservation, it is heterogeneously adopted as nutrient enrichment strategy, erosion control and other similar conservation protocols. The study sought to (1) expose landowners to identify erosion problems and soil loss assessment, (2) present findings to farmers and landowners on extent of erosion and how much soil productivity was proportionally affected, (3) capacitate farmers/landowners on using Agroforestry strategies for soil conservation in land-use system. Contour hedgerow Agroforestry demonstration was established on a 3.84 ha piece of land; on which the soil loss assessment was earlier made. This paper presents key milestone for successful soil conservation efforts on irrigated vegetable field characterized by soil erosion (sheet and rill erosion) which consequently had rendered the landscape prone and nearly less fertile for the support of productive agriculture production. Soil loss assessment, contour hedgerow Agroforest system were employed to ascertain the extent of soil degradation and mitigation measure respectively. The study concludes that, the contour hedgerow Agroforest system was highly effective in control of runoff; thus reduced soil erosion significantly on the vegetable demonstration field. Consequently, the Agroforestry land-use system enabled an enrichment pathway for [nutrient](#) fixation by trees via rooting systems and mulching whiles concurrently providing regulation of micro-climate favourable for crops growth and development on the crop field.

Keywords: *Soil Erosion, Agroforestry, Soil Loss Assessment, Contour Hedgerow, Soil Nutrient.*

TLS WITHIN MIXED FORESTS

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There is an increasing trend where many authors noted the importance of mixed forest for climate change; nevertheless, this statement has been rarely quantified due to the complex structure this kind of forest present. Within this problem, Terrestrial Laser Scanning (TLS) is a survey method that is starting to stand out due to its great adaptability. In previous researches, we have already proved the accuracy of this technology in forest mensuration both in pure and mixed stands. The objective of this study, is trying to fit new tape equations for *Pinus sylvestris* and *Quercus pyrenaica* in mixed conditions. For these purpose, we have selected three plots where these two species live together, each plot is 50x40m. In total, we have selected 90 trees of each species. For this selection we have calculated the KMA Index (5m radio) for each tree belonging to the plots and we have created a buffer of 5 m in the statistic software R to avoid the border effect. Thanks to this we have created subplots 5m radio which simulate pure conditions within the general plots so that we can compare the allometry of these species both in pure and mixed conditions. Due to the difficult orography of these plots, we are currently working in the development of new methodology that allows us to isolate the selected trees.

Keywords: *Pinus sylvestris*; *Quercus pyrenaica*; Tape equation; KMA; dendrometric variables.

MASS MOVEMENTS AND EFFECTS ON LAND AND FOREST

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I will talk about mass movements, what is it? Types like "Landslide, Rock Fall, and Avalanches, causes, and the effect on earth composition. Mass movement has really effect with forest and trees stability. How forest is helps us in stabilization of land, because in case large system tree roots will be more effectively in stabilization, and this is consider part of prevent from hazards of mass movements. Finally will go shortly throw the ways of prevention and reduce the hazards of mass movements.

Keywords: *landslide, rock fall, avalanches, trees stability, hazards of mass movements.*

LANDSCAPE EVOLUTION IN EL PRIORATO. QUANTITATIVE DIACHRONIC ANALYSIS 1956-2014

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This study aims to accomplish a quantitative analysis on the evolution of the landscape in the Region of El Priorato in Tarragona, using as a methodological basis the fundamentals of landscape ecology. In addition, the heritage of these landscapes and the processes that have attributed its value will also be studied. In turn, the validity of quantitative studies is discussed in the conceptualization and identification of the patrimonial value of the landscapes, specializing the study for this specific territory. In this case it is a territory whose centuries-old viticulture tradition has shaped and characterized the territory since the founding of Escaladei's monastery in 12th century. The landscape is also influenced by the recent recovery of an economic and social crisis that lashed the region since the late nineteenth century. That crisis labeled El Priorato as a depressed and marginal territory until the 1980's. During these crises, the decline of demographic and economic allowed the woodlands to colonize the former terraces and crops creating a mosaic landscape that reflects the interaction between the population and the territory. The methodology is based on SISPARES project, in which a static and dynamic analysis of a certain landscape is carried out during a given timeframe (1956-2014). In the static analysis, a study of the elements of the landscape from a structural approach is sought, whereas the dynamic analysis studies the processes of change that have modified the landscape during the period of study. Thus, GIS and photointerpretation techniques are required to identify, on orthophotographies, the Types of Use and Cover (TUCs) and their hierarchical set of subunits (SubTUCs) that compose the territory given. These SubTUCs, which are specific to this study, allow the researcher to achieve a more detailed study of vegetation, even in mosaics as complex as those of El Priorato. Also, we calculate the main indices that describes the structure of the landscape and calculate its variation in the given period. The static analysis shows that the region at the beginning of the period was a predominantly agricultural region dominated by crops (44%). However, at the end of the period, 15% of the crops disappear. As a result, there is an increase in the coverage of the forested area occupying almost 50% of the region. The analysis of the subunits shows that currently the dominant open woodland is the most present landscape unit in El Priorato. Under a TUC approach, the dynamic analysis shows that the most influential processes that triggered the change of the landscape were: progressions, highlighting the increase of forests to the detriment of crops and scrubland, and the stabilization of crops. Finally, the indexes analysis shows an increase in the number of tiles because of the reduction of the crops surface and the subsequent colonization of the forest mass that increased the fragmentation of the crops. In turn, the large increase in the forest category (TUC) has triggered in a homogenization of the landscape and increased connectivity as reflected in the Mean Proximity Index.

Keywords: *Landscape ecology, SISPARES, SubTUCS, Mediterranean forest, GIS.*

ILLEGAL LOGGING IN PUNJAB WITH SPECIAL REFERENCE TO BHAKKAR PLANTATION RANGE

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Illegal logging specifically in southern part of the Punjab province, is one of the main challenges faced by forest department. Illegal logging is four times greater than legally harvested wood from state forests. Bhakkar plantation is located in district Bhakkar which have 6% forest cover comprising of private and state owned compact forests, canal and road side plantations. State enforced ban on green felling and auction of dead dry trees in province. Here, I will share my experience and discuss the extent of logging from beat to a Range level by timber mafia and data generated for three years working as Forest Ranger. It is observed that magnitude of illegal logging fluctuates with territory, official in charge, month wise, kind of tree, head of police station, source of information and patrolling schedule. It is further realized that participatory approach may adopted than administrative for better protection of natural resources.

Keywords: *timber mafia, forest department, Forest Ranger, fluctuates, protection, natural resources.*

IN VITRO MYCORRHIZATION OF POPULUS TREMULA WITH LECCINUM AURANTIACUM

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The mycorrhiza effects of *Leccinum aurantiacum* with micropropagated *Populus tremula* explants were unknown. We cultivated in vitro *P. tremula* with *L. aurantiacum* mycelium to study the interactions between them. The culture was carried out on substrate composed of 1000 ml of vermiculite, 200 ml of peat and 600 ml of Modified Melin-Norkrans (MMN) agar medium with pH 5.0-5.5. Eight different treatments were defined in the experiment, and their factors are the immersion of the explants in indolebutyric acid before introducing the plantlets, a previous root growth culture induced by the change of one hormone and the fungal material differences: absence or progress of the mycelium, dividing the fungus development in three conditions: absence, initiated (inoculated at the same time than the plant) and developed (inoculated in the substrate two months before the plant). We used 12 different clones and 3 explants per clone in all the treatments to ensure genetic variability. After 20 weeks, the evaluation of the aerial and the subterranean growth of the plant was focused on macroscopic variables (survival, polluted sample, length of the stem, number of leaves, length of the longest root, number of main roots,...) Microscopic evaluation using magnifying glasses was used to analyse the presence of mycorrhiza. The results will provide information about the interaction between fungus and plant and the proposed conditions to cultivate it.

Keywords: *mycorrhiza, in vitro synthesis, European aspen, root-fungus interaction, indolebutyric acid.*

SESSION 2

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RESEARCH ON THE POTENTIAL ENVIRONMENTAL ZONATION OF RED FLESH DRAGON FRUIT IN VINH PHUC PROVINCE

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Red flesh dragon fruit (*Hylocereus polyrhizus*) or pitaya is well known as an excellent source of antioxidants and high content of nutrients, particularly potassium, as well as dietary fibre. The Red flesh dragon fruit is a hybrid of the white flesh dragon fruit *Hylocereus undatus* and a native *Hylocereus costaricensis* from Middle and North America. The red flesh dragon fruit is one of fruit that bring high economic efficiency and currently being developed in Vinh Phuc province. The main objective of the study is creating a model, which help determine the suitability in developing dragon fruit cultivation in Vinh Phuc province in order to support local agricultural and land use planning. The model is built based on the application of GIS, Multi-Criteria Decision Analysis (MCDA) method, Fuzzy Set Theory and Analytic Hierarchy Process (AHP) to evaluate and map the area suitability for farming.

Keywords: *Hylocereus polyrhizus*, GIS, MCDA, AHP, modelling.

ANALYSIS OF PROCESS ASSOCIATED WITH THE GOVERNANCE STRUCTURE IN THE MODEL FOREST IN PALENCIA, SPAIN

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The governance is the organization for decision making in territory planning. As a part of territory planning, social processes must be considered for the success of the project. However, social interactions often are underestimated in project formulation, investigation, public policies and others. Using a landscape-approached territorial planning allows to recognize all stakeholder and the relationships among them. In addition, the landscape approach offers the possibility of participating in the formulation of horizontal form public policies; thus, creating a good structure of governance. The model forest is a governance figure that facilitates and improves the sustainable management of the natural resources through participation. The model forest in Palencia started in 2015, as local initiative, with the participation of companies, forest associations, academy and community. The aim of this research is to analyse the governance structure of the model forest using qualitative methodology, which allows to assess the complexity of the territory. The use of qualitative method, case study exactly, and analysis with open source techniques allows to capture objectively the reality of the territory.

Keywords: *governance, model forest, stakeholder participation, environmental management, landscape approach.*

BIODIVERSITY ASSESSMENT AND IPM APPROACH FOR SUSTAINABLE AGRICULTURE AT YEN BAI COMMUNE, BA VI, HANOI

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Viet Nam is endowed with extraordinary biodiversity, with many types of ecosystems, species and genetic resources, which are rich and endemic. The case study of this research is Yen Bai commune in Hanoi where local people are not fully aware of biodiversity importance and pesticide impacts. The research results have identified a total of 313 plant species and 80 families, of 5 phyla, in which, 304 species have the value of usage. Furthermore, there are 253 animal species in 99 families that have been identified, in which, insects class takes up 71.15% of total species and many of these are innocuous or even beneficial. However, the overuse of agricultural chemicals has led to loss of biodiversity, environmental contamination and negative influences on human health. In Yen Bai, there were 25 different kinds of pesticide were collected and studied, in which insecticide counts for more than 86% of pesticide labels. Moreover, around 28% of pesticides are classified as group II, which mean they are quite dangerous for not only environment but also human health. One of the effective solutions for sustainable agricultural development in Yen Bai is IPM associated with habitats management, minimize using pesticides, replaced by using biopesticides and finally removing pesticides along with its impact on biodiversity.

Keywords: *integrated pest management, agricultural chemicals, pesticides impacts, biodiversity loss, environmental contamination.*

MODELLING REGENERATION OCCURRENCE IN MIXED MEDITARREAN FOREST THROUGH SURVIVAL ANALYSIS

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Natural regeneration is commonly unsuccessful in pine Mediterranean forest, being the occurrence and establishment of seedlings key steps of the process. In this context, an adequate management design is essential. In this study, we used data from a network of 1936 permanent plots in mixed and pure forests of *P.pinea* and *P.pinaster* located on the Northern Plateau of Spain, to assess the regeneration occurrence through a survival analysis after uniform shelterwood had been applied. Climate and plot covariates were tested. In the analysis, we also included random effects to consider the spatial correlation of the data. The results showed that the relationship between regeneration and presence of adults trees varies as a function of the species. However, greater regeneration occurrence was associated with conspecific situations, as well as a greater level of grass in the soil. In the two species, regeneration occurrence was controlled through climate variables at the region level. Spatial random effect leads an improvement on the model fit. Using a time-varying variable, these results reinforce the findings reported in previous studies about the main limitations on the processes of the natural regeneration. Lastly, this information could be used to understand the role of mixtures along the regeneration processes under a climate-change context.

Keywords: *survival analysis, Natural regeneration, P.pinea, P.pinaster, mixed forest.*

LAND COVER CHANGE DETECTION IN MONGOLIA IN LAST DECADE USING MODIS IMAGERY

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Land cover composition and its change are important factors that estimate environmental change and sustainable development. Satellite derived remotely sensed images make it possible to monitor landscape condition, its change and trend over a specified time intervals at regional, national and global scales. The main objective of the study were to classify land cover types in Mongolia using remote sensing classification technique and to investigate spatial and temporal change in 2000 and 2009 on different land cover types through post classification change detection method. Maximum Likelihood Classification algorithm along with post-classification change detection techniques were carried out on MOD13Q1.5 Vegetation index product at 250 km resolution in order to characterize land cover types in 2000 and 2009 respectively. The result showed that a considerable change in land cover classes has taken place as huge transition from barrenland to sandyland in southern part of Mongolia due to desertification process. Otherwise, the study did not confirm any overall degradation in land cover types as far as concern just two year time frequencies of changes. In general, 74.8% of Mongolia territory (out of 157830291 ha), is unchanged area, 8.68 % is decreased area and 16.5 % is increased area during study period. The overall accuracies of classification performances were 89.59 and 89.42 in 2000 and 2009 respectively.

Keywords: *Mongolia, remote sensing, land cover types, change detection.*

TERRESTRIAL LIDAR AS A TOOL TO ANALYZE MIXTURE EFFECTS. INSIGHTS AT THE INDIVIDUAL TREE LEVEL

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Mixed-species forests are taking a greater role in forest management due to the increasing evidence of their greatest potential to supply ecological and socio-economical goods and services compared with monocultures. Since the scientific foundations of forest management have been largely derived from monocultures, there is a growing need to understand the properties that emerge due to interactions between species, in order to adapt current silvicultural tools to mixed forest. One of the most studied phenomena in mixed forests is the increase in yield (overyielding), that is a consequence of species growing more efficiently due to the occurrence of positive interactions between them (commonly called mixing effects). Mediterranean mixed forests of *Pinus sylvestris* L. and *Pinus pinaster* Ait., located in the North-Iberian Range (Spain), in which recent studies have found positive mixing effects related to increases in growth efficiency, have a special interest because they are located at the boundaries of the distribution of both species, and the mixture contributing actively to the regional economy. Further, previous analysis showed a greater structural heterogeneity in the mixtures compared to mono-specific stands, suggesting that structural changes at crown level may be responsible for the increases in yield. However, the changes at the crown level were for a long time misunderstood, since they are difficult to quantify. Until a few years ago, the only way to study the tree crowns consisted of measures taken from the forest floor or on felled trees. New techniques like Terrestrial Laser Scanning (TLS) provide a very accurate three-dimensional representation of a forest and overcome some limitations of traditional canopy studies. In order to unravel the mechanisms behind the mixing effects, the main objective this work was the study of the changes at crown level that underlie productivity increases observed in *P. sylvestris* and *P. pinaster* mixed forests. To do so, 15 experimental plots were scanned with a Faro Focus 3D TLS. Individual tree point clouds were isolated (n = 380), representing not only individuals of the two species in pure and mixed stands, but also different situations of competition and growing-space efficiency. From the individual-tree point clouds, several crown metrics and measures of interactions were constructed, using volumes, surfaces, point coordinates manually recorded on the field, distance between objects and three-dimensional representations of the crowns. Results were analysed in relation to the differences between stand types (mixed vs pure), competition status and by searching links between crown metrics and growing-space efficiency measures of individual trees.

Keywords: TLS, mixed, crown, efficiency, metrics.

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DO PEAT-BASED SUBSTRATES FAVOUR BLACK TRUFFLE MYCELIUM DEVELOPMENT?

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Black truffle (*Tuber melanosporum* Vittad.) is one of the most valuable non-timber forest products. Since the 19th century, many people have been trying to cultivate this mycorrhizal fungus with different host trees species in orchards, in order to imitate natural truffle-producing forests. For some years, Spanish orchard owners started to incorporate peat with black truffle spores in these holes instead of natural soil. Nowadays this is a usual practice in Spanish orchards. Nevertheless, nobody has proved the effectiveness of this management from a strictly scientific point of view. The aim of the study was to evaluate if peat based substrates could help to produce more truffles. As an early evaluation, we studied black truffle mycelium development. 106 holm oak trees (*Quercus ilex* subsp. *ballota*) were selected in an orchard situated in Tozalmoro (Soria). For each tree, four holes (North, South, East, West) (0,3 x 0,3 x 0,3 m) were made fifty centimeters away from the stem. Five different formulae of peat-based substrates were incorporated into the holes, and the control treatment which consisted in tilling the soil. Approximately in half of the treatments black truffle spores were incorporated. The treatments distribution was randomly executed during the spring. Later, in autumn of the same year, samples were collected. A real-time quantitative PCR test was run for each sample, in order to estimate the concentration of black truffle mycelium in the soil. Black truffle was detected in all analysed samples. After evaluating the effects of adding spores, we could observe that this addition did not significantly affect the amount of mycelium. The large amount of DNA detected seems to indicate that it comes from the mycelium that has been developed in the substrates. The statistical data analysis showed no significant differences among substrates in spite of having different formulations. These results suggest that even if peat-based substrates do not enhance the growth of black truffle mycelium, but they do not hamper it either. Although it was expected that some of the substrates stand out in relation to the rest as a consequence of the different formulae, it cannot be concluded that any of the substrates is better than the rest. The next step of the experiment will be to determine truffle productions in those holes.

Keywords: black truffle, peat, biotechnology, non-timber forest products, qPCR.

RAINWATER HARVESTING FOR MITIGATING AGRO-METEOROLOGICAL CHALLENGES IN DRY LANDS OF ETHIOPIA

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Agricultural water scarcity is a major limiting factor for crop production in dry land regions of sub-Saharan Africa (SSA). Despite notable efforts of developing macro-catchment rainwater harvesting (RWH) techniques, few studies have evaluated the performance of RWH for deficit supplemental irrigation of crops. We examine the agro-meteorological risks such as late onset, early cessation, overall low rainfall amounts and long dry spells during the growing season and evaluate the potential of macro-catchment RWH for supplemental irrigation of onion in the southern dry lands of Ethiopia. Field experiments were undertaken during 2012 and 2013 to evaluate the effects of 50% ET_c, 75% ET_c and 100% ET_c irrigation levels on yield and water productivity of onion during dry and wet seasons. The harvestable yield and water productivity of onion under 75% ET_c irrigation were not significantly lower than that under 100% ET_c irrigation during both the dry and wet seasons. Thus, deficit supplemental irrigation of onion at 75% ET_c can be implemented with macro-catchment RWH to reduce the risks of crop failure and significant yield declines in dryland areas.

Keywords: *dry spell, onset, cessation, water productivity, water supply efficiency.*

EVALUATION OF THE POTENTIALITIES OF VALORISATION AND MARKETING OF AROMATIC AND MEDICINAL PLANTS IN THE OURIKA WATERSHED

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The Ourika valley is affected by enormous climatic hazards that ravage the region in this case the torrential floods that cause damage and regression of vegetation cover. To these constraints are added the overgrazing and the anthropic pressure on the natural resources the aromatic and medicinal plants. This study deals with the determination of the different traditional uses and the potential for the valorization and commercialization of aromatic and medicinal plants existing in the Ourika valley. The domestication of these AMP to supplement their scarcity can be an important source of income for the local population and thus reduce the pressure on these precious natural resources. The methodological approach was based mainly on the surveys for the ethnobotanical study and the socio-economic study at the level of all the actors of valorization and commercialization intervening in the path of the AMP in the zone of study. The study revealed 26 species belonging to 13 different botanical families, the most represented in the valley of ourika are the Lamiaceae (42.3%). Approximately half of these AMP are harvested from local forests, 36% from rangelands and (16%) from rivers. More than half of the AMP inventories are used for predominantly therapeutic uses, 26.1% are used in both food as herbal teas and for the therapy of certain diseases, and 21.7% of these AMP are used for Both for therapeutic and cosmetic purposes. The leaves of the plants are the most used part, with a proportion of 41%. The most dominant type of preparation is infusion with a proportion of 45%. The diseases most treated by plants for medicinal use are digestive infections (47.1%). All the AMP in all the actors involved in the value chain and in the marketing sector involved in the sector in the study area generate a significant profit margin. Plants inventoried in the study area that are not spontaneous are either native to the outside of the Ourika valley, namely Marrakech, Azilal, Meknes, Errachadia, Casablanca or are cultivated in the valley of Ourika. The spontaneous AMP of the study area that have better profit margins are: sage leafroller, odorous mint, strawberry tree, and thymus satureioides. The domestication of these spontaneous AMP with better profit margins would be a good option for improving the living standards of the local population by creating income sources while alleviating anthropogenic pressures on the natural resources of the region. The creation of women's cooperatives made up of beneficiaries to better sensitize the women of the ourika douars concerning the traditional use of these AMP and their better valorization and commercialization would also be a good prospect.

Keywords: AMP, Ourika valley, ethnobotany, valuation, marketing, profit margin.

SMARTELO: AN OPEN ACCESS APPLICATION TO CALCULATE, MANAGE AND VISUALIZE DATA IN MARTELOSCHOPES

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With the advancement of new technologies, it is essential to have tools capable of managing the large amount of data generated and transforming them into valuable information. Smartelo is a computer tool born with the aim of facilitating decision making in sustainable forest management. It is developed in Microsoft Excel - VBA, and consists of a desktop version, known as Smartelo PC, and a version adapted for mobile devices, known as Smartelo Portable. The first of these is aimed at the calculation, management and presentation of dendrometric, economic and ecological data in forest plots. In addition, it allows to obtain analysis related to biomass, wood industries and other activities of the forestry sector. On the other hand, Smartelo Portable has been designed to facilitate the task of forest signaling in the field. By defining different silvicultural objectives, the application shows in real time the state of the signaling both numerically and graphically, taking into account different tree and stand variables. Smartelo has been initially developed as a tool to be used mainly in education and training areas, but currently it is being used in research, technical and social activities. Both versions are free to use, open and complementary between them and different model simulation platforms, like SIMANFOR. This makes Smartelo an innovative tool based on data science, created to support and develop training, technical and research activities for sustainable forest management.

Keywords: *sustainable forest management, data science, forest inventory, analytics, software.*

PARTICIPATIVE GOVERNANCE APPROACH IN ECOSYSTEM SERVICES VALUATION: A CASE STUDY ASSESSMENT IN NORTHERN FINLAND

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In real world situations, it is imperative to understand that ecosystem service (ES) evaluation through participative governance and management approach, characterized by an argumentative and competitive bottom-up approach is achievable and could be effective. Even though, there could be slight variations in the use of this approach depending on the part of the world and the existing governance structures in place. This very interesting approach which is based on Strategic Ecosystem Valuation through argumentation can be better understood by looking at a case study that examines how tourism entrepreneurs, reindeer herders, a local environmental non-government organization and local hunting association in collaboration with the state/municipal forestry authority performed ES valuation through argumentation, to advance specific interests in practical governance in northern Finland. This case study shows that recognition and involvement of the relevant stakeholders by the state/regional/municipal forestry authorities can go a long way in improving relations between the two parties, improving the level of trust and also ensure that there is active participation of the stakeholders in ensuring sustainability and conservation of the forestry resources. This approach increases knowledge production in the ES values perception and trade-offs across stakeholder groups.

Keywords: *argumentative and bottom-up approach, strategic valuation, stakeholders, sustainability, conservation.*

MIXED PINE FORESTS: A STRATEGY AGAINST CLIMATE CHANGE

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The 40% of European forests are mixed forests. There is an increasing number of studies highlighting that mixed forests are an important source of ecosystem goods and services, such as carbon sequestration and biodiversity conservation. This study assesses the mitigating potential of CO₂ emissions of Scots and Maritime pine mixed stands against monospecific stands of each species as a forest management alternative to mitigate climate change. To achieve this objective six triplets (circular plots of 15 m radius) along the Sierra de la Demanda, between 'Soria' and 'Burgos' regions (Spain), were selected. One soil pit of at least 50 cm depth was dug at each plot for organic and mineral soil horizons characterization. A 25x25 cm quadrant was used to collect the forest floor (FF) that was separated into three decomposition fractions: fresh, fragmented and humidified fractions. FF was dried and weighed to calculate the biomass (B). Organic carbon (C) was analyzed in each fraction to calculate Carbon stock of FF ($CS_{FF} = C_{FF} * B_{FF}$). The % of fine roots was estimated in each horizon when the soil pit was characterized. Undisturbed and disturbed samples were taken from each mineral horizon soil. C, easily oxidizable Carbon (oxC), bulk density (bD) and % stones were analyzed in each mineral horizon, and Carbon stock of mineral soil was calculated ($CS_{SOIL} = C_{SOIL} * bD_{SOIL} * Thickness_{SOIL} * [100 - \%stones_{SOIL}]$). The information of the mineral horizons was transformed into five different depths (every 10 cm) calculating weighted averages between the horizons. CS of soil profile was higher in mixed stands ($97.84 \pm 13.53 \text{ Mg C ha}^{-1}$), lower in the *P. pinaster* stands ($75.35 \pm 10.33 \text{ Mg C ha}^{-1}$) and intermediate in *P. sylvestris* stands ($88.07 \pm 11.42 \text{ Mg C ha}^{-1}$), since the CS_{SOIL} was higher in mixed stands at intermediate soil layers (10-20 and 20-30cm). These results emphasize the importance of considering the knowledge about the effect of forest management as a mitigation tool regarding carbon sequestration in Mediterranean ecosystems.

Keywords: *Pinus pinaster*, *Pinus sylvestris*, edaphic profile, Cstock, Mixed forest.

TAXONOMY AND ECOLOGICAL ROLES OF SAPROTROPHIC PERONOSPORALES (OOMYCETES, STRAMINIPILA) IN NATURAL ENVIRONMENTS

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The fungus-like Peronosporales are composed of several lineages of mainly biotrophic and hemibiotrophic representatives. Saprotrophic species of Peronosporales are limited to the genera Halophytophthora and Salisapilia, and to some species in Phytopythium and Phytophythora Clades 6 and 9, which inhabit terrestrial and all types of aquatic ecosystems. The recent discovery of species of Phytophthora in marine habitats and of Halophytophthora in freshwater indicated that these genera are not only morphologically but also ecologically poorly delineated. In addition, half of these genera are not monophyletic. They play key ecological roles by upgrading nutrients to higher trophic levels through colonization of plant debris, which makes substrata more palatable for detritivores or through zoospore grazing by zooplankton, although their role as saprotrophs is still largely neglected. Some species of Phytophthora can be aggressive opportunistic pathogens of riverine forests in the presence of susceptible hosts and favourable environmental conditions and, as a consequence, most studies have focused on their role as pathogens. Identification of species is challenging due to hybridization and species complexes that harbour multiple cryptic species and, therefore, is not reliable without DNA sequencing tools.

Keywords: *ecology, estuarine and marine ecosystems, freshwater, opportunistic pathogens, saprotrophs.*

PHYLOGENETIC STUDY OF THE GENUS MALVELLA (MALVACEAE) BASED ON ITS AND MATK SEQUENCES

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The 4 species assigned to the genus *Malvella* are distributed in the Old (1 sp) and New World (3 spp.). These species are characterized by growing in semi-desert and/or steppe environments on alkaline soils. Although they present morphological similarities (prostrate habit, lepidota trichomes indumentum, schizocarps fruits), there is no phylogenetic evidence that confirms the monophyly of this group. By obtaining sequences of nuclear ribosomal DNA (ITS), plastid DNA (matK), and using a previously existing database, we carried out a phylogenetic analysis of the various *Malvella* species to establish their placement within the Malveae tribe in the Malvaceae family, and in particular of the threatened species *Malvella sherardiana*, in Spain.

Keywords: *molecular phylogeny, evolutionary biology, plant genetics, bayesian inference, taxonomy.*

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CONSERVATION OF THE ROTHSCHILD'S GIRAFFE

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Due to both, poaching and the general pressure from expanding human populations, the total number of giraffe in Africa is steadily decreasing. In the late 1990s, about 140.000 giraffe lived in Africa, but within the last decade the numbers have dropped rapidly to about 80.000. One of the subspecies, the Rothschild's giraffe (*Giraffa camelopardalis rothschildi*), which is only native to Kenya and Uganda, was declared as endangered in 2010. In the past, the main problem they were facing was poaching but today it is habitat loss and degradation as well as human wildlife conflict. Due to an intense poaching pressure in the past, the numbers dropped to only a few hundred individuals in the 1980's and since then the species is recovering slowly but steadily. This however, was only possible due to several reintroductions and translocations and by limiting their range to clearly defined conservation areas. One of these areas is Kigio Wildlife Conservancy which is home to one out of 12 Rothschild's giraffe populations in Kenya. It is a small conservancy and thus can only hold a small population. Problems that the population is facing include browsing pressure and loss of genetic diversity due to inbreeding and the lack of new genes in the gene pool. The latter could be solved by an increased amount of translocations, however these operations are very costly as well as risky. Besides considering problems concerning the ecological point of view, it is also important to consider the social and cultural perspective when working in the field of conservation. The conservancy is surrounded by local farmers and families (approximately 100 households), which are either involved in the work of the conservancy or included in several community projects. Nevertheless, the conservancy's existence also induced several limitations to the neighbouring community, like the loss of grazing land or access to fire wood. I conducted a small study (43 questionnaires) within the local community to find out their point of view about the conservancy as well as the conservation of the Rothschild's giraffe. The results clearly showed that the people have a very positive opinion about the conservancy and the introduction of Rothschild's giraffe. Their opinion was mainly influenced by the existence of community projects conducted by the conservancy, benefiting their livelihoods as well as by the fact that the conservancy creates jobs and attracts tourists to visit the area. All in all, the survey showed that it is very important to include to community into conservation work to reduce human-wildlife conflict and to promote the peaceful coexistence of animals and humans.

Keywords: *human-wildlife-conflict, habitat degradation, genetic diversity loss, Kenya, endangered species conservation, community-based conservation.*

QUANTITY AND QUALITY OF SOIL ORGANIC MATTER IN MIXED VERSUS MONOSPECIFIC FORESTS OF PINE AND OAK

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In the last century, the exponential growth suffered by the population of our planet combine with the fossil fuel consumption has led to an increase in greenhouse gas emissions responsible for global warming. This is probably the biggest environmental threat that current and future generations have to cope with. It is important to point out the role of forest ecosystems in the framework of the Global Climate Change, being able to act as C sink or source. During the last decades, forest management of mixed stands has aroused great interest due to strong evidences that mixed forests can supply numerous ecological, economic and socio-cultural goods and services more efficiently than monospecific ones. But it is still necessary to intensify the studies to estimate soil C sequestration potential and soil organic matter (SOM) quality in mixed stands. A sustainable forest management of stands may increase their capacity for C accumulation both in biomass and soil. Soils are the largest C store on the earth, containing more C than the vegetation and the atmosphere combined. This fact underlines the need that soil has a great potential for C sequestration, contributing to the mitigation of global warming. In order to propose management alternatives considering soil as a carbon sink, it is necessary to understand the mechanisms of C stabilization in soils. The degree of soil organic carbon (SOC) stabilization depends on the chemical and physical characteristics of the soil mineral matrix, its aggregation and the chemical composition of SOM. Therefore, new management options involving the accumulation of stable fractions resilient to possible changes may be proposed. This project seeks to increase the knowledge about dynamics of mixed stands compared with monospecific ones in relation to the content and dynamics of SOM. To this end, mechanisms of stabilization involved in the accumulation of SOM will be studied along edaphic profiles of soils under monospecific and mixed stands of Scots pine (*Pinus sylvestris*) and Sessile oak (*Quercus petraea*). In addition, the effect of percentage mixture of species and stand density on the quality and quantity of the organic matter accumulated in forest litter and soil will be determined.

Keywords: C sequestration, SOM, Mixed forest, *Pinus sylvestris*, *Quercus petraea*.

PREPARING A DIGITAL MAP OF *PINUS BRUTIA* STANDS IN JABLE - LATAKIA

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The study was carried out in the area of Jablah - Latakia in 2011, and the study includes a number of afforestation sites of *pinus brutia* in the area of Jablah (Alboudy, Kfardebil, Al-Fiteh, Btmana, Al-Daliya). The practical importance of this study is the development of a map showing the distribution of *Pinus brutia* in the area of Jablah, as this map is not available to forest managers of this area. In addition, the database accompanying this map can help forest managers organize and determine the type of forestry treatments to be taken at the studied sites. A set of maps showing variance in the area, density, mean diameter, average height, and timber volume were obtained, for *Pinus brutia* stands in the studied area.

Keywords: GIS, visual interpretation, afforestation, stands, distribution, density.

EFFECT OF LEAF AND LITTER TRAITS ON DECOMPOSITION RATE OF 32 TREE SPECIES IN A TROPICAL MOIST FOREST OF BANGLADESH

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Decomposition is a fundamental global biogeochemical process that determines nutrient and carbon cycling. Associated and individual leaf and litter traits are good predictors of decomposition rate in tropical forest worldwide, but knowledge of which traits are the best predictor for tropical tree species remains scarce. Land use change is the most immediate and widespread global change driver, with potentially significant consequences for decomposition. The present study has been conducted to investigate the relation of decomposition rate and different leaf and litter traits. For this study I evaluate 9 leaf and litter traits, and litter decomposition rates of 32 tree species from three different land use types (natural forest, plantation forest and agroforestry field) in the moist tropical forest of Rema- Kalenga wildlife sanctuary, Sylhet. A backward multiple regression analysis showed that Specific Force to punch (SFp), Force to punch (Fp) with leaf thickness were best predictor of the decomposition rate and among them Specific Force to punch (SFp) found to be the good predictor and positively related to decomposition rate ($r=0.51, n=32, P<0.05$). Specific Leaf Area (SLA) was also positively related to decomposition rate. Tree community from natural forest had significantly higher SFp than tree community from plantation and agroforestry field and natural forest tree species also showed higher average decomposition rate than two other types. This study demonstrated that high scores of SFp and SLA is responsible for quick decomposition and these criteria match more in case of natural forest.

Keywords: leaf and litter traits, land use, specific force to punch, force to punch, specific leaf area.

CONTRIBUTION TO THE EVALUATION OF LOSSES DUE TO FIRES IN THE NATIONAL FOREST “TAOURIRT IGHIL” (BEJAÏA PROVINCE)

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The presentation addresses the issue of assessment of ecosystem services from an angle scientist. From the publication of the article by Velez (1993), an experimental model that responds more broadly with the aim of capacity building and developing new knowledge on the economic valuation and methods of this assessment of environmental goods and services, we know that it is difficult to estimate losses and impacts due to forest fires taking into account a practical case. For the purposes of this Directive, the estimation of losses should focus on methods dimension, in time and space, an evaluation project, which aims at compensating for the losses of natural resources and / or ecological services resulting from fires in National Forest “Taourirt Ighil”, mainly during the year 2012. We have tried to show that the vital role that these goods and services play in the Algerian economy, and how this role is frequently underestimated.

Keywords: *assessment, ecosystem services, economic valuation, impacts, natural resources.*

METHODS OF MEDICINAL PLANTS EXTRACTION AND ITS EFFECTS ON FOREST CONSERVATION

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The study was carried out in Kumasi metropolis in the Ashanti Region of Ghana. It was aimed at investigating the method of extracting medicinal plants from the forest. Structured questionnaires were used for the study. It was focused on plant species that are known to be used by herbalists, particularly trees, shrubs, herbs, climbers. Methods of collection that was being used by herbalists include debarking, root cutting, debranching, uprooting, slashing, exudation, plucking, and piercing. Consequently, these species are neither established in plantations nor home gardens. Most of these species are disappearing at a fast rate. Issuance of permit and ensuring conservation after collection was known to be lacking. Also, cultivation of medicinal plants in home gardens and plantations, monitoring of collection of medicinal plants from the forests and acquisition of permit must be ensured and enforced.

Keywords: *debarking, debranching, exudation, herbalist, home gardens, medicinal plants.*

ISOLATION AND IDENTIFICATION OF ENTOMOPATHOGENIC FUNGI (EPF) IN MOROBE SOILS

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One of the EPF strain particularly *Metarhizium spp* was successfully isolated from the soil sample collected from the Unitech farm area. This strain was isolated using selected media method at the Unitech Biotech Lab. The colony colour was green in culture condition. Microscopic view differentiated it from other strains that, for this particular strain there were no branching habit rather spores were clutched or aggregated together in a form of single chain or parallel chain to each other for some of them. Some spores were entangled while others were individually present in isolation. All the spore dimensions were almost equally same in length and with ranging from 9 - 9.5µm width and 13 - 15.2µm length. While the concentration of spores per 1ml vary for three samples ranging from 2.9 x 10⁵ to 4.6 x10⁶ conid/mL. Since this morphological identification is insufficient to say with confident that this was a *Metarhizium* species. It is recommendable for molecular identification necessary to cross check its gene sequence with those that are already in the Genbank. Also at this stage it is uncertain if this species can be virulent against insect pests. Therefore, virulent testing has to be conducted to find out the virulent potential of the strain. Furthermore, it was an also uncertain task in trying to find which type of media this particular strain prefers best. That is why it is important to conduct media preferential test and observe their response to different media for further culture and isolation purposes.

Keywords: biopesticide, *Metarhizium spp*, culture, morphology, virulence.

EXPLORATORY STUDY ABOUT THE RELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS AND PLANT SPECIES RICHNESS IN SEMI-NATURAL PYRENEAN GRASSLAND

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Is plant species richness in grasslands regulated by the interaction between climate and land use, including management and landscape fragmentation? Do land use and climate changes overcome topographical effects on plant species richness distribution? The study area range goes from Mediterranean to Continental and Boreo-Alpine grasslands in the Catalan Pyrenees. Statistical approach to the data with backwards-forwards linear modelling finding a model that explains most of the interactions between the factors determining the plant species richness. We found that plant species richness is principally driven by climate and isolation. Livestock type role is relative to the surrounding environmental conditions, in that sheep and cattle prefers to graze different plant species. Results that in rainy and cold environments, to obtain a higher plant biodiversity, we should use cattle, while sheep seem to guaranty it in high isolation conditions. The topography role affecting plant biodiversity result outclassed by climate and biogeographical variables.

Keywords: *biodiversity, climate, topography, livestock, grazing.*

SESSION 5

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MANAGEMENT MODELS OF PASTORAL IMPROVEMENT PERIMETERS IN THE RURAL CUMMUNITY LAMRIJA, MOROCCO.

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Pastoral areas in the eastern highlands are subjected to increased anthropogenic pressure due to many factors, including sedentarization of pastoralists, the cultivation of rangelands, overgrazing, etc. The creation of areas for pastoral improvement is a measure that makes it possible to remedy the situation of degradation of pastoral resources, if it is used rationally and managed sustainably. The aim of this work is to propose a model for the management of pastoral improvement perimeters based on *Atriplex nummularia*, located in the rural municipality Lamrija-Morocco. However, to fulfill this objective, a cross-analysis of the pastoral potential and the exploitation of the forage resources of these perimeters before the defense was carried out. The results obtained show a clear improvement in the parameters of structure, operation and diversity of improvement perimeters. Indeed, the total overlap for Canton Jbiel 7 is much greater compared to the other Cantons Jbiel 3 and 5, which shows that there is an improvement in species with the duration of defense, and therefore the greater specific diversity. Surveys show that the natural resource exploitation system triggers changes in the demographic, environmental and economic conditions, for example, the development of sedentarization, and the change in herd management. The dry biomass shows that the average production for the *Atriplex* with age 7 is the best (total phytomass 5700 KgMs / ha). Therefore, the phytomass production varies according to age and density. However, in the case of *Stipa tenacissima*, station 7 has the largest dry biomass of 108 KgMs / ha). Overall, a pastoral management plan is established on the perimeter over time given the sustainable and efficient use of natural resources (*Atriplex nummularia*, *Stipa tenacissima*).

Keywords: *pastoral improvement, highlands, management model, phytomasse, structural parameters.*

MODEL FORESTS AS LEARNING LANDSCAPES, THE EXAMPLE OF THE PALENCIA AND URBION MODEL FORESTS INITIATIVES (SPAIN)

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Model Forest are defined as “both a geographic area and an approach to the sustainable management of landscapes and natural resources” (www.imfn.net), and with more than 60 sites all over the world, some of them working for more than 25 years, they represent one of the networks of landscape approaches more mature. These initiatives have a huge potential as learning landscapes, not only about the development of governance processes, but to consider other subjects. For these, we need to understand better the processes of construction of these landscape approach initiatives and the elements required to its construction. The Palencia Model Forest initiative was launched by the University Institute for Sustainable Forest Management (Instituto Universitario de Gestión Forestal Sostenible), the Smart Forest Foundation and the Group of Businesses for a Sustainable Palencia (Agrupación de Empresas por la Sostenibilidad de Palencia). It was declared Model Forest Candidate and became part of the International Model Forest Network in March 2017, after a long process of nearly two years of meetings and workshops. The Palencia Candidate Model Forest covers over 4000Km² and comprised of 92 municipalities, and it has been defined as a neo-forestry landscape. We want to analyze and explain in a comparable way the motivations and conditions necessary for the process of construction of the governance of an initiative such as the Model Forest, landscape approach initiative, in order to systematize a work methodology with social participation for territorial development. And identify, factors that significantly influence an experience to be successful or have a greater impact on a territory and those that, on the contrary, cause the initiative to fail. The social agents linked to the territory are the ones who can contribute the most information to the research, choosing in this way by a qualitative methodology that allows us to find a greater understanding of the social phenomena objects of study. The research will be carried out through a case study (Stake, 1998). Based on in-depth interviews and participant observation, we analyzed the development process of the Palencia Model Forest initiative (Spain) and the Urbión Model Forests (Spain), and other initiatives in the Mediterranean and Europe.

Keywords: *landscape approach, collaborative learning, model forest, governance, qualitative research.*

EFFECT OF INORGANIC FERTILIZATION AND SEED WEIGHT ON SEEDLINGS: EXAMPLES OF BANGLADESH

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This paper reveals the effect of seed weight and three inorganic fertilizers viz, nitrogen, phosphorous and potassium (NPK) on the germination and seedling growth (shoot length, leaf number, collar dia, root length, biomass accumulation and carbon sequestration) of *Syzygium cumini* and *Artocarpus heterophyllus* at the nursery conditions. Seedlings were evaluated for 6 months in the nursery. The application of different combinations of three commercial fertilizers were applied in 6 treatments (T0: no fertilizer; T1: 1kg NPK fertilizer / m³ soil; T2: 1.5kg NPK fertilizer/ m³ soil; T3: 2kg NPK fertilizer/ m³ soil; T4: 2.5kg NPK fertilizer/ m³ soil; T5: 3kg NPK fertilizer/ m³ soil) including one control treatment (T0). Seed weight was taken before sowing. Regression analysis suggests that seed weight have positive effect on germination of *S. cumini* and *A. heterophyllus*. Seed germination time was gradually reduced with an increase of seed weight within the same species. However, fertilizer application slightly delayed the germination time. After germination the seedlings were measured for leaf number, shoot length, collar diameter, root length and biomass. Results showed that leaf number, collar dia, shoot length, root length of seedlings under treatment T3 provided the maximum values. Moreover, total biomass production of these two seedlings was also showed the maximum effect under T3 treatment. However, T5 has the lowest growth performance than the other treatments which indicates that higher doses of NPK fertilizer have negative effect on seedling growth.

Keywords: *soil nutrient, plant traits, plant nutrient interaction, plant early stage, primary production and native tree species.*

FOREST POLICY, GOOD GOVERNANCE AND SUSTAINABLE RURAL DEVELOPMENT IN THE MEDITERRANEAN REGION

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The increasing importance and demands for food, timber, environmental services and biofuel in the Mediterranean region has posed severe treats and challenges for efficient and effective governance in the region. It has a direct and indirect impacts on climate change which has limits the possibility of attaining sustainable rural and integral development for inclusive growth of all the region in the future. Good governance in the forest sector will address the complex challenge of forest policy failure, market failure and information failure which will regulate and represent the complex interest of various stakeholders and actors in the sector. Although most of the forest are owned by the government, good forest governance can be achieved through decentralization of forest management, timber certification and logging concession in public owned forest.

Keywords: *stakeholders, inclusive growth, certification, decentralization, ecosystem services.*

SESSION 6

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WORKING IN QUEENSLAND (AUSTRALIA) PLANTATION FORESTRY SECTOR - A BRIEF ANECDOTAL EXPERIENCE

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The Australian Forestry Sector is dynamic providing direct and indirect employment to almost 75,000 people across the country in timber and timber industry. Furthermore, the sector provides sources of social and environmental services/benefits to the wider population such as camping, hiking, water conservation, water catchment management and soil degradation mitigation. This presentation will focus on my brief professional career in the plantation forestry industry specifically. It will reference anecdotal experiences from the two specific regions of Queensland in which I worked and attempt to highlight responses to a myriad of challenges based on seasonal weather patterns, major natural disturbances, limitations and advantages of markets and complex wood supply contracts sawmills. Being anecdotal in nature, I aim to provide a personal insight into both the plantation sector in Queensland and the challenges often faced by students transitioning into the professional world. A series of open question will be provided with respect to the aforementioned issues of major natural disturbances and risk management, market availability in isolated regional areas and requirements for successful transition from student to professional.

Keywords: *plantation, Natural Disturbance, Employment, Student, Industry.*

IDENTIFICATION OF NATIVE PARASITIDS OF *LEPTOGLOSSUS OCCIDENTALIS* HEIDEMANN (HETEROPTERA: COREIDAE) EGGS IN CASTILLA Y LEÓN (SPAIN)

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Leptoglossus occidentalis, the Western Conifer Seed Bug (WCSB), is an important economic pest in Mediterranean areas because reduces the production of pine stone nuts. Currently no effective methods to control this pest is not known. In its native area have been found native parasitoids that reduce the population of this pest, so this parasitoids can be used such as biological control agent. In Italia, researchers studied several *L. occidentalis* parasitoids to determine the most competitive, but the result was that the better parasitoid isn't native of Europa, and their introduction in our continent can be negative for populations of potential non-target heteropteran host. To catch and identify native parasitoids of *L. occidentalis* in Spain, we caged several males and females of WCSB in different *Pinus pinea* L. branches in the field during summer of 2017. These couples laid 315 egg masses with 1.700 eggs, the 55,2% of egg masses were parasite, while the 23,5% of the eggs were parasitized, these numbers show a large level of parasitism over WCSB eggs in the field. The parasite eggs were removed to the lab to obtain the parasitoids when they emerged. In the lab, we got 275 parasitoids. We expect that these parasitoids were *Ooencyrtus pytiocampae* Mercet or *Ooencyrtus telenocimida* Vassiliev, but we identified eight different morphotypes. To identify the species, we selected 22 to extract their DNA, repeated each morphotype at least two times. We did an extraction of total nucleic acids, amplified the DNA with LCO149 and HCO2198 Primers and sent one sample of each morphotype to sequence. We compare our results with GenBank database, but our sequences don't match with their sequences, we only know that our parasitoids belong to *Ooencyrtus* genus. Next step is to try to identify this parasitoids morphologically.

Keywords: biological control, Western Conifer Seed Bug, *Ooencyrtus* sp., DNA, GenBank.

OPPORTUNITIES AND CONSTRAINTS FOR INTEGRATING TREE AND SHRUB SPECIES IN THE CROP-LIVESTOCK FARMING SYSTEMS OF BORODO WATERSHED, CENTRAL ETHIOPIA

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Tree and shrub integration in a watershed has been promoted as a means to enhance rural livelihoods through sustaining its potential services and products. Thus, rural tree planting on different niches are a history of long time in Ethiopia. However, the efforts made were unsuccessful mainly due to various factors. Owing to this fact, this study was conducted at *Borodo* watershed, to identify the existing tree and shrub species, explore those multiple factors impacting tree and shrub integration, and to investigate major soil properties of potential tree and shrub planting niches. The study was based on a survey of 148 household heads and focus group discussions, key informant interview and field observations. A total of 45 soil samples (5 niches * 3 replicates * 3 depths) were also collected to investigate major soil properties of the potential niches. The study identified a total of 42 tree and shrub species at different niches in the watershed. The study also found out improved access to information, availability of market for tree products, positive prospect of land tenure, cash availability and land certification as the most important factors that encourage farmers to plant more tree and shrub species. Concerns identified that constraints tree and shrub species integration at the watershed include: shortage of planting area, soil cracking, free grazing, lack of seed and seedlings of desired species, and water– logging are found to be decisive. The potential tree and shrub growing niches that farmers identified and preferred were homestead (95.5%), gully side (67.4%), streamside (61.8%), road side (60.7%), and outfield (12.4%). The soil property examined exhibited significant variations for total N. Potassium (K⁺) was also showed significant variation at 0–15 sampling depth. On the other hand, pH values didn't show significant variation among potential niches. It is essential to address the factors that hinder tree and shrub species integration at various landscape position of the watershed so as to improve the availability of tree products and services. Moreover, the capacity of farmers should be upgraded through training and demonstration of best tree planting, management and utilization practices.

Keywords: *household, landscape, niche, soil properties, species preference.*

PHENOTYPIC PLASTICITY OF BARK ALLOCATION IN A MODEL CONIFER

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The bark is a key feature that structures plant communities, but knowledge about its phenotypic plasticity is absent. Among its different functions, thermal insulation is its most studied role. To address allocation to bark, it is necessary to distinguish the environmental effects from the developmental differences and also to separate the genetic effects. Despite the relevance of differential allocation to bark to understand its plasticity, plant survival facing fires depends on its absolute –not relative– bark thickness. Therefore, the fact of trees having reached or not a critical bark thickness that allows survival should modify the allometry of resource allocation to bark, hence contributing to the plastic variation between sites and genetic differentiation among populations. We used a *Pinus halepensis* common garden replicated in two contrasting sites. This well-studied model species in Mediterranean fire-prone environments is an obligate seeder –so its vital strategy is not based on adult survival–, but it is mentioned in the literature either as a thin- and as a thick-barked species, and some works indicate that it can survive low-moderate intensity fires under certain conditions. Our objectives were (1) to check whether the populations at each experimental site could achieve a minimum critical bark thickness (in absolute terms), inferring also its implication for survival both on surface fires (hence, linked to basal bark thickness) and on moderately intense fires (hence linked to breast-height bark thickness) and (2) to study the possible different patterns of allocation to bark and the possible effects of the environment (plasticity linked to test site), the genotype (population) and their interaction in the allocation, once allometric effects are properly accounted for. Our analyses indicated clear site and population effects on the absolute bark thickness, both at tree base and at breast height, achieving a greater degree of bark insulation at the high-resource site and in the higher growth populations. The resource allocation to bark was also significantly affected by the test site, the population, and their interaction. These results indicated that the populations at the high-resource site, allocate a somewhat fixed quantity of resources independently on tree size since almost all of them already have an absolute bark thickness that would allow survival. However, at the low-resource site, populations generally do not reach the necessary thickness to survive, so they are using more resources (which will not be available for other vital functions) to achieve that bark thickness threshold. In conclusion, our results point to an increased risk of immaturity (death by moderately intense fires before achieving sufficient recruitment) under harsher environments that may be increasingly common under climate change.

Keywords: *allometry, critical bark thickness, fire adaptation, genotype-environment interaction, Pinaceae.*

ASSESSING THE PATRONAGE OF BOBIRI FOREST AND BUTTERFLY SANCTUARY AS TOURIST AND RECREATION SITE

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Ecotourism and forest recreation is gaining increasing attention as one of the important services of the forest throughout the early 1990s. The purpose of the study was aimed at determining the trends of tourist and accessibility constraints of patronage in Bobiri Forest and Butterfly Sanctuary. The study was carried out in Bobiri Forest and Butterfly Sanctuary. Systematic sampling technique was used to select a total of 60 respondents and structured questionnaire administered. Director of Forest Research Institute of Ghana (FORIG), Technical Officer and Staff were contacted and interviewed. The study was conducted within 2 months. The data collected was analyzed using Statistical Package for Social Scientist (SPSS) and Microsoft excel. The study revealed that total patronage for both local and international tourist from 2001 to 2011 was 24,435. This was made up 12,569 international tourists and 11,866 local tourists. The highest level of total patronage on annual basis was recorded in 2011, while 2001 recorded the lowest. Similarly, the highest level of total patronage on monthly basis was recorded in April 2006, while the lowest was recorded in June 2006. Again, the highest level of international and local tourists recorded in April 2006 and March 2008. The lowest was in June 2006 and March 2008. The total month of patronage for the 11 years was recorded in July and lowest in September. Apart from this, lack of adequate signage, bad roads and transportation problems was identified as the major constraints to the reserve. Majority of tourists got to know of Bobiri through recommendation. If forest recreation and ecotourism is to contribute to sustainable socioeconomic development, marketing strategy should focus on domestic tourists. With appropriate facility, improved accessibility and marketing it is conceivable that reserve could be drawing over 10,000 paying tourists on an annual basis without jeopardizing the ecological integrity.

Keywords: *recreation, arboretum, butterfly sanctuary, accessibility, conservation.*

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NON FOREST PRODUCTS – BLACK TRUFFLE

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A truffle is the fruiting body of an underground mushroom. Almost all truffles are found in close association with trees. There are hundreds of species of truffles that are big, but the fruiting body of some (mostly in the genus 'Tuber') are highly prized as a food. Also known as "the diamond of the kitchen", after the Second World War there is drastic changes in truffle availability. Nowadays it's highly expensive food in the world due to lack of awareness about cultivation techniques. The black truffle (*Tuber melanosporum* Vittad.) has become an important profitable agricultural alternative in rural Mediterranean regions. The declines of wild production throughout its natural range, its high market value and the development of nursery and cultivation techniques have enhanced its successful cultivation during the last few decades. In this article, we present the state of the art of black truffle cultivation, the requirements of the fungi and the cultivation techniques of this culinary fungus. This study will help to people how to cultivate and manage Black Truffle.

Keywords: *Tuber melanosporum*, cultivation techniques, land suitability, diamond of the kitchen, profitable cultivation.

REDD+ AND WOMEN PARTICIPATION

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The study mainly focuses on the analysis of “Women’s participation in REDD+ national decision-making in Vietnam” by Pham, T.T., Mai Y.H., Moeliono M. and Brockhaus M. REDD+ is an accepted climate change Mechanism of Reducing Emissions from Deforestation and Forest Degradation under the United Nations Framework Convention on Climate Change (UNFCCC). Engaging women is critical to REDD+ for the achievement of equitable and sustainable results and also is necessary under the International Agreements on Gender Equality. The incorporation of gender considerations into REDD+ brings about the increased efficiency. There are numerous studies that have been carried on the participation of women in decision making bodies related to forestry. However, very little of this has been applied to REDD+ decision making at the national level. The analysis uses the Vietnam as a case study to analyse the factors that influence women’s participation in REDD+ decision making such as (i) cultural and social norms (Sunam and McCarthy 2010); (ii) social perceptions that forestry is a male domain (Agrawal 2010b, Mai et al. 2011); (iii) laws and regulations that deliberately exclude women; (iv) underrepresentation of women in decision-making bodies (Agrawal 2010a); (v) lack of recognition of heterogeneity among women (Agrawal 2010a,b, Colfer 2005). Although REDD+ has worked in many countries to mainstream gender equality but Vietnam still lacks full participation. The recruitment process is not favourable to women, they are rarely appointed to leadership position in REDD+. In addition to this, there is a lack of interest in gender equality among the national organizations working in REDD+ in Vietnam. Since centuries, we know women are most often tasked to meet a family’s Non-Timber Forest Products (NTFP) such as food, fuel wood, fodder and other NTFPs used to meet daily needs and generate income. Given their knowledge and roles of forests and the forestry sector, women need to be sufficiently represented in relevant institutions, accepted as stakeholders with specific views and interests, and empowered to have a say in transformative decisions. Studies have shown such as Agrawal’s (2009), in Nepal and India inclusion of women in forest management committees and their effective participation in decision-making have improved forest governance and resource sustainability. Men and women 'knowledge and management strategies for forests are distant and directly related to their use. And so, their behaviour and practices are critical to securing the uptake of REDD+. It is important to include women stakeholder, ensuring REDD+ strategy development. A more gender-sensitive legal framework is required. Many NGOs and government agencies should be encouraged to work with REDD+ and environment programs with the focus on gender equality and women ‘s rights.

Keywords: REDD+, women, Vietnam, forestry, gender.

SOIL BULK DENSITY VARIATION IN A *RHIZOPHORA RACEMOSA* PLANTATION

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In spite of an increased effort to conserve and restore mangroves in the Songor Ramsar site, there is a marked lack of information on edaphic factors such as soil bulk density, and how it could possibly influence root growth. The study was therefore undertaken as part of a broader research on soil properties and carbon stocks in mangrove ecosystems in the eastern coastline of Ghana. The aim was to provide information on how different site conditions (intact and degraded), in terms of tree stand density and surface hydrology differences could influence the variation of soil bulk density in a fifteen-year-old *Rhizophora racemosa* plantation. The results showed that, bulk density increased significantly with depth, with values of 0.47 g/cm³ (0-15cm), 0.81 g/cm³ (15-30cm) and 0.87 g/cm³ (30-50cm). Site condition on the other hand had no significant effect on soil bulk density. However, soil bulk density of 0.69 g/cm³ was recorded under the intact conditions whereas 0.76 g/cm³ was recorded for the degraded conditions. The study showed that soil bulk density in the deeper layers could be two times higher than that of the surface layers (30-50cm, 0.87 g/cm³ and 0-15cm, 0.47 g/cm³). The increase in bulk density with depth was attributed to reduction in organic matter, soil aggregation and root penetration. Lower bulk density under the intact conditions is attributed to high stand density and its resultant contribution of higher organic matter inputs, optimum moisture regime and closed canopy. The reverse of this accounts for the generally higher bulk density recorded under the degraded conditions. The study therefore holds implications for the productive restoration of soil physical properties in degraded mangrove sites.

Keywords: mangrove, restoration, degradation, pneumatophores, intertidal zones.

RODENTS AS RESERVOIRS OF ZONOTIC DISEASES IN AGRICULTURAL LANDSCAPES IN CASTILLA Y LEÓN (SPAIN)

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Emerging infectious diseases (EIDs) are a real burden for global economies and public health. EIDs have increased during the last years, specially zoonotic diseases (EIDs mediated by non-human animals). Wild rodents are, together with bats, the main natural reservoirs of a considerably high number of zoonotic pathogens (mostly virus, bacteria and protozoa). It is known that more than a third of the rodent species acts as a reservoir for some pathogen, and these species can be considered as “hyper-reservoirs” since they can host from 2 to 11 different pathogens. Correlative associations between rodent abundances and the prevalence of specific pathogens are common. Yet, studies considering guild, community and temporal dynamic scales (ie, more realistic scenarios) are scarce. Most hosts could be infected by several pathogens species, simultaneously or consecutively, but little is known about co-infection patterns and time-space dynamics of these communities. Considering the association between zoonotic pathogens of risk to humans and wild rodents (taxon characterized for its opportunistic lifestyle strategy), as well as the forecasted strong environmental anthropogenic-driven changes favoring the spread of certain rodent species (including commensal and semi-commensal species), a continued raise of rodent-borne and/or rodent-vectored EIDs could be expected in the near future. This project aims to explore and analyze the variation patterns of 6 zoonotic pathogens of risk to humans (*Anaplasma* sp., *Borrelia* sp., *Bartonella* sp., *Coxiella* sp., *Rickettsia* sp. and *Francisella* sp.) among dynamic populations of 3 rodent hosts (*Microtus arvalis*, *Apodemus sylvaticus* y *Mus spretus*). More specifically, I will evaluate the causative factors and processes behind patterns of variations, in order to acquire a greater knowledge of pathogen co-infection patterns and their time-space dynamics. A biological data base gathered during a complete boom-and-bust population fluctuation of rodent communities (from 2013 to 2015) in three different localities (replicates: Palencia, Valladolid and Zamora populations) will be used; another complete fluctuation is expected during the next months (probably by the end of 2018), so, if this is the case, it will provide further temporal replicates. Animals will be dissected in order to isolate the spleen and liver, which are needed for molecular analyses. PCR Multiplex techniques will be carried out to detect and identify simultaneously the characteristic DNA region determined for each one of the bacteria species in every sample.

Keywords: *bacteria, EID, Microtus arvalis, pathogens, PCR Multiplex.*

SELF-DISSEMINATION OF ENTOMOPATHOGENIC FUNGUS *BEAUVERIA PSEUDOBASSIANA* FOR BIOLOGICAL CONTROL OF PINE WOOD NEMATODE VECTOR *MONOCHAMUS GALLOPROVINCIALIS*

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Pine Wood Nematode *Bursaphelenchus xylophilus* causes Pine Wilt Disease (PWD), resulting in widespread tree mortality. This quarantine organism is necessarily vectored by long horn *Monochamus* spp. beetles. PWD management through control of the insect vectors has been proposed. Recently, the high potential of entomopathogenic fungus *Beauveria pseudobassiana* for the biological control of *M. galloprovincialis*, the only known vector of the disease in Europe, has been shown. Several experiments were carried out aimed to develop a practical method to spread this biological control agent within the beetle population by self-dissemination tactics. Multiple funnel trap collection cups were provided with screened bottoms to effectively reduce by-catch of non-targeted beetles by 73%. Two self-release devices attached to the trap collection cups were field tested and resulted 100% effective in allowing escape of trapped *M. galloprovincialis* adults. These devices were further developed to serve for the self-infection purpose. Two *B. pseudobassiana* concentrations, [10⁹] and [10¹⁰] conidia/g in talc powder, were assayed in two self-infection devices in the laboratory. Complete mortality occurred after 9-10 days and 15-19 days for each dosage respectively. Survival time averaged was 6,2 days and 10,2 days for the high and low dosage respectively. Further studies testing horizontal transmission of self-infected beetles would extend these results.

Keywords: *Lure&Infect, self-infection device, non-woven textile, modified collection cup, mesh.*

MODELING THE GROWTH AND YIELD OF *EUCALYPTUS GRANDIS* HYBRID IN BRAZIL USING 3-PG MODEL

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Eucalyptus grandis W. Hill is largely planted in Brazil as it finds the appropriate conditions for a fast growth in some regions of the country. Although it presents a considerably fast growth rate, it is a very demanding tree in terms of its climate requirements. A hybrid tree called *Eucalyptus urograndis*, created by breeding *Eucalyptus grandis* and *Eucalyptus urophylla*, is usually the best option for reforestation in areas affected by small periods of drought, as it offers higher resistance during periods of low precipitation. This piece will examine the growth of *Eucalyptus grandis* hybrid in Brazil using the 3-PG growth and yield model, taking into consideration different regions within the country. The three selected regions are; Santa Maria in the south, Espírito Santo in the southeast and Juazeiro do Norte in the north. Climate data of the regions between 1996 until 2001 was collected from INMET and INPE and inputted in the model. When running the model, for each of the locations three different fertility rates were analysed (0.3, 0.5 and 0.7) and two Available Soil Water (ASW) conditions (60 and 240). This was completed to simulate the growth in different combinations of site quality and to check if the growth would be affected or limited by these factors. The climate data input showed that Santa Maria presented the higher precipitation indices from all the three locations, having a well distributed pattern of raining days throughout the entire year. On the other hand, Juazeiro do Norte presented a long period of drought from June until September with very few precipitations. In Santa Maria, we found a mild winter with relatively low temperatures from May until August, if compared to the other two locations, meanwhile the higher temperatures were found in Juazeiro do Norte. After running the model, Espírito Santo was found to be the best location for the growth of the species, showing the higher results for the three outputs when running the model using 0.7 of fertility rate and 240 of ASW. Despite high precipitation in Santa Maria, the growth of *Eucalyptus* in this region did not reach such as good results as in Espírito Santo. Juazeiro do Norte presented the worst conditions for the growth of the species, which were negatively affected by the changes in ASW. The ASW did not influence the growth of *Eucalyptus* in Santa Maria as precipitation is high all year around. Despite high precipitation in Santa Maria, the lower temperatures negatively influenced the species growth when compared to Espírito Santo. Despite the fact of high temperatures, low precipitation levels in Juazeiro do Norte negatively affected the development of the trees in this region. Fertility does not seem to limit the growth in Juazeiro do Norte.

Keywords: *Eucalyptus grandis*, 3-PG model, growth, yield, Brazil.

SHADING EFFECT ON THE GROWTH OF FIVE INDIGENOUS TREE SPECIES IN EGERTON UNIVERSITY BOTANIC GARDEN, IN KENYA

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Indigenous tree species have been part and parcel in the evolution of rural communities in Kenya. The use of these trees includes traditional medicine, fuelwood, fodder, and timber. However, the substitution of these indigenous tree species with the exotic ones in farmlands, coupled with their illegal harvesting in natural forests, has endangered some of the tree species. Therefore, there is need to understand the growth of juvenile indigenous tree species on different site conditions to ensure successful establishment and optimum growth. The study assessed the response of five tree species (*Prunus africana*, *Warburgia ugandensis*, *Hagenia abyssinica*, *Olea europaea* subsp. *cuspidata*, and *Ekebergia capensis*) to the availability of sunlight, in a 50m by 50m mixed indigenous plantation. Two plots of 4.5 m by 5 m were established, one under a natural shade of a flat-topped *Acacia* and another in an open site, to compare stem diameter and total height increment of these tree species. This assessment was carried out 9 months after the plantation was established. A digital caliper was used to measure the stem diameter, at ground-level, of 15 juvenile-trees from each plot, where 3 tree-individuals were taken as a representative of each of the five species under study. The total height, from the ground-level to the tip of the juvenile-trees, was measured using a measuring tape. A two-sample t-test revealed a significant height increment for the tree species growing under the shade ($P < 0.05$). However, stem diameter increment did not vary significantly between the two study plots ($P > 0.05$). These preliminary findings offer us an opportunity to select better sites for the establishment of these indigenous species to enhance their conservation.

Keywords: *conservation, endangered, site conditions, plantation, establishment.*