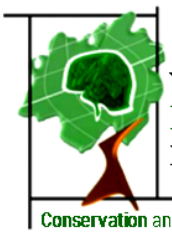

YOUNG RESEARCHERS MEETING

Conservation and Sustainable Use of Forest Systems

XVI Young Researchers Meeting on Conservation and Sustainable Use of Forest Systems

Palencia (Spain), 26-27 January 2022

Universidad de Valladolid

INIA Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

MEDfOR Mediterranean Forestry and Natural Resources Management

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INDEX

PREFACE

As the Director of the Research Institute on Sustainable Forest Management Research (iuFOR), I am pleased to present the abstract book of the XVIth edition of the Young Researchers Meeting on Conservation and Sustainable Use of Forest Systems, celebrated this year at the Campus of Palencia.

Like in other editions students from different master programs from the University of Valladolid, such as Master of Forest Management based on Data Science (DATAFOREST), Master on Forestry Engineering, Erasmus Mundus Master in Mediterranean Forestry and Natural Resources (MEDFOR) and researchers from the PhD program on Conservation and Sustainable Use of Forest Systems have participated in the Meeting. MEDFOR students participate in it as a part of the Winter School hosted and organized by the Agricultural, Food and Forestry School (University of Valladolid).

After sixteen years of celebration, this meeting has become a reference for the dissemination of scientific work of our research students and allows establishing new synergies that will help their personal and scientific development. In this edition more than 70 people among students and researchers from 20 countries and 5 continents (from India to Brazil and from Kazkhastan to France including Sweden, Armenia, Ethiopia, Indonesia, or Spain, among others) have participated. The geographic distribution of the participants along with the diverse ecosystems studied, allow us to cover all the topics of sustainable forest management.

This edition Professor Hans Pretzsch from the Thechnical University of Munich, Germany has delivered the inaugural lecture entitled: "*Forest dynamics. From monospecific to mixed species stands"*

The 2022 edition of the Meeting of Young Researchers had the institutional support of the Junta de Castilla y León with the presence of Dr. Pilar Garcés García Vice Minister of Universities and Research of the Castilla y León regional government who, together with the Vice Chancellor of Research, Innovation and Transfer of the University of Valladolid, Dr. Oscar Martínez Sacristan, closed the event.

Also, I would like to especially thank the professors and students who coordinated and managed the meeting for their hard work which is reflected in the quality of the organization. Finally, as in other opportunities, I hope that this conference will serve to guide and enlighten our students (current and future) on what we pursue through our research training programs.

Prof. Dr. María-Belén Turrión
Sustainable Forest Management Research Institute
Universidad de Valladolid

PREFACE

Once more and on behalf of the Organization Committee, I am proud to present you the Abstracts Book of our Young Foresters Meeting 2022 in its XVIth edition.

This time and due to covid pandemic we have limited the number of short presentations to only 21, as always, mainly by our Young Researchers in Forest, masters, and PhD students, but we have given floor to many other of them through poster sessions and "Open mic" format.

Again, we have created an open space for scientific exchange, in which young foresters have had the opportunity of practicing their skills as scientific communicators and strengthen their experience in Scientific Meetings in front of an international and crowded audience. At the same time, the poster sessions and informal conversations during open mic sessions and break lapses, have favored the interactions and networking among them and with more experienced researchers.

Once more, our masters' students have also been responsible for the whole organization of the Meeting, including the chair responsibilities or the edition of this Abstract Book. We are grateful to them all for their hard work, their effort, their time, and their availability.

Last, we also want to emphasize the active and enriching participation in the Meeting of the Professors and senior researchers of the different programs whose guidance and supervision of the presentations and abstracts and whose direct participation in the Meeting through questions and comments, are always very much appreciated.

We are sure that this edition has been a real showcase of our activity at IuFOR

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

YOUNG RESEARCHERS MEETING
Conservation and Sustainable Use of Forest Systems

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PROGRAMME

WEDNESDAY 26th JANUARY

9:00-9:30 **Registration & Poster Hanging**

9:30-10:30 **Welcome and Session I:**

Chairpersons: Aitor Vázquez and Natalia Crespo

Speakers:

- **Jihane Khairallah:** *Re-envisioning Coastal Public Space - Case of Kfaraabida, Lebanon*
- **Marina Getino Álvarez:** *Assessing quantity and quality of soil organic matter under mixed pine-oak forests*
- **Frederico Simões:** *Using handheld and airborne laser scanning to improve tree-level mapping. A mixed-forest showcase in Spain*
- **David Candel Pérez:** *Unravelling historical pruning patterns in pollarded ash trees*
- **Héctor Hernández Alonso:** *All sizes matter in forest carbon sink*

10:30-11:30 Coffee break & Poster Session I

Celia Herrero: Escalera de Excelencia + Open Mic

11:30-12:00 **Opening conference**

Chairperson: Felipe Bravo Oviedo

Key Speaker: Hans Pretzsch, Technical University of Munich, Germany
Forest dynamics. From monospecific to mixed-species stands

12:00-12:20 **GROUP PICTURE**

13:00- 13:30 Opening Session

- **Oscar Martinez, Research Vice Chancellor**
- **Belén Turrión, IuFOR Director**
- **Pilar Garcés, Vice Chancellor for Universities, Junta de Castilla y León**

14:00-15:30 Lunch at YUTERA

15:00-16:00 **Session II**

Chairpersons: Irene Bocos and Wilson Acosta

Speakers:

- **Miguel García Hidalgo:** *Meet CaptuRING: an open source tool for wood sample digitization*
- **Luiz Henrique Elias Cosimo:** *Bird community as an indicator to monitor Atlantic Forest restoration in southeast Brazil*
- **Raquel Martínez Rodrigo:** *Predicting the existence of Lactarius deliciosus yields with remote sensing data*
- **Laura Martín:** *Social-ecological information system using open data. Palencia Model Forest*
- **Darío Domingo:** *Assessment of oak groves conservation status in Natura 2000 SACs with single photon LiDAR*

16:00-17:00 Coffee break & Poster Session II

Aitor Vázquez: IFSA + Open Mic

17:00-18:00 **Session III**

Chairpersons: Laura Martín and Pedro Luis Pérez

Speakers:

- **Ani Ahmetaj:**
  Usage of drones in forest pest control: Case study of the usage of drones in combating Thaumetopoea Pityocampa in Albania
- **Rafael Villafuerte Jordán:**
  Efficiency of assessing current year twigs browsed as an early warning system of red deer impact on Mediterranean ecosystems
- **Daniel Herrera Rodríguez:**
  The role of mosquitoes in the epidemiology of Francisella tularensis

18:00-21:00 **Social activities in town**

Free time / Free dinner

THURSDAY 27th JANUARY

9:00-10:00 **Session IV**

Chairpersons: Silvia Herrero and José Bernardo González

Speakers:

- **Mireille Aimée Bienvenue Ginesy:**
  Recycling forest-based industries wastes to produce seedlings fertilizer
- **Aitor Vázquez Veloso:**
  Simulation of non-wood resources productivity (mushrooms and pinion) under different management scenarios by using SIMANFOR
- **Cristina Zamora Ballesteros:**
  Genome-wide identification and characterization of defense-related long non-coding RNAs in non-model plant Pinus radiata

10:00-11:00 Coffee break & Poster Session III

Frederico Simões: Project Marie Curie + Open Mic

11:00-12:00 **Session V**

Chairpersons: Ali Askarieh and Margarita Elizabeth Rico

Speakers:

- **Daniel Chukwuemeka Amaougu:**
  From organic saline soil remediation to agroforestry: a potential paradigm for climate change mitigation and adaptation in Nigeria
- **Silvia Herrero Cófreces:**
  Main potential arthropod vectors infesting small mammals in farmland from NW Spain
- **Rocío Tarjuelo:**
  Research experience of a young postdoc: from farmland to forest ecosystems

12:00-12:30 Picking up Posters

12:30-13:30 **Session VI**

Chairpersons: Cristina Zamora and Pilar Valbuena

Speakers:

- **Emmanuel Gabriel Njoku:**
  Evaluation of The Performance of Populus tremula Clones in Two Different Media (ACM And MS) in The Establishment and Multiplication Phases In Vitro
- **Przemyslaw Andrzej Jankowski:**
  Spatio-temporal patterns of the intra- and inter-specific growth synchrony related to climate variation in Mediterranean mixed and monospecific stands

13:30-14:00: Closing session

Joaquín Navarro (Director de la ETSIIAA)

Felipe Bravo and Elena Hidalgo

14:30 Lunch at YUTERA

SESSION I

RE-ENVISIONING COASTAL PUBLIC SPACE – CASE OF KFARAABIDA, LEBANON

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Keywords: sustainable, landscape, management, ecosystem, restoration.

In most parts of the world, almost all trips to the seaside never include a stop at a reception desk with a passed credit card, unless people are targeting a resort or hotel.
The concept of "public" beach means free entrance, non-exclusiveness in terms of social class, and no specific privilege. Just like any public space, public beaches mean to the people; people meet, greet, and grow in them, while celebrating life.
Sadly, the mentioned above is not the case of Lebanon's beaches today. What alarms the Lebanese the most is the complete loss of the public seashore in the capital Beirut, where locals had a very close connection to in the past. This disappearance spread out to the larger Beirut at a fast rate, until it got to more remote areas of the country. Now, few public beaches remain in Lebanon, and that is in the Southern and Northern shores. This research focuses on the area of Kfaraabida in the Northern district, as it is one of the fewest *pristine* stretches of public beaches left in the country. However, it is currently being threatened by heavy privatization. This is a landscape architectural approach aiming at making a conscious design decision to preserve and reclaim the publicness of the site, while keeping its habitat ecologically sound. The strategy is to connect destinations along the waterfront, creating a necklace of experiences, and to alleviate pressure caused by human trampling on the shoreline. The result is delicate floating platforms that invite visitors to the shoreline, but protect the area's vulnerable rock beds and *vermetid* reefs. Kfaraabida's abandoned spaces of great potential are linked through well-designed pedestrian, cycling, and vehicular lanes, creating nodes along the coastal *zone*. Re-envisioning coastal Kfaraabida can become a prototype to be replicated along the Lebanese littoral, while emphasizing the coast as a zone, not just a line.

ASSESSING QUANTITY AND QUIALITY OF SOIL ORGANIC MATTER UNDER MIXED PINE-OAK FORESTS

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

Healthy soils are the second C sink on Earth, and this sink could last for hundreds or even thousands of years as stable soil organic matter (SOM). In this context, forest soils play a very important role in mitigating global change through carbon sequestration. However, the amount and quality of the C sequestered is conditioned by the vegetation influencing those soils. Depending on species composition of forest stands, the production and composition of leaf litter will be different and so quality and quantity of SOM. This study aims to assess the effect of species mixture proportion on SOC stock in mixed forests of Scots pine and Sessile oak. To this end, 39 circular subplots of 5m radius were selected within three experimental triplets, covering the whole range of species mixture. Two triplets were located in the Cantabrian Mountains and one in the Pyrenees (Spain). Each triplet consisted of a mixed Pine-Oak stand (*P. sylvestris* and *Quercus sp*.) and pure stands of both species. Mineral soil (0-10cm) and forest floor (litterfall) were collected in three points at each subplot and then mixed in order to have a single representative sample per subplot. Litterfall was separated into 3 fractions: fresh (FsL), fragmented (FgL) and humified (HmL). Total carbon and nitrogen content were determined for all samples, and C stock and C to N ratio calculated. In the forest floor, a significant interaction effect between pine proportion and litter fraction ($p<0.05$) was found for TOC and TN. Higher TOC content was found in FsL and FgL fractions, in both cases reaching their maximum in mixtures with 60-65% pine. TN showed an opposite trend, in this case, FsL and HmL decreased with pine proportion, until 50% approximately, and then increased. C to N ratio in litterfall showed the following trend: $CN_{FsL} > CN_{FgL} > CN_{HmL}$, and did not change with pine proportion. Regarding mineral soil, C to N ratio increased with pine proportion ($p<0.05$), showing the highest values in mixtures with more than 70% of pine. Higher C to N ratio indicates low-rate humification and thus less stable and poor quality of SOM. Cstock in the whole profile ranged between 21.2 and 69.2 Mg C ha^{-1} with an average of 37.9 Mg C ha^{-1} across all sites and management types. No effect of pine proportion was found on Carbon stocks on the mineral topsoil neither on the forest floor. Overall, these results suggest that increasing pine proportion in mixtures did not affect C sequester in soils, but did negatively affect the quality of that C.

USING HANDHELD AND AIRBORNE LASER SCANNING TO IMPROVE TREE-LEVEL MAPPING. A MIXED-FOREST SHOWCASE IN SPAIN

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Keywords: HHLS, ALS, scanning standardization, individual-tree detection, marteloscope

In this work, we merged the data from two different scan approaches, one scan using handheld devices (HHLS) with a higher point density under canopy, and another approach with airborne laser scan (ALS) with the capacity to get better pint cloud from the upper layer of the canopy. The challenges of laser scanning start at the beginning of the work, and the difficulties increase with the stand density; in mixed forests with stratified canopy, it is even more challenging to obtain points in the upper part of the forest than in monospecific plantations. The objective of this paper is to establish protocols for using HHLS in mixed forests, to identify the need for complementing the HHLS point cloud, to present a methodology for extracting forest data from a fused point cloud, and to determine the increment in results with this methodology. The marteloscope was segmented into different fractions (Total, half, quarter), weighting the difficulty of merging the data with the size of the point cloud. For merging the point clouds, spheres located in common with the scans, and georeferenced control points were used. The HHLS and ALS point clouds were merged using an algorithm that identifies the tree position and aligns the point clouds according to their geolocation. The expected results are: Regarding the ALS point cloud, to be able to improve the identification of individuals and obtain better forest parameters after data fusion. And as for the HHLS point cloud it is intended to improve the parameters of the crown, especially related to crown height.

UNRAVELLING HISTORICAL PRUNING PATTERNS IN POLLARDED ASH TREES

Candel-Pérez, D. [1*], Hernández-Alonso, H [1,2], Castro, F. [3], Mutke, S. [4], Sangüesa-Barreda, G. [1], García-Hidalgo, M. [1], López-Molina, J. [1], Rozas, V. [1], Olano, J.M. [1]

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Keywords: dendrochronology, Fraxinus angustifolia, management, silvopastoral system, tree-ring growth

Pollarded forests of ash trees (*Fraxinus angustifolia* Vahl.) constitute silvopastoral systems of important cultural and environmental interest and configure landscapes with great conservation values. Pollarding has traditionally been conducted to provide fresh fodder for livestock immediately after pruning. However, rigorous historical records of the variation patterns of this treatment are non-existent. The main objective of this work is to reveal the traditional management techniques in different pollarded ash forests in the central Iberian Peninsula. For this purpose, we reconstructed the historical patterns of pruning management since the 18th century by identifying sudden growth changes and anatomical markers through dendrochronological analysis. The characterization of the pruning regime and the reconstruction of traditional treatments carried out in the past was possible through tree-ring growth analysis. We identified different historical management periods with contrasting frequencies between pruning treatments throughout the last two centuries. We have also observed an evolution from the initial, synchronous and constant treatments, to more irregular and asynchronous patterns in recent decades. Our findings provide important and useful information to managers and stakeholders, and help to apply the necessary treatments to preserve this characteristic cultural landscape.

ALL SIZES MATTER IN FOREST CARBON SINK

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Keywords: Forest carbon, Tree-size diversity, Canopy age.

Organic carbon is mainly stored in woody tissues and in the superior layer of soil. An important fraction of soil organic carbon (SOC) is composed by the biomass that was incorporated to the ground in the form of litterfall, root litter, bark, branches and dead stems. In addition, tree biomass productivity is linked to forest ageing processes and to ecological characteristics such as tree species diversity and forest structure. Given that close relationship, it should be then expected that the same factors driving forest productivity drive carbon accumulation in the same manner. To solve this question, we selected and sampled out 30 forest stands in the Central System mountain range (Spain). Tree aerial and root biomass, and consequently carbon content, was estimated by relating allometric equations and radial tree measurements of all standing -living or dead- trees inside sampling plots (Standing Biomass Carbon, SBC). Soil organic carbon in 0 – 40 cm was assessed thanks to the quantification of organic matter and bulk density. Both carbon compartments, SBC and SOC, were regressed against forest factors including forest maximum age, forest tree species diversity and tree-size heterogeneity. The joint effect of forest age and tree-size heterogeneity was the main factor driving carbon accumulation on both SBC and SOC. This effect was notably greater in SBC than in SOC. Our results highlight that young and aged forests contain similar carbon stocks if they are composed by trees with similar sizes. However, the size-effect of forest age became greater in forests with high-than-average levels of tree size heterogeneity. Thus, mature uneven-sized forests are those capable of store larger carbon pools. Models did not give support enough to consider a control of species diversity on carbon stocks. Carbon sink is more efficiently provided in uneven-sized aged forest than in its even-sized counterparts since mature forests are not capable to store large amounts of carbon without the consideration of structural factors like tree sizes diversity.

FOREST DYNAMICS. FROM MONOSPECIFIC TO MIXED-SPECIES STANDS

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Keywords: integrative forestry, criteria for sustainability, mixed-species stands, silvicultural prescriptions, transition to uneven-aged mixed stands

First, the principle of integrative forest management is introduced. In contrast to segregating concepts, integrated forest management strives for combining many different functions and services in the same forest. Second, we present the six criteria for integrative management the 40 European states agreed on (MCPFE, Helsinki Process): Maintenance of the forest area and stock, health and vitality, forest growth and yield, biological diversity, protective functions, and socio-economic functions. Third, it is shown that mixed-species stands often fulfill many forest functions and services better than mono-specific stands and that they are more suitable for integrative and multifunctional forest management. Fourth, it is stressed that silvicultural management of mixed-species forests requires new knowledge and innovative silvicultural prescriptions. By example, we sketch three main challenges: The competition regulation in mixed-species stands by spatial or temporal separation, the species-specific growing space provision, and the density regulation in even-aged mixed species stands. In many areas worldwide the diversification of forest stands is aiming at uneven-aged mixed species stands. Fifth, the principle of transitioning from even-aged, mono-specific stands to mixed and uneven-aged stands is introduced. Especially the creation of selection forests may lead to higher multifunctionality and a higher stability, resilience, resistance, and recovery in view of climate change. The transition may result in selection forests; we introduce the basic measures for maintanance of selection forests in a steady-state. In essence, we show and discuss how the creation of more diverse forests contributes to the one-health idea and the wellbeing of both humans and nature.

IUFOR-RECOGNITION AS A UNIT OF EXCELLENCE PROJECT, A GREAT DEAL TO INCREASE THE EXCELLENCE IN THE FOREST RESEARCH.

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Keywords: scientific production, multidisciplinary approach, synergies, key questions, international impact

The project "*iuFOR-Recognition as a Unit of excellence*", is one of the projects setting in the *Sustainable Forest Management Research Institute*, research unit between Universidad de Valladolid & INIA.
Included within the Castilla y León Research and Innovation Strategy for Specialization Intelligent (RIS3) and it has been funded by the Junta de Castilla y León and co-financed by the European Union (ERDF "Europe drives our growth"), started in 2021 and it will finish at the end of 2023. At the end of 2021, a new proposal has been submitted to enhance the internationalization of this project.
The project is focused on the use of massive data and big data methods to gain insight on key questions and to provide scientifically knowledge for managers, civil society and policy makers. This aim is structured in three specific objectives:
1) to increase in the excellence and applicability of scientific research, through being pioneers in resolving key scientific questions in the forest sector;
2) to advance in the regional effort in R + D + I, as IuFOR is involved in the contribution of increasing the RIS3 priority III and
3) to promote a highly innovative business framework with different spin-offs of the UVa and other research foundations.
The project is composed of five work packages (Biotic and abiotic interactions, Resilience, Resistance and Recovery, Tools, Decision making and Dissemination and Transfer), which are dimensions to integrate different scales and organisms and to address different scientific questions and technological developments.
The *iuFOR-Recognition as a Unit of excellence* project personnel is composed of highest level scientists, postdoc, predoc and technician staff who are working with the maximum rigour and enthusiasm to reach the milestones of the project.

SESSION II

Meet CaptuRING: AN OPEN SOURCE TOOL FOR WOOD SAMPLE DIGITIZATION

Miguel García-Hidalgo[1*], Ángel García-Pedrero[2], Gabriel Sangüesa-Barreda[1], Ana I. García-Cervigón[3], Víctor Alonso-Gómez[4], José Miguel Olano[1]

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Digitization in forestry sciences has evolved in the last decades due to advances in data collection and management. Remote sensors and satellite imagery have opened a new vast field in forest research providing increasingly high spatial, temporal and spectral resolution data from different forest species and their environment. Meanwhile, advances in computing sciences allow to get valuable information from those, until now, unmanageable data. However, sample digitization in forestry sciences includes much more than remote sensing.

Descending to ground truth, an enormous amount of valuable information from ecosystems is collected by using dendrochronological techniques. By studying wood formation and characteristics, dendrochronology unmasks both individual and environmental information which can be dated due to plant secondary growth. Traditionally, dendrochronological studies have focused on ring width measurements using a stereoscope and an expensive tree-ring measuring system (e.g., Lintab, Velmex). However, dendrochronological software advances (e.g., MTreeRing) allows to extract measurements from digitized wood transforming pixels into micrometers.

Wood sample digitization is mainly made with high-resolution flat scanners. Those devices store a digital image (maximum 6400 dpi), albeit restricted hardware capacity makes this procedure a very time-consuming task requiring extensive pre and post capture processes to individualize and store sample images and metadata. Additionally, limited scanning resolution based on sample length or uneven surface sample hamper tree-ring analysis in slow growing or diffuse porous species. High resolution digital photography can overcome these limitations, leading to the rapid obtention of high-definition images. Although some alternatives for core digitization exist, either they show reduced capacity, or their cost is prohibitive.

We propose the combination of a do-it-yourself hardware and an open-source software Graphical User Interface to promote the use of high-resolution photography for dendrochronology (CaptuRing). Once the wood sample is mounted and sanded, CaptuRing auto-focuses and takes multiple captures to finally obtain a complete high-resolution image (minimum 4200 dpi) of the sample. CaptuRing is not sensible to hardware limitations or to uneven sanding surfaces and streamlines the process to automatically store each digital sample and associated metadata in optimized time (3x faster than scanning). This proposal may enable to move tree-ring measurements to the digital world. Comparative image: https://tinyurl.com/YF-MGH22

BIRD COMMUNITY AS AN INDICATOR TO MONITOR ATLANTIC FOREST RESTORATION IN SOUTHEAST BRAZIL

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Keywords: Ecological restoration, monitoring, indicators, biodiversity, bauxite mining

Birds can be good indicators to monitor the restoration of the Brazilian Atlantic Forest hotspot because they are highly sensitive to environmental changes and are easy to detect. The objective was to evaluate the bird community of two restoration areas with different ages and compare with neighbor secondary native forest patches to assess restoration status. Restoration was conducted with the planting of native species and return of topsoil after bauxite mining. One of the areas had 4 years of restoration and 2.18 ha, which was compared with a neighbor forest with 6.27 ha. The other area had 12 years of restoration and 1.00 ha, which was compared with a neighbor forest with 13.00 ha. Bird community was surveyed by the intensive search method in different days on the reproductive season based on vocalization or sight. Species were classified based on diet, habitat and endemism/strict-rage distribution. The number of species, families and endemic/strict-range species was always higher in the secondary native forests. The difference in the number of species was lower in the area with 12 years restoration. Similarity indexes between bird communities indicates that the assemblage of birds tends to be more similar overtime. The marked presence of frugivore and nectarivore species is essential for tropical forest functioning and restoration advance, since they play a key role as seed dispersers and pollinators, respectively. For the area with four years of restoration, the absolute number of insectivore and forest species was much lower than in the neighbor forest. This may have happened because the simplified vegetation structure does not offer suitable habitat for some specialized species. Overall, quantitative and qualitative differences can be observed between the restoration areas and the neighbor secondary native forests, but results are very positive when considering the short interval of restoration.

PREDICTING THE EXISTENCE OF *LACTARIUS DELICIOSUS* YIELDS WITH REMOTE SENSING DATA

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Keywords: climate, ectomycorrhizal fungi, edible mushrooms, Landsat, LiDAR, vegetation indices, yield

Fungi play a key role in ecosystem function, decomposing organic matter and contributing to root nutrition. Fungi reproductive bodies, mushrooms, have important medicinal and nutritional applications, with a growing commercial value and recreational importance. Mushrooms exploitation is hampered by the high temporal variability of their yields. Moreover, mushroom yields in Mediterranean forests may be affected by an increase in drought events due to climate change. Fungal fruiting in forests depends on multiple factors include climate but also local factors as soil, characteristics, topography and forest structure and management. We use a long-term temporal series of *Lactarius deliciosus* yields in 18 plots from a *Pinus pinaster* forest in the Soria province (Spain) to model yield spatiotemporal patterns. Plots were structurally characterized with LiDAR data (PNOA-LiDAR) data, vegetation indices from NASA Landsat missions (seasonal indices of the current and previous year) and climatic data (monthly mean, maximum and minimum temperature, monthly precipitation relative humidity). We used this multisource database to estimate a '*mycological possibility*', an index with the potential to include mycological expected production in sustainable forest management plans. Classification models were built with several artificial intelligence techniques (classification trees, random forest, support vector machine lineal, support machine radial and neural networks). Neural networks provided the best models with an overall accuracy of 0.88. The most important variables were climatic (September maximum and November minimum temperatures). The remote sensing variables were NDMI (Normalized Difference Moisture Index) of the Summer and GNDVI (Green Normalized Difference Vegetation Index) of the previous Summer and plot tree number (calculated with LiDAR). Our results contribute to improve the models to predict mushroom yields and shows the importance of including remotely sensed observations in non-wood forest products modelling efforts.

SOCIAL-ECOLOGICAL INFORMATION SYSTEM USING OPEN DATA. PALENCIA MODEL FOREST

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Keywords: Geographic Information System (GIS), land cover, multicriteria decision analysis, sustainability.

The Palencia Model Forest is a mosaic of different eco-social landscapes that make up a diverse and complex territory. Understanding this territory and the dynamics of change requires information about characteristics and attributes of the main economic, social and ecological drivers.
Currently, the data published and available in all disciplines is growing exponentially. However, this information is not incorporated yet at the same speed into local knowledge and decision-making processes, due to it requires highly technical data mining and homogenisation tasks and processes.
The main objective of this work is to search, compile, structure and homogenise data from different sources and formats about land use in 2009-2015 period and to analyse land cover changes in the Palencia Model Forest. With the main results a multicriteria datasets and information tools will be created and made available to managers and social agents at local and regional level.
This information system aims to become a reference information tool for the Palencia Model Forest, flexible and replicable for the rest of the Model Forest network partners. They must be able to incorporate future results of exploitation of multi-angle data analysis that will help to better understanding. This tool will also help to face management challenges and future scenarios in the Model Forest.

ASSESSMENT OF OAK GROVES CONSERVATION STATUS IN NATURA 2000 SACS WITH SINGLE PHOTON LIDAR

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Keywords: conservation status, European ecological networks, LiDAR, machine learning

Monitoring the conservation status for Natura 2000 Network sites is required under a reasonable cost and temporal frequency. The aim of this study is to assess the ability of single photon LiDAR to classify the conservation status of oak forests in four Special Areas for Conservation in Navarra province (Spain): “Montes de Valdorba”, “Sierra de Lokiz”, “Belate” and “Robledales de Ultzama”. To conduct the analysis a random sample of pixels was selected using a stratified mapping based on the conservation status of the study zones performed by GAN-NIK (Gestión Ambiental de Navarra S.A.), terrain slope, height and cover of forest canopy. Wall to wall point cloud derived-metrics were computed for the study areas, including structural diversity indices derived from LiDAR (LHDI and LHEI). Then, random forest (RF) and support vector machine (SVM) machine learning classifiers were compared to select the most accurate method. The best-fitted classification model was computed using Random Forest with an overall classification accuracy after validation of 83.01 %, 75.51 %, and 88.25 % for habitats 9160 9230, and 9240, respectively. The models include three to six LiDAR metrics, being the structural diversity indices and coverage fraction the most relevant ones. This approach demonstrates its value for classifying and mapping conservation status in oak groves Natura 2000 Network habitat sites at a regional scale to better monitory high biodiversity habitats.

SESSION III

USAGE OF DRONES IN FOREST PEST CONTROL: CASE STUDY OF THE USAGE OF DRONES IN COMBATING *THAUMETOPOEA PITYOCAMPA* IN ALBANIA

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Keywords: aerial, spraying, processionary, bacillus, pinus

The pine processionary caterpillar (Thaumetopoea Pityocampa) is one of the main defoliating pests of pines in the Mediterranean. The pest feeds on the needles of pine trees and other conifer tree species. It is an insect that is currently damaging an estimated area of 100,000 ha of pine forests in Albania, mainly the black pine (Pinus Nigra). Seeing as the overall forested area in Albania is about 776,000 ha, it is a large issue. Due to the large impact of the issue, multiple intervention projects have been carried out in recent years, but their result is yet to show as the area affected by the processionary caterpillar continues to grow. We confirmed the methods currently used to fight the processionary caterpillar in Albania and also in other countries of the Mediterranean region. One of the methods used to fight Thaumetopoea Pityocampa is the usage of Bacillus Thuringiensis, especially the Kurstaki variety. In order to be able to spray large forested areas with trees of varying heights, aerial spraying was considered. In order to have minimal impact on the surrounding biodiversity, it was decided that the best method for aerial spraying would be the usage of remote controlled drones, hexacopters and octacopters. We compared the current offerings in the market and analysed their financial viability. We decided on a custom solution where the drone payload could be changed, as while the initial investment was bigger, there was potential in using the drone for different purposes. We first have to consider that for a reliable and efficient spraying, automation was needed. To enable to drone to fly autonomously without accidents, the area was mapped using a different payload and a photogrammetry map was created. This map was used by a computer software to calculate the best flight path, altitude and spraying area. To test the efficiency of this method, a Pinus Nigra plot near Lin, Pogradec, Albania was selected. The selection of this plot was done to allow testing of the method in steep slopes, with strong winds, while allowing for prevention of any human accidents due to the distance of the plot from any human settlements. It was also chosen because of the proximity to touristic attractions as well as the border with North Macedonia, which provided more marketing opportunities and helped to fix an issue in the panorama. This method resulted successful in performing the aerial spraying of Bacillus Thuringiensis Kurstaki (BTK) on the selected pine plot, giving us confirmation on the reliability of the technology chosen. While the results in regards to the efficiency of BTK against the processionary caterpillar are unconclusive as of yet, the viability of using drones in forest pest control has been confirmed. The use of drones in monitoring, mapping and performing aerial spraying operations in forests where pests are a problem is economically viable when discussing large areas, multiple operations or combined operations made possible by different payloads. In smaller plots and operations, the higher initial cost of purchasing the drone makes it not viable economically, unless the operations are carried as a cooperative of forest owners or the drone owner provides this service for others in forestry and agriculture.

EFFICIENCY OF ASSESSING CURRENT YEAR TWIGS BROWSED AS AN EARLY WARNING SYSTEM OF RED DEER IMPACT ON MEDITERRANEAN ECOSYSTEMS

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Keywords: Browsing, Cervus elaphus, herbivory, indicator, monitoring.

The red deer (*Cervus elaphus*) plays a key role in the functioning of the Mediterranean socio-ecosystem. Red deer populations are currently increasing throughout Europe and this could cause impacts on ecosystems, which makes necessary monitoring their populations and the environment affected. The objective of this study was to assess the herbivory pressure in the Mediterranean socio-ecosystem by counting the percentage of current year twigs of six different woody species affected by deer herbivory over time and space. We sampled the herbivory pressure along 30 transects (20m x 4m) regularly distributed in a 6,600-hectare fenced estate in The Montes de Toledo (continental Spain), and the percentage of twigs browsed in the same individuals has been followed over time (from June to December 2021). The most abundant and browsed species were *Arbutus unedo, Quercus faginea* and *Quercus ilex* among trees and *Cistus ladanifer, Erica arborea* and *Phillyrea angustifolia* among scrubs. Our preliminary results suggest that the maximum browsing impact occur in August, although there were some variations between habitats (i.e., shaded hillsade, sunny hillsade, plain and interface-areas) and species. This raises the question: are autumn measurements necessary (or useful) knowing that the maximum browsing seems to occur during the late summer for these species and in Mediterranean socio-ecoystems?

THE ROLE OF MOSQUITOES IN THE EPIDEMIOLOGY OF *FRANCISELLA TULARENSIS*

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Keywords: zoonosis, infectious disease, One Health, vector, bacteria

Francisella tularensis is the etiological agent of Tularaemia, a zoonotic disease affecting the North hemisphere. The most affected area in Spain is Tierra de Campos, in Castilla y León. The common vole is one of the potential reservoirs of the bacteria, showing cyclic demographic outbreaks that are linked to the increase in Tularaemia human cases. Mosquitoes are an important reservoir and potential vector for *F. tularensis* in Sweden, Norway, and Finland, but there is a lack of information in Spain. Here, we discuss the potential of mosquitoes as *F. tularensis* reservoir and vectors in Spain: their relationship with the disease and its etiological agent, how aquatic environments and their components could be an important factor, and how they can be studied in the future in the context of Tierra de Campos. Mosquitoes are known to be important vectors of numerous infectious diseases, mainly produced by viruses. Their role as vectors of bacterial diseases is unclear, but it has been showed that they potentially act as vectors of *Bacillus anthrancis* or *Rickettsia felis,* for example. In the case of *F. tularensis*, mosquitoes have been proved to be vectors in northern European countries, but experimental studies of survival and transmission have not been very fruitful (probably due to the use of the incorrect species of mosquitoes). *F. tularensis* is linked to an aquatic cycle. It is hypothesized that bacteria are maintained in the water during inter-epidemic periods thanks to two factors: their survival inside free-living amoeba, and the formation of biofilm. These probably are the sources of mosquito infection, that feed on them during their larval life stage. Future research about mosquitoes and *F. tularensis* in Spain should be focus on determining the species that shape the mosquito community in Castilla y León, experimentally studying the potential of survival and transmission of *F. tularensis* by local species; and analyse the prevalence of *F. tularensis* in mosquitoes during inter-epidemic and epidemic periods.

SESSION IV

RECYCLING FOREST-BASED INDUSTRIES WASTES TO PRODUCE SEEDLINGS FERTILIZER

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Keywords: Arginine, fermentation, feedstock, Escherichia coli, *nitrogen*

The forest landscape in Sweden mainly consists of intensively managed *Pinus sylvestris* and *Picea abies* plantations. In nursery, conventional fertilizers containing ammonium and/or nitrate are applied multiple times, however a large part is not taken up by plants and quick leach away. The amino acid arginine is as efficient as promoting conifers' growth, while showing a better uptake rate and reduced leaching. To enable the large-scale production of arginine bases fertilizer, sustainably produced and affordable arginine is needed.

This project was a first step towards the production of arginine by microbial fermentation from waste streams of forest-bases industries. First, *Escherichia coli* was genetically modified and tested for arginine production in bioreactors. Secondly, a metabolomic study was conducted to identify new potential modifications of interest. Then, the effects of different nitrogen sources and concentrations on arginine production were investigated. Finally, sugars commonly found in wood hydrolysates were screened to identify what waste streams could be suitable for arginine production.

E coli arginine production was increased from 0 g/L to 12 g/L, and a few mutations were identified that could potentially lead to further increase. Ammonium sulphate, ammonium phosphate dibasic, ammonium chloride and ammonia solution were found to be the best suited n source abs the optimal concentration was 0.1g nitrogen / g glucose. Glucose and xylose were the best individual sugar, but a mixture of glucose, xylose, mannose, galactose and arabinose was found to be an even better carbon source even though some of the sugars it contained were not effective when tested by themselves.

In conclusion, the feasibility of arginine production was demonstrated, but further strain improvement and process optimisation are required before the process can be scaled-up.

SIMULATION OF NON-WOOD RESOURCES PRODUCTIVITY (MUSHROOMS AND PINION) UNDER DIFFERENT MANAGEMENT SCENARIOS BY USING SIMANFOR

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Keywords: Lactarius, Pinus pinea, Pinus pinaster, Pinus sylvestris, Pinus nigra

SIMANFOR is a tool used to simulate forest management alternatives for different species and locations. Its objective is to let the user know the evolution of forest stands under different silvicultural scenarios, supporting decision making with information. Sometimes it can be useful to know the production of non-wood products, which value can be higher than the properly wood, even being the main forest resource. SIMANFOR allow us to use, in an easy way, forest models that estimate the mushroom production (*Pinus pinaster mesogeensis, Pinus sylvestris* and *Pinus nigra*) and pinion (*Pinus pinea*), at the same time it calculates the wood production, like so several variables of interest. This work analyzes different real silvicultural management scenarios to know the viability, in terms of production, of this non-wood resources. The results allow us to know which type of management returns a higher production of mushrooms and pinion, being more economic incomes and the end of the management scenario. On the other hand, for the scenarios non focused on productivity (i.e., wildfire resistance), these models allow us to know if the exploitation of this resources can be viable from the productive point of view.

GENOME-WIDE IDENTIFICATION AND CHARACTERIZATION OF DEFENSE-RELATED LONG NON-CODING RNAS IN NON-MODEL PLANT *Pinus radiata*

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Keywords: lncRNA, Fusarium circinatum, Pine Pitch Canker, transcriptomics, RNA-Seq

Long non-coding RNAs (lncRNAs) are emerging as important transcriptional regulators under biotic stresses in plants. However, to date, characterization of lncRNAs in conifer trees has not been reported. The identification and the functional prediction of lncRNAs require the use of different bioinformatics approaches that result especially challenging for non-model organisms such as *Pinus radiata*. In this study, transcriptomic identification of lncRNAs was carried out using strand-specific paired-end RNA sequencing, from *P. radiata* samples inoculated with the pathogenic fungus *Fusarium circinatum*. Overall, 13,312 lncRNAs were predicted after the computational analysis, including long intergenic non-coding RNAs (92.3%), antisense lncRNAs (3.3%) and intronic lncRNAs (2.9%). Compared with protein-coding RNAs, pine lncRNAs are shorter, have lower expression, lower GC content and harbour fewer and shorter exons. A total of 164 differentially expressed (DE) lncRNAs were identified in response to *F. circinatum* infection in the inoculated versus mock-inoculated *P. radiata* seedlings. The predicted *cis*-regulated target genes of these pathogen-responsive lncRNAs were related to defence mechanisms such as kinase activity, phytohormone regulation, and cell wall reinforcement. Co-expression network analysis of DE lncRNAs, DE protein-coding RNAs and lncRNA target genes also indicated a potential network regulating pectinesterase activity and cell wall remodelling. This study presents the first comprehensive genome-wide analysis of *P. radiata* lncRNAs and provides the basis for future functional characterizations of lncRNAs in the *Pinus-F. circinatum* interaction.

SESSION V

FROM ORGANIC SALINE SOIL REMEDIATION TO AGROFORESTRY: A POTENTIAL PARADIGM FOR CLIMATE CHANGE MITIGATION AND ADAPTATION IN NIGERIA.

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Keyword: Amelioration, Restoration, Moringa oleifera, Electrical Conductivity, Ecosystem

Saline agricultural land abandonment for more productive forestlands in Nigeria is problematic to climate change mitigation and adaptation, thus the heightened need for sustainable and eco-friendly solutions. To this end, this study evaluated the saline soil ameliorating efficacy of Moringa oleifera crude liquid extracts. Four units of 100kg soils with electrical conductivity (EC) values 0.00dsm-1 (Control), 4.07dsm-1(T1), 8.07dsm-1 (T2), 12.80dsm-1 (T3) were set up on farmland. Similar units (T4, T5, T6) amended with 1litre of crude liquid extract of Moringa oleifera were also set up on the same farmland. Both setups lasted for 6months distributed equally between rainy and dry seasons respectively. Subsequently, the growth performances of Annona muricata at the different treatments were evaluated using Completely Randomized Design (CRD). At field trial, 3-natural saline plots (10m x 10m each) with EC values of 4.51dsm-1, 9.10 dsm-1, 12.30dsm-1 were irrigated once with 20 litres of Moringa oleifera crude liquid extracts one by one, followed by transplanting of Annona muricata seedlings 6months after irrigation. One-way ANOVA was used to test for significant differences in growth attributes and soil elemental compositions among treatments. T-test was used to test for significant differences in each growth attribute and soil elemental composition between the amended and unamended saline soils. Seedling height, collar diameter and leaf number reduced significantly ($P<0.05$) T1 -T3 compared to the control while they increased significantly ($P<0.05$) in T4- T6. Total Nitrogen, Phosphorus, Potassium & soil pH reduced significantly ($P<0.05$) in T1-T3 while they significantly increased ($P<0.05$) in T4-T6, respectively. In T4-T6, there was a 96%, 91.31% & 66.09% reduction in EC respectively. Sixth month after field trial, a 100% seedling survival rate was observed in all amended saline plots. Based on the findings of this study, the application of Moringa oleifera crude liquid extracts on saline soils resulted in reduced EC values and improved soil conditions for growth. Having litters of Moringa oleifera will guarantee natural saline soil remediation processes in agroecosystems prone to recurring salinity issues. Conclusively, this study therefore, finds potentials in Moringa oleifera agroforestry system to be the eco-friendly and cheap solution to saline soil restoration in Nigeria.

MAIN POTENTIAL ARTHROPOD VECTORS INFESTING SMALL MAMMALS IN FARMLAND FROM NW SPAIN

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Keywords: disease risk, flea, rodents, tick, zoonoses

Fleas and ticks are the main vectors of diseases whose origin is the wild fauna, especially mammals, and rodents are the host group harbouring the highest number of potential pathogens. The highly fluctuating dynamic of some rodent species is of special concern because of the impact on the vector population dynamics and thus, on the pathogen prevalence. In intensive farmland of NW Spain, *Microtus arvalis* (common vole) dominate the small mammal community and shows cyclic multiannual fluctuations associated with zoonotic outbreaks in humans. Here, we report on the characterization of the arthropod vector community hosted by the small mammal guild (*M. arvalis*, *Apodemus sylvaticus*, *Mus spretus* and *Crocidura russula*). The most common vectors found were three flea species (*Ctenophthalmus apertus*, *Leptopsylla taschenbergi* and *Nosopsyllus fasciatus*) and one tick (*Rhipicephalus turanicus*). Flea prevalence was higher in *M. arvalis* (68.2%), lower in *M. spretus* and *C. russula* (16.1% and 14.3%) and intermediate in *A. sylvaticus* (45.6%). Tick prevalence was higher in *C. russula* (15.8%), lower in *M. spretus* (2.1%) and intermediate in *M. arvalis* and *A. sylvaticus* (5.6% in both). Co-infections of tick species were very rare (2 out of 2660 total hosts), while flea species occurred in 13.3-28.8% of cases and flea-tick assemblage, in 0.3-3.7%. Co-occurrence of vectors can increase the transmission of pathogens, augmenting their prevalence in the ecosystem and hence the risk to humans. In the current global change scenario, the distribution and abundance of arthropod vectors will be deeply affected, so the knowledge of the existing vector community will be basic to predict and understand the circulation of future zoonotic diseases.

RESEARCH EXPERIENCE OF A YOUNG POSTDOC: FROM FARMLAND TO FOREST ECOSYSTEMS

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Keywords: biodiversity conservation, biotic interactions, large ungulates, little bustard, wildlife management

The career of a young researcher is often full of obstacles. Patience, perseverance, and high doses of illusion for your work are mandatory if you wish to find a place in the highly competitive world of science. After finishing my bachelor's degree in Biology, I started my PhD in Ecology at Universidad Autónoma de Madrid. With a high interest in animal behavior and biodiversity conservation, I investigated the role of biotic interactions on the ecology and spatial use of a threatened farmland bird, the little bustard (*Tetrax tetrax*), for several years. Thanks to this research, I had the opportunity to learn about eco-evolutionary theory as well as multiple techniques and analytical approaches. I got involved in different field work tasks: bird censuses, bird capturing and radio-tracking, recording of animal behavior and free-ranging bird songs, or land-use monitoring. I could also participate in laboratory work to quantify stress hormones from biological samples. I improved my analytical skills by using different data types (from individual to community level, land-cover, remote sensing resources) and applying a variety of analytical methods such as mixed regression models, machine learning, or spatial analysis. My PhD findings revealed how interactions with conspecific and heterospecific determine the use of the space by this farmland bird, knowledge that should be integrated within conservation plans. Since I finished my PhD thesis, I have been a postdoc in three different research centers in Spain (applied for multiple positions abroad) and a GIS assistant too. As a postdoc, I continued working on farmland ecosystems and expanded my network of collaborators. I pushed forward my scientific profile by participating in new scientific projects and topics, conducting research on other taxa, and advancing my mathematical skills. Besides, I engaged in several dissemination activities to share our scientific work with young scholars. Currently, I am a postdoc in the iuFOR within the project "iuFOR-Recognition as a Unit of excellence", where I face a new scientific challenge: investigating the ecology of large ungulates and its implications for their management. Large ungulates are species linked to forest ecosystems, though they often use agricultural land to access food resources. Populations of these species have steadily grown all over Europe in the last decades, reaching very high abundance in many regions and causing several impacts such as damage to forest and agricultural production or increased traffic accidents. Advancing our knowledge on the ecology of this species is needed to implement effective management measures. A final message to future and young researchers: keep your eyes open to opportunities; success is hiding in the most unexpected place.

SESSION VI

EVALUATION OF THE PERFORMANCE OF *Populus tremula* CLONES IN TWO DIFFERENT MEDIA (ACM AND MS) IN THE ESTABLISHMENT AND MULTIPLICATION PHASES *IN VITRO*

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Keyword: In vitro, Populus tremula, ACM, MS, conservation

The loss of biodiversity is a great threat to the survival of species and hence, the need for conservation. Seed conservation for *Populus tremula* is short lived and therefore, in vitro conservation is needed for long term preservation of genetic resources. To this end, this study evaluated the best medium for the conservation, establishment and multiplication of *Populus tremula* clones. Eight (8) clones of *Populus tremula* were cultured in two media (MS and ACM) and five replications were made for each medium. Explant height, vigour, rosette, callus formation and contamination readings were taken at 14 days interval for 3 months. Descriptive analysis was carried out and the result showed that ACM medium is best for clone 1 PT PAJ and 19 PT GOM while MS medium is best for clone 7 PT MUE, 20 PT BES and 21 PT AMA. The other clones show no significant difference for the two media. Three months after culturing, 10%, 10%, 80%, 20%, 80%, 30%, 90% and 80 % callus formation were observed in 1 PT PAJ, 7PT MUE, 8PT MAN, 15PT BOY, 18PT TOR, 19 PT GOM, 20PT BES and 21 PT AMA respectively. The result of this study showed the difference in the culturing of the different clones in the two media as well as in the multiplication stages. Conclusively, this study strongly encourages the conservation and multiplication of *Populus tremula* clones in best suited media in order to maximize productivity and ensure long term preservation.

SPATIO-TEMPORAL PATTERNS OF THE INTRA- AND INTER-SPECIFIC GROWTH SYNCHRONY RELATED TO CLIMATE VARIATION IN MEDITERRANEAN MIXED AND MONOSPECIFIC STANDS.

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Keywords: Lloret indices, drought response, Area Overlap Indices

In this preliminary presentation we show our currently ongoing investigation aiming to describe the effect of mixing in four coexisting Mediterranean tree species (P. pinea, P. pinaster, J. thurifera, Q. ilex) and their response to drought in terms of intra- and inter- specific growth. The response to water stress will be quantified in terms of indices of recovery, resilience and resistance, calculated from annual Basal Area Increments (BAI) in the years before, during and after a drought event. These data will be obtained from tree-ring series collected in trees of the four species growing in different mixing conditions. In addition, patterns of inter and intra-specific synchrony between the complete tree-ring series will be analysed. In order to evaluate factors influencing the variability in the response, linear mixed effects models will be used. The ecological indices for every species will be the dependent variable, explained by a set of coefficients, such as tree size, age, occurrence of drought event, stand composition and competition effect. The competition effect will be described by Area Overlap Indices (AOI), considering both inter – and intraspecific competition between trees. This will allow answering the question if tree's response to drought differs depending on the type of competition experimented. In addition, AOI will be used for modelling the BAI for each species separately, taking in consideration the abovementioned coefficients. During the presentation, results showing AOI of each species separately for mixed and pure stand will be showed and commented, trying to point out some first conclusions and possible hypotheses.

POSTERS

DO ECOSYSTEM SERVICES BENEFIT FROM INTERCROPPING IN OIL PALM SMALLHOLDINGS?

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Keywords: natural pest control, by-products, carbon sequestration, oil palms

The controversy around the expansion of monoculture oil palm plantation has increased the demand for sustainably produced palm oil. Many studies have been conducted on the impact of sustainable farming practices in oil palm plantations on biodiversity, but there is a lack of studies concerning the effect it has on ecosystem services. This study identifies the effects of intercropping in oil palm smallholdings in the Tanjung Karang area, Malaysia, on management practices, and the effect on the provisioning and regulating ecosystem services. The focus was on natural pest control, by-products, and carbon sequestration. Literature search gave global insights, interviews supplied local perceptions, and fieldwork provided accurate data from the study area. The results show that intercropping has an influence on the management practices. Polyculture oil palm smallholdings have less herbivory, thus better pest control management than monoculture smallholdings. Intercropping provides many by-products that can be produced in the study area, to improve the livelihoods of smallholders. Polyculture oil palm smallholdings sequester more carbon than monoculture smallholdings. Although the results showed no significance, they did indicate that ecosystem services benefit from intercropping in oil palm smallholdings. With a positive effect of intercropping on ecosystem services, but a lack of significance, it is advised to conduct more research on the effects of intercropping in oil palm smallholdings on ecosystem services.

THE EMERGANCE AND EFFECTS OF TREE AND LARGE SHRUB SPECIES IN GREENLAND

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Keywords: Greenland, deglaciation, tree expansion, primary succession, positive feedback mechanisms

Expansion of tree and shrub species as a result of climate change will have a major impact on in Arctic and subarctic ecosystems. Greenland harboured the first tipping point that exceeded its critical threshold, converting ecosystem dynamics from predominantly negative feedback mechanisms to predominantly positive feedback mechanisms. Decrease of the global average temperature since the Upper Pliocene reduced the occurrences of forests in Greenland, until now. A rise of the global average temperature causes bioclimatic models as well as vegetation models to indicate that primary and natural succession will accelerate as these processes follow the deglaciation of the Greenland ice sheet (GIS). Investigation of scientific literature: indicated that (1), based on bioclimatic models and afforestation experiments that *Picea glauca, Pinus contorta* var. *latifolia, Picea sitchensis* x *glauca*, *Abies lasiocarpa, Larix sibirica* var. *sukaczewii* should be able to establish and colonize southwestern Greenland; (2) highlighted the importance of elevation, dispersal and soil development as the crucial factors for vegetation development; (3) showed that potential effects of tree and shrub expansion on positive feedback mechanisms will change global climate. Despite drastic changes in Greenland, effects of climate change are embraced by many locals due to the socioeconomic opportunities that it offers.

ASSESSMENT OF WOODY SPECIES DIVERSITY AND REGENERATION STATUS OF HAFURSA FOREST IN SIDAMA REGION, ETHIOPIA

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Keywords: Hafursa forest, Dry evergreen afromontane forest, Woody diversity, population structure, regeneration status

The study was conducted on Hafursa forest in Arbegona Woreda, Sidama Region, Ethiopia, to determine woody species diversity, structure, and regeneration status of the vegetations along with altitudinal variation. The forest is found under dry evergreen afromontane forest ecology. A systematic sampling technique was used to collect sample data. A total of 32 quadrats each with 400m^2 (20m x 20m) were established along four transect lines. To collect data on seedlings and saplings, five subplots of 1 m × 1m (1m^2) size located at the four corners and center of the main plot were used. The diversity of species was determined by using the Shannon-Wiener diversity index (H') and MS-Excel spreadsheet used for the data analysis. About 26 woody species belonging to 22 genera and 20 families were recorded in the forest. The overall Shannon-Wiener diversity index (H') and evenness values (E) for the entire forest were 2.45 and 0.75, respectively. The total basal area of the forest was found to be 9.43 m^2/ha for woody species ≥ 2.5 cm in DBH, and the total density of all woody species collected in the forest was 522 individuals ha-1. The analysis of the diameter at breast height distribution shows an inverted J-shaped pattern. Four of the most dominant woody species of Hafursa forest occupied 52.44% of the total import value index were Faurea rochetiana (17.12%), Ilex mitis (16.99%), Maesa lanceolata (9.28%), and Hagenia abyssinica (9.05%). A total of 586 seedlings, 431 saplings, and 668 matured individuals were recorded in the study area. The community structure and regeneration status of the forest shows that there have been high forest degradation and serious anthropogenic disturbances in the area. Therefore, the recommendation is made to improve the protection and conservation status of the forest, through the modern joint of forest management approaches as well as sustainable utilization by recognizing its significance.

ECOLOGICAL-LANDSCAPE CONCEPT OF FLOWER DECORATION OF THE CITY NUR-SULTAN

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Key words: flower decoration object, principals, city structure

In the development of the flower decoration of the capital of Kazakhstan, little attention is paid as an ecological landscape system according to this scheme. The article deals with some results of studying floral design element of the city structure to assess the placement of objects in floral design. The suggested methods can be used to estimate the quality of urban floral design. The above methods regard the floral design as one of the city structure elements in its planning procedure and bring it as a part (or a piece) in a single unit. The basic function of this methodology is to set the statements to evaluate the suitability of floral design elements, to determine the optimal order of testing floral design facilities and to make some useful recommendations to develop new flower gardens and/or to redesign the present ones. The following structure are held according to the data received during the assessment. The goal of this is to identify specific features of floral design objects for revealing typological situations of structure elements which are typical of the definite climate zone. The existing conditions of flower arrangement in the city have been analyzed from the point of view of changing planned structures and implementation of the decisions in the general plan of the city taking into account the installation of the administrative and public centers, sports centers, parks, squares, parkways, prospectuses, highways and other major town-planning formations and objects. To assess the functional role of the floral design object, the following criteria are used: the object of the survey is the center of the composition; the object completes and dresses the composition; the object is neutral to the composition; the object doesn't discord and break the composition. The principles of flower arrangement of separate objects have their special features, but they should be thoroughly considered and built organically into the whole system of the city.

PALYNOLOGICAL STUDY OF THE LATE HOLOCENE VEGETATION DYNAMICS IN HYRCANIAN FORESTS, NORTHERN IRAN

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Keywords: Hyrcanian region, Mediaeval Climatic Anomaly, peatland, vegetation history.

Pollen grains and spores are the basis of pollen analysis, or palynology as an important aspect of paleoclimatic reconstruction. Lakes, peatlands, bogs and other wetlands preserve pollen and provide a record of past vegetation. To reconstruct the vegetation history and changes in the climate of Kelardasht and Hyrcanian region in this research, a one meter deep core was taken from Tapeh Kelar peatland and sub-samples with intervals of 10 centimeters were taken of each core. After treating and mounting the subsamples in silicon oil, slides were prepared, pollen grains were counted and pollen diagrams were drawn. To reach adequate pollen sum for each depth, on average four slides were counted. The diagrams showed that alder, hornbeam and oak has always been the most common trees in the forests facing the meadow. Also, the existence of walnut and Avena-Triticum group throughout the records is a sign of agriculture and human activity in the region in the last 850 years ago. The diagrams also showed that in the past 850 years, hillsides facing Kelardasht plain has always been covered with forest but the meadow itself was never fully covered by trees. Between 700 to 850 years ago, the number of Pterocarya fraxinifolia pollen in the records dramatically reduced. This could also be seen in other palynology studies in Hyrcanian and Colchis regions, which could be related to Mediaeval Climatic Anomaly. During this period, Hyrcanian region seemingly had a warmer and drier climate. Palynology is a very young field of study in Iran and studies like this are needed to be conducted in other parts of the Hyrcanian region to have a better understanding of past vegetation and climatic changes.

COMPARATIVE ANALYSIS OF PERFORMANCE OF NATURAL REGENERATION IN SCIENTIFICALLY MANAGED COMMUNITY FOREST

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Keywords: management, diversity, forest-block, sampling, sustainable

Scientific forest management, a production-oriented approach of forest management, has been popular in Nepal. Government policy has also encouraged for its application for the sustainable management of forest. The study entitled "Comparative Analysis of Performance of Natural Regeneration in Scientifically Managed Community Forest" was conducted in Janasewa Community Forest of Morang district. The main objective of this study was to compare the performance of natural regeneration between scientifically managed and unmanaged block of a community forest. Mostly bio-physical data were collected and analyzed. Field inventory and regeneration survey were carried out with 1 % sampling intensity. A systematic sampling method was employed and Simpson Diversity Index was used to calculate the species /diversity. The study showed that the regeneration of *Shorea robusta* was very high (22,006/ha) in scientifically managed block followed by other species such as *Schleichere oleosa* (500/ha), *Murraya koenigii* (472/ha) and *Adina cordifolia* (383/ha). The density of sapling (76/ha) and seedling (1441/ha) of *S. robusta* were found to be higher followed by *Murraya koenigii* (47/ha), *Adina cordifolia* (36/ha) and *Bixa orellana* (30/ha) in managed block. Managed block of community forest is seen to be homogenous in nature. Similarly, sapling frequency of *S. robusta* was found to be higher (72.22%) in managed block whereas seedling frequency was found almost 99% in both blocks. Scientifically managed block possesses higher Simpson's diversity index (0.97). The study concludes that scientific management of forest is one of the options for improving forest condition through regeneration promotion. The study recommends for the application of scientific forest management approach for promoting regeneration in eastern Terai Sal forest.

ASSESSMENT OF THE IMPORTANCE OF MYCORRHIZAL FUNGI FOR THE FOREST: CASE STUDY OF ARMENIA

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Keywords: mycorrhizae, the database, information field

Mycorrhizal fungi are one of the important ecological groups of macromycetes. Mycorrhiza is a simbioses with tree roots. The mycelium of mycorrhizal fungi is in shell form, composed of interwoven hyphae system, is covering the plants with small roots and root hairs increasing the surface area and water supply several times. The mycorrhiza of trees, which is broadly common in nature, is the basis for the survival of forests and their study and conservation have a great practical importance. Some macromycetes and plants can be grown independently in the greenhouse or laboratory, in nature most species require the symbiosis. For this reason, mycorrhizal fungi have been introduced to novel ranges when plants are managed for commercial purposes. For example, in the southern hemisphere, pine forests did not grow until soils with mycorrhizal fungi were imported and mixed with the native soils around planted pine seedlings.

In this respect, computerized database of mycorrhizal fungi of Armenia was created.

For creating the database personally collected fungi, the collections of fungi preserved in the Department of Botany and Mycology (ERHM), also literature data were used as materials. The database was prepared in Windows Access 2007. It includes the following information: the classification of fungi (class, order, family, genus), species name in Latin and Armenian, author's name, synonyms, floristic regions, height of location (m. above sea level), collection month, description of species, nutritional value, meeting frequency, picture and links.

The database of micorrhizal fungi includes 211 species of macromycetes, which belong to 32 genera and they are included into 20 families.

Creating such database allows to make information available to specialists and researchers. The data can be useful for choosing fungal species, which can be used for artificial mycorrhizing of seedlings and plantations. It will be a base in agriculture and forest recovering works.

ORGANIC CARBON CONCENTRATION IN THE SOILS OF COASTAL AFFORESTATION SITES IN BOGACHATTOR, CHITTAGONG

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Keyword: Carbon Stock, mangrove species, Organic matter, Loss on ignition method, Wet oxidation method

Coastal plantation is one of the important forestry activities which play a vital role in carbon sequestration and thereby mitigating climate change. The present study conducted in Bogachattor forest beat under Sitakunda Upazila to find out total carbon stock in coastal afforestation. The study aims at quantifying the organic carbon in the soils of the Bogachattor forest beat which is a part of the Chittagong coastal afforestation activities. The study also aims at comparing the two methods, i.e, wet oxidation method and loss on ignition, for measuring soil organic carbon. The study encountered three mangrove species, i.e., *Sonneratia apetala*, *Excoecaria agallocha* and *Avicennia officinalis*. Among three species, the mean dbh and mean total height found highest in the *Sonneratia apetala* stand, 20.05±0.93 cm and 11.17±0.29 m, respectively. Similarly, in the *Avicennia officinalis* and *Excoecaria agallocha* stands, the mean dbh and mean total height are 19.04±0.61 cm and 9.08±0.23 m and 9.55±0.21 cm and 6.91± 0.14 m, respectively. And the carbon stock is the highest in the *Excoecaria agallocha* stands, 107.29±7.71 tC/ha at 0-30cm depth and 35.76±2.57 tC/ha at 0-10cm depth, respectively. On the other hand, carbon stock found in the *Sonneratia apetala* stands, 98.95±8.15 tC /ha and 32.98±2.72 tC/ha, respectively at 0-30 cm and 0-10 cm depth. For *Avicennia officinalis*, the values are 92.40±6.99 tC/ha and 30.80±2.33 tC /ha, respectively at 0-30 and 0-10 cm depth. This result also reveals that, both wet oxidation and loss on ignition method methods were reliable for measuring soil organic carbon but loss on ignition is more accurate and suitable with high organic matter. The quantification of the soil carbon concentration by the coastal plantation can lead the policy makers, researchers and administrators to bargain the price of the international greenhouse gas reduction

EFFICIENCY OF DIFFERENT BIOCHAR-FERTILIZER MIXING FORMULA TO ENHANCE NUTRITION RETENTION CAPACITY IN AGRICULTURAL SOIL IN VIETNAM

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Keywords: Coastal sandy soil, drought, new material, moisture, plants.

Coastal sandy soil is a type of soil with coarse mechanical component that is susceptible to drought because of its large pores, poor humus, low cation adsorption capacity, low water holding and fertilizer retention due to the low content of colloids. The traditional method for soil improvement is adding organic fertilizer or vegetative substrates such as straw, rice husks, plant residues, green manure. However, due to the rapid decomposition of organic matter in sandy soils, the organic matter applied to sandy soils is likely to be non-persistent. Especially, in the current drought condition, due to climate change, coastal sandy land in the Central Coast of Vietnam is heavily affected. Finding a material that can last long in sandy soil and helps to keep water and nutrients, increase drought tolerance for crops is vital. Biochar is a kind of new material which is easy to produce, to use and can respond the above requirements of coastal sandy land in Central of Vietnam. This research was conducted on the basis of mixing NPK with biochar at different ratios to find out the most suitable formula which helps to increase fertilizer efficiency, easy to use for plants, enhance soil moisture retention in the cultivation process, respond to increasing drought conditions. We used NPK at (5: 10: 3) proportion mixing with different biochar ratios to form NPK-Biochar fertilizer. After mixing in 24 hours, the analysis showed that pH value had changed from alkaline pH in biochar to less alkaline in NPK-Biochar fertilizer. After incubation for 0, 1, 2, 3, and 4 weeks, the samples were analyzed for N, P and K in the treated soil and fertilizer. Analysis showed that the application of mineral fertilizers to the soil in the first week provided the highest amount of N, P, K. In the following weeks, the amount of nutrients in the soil was slightly reduced. Increasing the amount of biochar reduces the available nitrogen loss during storage and applying to the soil. In fertilizers with different biochar ratios, NPK-Biochar 5: 10: 3 - 20% biochar is the most suitable for mass production.

DETERMINING FACTORS IN THE RECOVERY OF THE CANARIAN LAUREL FOREST: THE RETURN OF THE CLOUD FORESTS

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Keywords: dendrochronology, dynamics, growth rings, release patterns, conservation.

Rising temperatures and changes in land use have been crucial factors in the loss of biodiversity. In the Canary Islands, intensive forestry led to a drastic decline in laurel forests. However, since the mid-twentieth century, the abandonment of traditional uses for an economy focused on tourism, together with initiatives for the recovery of native forests, have led to an increase in the extent and diversity of laurel forests.

The study of the dynamics of these forests has traditionally been based on the monitoring of temporal plots, dendrochronological studies being scarce due to the false belief that the lack of a marked seasonality prevented the formation of annual growth rings. Our objective was to use dendrochronology to study the dynamics of laurel forest growth and to determine the mechanisms that maintain species diversity over time. For this purpose, we sampled the entire tree community in four plots at different altitudes and orientations in the Anaga Rural Park, Tenerife.

Annual radial growth time series indicated that these are secondary forests originating between 1940 and 1960, with maximum ages of 80 years. Analysis of release and suppression patterns showed releases due to strong winds (1958, 1965) followed by growth stagnation due to canopy closure and increased competition. Knowing the factors that determine the dynamics of these stands is fundamental for their conservation.

GROUP SELECTION HARVEST MIGHT HELP TO NATURAL REGENERATION AND CONVERSION OF PINE PLANTATIONS TO UNEVEN-AGED AND DIVERSIFIED STANDS

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Keywords: natural regeneration, group harvesting, Pinus pinaster, Quercus rotundifolia, ecosystem resilience

Mixed and un-even forests have positive effects over geochemical cycles, biodiversity conservation, climate change mitigation and ecosystem resilience. For this reason current studies are promoting the increase of forest biodiversity. However, many forest stands in Spain are monospecific and regular. The main goal of this research is to observe how group selection harvest can affect either natural regeneration or tree diversity. In 2020 group harvest treatment was implemented in a mature *Pinus pinaster plantation* located in Cabañeros National Park (Ciudad Real, Spain). Plots were aprox. 0.03 and 0.07 ha and were replicated three times including a slope gradient. Heights of the group openings' border was around 20 m. A control harvest gap with no treatment was also included in each slope position. Regeneration survey (species and number of seedlings) was measured in random circular plots of 1 m^2 in spring, summer and autumn of 2021. Number of plots varied from 15 to 26 according to gap size. Preliminary results showed significantly higher probability of establishment for *Pinus pinaster* in 0.7 ha gap. However, we didn't find a clear relationship between treatment and natural regeneration of *Quercus* species. *Pinus pinaster* is a pioneer species and therefore better competitor colonizating areas without vegetation than other tree species. For this reason, *Pinus pinaster* seedlings may benefit from forests gap in this study. However, *Quercus* species might need more time to establish successfully after forest clearing and consequently further monitoring is needed to observe a longer term tendency of its establishment.

HARVESTER HEADS FOR THE USE IN HARDWOODS

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Keywords: harvester, harvester head, hardwood, productivity, damage

Since at least the hurricanes Vivian and Wiebke in February 1990, harvesters have become an inherent part of German forestry. In contrast to motor-manual felling, their employment allows a significantly higher productivity, while reducing the risks of injuries. Especially after severe storm calamities like hurricanes, this has advantages as the fallen trees can be under tension. Moreover, high amounts of timber must be processed in relatively short time to avoid devaluation by fungal activity. Harvesters have also been proved to be valuable for thinning and final harvests, and thus became standard in German softwood stands. As harvesters were developed in Scandinavian countries, in which softwood stands of *Picea abies* and *Pinus sylvestris* are dominant, but also hardwood species like *Populus spec.* and *Betula spec.* have small dimensions, harvester heads were designed for trees with these very characteristics. This results in the fact that harvesters are well suited for softwood species in Germany and Central Europe, but lack practicability in hardwood stands, especially in those with trees of big dimensions. The often-crooked stems, large crowns with thick branches, and high wood densities of many hardwood species, can reduce the productivities of harvests and timber quality significantly. As forest conversion from softwood-dominated forests to mixed forests is ongoing for considerable time to convert vulnerable monocultures to site-appropriate forests, there is demand for specialized harvester heads for hardwood species.

dsRNA MOLECULES DESIGN FOR SIGS APPROACHES IN FORESTRY

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Keywords: RNAi, gene silencing, target genes, overlapping PCR, forest diseases

RNA interference (RNAi) is a conserved eukaryotic gene-silencing mechanism naturally occurring in cells. It is initiated by double-stranded RNA (dsRNA), which can regulate gene expression through targeted degradation of the homologous messengers RNAs (mRNAs). This mechanism has been mimicked to silence genes in pathogenic organisms affecting plants, reducing their virulence and even inhibiting infection. The technology called SIGS (spray-induced gene silencing) is based on RNAi and by spraying artificially synthesized dsRNA molecules that target pathogen genes on plant surfaces results in disease reduction. The success of this technology lies, among other factors, in a good design and production of dsRNAs to achieve gene silencing. The choice of genes is therefore also of importance to reduce the pathogen infection. Thus, genes present in metabolic pathways relevant for infection are chosen and dsRNA molecules are designed to target more than one gene using the overlapping PCR technique, in order to enhance pathogen inhibition. The dsRNA molecules are designed to avoid conserved domains and off-target effects. As for dsRNA production, in vitro synthesis using commercial kits is expensive and limited, so alternatives using genetically modified organisms for dsRNA production are being developed, such as *Escherichia coli* strain HT115, which is deficient in RNase III to protect dsRNAs. This method obtains good yields and is cost-effective but requires a proper purification of the dsRNA produced. All these aspects are of great importance for the success of SIGS and the development of fungicides based on this approach. SIGS strategy is presented as an alternative with great potential to control forest diseases, which lack effective treatments or whose treatments are harmful to ecosystems, which presents a major problem for the preservation of forests. This technology is under constant development in the agricultural sector but requires a great research effort in the forestry sector, where it is still unexplored.

SPATIO-TEMPORAL VEGETATION TREND ANALYSIS OF MURREE BY USING GEO-SPATIAL TECHNOLOGY

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Keywords: Remote Sensing, NDVI, Hybrid classification, Landuse, Landcover

Consistent monitoring and analysis of forest resource is essential for the development of country's economy as well as in shaping the ecology of planet Earth. Forests are vital resources to a developing country like Pakistan whose population depends upon the trees and their products for livelihood generation. Increased population pressure has exerted extra pressure on forest resources of Pakistan, which is already a forest deficit country with 0.023 hectare per capita forest area as compared to the world average of one hectare per capita with an average annual deforestation rate of 11,000 ha. Rapid urbanization and illegal tree cutting are the key factors of vegetation shifts over space and time. Increased reduction in forests is posing serious threats of climate change. Periodical monitoring of forests can help in assisting and planning the schema for efficient strategies for restraining climate change both at global and national levels particularly in Reducing Emissions from Deforestation and Forest Degradation (REDD+). Geo-spatial technologies rendered us the opportunity to efficiently monitor and sustainably manage the forests. It provided sound footing by yielding reliable estimates regarding vegetation trend analysis of study area of Murree. This research aimed at focusing on determining the change in magnitude of vegetation coverage intensity, change in rate and trend of vegetation shifts by using pixel based change detection technique namely Normalized Difference Vegetation Index (NDVI) and through guided clustering algorithm "hybrid classification". Study reveals that vegetation cover of the area has decreased during 15 years period from 2001 to 2015. The advanced Geospatial techniques played a vital role in mapping vegetation as well as in providing future prospects in designing conservation projects.

MIXED VERSUS PURE PINE FORESTS SHOW A DIFFERENT PATTERN OF CARBON ACCUMULATION IN THE SOIL PROFILE

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Keywords: mixed pine stands, Pinus sylvestris pure stands, Pinus pinaster pure stands, soil profile, carbon stocks

Many studies highlight the positive effect of mixed versus monospecific forests to supply numerous ecosystem services like carbon sequestration, but little is known about the tree mixture on carbon storage (Cstock) and the underlying mechanisms in tree mixtures of the same genus. Here, the effect of mixed vs. monospecific stands of Scots and Maritime pine on carbon storage along with the soil profile, based on research with six triplets in the northern Iberian Peninsula (Spain) was assessed. A 25x25 cm quadrant was used to collect the forest floor (FF) and its Cstock and carbon-nitrogen ratio (C/N) were analyzed. In addition, one soil pit of at least 30 cm depth was dug at each plot for soil characterization: the percentage of fine roots (%FR) and the Cstock were analyzed every 10 cm. We found two trends: in the topsoil (0-10 cm), the Cstocks soil was higher in Scots pine stands, lower in Maritime pine stands, and intermediate in mixed stands; this pattern was related to the C/N of the FF. In the intermediate soil layers (10-30 cm), Cstock tends to be higher in mixed stands and is related to the %FR and the greater thickness of the first mineral horizon. These results improve our understanding of the mechanisms underlying soil carbon accumulation in mixed stands and emphasize the use of mixtures as a strategy to combat climate change, due to the advantage in the accumulation of carbon in the subsoil layers that hinders its mineralization.

DO MIXED PINE STANDS IMPROVE SOIL FERTILITY AND CONSERVE THE UNDERSTORY RICHNESS UNDER WORSE WATER SOIL CONDITIONS?

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Keywords: mixed pine stands, Pinus sylvestris pure stands, Pinus pinaster pure stands, understory richness, soil water and fertility

Many studies inform about a more efficient supply of ecosystem services of mixed forests compared to monospecific forests. Many of them are focused on mixtures that combine tree species with contrasting traits and report the positive mixture effect on biodiversity, but little is known about the relationship overstory-understory-soil in coniferous tree mixtures. Here, 6 triplets of Scots pine and Maritime pine were selected in North-Central Spain to assess the effects of mixed vs monospecific stands in the understory richness and composition and its relationship with the soil status. First, the cover of every understory vascular plant species was estimated visually and data were codified according to Raunkiær's life-forms in ten one square meter quadrats randomly located per plot. Also, one pit soil of 50 cm depth was dug in each plot to determine the soil´s water-holding capacity and fertility status (carbon and exchangeable cations stocks). We found that the overstory and understory respond to a water-stress gradient: Maritime pine tolerates lower soil´s water holding capacity than Scots pine. Secondarily, a soil fertility gradient defined by organic carbon and exchangeable magnesium stocks was identified. Mixed stands under greater water stress than Scots pine stands maintain the same level of understory richness. Hemicryptophytes, whose abundance is greater in mixed stands, were the only understory life-form positively correlated to soil fertility. We conclude that the mixture of both *Pinus* species should continue to be favored in the study area because it helps to maintain understory richness, similar to *Pinus sylvestris* stands, under greater water-stress conditions and improves soil fertility.

MIXED PINE FOREST CONSERVE THE UNDERSTORY RICHNESS THROUGH THE NATIVE OAK REGENERATION

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Keywords: mixed pine stands, Pinus sylvestris pure stands, Pinus pinaster pure stands, niche amplitude, tree regeneration

The relevance of mixed forests management has increased due to their more efficient supply of ecosystem services like biodiversity. Most reports of the positive effects of mixtures on biodiversity conservation focus on coniferous–deciduous combinations, but little is known about the tree regeneration role on understory biodiversity in mixtures combining coniferous species. Thus, 6 triplets of Scot pine and Maritime pine were selected in northern Spain to assess the effects of mixed vs monospecific stands on tree regeneration relationship with the niche amplitude and richness of the understory. The cover of every understory vascular plant species, including tree regeneration and bryophytes, and the number of individuals of the tree regeneration were estimated in ten one square meter quadrats randomly located per plot. A gradient in the percentage of basal area of both *Pinus* species explained the understory composition and tree regeneration: Scots pine monospecific stands host species characteristics of humid zones, including *P. sylvestris* regeneration, whereas typical Mediterranean species of well-drained areas, including *P. pinaster* regeneration, dominates in *P. pinaster* monospecific stands. In mixed stands, the highest regeneration of the native Pyrenean oak was accompanied by typical species that share the same regeneration niche and contributed to maintaining the understory richness under worse environmental conditions.

IMPACT OF LAND USE LAND COVER DYNAMICS ON HYDROLOGY AND WETLANDS OF BORKENA WATERSHED, ETHIOPIA

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Keywords: streamflow, Water, Remote-sensing, modelling, landscape

This study aims to analyse long term land-use and land-cover dynamics and its impact on hydrology and wetlands of Borkena watershed, Northern Ethiopia. Landsat imageries of 1985 (TM), 2003 (ETM+) and 2015 (Landsat 8) were used to analyse land use and land cover classes for the last 30 years. Supervised classification with maximum likelihood algorithm was used to classify the images. Soil and Water Assessment Tool (SWAT) model was used to analyse the impact of land-use and land-cover change on hydrology and Sensitivity analysis was performed using SWAT-CUP. Based on the accuracy assessment about 93.53% overall accuracy and 0.91 Kappa Coefficient value were attained for 2015 classification. The result showed that 58.57% and 53.9% of the area had undergone change from its initial category to another category during the period of 1985-2003 and 2003-2015, respectively. During 1985, 203.2 Km^2 of Borkena watershed was covered by wetland, only 68 Km^2 of the watershed was classified as wetland during 2015, which means about 135 Km^2 were converted to another land use/land cover type. Most of wetland area was converted to cropland (73.85 Km^2) and to shrub land (51.2 Km^2). Based on sensitivity analysis, ten parameters were identified. The coefficient of determination (R^2) and Nash Sutcliffe efficiency (ENS) values for the modelling performance were 0.81 and 0.78 for calibration, 0.79 and 0.76 for validation, respectively. The evaluation of the SWAT model response to land use land cover changes shows, increment of mean total of monthly surface runoff by 11.6% from 2003 to that of 2015 and by 9.4% from 1985 to that of 2015. The average wet, dry and belg monthly stream flow generated using 2015 land use/ cover was increased by 4.43%, 7.88% and 5.96% from the initial land use/cover (1985), respectively.

RECYCLING OF LIGNOCELLULOSIC GRAPEVINE WASTES AS NUTRITIVE COMPOSTS

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Keywords: pruning shoots, composting pile, biodegradation, quality index, germination index

Pruning shoots are considered biomass but their burning has environmental drawbacks, or if are left in the vineyard they represent a fungal "reservoir" for grapevine trunk diseases (GTDs).Therefore, natural mitigation by hygienization and controlling lignocellulosic residues is essential, and the main objective of this work was to recycle this waste by composting. Biodegradation in solid phase by composting the mix between vine pruning lignocellulosic residues with laying hen manure (2:1 w/w) in an open pile has determined the obtaining of a class-A organo-mineral fertilizer. The nutrient compost obtained with high values of the germination index (IG 92.2) does not indicate a degree of phytotoxicity and can be used as a substrate for seedlings. The mixture between different (%) of lignocellulosic compost and different (%) of peat, has shown that higher values for the quality index (Qi 1.67) were obtained from the mixture of 75% lignocellulosic compost with 25% peat compared to the control (100% peat) that has had a value twice lower for the quality index (Qi 0.82).

EFFECT OF SEED TUBER PLANTING DEPTH AND NITROGEN RATE ON YIELD AND YIELD RELATED TRAITS OF POTATO (*SOLANUM TUBEROSUM* L.) AT HARAMAYA AND HIRNA, EASTERN ETHIOPIA

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Keywords: marketable, dry matter, quality, size

The potato (*Solanum tuberosum* L.) is important cash and food security crop in the eastern highlands of Ethiopia. However, the yield of the crop is constrained by low soil fertility and poor agronomic practices. Therefore, the field experiment was conducted at the main campus of Haramaya University and Hirna Research substation during the 2015 main cropping season. The objective of the experiments was to elucidate the effect of seed tuber planting depth and nitrogen fertilizer rate on yield-related traits and yield of the crop. The treatments consisted of four seed tuber planting depths (5, 10, 15, and 20 cm) and five rates of nitrogen (0, 46, 92, 138, and 184 kg N ha^{-1}). The experiment was laid out as a randomized complete block design with three replications. The results of the experiment at both locations revealed that the main effect of nitrogen application rate influenced total dry weight, unmarketable tuber yield, the percentage of small-sized and medium-sized tubers. Nitrogen rate and seed tuber planting depth also interacted to influence unmarketable tuber yield, the percentage of medium and large-sized tubers produced, and tuber starch content. The main effects of seed tuber planting depth significantly influenced total dry biomass, unmarketable tuber yield, total tuber yield, marketable tuber yield, the percentage of small-sized tubers produced, and tuber starch content. Increasing seed tuber planting depth generally enhanced the parameters. However, for most parameters, the highest values were obtained already at the seed tuber planting depth of 10 cm. The optimum total and marketable tuber yield of 26.93 t ha^{-1} and 26 t ha^{-1} for Haramaya and 34.57 t ha^{-1} and 32.65 t ha^{-1} for Hirna were obtained in response to planting seed tubers at the depth of 10 cm.

SOLAR KILN DRYING OF *Syzygium cumini* Linn. Skeels. and *Chukrasia tabularis* A.Juss.

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Keywords: Moisture content, Drying rate, Moisture distribution test, Stress Detection Test, Drying defects

Timber needs to be properly dried for ensuring dimensional stability before putting into use. Steam heated and electrically heated dry kilns remain the principal commercial seasoning methods in the wood-based industries in India. Use of solar energy as a heat source is a partial solution to make drying cost effective. Use of specially designed Glass House type solar kiln can have better control over the air-drying conditions, and the air-drying time can also be reduced considerably, depending on the species and thickness of sizes. The Glass House type Forest Research Institute (FRI) solar kiln can be effectively utilized for reducing the energy requirements for drying timber. Kiln design can be appropriately modified depending on the geographic location, for tapping more heat from the sun by selecting the roof slope. Kiln conditions can be controlled using vents. Humidity can be controlled by vents, water spray and fan. Air circulation can be ensured by another fan. Efficient recovery of solar heat can be made use of by black body radiation principle, using black painted corrugated GI/aluminium baffles. This study was carried out on solar kiln drying of *Syzygium cumini* (Black Plum) and *Chukrasia tabularis* (Indian Mahogany). For the purpose drying of these two species, modified design of FRI Solar Kiln is used. The purpose of the study is to provide the small-scale furniture manufacturers with required knowledge and skills about the solar kiln drying of these two commercially important timber species as they couldn't afford the costly drying methods and to discourage them from using air-drying method which results in uncontrolled drying and causes several drying defects of wood. For this study, the solar insolation during the day was recorded, also, the moisture content, drying rate of the kiln samples, Moisture Distribution Test and Stress Detection Test of kiln samples were also calculated. The results showed that *Syzygium cumini* dried faster when compared with the *Chukrasia tabularis* for the drying rates up to 10 days. Solar kiln can be used very effectively in regions receiving maximum solar insolation. In a nutshell, it can be concluded that *Syzygium cumini* and *Chukrasia tabularis* can be successfully dried in a solar kiln from very high initial moisture content (41.02% for *Syzygium cumini* and 61.62% for *Chukrasia tabularis*) to a desired final moisture content of around 10% in 10 and 21 days respectively with limited drying defects. The study helped in a better understanding of moisture removal and thus drying trend in *Syzygium cumini* and *Chukrasia tabularis*. The hands-on experience of solar kiln drying of *Syzygium cumini* and *Chukrasia tabularis* was extremely beneficial as it rendered a practical exposure to solar kiln drying which ultimately enhanced knowledge and confidence.

FINANCIAL ANALYSIS OF HIGHLAND BAMBOO PLANTATION: A COMPARATIVE ANALYSIS WITH OTHER LAND-USE SYSTEMS IN ETHIOPIA

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Key words: Highland bamboo, financial profitability, Land-use systems, Banja

Ethiopia is well-endowed with bamboo resources that have important economic, social, and ecological roles. Nevertheless, its contribution to producer's livelihoods and the national economy is very low compared to its potential. This study evaluates the financial performance of bamboo plantations against agricultural crops, *Acacia decurrens* plantations, and eucalyptus plantations in Banja district. Primary data were collected from 139 households and financial analysis was used to assess the profitability of the systems. The findings revealed that all land-use systems show positive values for all financial indicators. Comparatively, bamboo plantations are the second highly profitable land-use system next to Eucalyptus plantations with NPV of ETB 276,830.50 and BCR of 9, which is twice as high as crop production in the study area. However, the land allocation made by smallholder farmer for bamboo plantation was relatively smaller than other land use systems. Consequently, the current contribution of bamboo falls short of the contribution expected from the sector. Smallholder farmers in the area still rely on crop production though they are not satisfied with its return and it is sensitive to weather variability and is characterized by inherent low productivity. Hence, there is a need for a reform of the existing agricultural extension policy of the nation that has been biased to agronomic crops and it needs to be modified in a way that it is inclusive of alternative land uses on the basis of their financial profitability, social preferences and environmental resilience.

EFFECTS OF NATIVE SHRUBS ON SOME PHYSICO-CHEMICAL PROPERTIES OF MINING SUBSTRATES WITH LIVESTOCK USE

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Keywords: shrub cover, grazed areas, Sub-Mediterranean climate, soil improvement, coal mines

Previous studies have shown that leguminous shrubs (*Cytisus scoparius* and *Genista florida*) that actively colonise the coal mines of northern Palencia have a positive effect on the establishment, survival and growth of oak seedlings (*Quercus petraea* and *Quercus pyrenaica*). According to the scientific literature, the mechanisms involved in shrub-tree facilitation include microclimatic and soil improvement (direct facilitation) and mechanical defence against herbivores (indirect facilitation). Our study aims to find out whether soil improvement is one of the mechanisms of shrub-tree facilitation in grazed mining areas in the northwest of Palencia. The starting hypothesis is that nurse shrubs promote the fertility of 'mining soils' and improve their structure.

The results show higher bulk density (indicative of greater soil compaction), pH, clay and exchange sodium contents, as well as oxidisable-carbon/total-carbon ratio (indicative of more labile forms of carbon) outside the shrub canopy. While under shrubs there is a greater thickness of the herbaceous layer covering the soil and the mineral horizon, and higher values of total and oxidisable organic matter, total and oxidisable carbon, total nitrogen, electrical conductivity, cation exchange capacity and exchange magnesium, as well as the C/N ratio. The sum of bases, percent base saturation, coarse elements content, porosity, useful water and water holding capacity do not differ significantly under vs outside shrub canopy, although the values are slightly higher under shrubs.

These results allow us to accept the starting hypothesis and conclude that the soil improvement induced by native shrubs is one of the underlying facilitating mechanisms that could explain the higher survival and growth of oak seedlings in the grazed mining areas of the Palencia mountains. Moreover, the effects of grazing on soil properties are softened by the presence of shrubland, which also introduces greater spatial variability.

SPECIES DIVERSITY AND ABUNDANCE OF MACROZOOBENTHOS IN VARIOUS PLANTING YEARS AT MANGROVE REHABILITATION AREA OF KALIWLINGI VILLAGE, BREBES REGENCY, CENTRAL JAVA

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Keywords: macrozoobenthos, species diversity, abundance, mangrove

Mangrove is a complex ecosystem functioned as habitat of some marine fauna, including macrozoobenthos. Macrozoobenthos is group of benthos which has sized >1 mm and mature sized around 3 mm - 5 mm. These fauna have important roles as decomposer and bio-indicator on determining fertility and nutrient cycle in mangrove ecosystem. The aims of this research were to determined quality of mangrove habitat in various rehabilitation planting years, to identified species diversity and abundance of macrozoobenthos in various rehabilitation planting years, and to knew the difference between species diversity and abundance of macrozoobenthos with physical-chemical waterworks in various rehabilitation planting years. This research was conducted in Mangrove Rehabilitation Area, Kaliwlingi Village, Regency of Brebes, Central Java. Data collection was carried out in rehabilitation planting years 2007 with extent of 2 ha, planting years 2009 with extent of 4.5 ha, and planting years 2011 with extent of 3 ha. Data of vegetation along with physical-chemical waterworks (temperature, mud depth, pH, salinity, dissolved oxygen) was undertaken by plot 5m x 5m, while observation of macrozoobenthos was undertaken by visual on plot 1m x 1m. To located the beginning plot was random and the next plot was carried out by systematic. All of the data collections analyzed by variant test (Analysis of Variance). The results show that there are 21 species of macrozoobenthos founded on all rehabilitation planting years come from two classes, that's Crustacean and Gastropod. Species diversity of macrozoobenthos in planting year 2007 is 1.58, then planting year 2009 is 1.82, and for planting year 2011 is 0.51. Abundance of macrozoobenthos in planting year 2007 is 168 ind/m^2, planting year 2009 is 1286 ind/m^2, and then for planting year 2011 is 624 ind/m^2. Result of variant test (ANOVA) shows that species diversity and abundance of macrozoobenthos on three planting years are significantly different.

AN EFFICIENT WAY OF ANALYZING THE CHANGES IN WATERSHED OF MID HILL REGION OF NEPAL

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Key words: land use, land cover, satellite images, support vector machine

Geographic Information System (GIS) combined with remote sensing was used to understand the complexity of land use land cover dynamics of Phewa lake watershed, situated in the mid hill region of Nepal. Similar studies on this study area are very limited. Thus, this research was objectively carried out to assess the land use and land cover dynamics between 2005 and 2018, explore the causes of land cover change and management options of the study area. The satellite images (Landsat 7 ETM+ and Landsat 8 OLI/TIRS) were processed and different band ratios including Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI) and Normalized Difference Building Index (NDBI) were calculated using ENVI 5.3. The supervised classification was done to classify the image into agriculture land, build up area, degraded land, forest and water body using the support vector machine classification algorithm. The household survey was carried out to find the causes and management options of land use land cover change. The result revealed that, there is a decrease in 14.64%, 1.83% and 0.3% in agricultural land, degraded land, and water body respectively, whereas, forest cover and built-up area increased by 8.61% and 7.89% respectively. The change detection indicated that the highest land cover change was noticed from agriculture land to forest land (4.67%) and from agriculture to build up area (3.56%). All the respondents in the interview said that there was a decrease in agriculture land and increase in buildup land. Hence, for the proper land use practice, the potential management options like enforcement of rules and regulations and promotion of conservation practices will be effective. The research findings of land use land cover dynamics will not only be useful for formulating effective management policies but also will be useful for the planning of natural resources management and associated decision making.

ASSESSMENT OF THE SOILS QUALITY UNDER DIFFERENT VEGETATION COVER IN THE NORTH REGION OF ALBANIA

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Keywords: indicators,index,forest,agriculture,pasture,

The concept "Soil quality" has to do with the ability of soils to function properly in ecosystems. This study is focused on forest land, pasture land and agricultural land of the northern region of Albania, which include the administrative units of Shkodra, Kukes, and Lezha. Through this study we aim to draw conclusions on how the quality of the soil varies in soils under different vegetation cover, considering the latter an important factor that can be managed by humans. The study used secondary data on the composition and main physicochemical characteristics of the soil such as soil depth, pHH2O, CaCO3, organic carbon (C-org), cation exchange capacity (CEC), interchangeable bases (Na, K , Ca, Mg) and clay. The most representative soil quality parameters that form a minimum data set (SMD) were selected using principal component analysis (PCA), and numerical results of soil parameters were obtained using the linear estimation method. Varimax values for soil parameters were taken > 0.5. The results of the study showed that the total soil quality index (ICT) was 0.20 for land under grass cover, 0.30 for agricultural land, and 0.4 for land under tree and shrub vegetation. Comparing these values with the respective scaling, it results that ICT for land under grass cover and agricultural land to be low (<0.33), while for land under tree and shrub cover to be average (0.33-0.60). Total ICT values suggest that keeping the soil under cover of trees and shrubs makes the soil of higher quality, compared to other forms of use such as pasture and agricultural land. Apparently, the pasture land is of lower quality due to overgrazing in the study area. However, more in-depth research involving more soil fertility indicators such as nitrogen and phosphorus assimilable to plants is needed to reach a final conclusion on the best form of land use in the study area.

CHANGE VEGETATION DENSITY ANALYSIS OF SUMATRAN ORANGUTAN (*Pongo Abelii*) HABITAT IN BUKIT LAWANG AND SUB-DISTRICT OF BAHOROK

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Keywords: *Bukit Lawang, orangutan habitat, Pongo abelii, vegetation composition*

Gunung Leuser National Park forest in Bukit Lawang section is the main habitat of Sumatran Orangutan (*P. abelii*) in Sub-district of Bahorok. The condition of wildlife habitat in the region has been fragmented by various human activities which is the major threat to the wildlife survival including Sumatran Orangutan (*P. abelii*) as the umbrella species. This study was conducted by overlaid some spatial data of the year 2008 and 2018 to obtain data of vegetation density changes and the range of the Normalized Difference Vegetation Index (NDVI) in Section of Bukit Lawang and District of Bahorok. Vegetation analysis was carried out in forest in Section of Bukit Lawang, rubber plantation and mix plantation in District of Bahorok as supporting data. The purposes of this study are to get vegetation density value and analysing the changes of vegetation density of Sumatran Orangutan (*P. abelii*) habitat in Bukit Lawang and Sub-district of Bahorok year of 2018. The research shows that the largest vegetation density changes was decreased of high dense class which is 47,040.02 hectare or 49.9%. The largest increased was occurred in the highest dense of 43,304.1 hectare or 46.05%.

IMPROVEMENTS IN THE CENTRAL PLOT OF THE UNIVERSITY CAMPUS OF GIJÓN

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Keywords: conservation, recreation, sustainability, plantation, paths

The approach of this project seeks to solve a series of needs and some existing problems in the University Campus of Gijón. The distance from the campus to the city center and the lack of incentives in it causes that the members of the university community who go daily to the academic facilities do not spend more time in these than strictly necessary. It is palpable the need to create some type of attraction, so that the people who daily come to the mentioned campus value the possibility of performing, in these facilities, other of their daily activities, such as sports practice, lunch, recreation, etc. The other problem present is the poor pedestrian communication between the faculty buildings. The objective of the promoter, the University of Oviedo, is to obtain a greater use of the large spaces inside the campus, give an updated and responsible image with the environment and the region and encourage the practice of outdoor activities. In relation to the above, the central plot of the campus, with an area of more than 5 hectares, is in absolute disuse, so it has been decided to bet on this space by implementing a series of facilities and improvements. To decide which facilities to implement, a strategic plan has been made including, an assessment of alternatives through SWOT analysis. Finally, the chosen proposal is divided into 3 lots, the first, a plantation of about 700 trees and shrubs native to the region in the form of small groves of 3 to 25 trees that allow to achieve the objectives of landscape improvement, promotion of conservation and creation of an environment for recreation. A second lot that includes a circular path for sports practice, 1.3 km long and 2 m wide and a pedestrian connection path between two classroom buildings of 200m long. By last, a third lot consisting of the installation of a wooden structure type pergola, of 135m^2, with transparent methacrylate roof, right at the central point of the plot, equidistant from all the buildings and halfway to the connection path, where it is sought that the university community can meet. In the end, the project has been approved by the University and the work has been carried out.

LIVELIHOOD, CONFLICT AND CONSERVATION: LOCAL PERCEPTIONS TOWARDS SNOW LEOPARD IN TAPLEJUNG, NEPAL

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Key words: attitudes, wildlife, predation, damages, compensation

People's perceptions towards snow leopard and general wildlife were investigated by a questionnaire survey of 21 households that followed transhumance system in snow leopard critical conservation site in Taplejung, Nepal. Focus group discussion and Key Informant Interviews were conducted to gain an overview of people's attitudes towards conservation. Almost all the inhabitants practiced both agriculture and animal husbandry. Majority of the people were involved in cardamom business. People were highly dependent on natural resources for sustaining their daily life. They collected firewood, fodder, MAPs and wild edible plants from the private land, community land and government land. However there have been changes in the availability of those resources over a decade. People had hard time collecting firewood, fodder and Medicinal and Aromatic Plants (MAPs). People suffered major damages due to wildlife like crop raiding and livestock depredation. The average loss due to crop damages per household in 2017 was 103.47 Euros. Predation occurred more during summer season and during night time. Due to the damages, locals held negative attitudes towards wildlife and believed that removal of problematic animals was the best solution to the predation problem. However, people were not extremely negative about snow leopard. Chi-square test was used to test whether snow leopard conservation was influenced by gender and education. Results showed that snow leopard conservation was influenced by education and not by gender. Compensation scheme had not been launched in that area, however people were hopeful for its implementation by Government of Nepal (GoN) or any legal institution.

UNDERSTANDING LEPIDOPTERAN BEHAVIOR AND IMPLEMENTATION OF BUTTERFLY GARDEN
A Project under FOWEX 2019-20

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To set up new butterfly garden what we need is a suitable piece of land at the right location, manpower, working knowledge of landscaping, good knowledge about butterflies and their requirement, knowledge about plants and finances to run the garden. Butterfly garden can be of two types: Closed and Open. Before start working on setting up butterfly garden one must know about life cycle of butterfly. Butterfly completes its life cycle in four stages, Viz., egg, caterpillar (larva), pupa (chrysalis) and adult butterfly. Butterfly is very particular to lay eggs on plants which are called larval host plants. The caterpillar emerge from these eggs feed voraciously on the leaves or larval host plants. The caterpillar moults two times and stops eating after certain growth and gets metamorphosed into pupa. After few days, an adult butterfly emerges from pupa. This means butterfly needs the larval host plant on which caterpillar will grow and food plants for the adult butterfly on which they will survive. We did a primary survey in the premises of our campus to identify the commonly found butterflies, their host plants and nectar plants. We reared more than 10 species of butterflies to observe and study their behavior. Later we collected seedlings and cuttings of different host plants and nectar plants of common butterflies and made a food plant nursery for plantation. We identified a suitable site for the garden, and prepared the site for plantation; weeding, leveling, thinning and pruning. We designed a layout for the garden with the help of a table top survey, installed a water reservoir inside the garden and facilitated drip irrigation pipes. Finally, planted the seedlings and made an artificial mud puddle and some additional nectar sources also. After few months of establishment of the plants we observed plenty of butterflies of 27 species and 4 families.