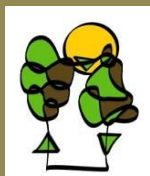


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*Sustainable Forest Management Research
Institute (University of Valladolid-INIA).*

**VII YOUNG RESEARCHERS
MEETING
ON CONSERVATION AND
SUSTAINABLE
USE OF FOREST SYSTEMS**



**CENEAM, Valsaín (Spain).
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PREFACE

As the Director of the Research Institute on Sustainable Forest Management Research (University of Valladolid-INIA) I am pleased to present the abstract book of the Conference of Young Researchers on Conservation and Sustainable Use of Forest Systems that in this opportunity reaches its seventh edition.

Like in other editions students from the University of Valladolid both **Master and PhD programs on Conservation and Sustainable Use of Forest Systems** participate in the Meeting, the main novelty being the incorporation of students from the **Erasmus Mundus Master in Mediterranean Forestry and Natural Resources-MEDFOR**. This program is organized jointly by the Technical University of Lisbon and Oporto Catholic University both from Portugal, Padova and della Tuscia Universities both from Italy, Karadeniz Technical University from Turkey and Universities of Lleida and Valladolid both from Spain. Besides this consortium the collaboration of an excellent set of stakeholders and associated partners favors the formation of these researchers with the highest standard. The Erasmus Mundus Programme aims to enhance the quality of higher education and promote dialogue and understanding between people and cultures through mobility and academic cooperation. These objectives, jointly with academic and scientific excellence, are at the core of our activities. MEDFOR students participate in this meeting as a part of the Winter School hosted and organized by the Agricultural, Food and Forestry School at Palencia (University of Valladolid).

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 73 students from 26 countries and four continents (from China to Argentina and from Pakistan to the United States including Syria, Benin, Cuba and Spain among others) will participate. The geographic distribution of the participants along with the diverse ecosystems studied, allow us to cover all the topics of sustainable forest management.

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

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. Felipe Bravo
Sustainable Forest Management Research Institute
Universidad de Valladolid-INIA

On behalf of the Coordinators of the Organizing Committee of the VIIth Young Researchers Meeting on Conservation and Sustainable Use of Forest Systems we welcome all the participants and authorities to this event.

One more time, we present herewith a large reflection of the research developed within the Sustainable Forest Management Research Institute through the presentation of the Research Projects of our Master and PhD. students, in a Scientific Meeting format. This academic activity, defined in the frame of the Master and PhD. degrees taught jointly by CIFOR-INIA and the School of Agricultural Engineering of the University of Valladolid, has been growing in size and in relevance, as well as in internationalization from the beginning. In this VIIth edition of the Meeting, more than 100 participants have come from very diverse backgrounds and nationalities.

This year, the main novelty is the presence of 27 students from the MEDfOR Erasmus Mundus Program and eight from the AGORA network, who have participated in the Winter School, carried out in Palencia, and some representatives of the corresponding Universities, Institutions and stakeholders. In this edition 40 posters and 29 short talks will be presented, clustered in five sections: Conservation, Management, Protection, Genetics, and Global Perspectives of Management, along with two invited conferences. In this book we have collected the abstracts of the scientific contributions. A digital edition of this Abstract Book will be available at the web page of the Institute (<http://sostenible.palencia.uva.es>).

Once again, we have been sponsored by INIA, University of Valladolid, and CENEAM, that will host us during this Meeting. In this occasion, we also have had the financial support of MEDfOR through the Winter School held in Palencia. Also, Spanish National Heritage (Delegación de Patrimonio Nacional en el Real Sitio de La Granja de San Ildefonso) has invited us to a guided visit to La Granja Palace and its Gardens. We want to emphasize our thanks to them all.

From the beginning, this Meeting has been an academic activity in which the students participate not only through the presentation and discussion of their research results, but also, getting involved in the different tasks of the organization. We would like to thank specially the active and enriching participation of those students accepting to be Chairpersons or Poster Session organizers.

We also want to thank the Professors of the Masters and the Advisors that have guided the students for this Meeting, with a particular mention to the coordinators of the Masters and PhD Programs: Dr. Felipe Bravo, and Dr. Jose Borges.

Finally, we are grateful for the effort and availability of the students belonging to the Organizing Committee, who have worked very hard for the success of this Meeting.

Belén Turrión and Elena Hidalgo
Coordinators of the Organizing Committee

WELCOME CONFERENCE

**ADDRESSING FOREST MANAGEMENT PLANNING PROCESSES WITH ADVANCED
DECISION SUPPORT TOOLS: THE PORTUGUESE EXPERIENCE**

**José G. Borges
(MEDfOR Coordinator)**

INVITED CONFERENCE

A TOUCH OF EVOLUTION: DISENTANGLING ADAPTIVE VARIATION OF FOREST TREES

**José Climent
SFMR Institute Researcher**

ADDRESSING FOREST MANAGEMENT PLANNING PROCESSES WITH ADVANCED DECISION SUPPORT TOOLS: THE PORTUGUESE EXPERIENCE

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Portugal's geographical position and natural resources endowment combined to make forestry and forest industry key elements in the Portuguese specialization pattern. Forest management planning in Portugal encompasses timber, market and non-market non-wood products and services' supply objectives within a single or a multiple-objective decision making framework. The country's land tenure pattern is associated to a wide range of management planning problems. They are characterized by spatial scales that range from stand to forest levels in the case of single NIPF and of industry, community or state ownership, respectively. Our talk will build from a recent survey to describe the experience of developing and applying advanced techniques and decision support systems to address the Portuguese forest management planning problems. Emphasis will be on the description of the tools as well as of the contexts in which they were applied. Recent research of approaches to address multiple objective management planning will be further addressed. Specifically, we describe an interactive approach that may take advantage of *a posteriori* preference modelling to facilitate the specification of the levels of achievement of various objectives in a typical forest management planning framework. The goal is to provide information about non-dominated points (Pareto frontier) so that decision-makers may take advantage of trade-off information to explicitly define their goals. We will further describe the development of a decision support system to encapsulate this technique.

Keywords: *Portugal, Forest Management Planning, Decision Support System, Pareto frontier.*

A TOUCH OF EVOLUTION: DISENTANGLING ADAPTIVE VARIATION OF FOREST TREES

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Adaptation is a term used with many different meanings, but in evolutionary ecology it distinctly refers to the genetic process that enhances fitness of an organism i.e. increasing the number of offspring in next generations. Similarly, adaptive traits are those that are genetically correlated with fitness. A very good knowledge of which traits affect fitness has been attained in model organisms including a quite limited number of plants. By contrast, forest trees are huge, long lived organisms in which fitness is extremely cumbersome to measure. We have been working with Mediterranean pines for two decades, as some of the most ecologically relevant species in Spain and southern Europe, searching for a better understanding of the genetic processes implied in past and future adaptation. A wide number of molecular and quantitative (phenotypic) traits and tools have been deployed in different species and environments, combining the estimation of extant neutral genetic variation, assessing gene flow in small populations and studying the performance of different genetic entries (families and populations) in common garden experiments planted under contrasted environments. While we are still far from the knowledge available for model plants, the recent inclusion of reproductive traits, closely linked to fitness, and more precise quantitative genetic tools have considerably enlarged our view of life-history evolution and local adaptation in these species.

Keywords: *Mediterranean pines, reproduction, fitness, phenotypic plasticity, genetic variation.*

I SESION: CONSERVATION

Oral communications

**UNDERSTANDING THE ENVIRONMENTAL EFFECTS ON POPULATION DYNAMICS OF AN
IBERIAN GYPSUM ENDEMIC SUB-SHRUB THROUGH INTEGRAL PROJECTION MODELS**
Ana Isabel García-Cervigón

**LAND USE CHANGE EFFECTS ON SOIL PHYSICAL AND CHEMICAL PROPERTIES IN THE
CENTRAL HIGHLANDS OF ETHIOPIA**
Temesgen Desaleng

**PRE-DISPERSAL FRUIT PREDATION IN TWO COEXISTING JUNIPERS *Juniperus
communis* AND *J. sabina*.**
Erik Rodriguez

**FUNGAL COMMUNITIES SUCCESSION FOLLOWING WILDFIRE AND CLASSIFICATORY
MODELS TO ESTIMATE MUSHROOM PRODUCTION IN A MEDITERRANEAN VEGETATION
TYPE DOMINATED BY *Pinus pinaster* IN NORTHWEST SPAIN.**
Pablo Vásquez

EFFECT OF SALINITY ON GERMINATION OF *Xylocarpus granatum* (KOEING) SEEDS
Serajis Salekin

Posters

**PROPOSALS FOR THE CHARACTERIZATION OF FOREST BIODIVERSITY BASED ON
FOREST INVENTORIES**
Adriana Olthoff

**APPLYING LANDSCAPE ECOLOGY METRICS FOR ANALYZING THE STRUCTURE
CHANGES IN A MEDITERRANEAN LANDSCAPE: A CASE STUDY IN THE NORTH-
WESTERN PART OF THE ALTO MIJARES AREA IN SPAIN**
Alex Pra

ENVIRONMENTAL REGENERATION IN THE MAGRO RIVER (VALENCIA)
Beatriz Olmo

**STUDY OF REGENERATION AND DEVELOPMENT OF *Taxus baccata* L. IN THE YEW
FOREST OF TOSANDE (PALENCIA, SPAIN)**
Berta Briñas Garcia

**MIGRATION PHENOLOGY AND STOPOVER DURATION OF THE AQUATIC WARBLER
(*Acrocephalus paludicola*) IN LA NAVA WETLAND (PALENCIA, SPAIN)
Emigdio Jordán Muñoz-Adalia**

**EFFECT OF GRAZING EXCLUSION ON THE FLORISTIC COMPOSITION, SOIL
PARAMETERS AND PASTURE PRODUCTION IN RESTORED COAL MINES IN NORTHERN
SPAIN
Franklin Sigcha**

**PRODUCTIVITY OF A SEASONAL MEDITERRANEAN WETLAND: LAGUNA DE LA NAVA
(PALENCIA, SPAIN)
Marta Manrique**

**MYCORRHIZAL SYNTHESIS BETWEEN *Cistus ladanifer* (L.) AND *Boletus edulis* (BULL.)
Olaya Mediavilla**

**STUDY OF THE BASIC PEATLAND OF CERRATO VALLEY (PALENCIA, SPAIN) AND ITS
POSSIBLE RECOVERY AND RESTORATION
Raquel Juan-Ovejero**

**VEGETATION DYNAMICS ON MOTORWAY SLOPES IN THE SALAMANCA PROVINCE
Ruth C. Martín Sanz**

**BIOPHYSICAL PARAMETERS OF TROPICAL SPECIES ANALYZED BY
SPECTRORADIOMETRY COMBINED WITH NDVI AND PRI
Lucielle Silva Laurentino**

**QUANTIFYING FOREST BIOMASS CALDEN (*Prosopis caldenia*) USING SATELLITE
IMAGERY
Rodrigo Cattaneo**

**MAPPING SOIL WATER EROSION OF AREAS MANAGED BY THE MCA PROJECT (SOUTH
MOROCCO)
El Mehdi Lemdarsaoui**

**MAPPING SOIL WATER EROSION OF AREAS MANAGED BY THE MCA PROJECT (RIF OF
MOROCCO)
Sakina Sellal**

UNDERSTANDING THE ENVIRONMENTAL EFFECTS ON POPULATION DYNAMICS OF AN IBERIAN GYPSUM ENDEMIC SUB-SHRUB THROUGH INTEGRAL PROJECTION MODELS

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Demographical models are usually constructed without considering variables other than those strictly related to vital rates. However, the inclusion of environmental factors that can be affecting different vital rates in a distinct way is a key point that would be extremely useful for example when incorporated in the management of endangered species. Our aim was to analyze the effect of environmental variables on population dynamics of *Helianthemum squamatum* (L.) Dum. Cours (Cistaceae), an endemic Iberian sub-shrub that inhabits gypsum areas. Our study system was located in Belinchón (Cuenca, central Spain), on one of the main gypsum outcrops of the Iberian Peninsula. Demographical data (survival, growth, probability of reproduction and number of seedlings) were collected between 2004 and 2012 on 100 plots of 0.5 x 0.5 m side distributed on two blocks of 20 x 20 m (see Quintana-Ascencio et al. 2009 Pop Ecol 51 for sampling design). Considered environmental variables were divided into three different groups: microenvironment (percentages of biological crust, soil and shrub cover per plot), seasonal climate and biological interactions (number of conspecifics per plot). We constructed generalized linear models to link vital rates (survival, probability of reproduction and fecundity) to environmental variables, and integrated the selected models into a battery of Integral Projection Models (IPMs) by using IPMPack in R environment. IPMs are a novel and powerful tool to conduct analysis of demographical data. Their main advantage is that, contrarily to matrix projection models, IPMs are ideal to analyze demographical rates (e.g. survival, growth or fecundity) related to a continuous variable such as plants' size without separating individuals into discrete classes (Coulson, 2012 Oikos 121). Survival was improved by higher winter and spring rainfall, as well as summer temperature. The nine years of available data were representative of a wide range of climatic conditions, thus allowing extrapolating these results and predicting the population vital rates. Shrub and conspecifics cover also had a positive effect on survival, probably due to a "false positive" related to habitat quality, since better habitats concentrate most of plants. Probability of reproduction was positively related to dry winter and springs, better microenvironments and higher summer temperatures, all of them decreasing the minimum reproductive size. Fecundity increased with higher summer temperature, higher winter and spring rainfall and higher percentage of bare soil.

Keywords: climate, continuous matrix models, demography, *Helianthemum squamatum*, microenvironment.

LAND USE CHANGE EFFECTS ON SOIL PHYSICAL AND CHEMICAL PROPERTIES IN THE CENTRAL HIGHLANDS OF ETHIOPIA

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In an attempt to investigate land use change effects on soil quality parameters, soil samples were collected from eight different sites from two depths (0-10 cm and 10- 20 cm) for four land uses (eucalyptus land, crop land, pasture land, limed lands) in the central highlands of Ethiopia. The collected soil samples were analyzed for selected soil physical and chemical properties. Results revealed that there were significant ($P \leq 0.05$) differences between different land use types on soil bulk density and moisture content as a measure of soil physical parameters. Looking into the particle size distribution, the highest values of per cent clay were observed in eucalyptus plantations followed by crop land and limed lands. On contrary, lowest values of per cent sand and highest values of percent silt were recorded in pasture land. The study on soil chemical parameters pointed out that soil pH, Organic carbon (OC), Potassium (K), Calcium (Ca), Magnesium (Mg) and Cation exchange capacity (CEC) were significantly ($P \leq 0.05$) affected by both soil depths and different land uses. Soil pH, Organic carbon, Nitrogen (N), Potassium and sodium (Na) contents of the soils were significantly affected due to soil depths. Higher values of OC, N, P and K were observed in the first 0-10 cm of the soil depth. Soil data on land use types showed that Soil pH, OC, N, Ca, Mg and CEC tended to be significantly higher in pasture land as compared to the other land uses. However, there was no significant difference in soil P, K and Na in different land use types. Soil pH and Ca recorded in five years old eucalyptus plantations were found to be the lowest. This preliminary finding is an indication of an adverse effect of land-use change leading to soil quality deterioration in the long term.

Keywords: *Eucalyptus, crop land, liming, soil degradation*

PRE-DISPERSAL FRUIT PREDATION IN TWO COEXISTING JUNIPERS *Juniperus communis* AND *J. sabina*

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According to the predator satiation hypothesis, sharp changes in seed production is a strategy to reduce pre- and post-dispersal seed predation. Most studies have addressed this hypothesis at individual species, although different plant species may share pre-dispersal predators, leading to complex interspecific interactions. In the case of junipers three main pre-dispersal predators co-occur (chalcid wasps, moths and mites). A recent study has shown that in *Juniperus thurifera* predator satiation occurs at different spatial scales depending on the mobility of each predator. Our aim was to examine fruit damage in two coexisting shrubby juniper species, *Juniperus communis* (erect) and *J. sabina* (prostrate) that share at least one pre-dispersal predator. We also evaluated the effect of crop size on predation rates at different spatial scales for each juniper species as well as for both species jointly. In a preliminary approximation, we estimated fruit abundance and predation levels in a 7.7 ha plot sited in the Alto Tajo Natural Park (Guadalajara, Spain), during November 2012. Predation was dominated by chalcid wasps in both species, being higher in *J. sabina* (Mean \pm S.E. = 18.8 \pm 2.5 %) than in *J. communis* (6.4 \pm 2.9 %) with much lower values for moths and mites. Infestation rate found for *J. communis* was lower than rates observed in previous studies, whereas no information was found for *J. sabina*. Exploratory analyses showed a marginally significant negative relationship between chalcid wasps and moths at the tree level in *J. sabina*, but positive in *J. communis*. Because fruit characteristics differ between both junipers, these results suggest that preferences by each predator diverge in *J. sabina* and converge in *J. communis*. Fruit predation was not spatially structured considering each juniper separately nor both juniper species together.

Keywords: *coexistence, juniper, predator satiation, spatial pattern.*

FUNGAL COMMUNITIES SUCCESSION FOLLOWING WILDFIRE AND CLASSIFICATORY MODELS TO ESTIMATE MUSHROOM PRODUCTION IN A MEDITERRANEAN VEGETATION TYPE DOMINATED BY *Pinus pinaster* IN NORTHWEST SPAIN

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This study examined the succession of fungal communities following fire in a Mediterranean ecosystem in Northwest Spain, dominated by *Pinus pinaster* Ait. A large wildfire occurred on August 2002. During the autumns 2003 until 2006, fruiting bodies were collected and identified, production in both burned (early stage) and unburned (late stage) areas were measured. Data were grouped into categories (saprotrophic/mycorrhizal; edible/inedible) for statistical analysis. 115 fungal taxa were collected during the four year sampling (85 in the late stage and 60 in the early one). Mycorrhizal population not only increased the number of species from early to late stage but also shifted in composition across the chronosequence. After fire, pyrophytic species appeared such as post fire fungi *Pholiota carbonaria*, *Peziza violacea* *Rhizopogon luteolus* and *Rhizopogon* sp. Fire strongly affected the production of fungal species in the studied area. Thus, yields in the early stage treatment were significantly lower than those observed in the late one. Total fungal fresh weight decreased from 209.95 kg fw ha⁻¹ in late stage to 162.45 kgfw ha⁻¹ in the early where richness and production of mycorrhizal species and production of edible fungi were significantly lower. Fresh weight for saprotrophic and inedible species was higher than for mycorrhizal fungi in the early stage treatment. Our results provide the first classificatory simple model for fungal production in *P. pinaster* forests. Climate variables related with the sporocarp production were included in the modelling procedure (discriminant functions) to classify the productions into four yield categories. Nine discriminant classificatory models were studied to determine these four yield categories within each dependent variable according to edibility and functional group. Models for edible and edible-mycorrhizal were fitted to allow an estimate of the production class ($R^2 = 0.92$ and 0.85 respectively) that could be useful to forest managers in order to optimize the management and harvesting of these more and more appreciated non wood resource.

Keywords: fire, fungal succession, modelling, fungal production and richness.

EFFECT OF SALINITY ON GERMINATION OF *Xylocarpus granatum* (KOEING) SEEDS

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Bangladesh has vast area of natural and planted mangrove forests. They are both economically and ecologically very important for the country. Salinity is an important regulatory factor in the coastal ecosystems which influences survival, distribution, growth, reproduction and zonation of mangroves. *Xylocarpus granatum* is an important species in the Sunderbans mangrove forest. Also, it could be important for mangrove rehabilitation or afforestation programme. Thus for effective conservation management and use, it is important to know the salt tolerance, of *Xylocarpus granatum*. In this study salt tolerance of *Xylocarpus granatum* was investigate in hydroponic culture. Salinity has a significant effect on the germination of *Xylocarpus granatum* seeds. 0 ppt shows highest germination percentage whether it is decrease by increase of salinity and 40 ppt shows the lowest germination percentage. Salinity had significant negative impact on germination of *Xylocarpus granatum* and they were strongly negatively correlated ($r=-0.866$).

Keywords: Coastal ecosystem, Mangrove forest, Regulatory factor, Hydroponic culture, germination percentage.

PROPOSALS FOR THE CHARACTERIZATION OF FOREST BIODIVERSITY BASED ON FOREST INVENTORIES

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The concept of biodiversity is complex because it is much more than a measurable ecosystem property, due to its self definition, the difficulties of measuring and interpretation its ecological significance and implications for conservation policies, including the concept of species. At a European level is possible to account with the ENFIN (European National Forest Inventory Network), which have defined four main criteria to estimate biodiversity in forest ecosystems: forest structure, deadwood, understory, and lichens and epiphytic plants. In this sense, forest inventories have been modified to contemplate the monitoring of these important data. Geographical scale is a key factor determining forest biodiversity, because there are interactions and processes underlying biodiversity that vary accordingly to it. This work presents some guidelines for a possible local characterization of the forest biodiversity of Palencia province, considering the main existing proposals.

Keywords: *forest biodiversity characterization, forest inventory, Palencia province.*

APPLYING LANDSCAPE ECOLOGY METRICS FOR ANALYZING THE STRUCTURE CHANGES IN A MEDITERRANEAN LANDSCAPE: A CASE STUDY IN THE NORTH-WESTERN PART OF THE ALTO MIJARES AREA IN SPAIN

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Mediterranean landscapes are strongly human-modified, resulting from millennia of severe pressures such as burning, cutting and grazing, clearing, terracing and cultivation of arable lands. In recent decades, especially in the northern countries of the Mediterranean basin, industrialization on the one hand, and the so-called rural crisis on the other, have led to the abandonment of many fields, forests and traditional activities, increasing the vegetation cover, the continuity of early succession species, and the landscape pattern and fire regime. Fires are a natural element considered to be part of the Mediterranean ecosystem, demonstrated for example by the capacity of the plants to cope with them, however in recent years a increase in number of wildfires reaching large dimensions, frequency and severity has been observed. It has been suggested that the current fire regimes in the Mediterranean may cause disasters in terms of introduction of abrupt vegetation community changes and also in terms of high risk of direct damage to humans and infrastructures, especially in the populated coastal region of the Mediterranean countries. Several studies hypothesized this higher wildfire occurrence observed is directly connected to the landscape homogenization, caused by land-use changes in the rural areas. Thus, it is assumed that the current vegetation composition and structure caused by land-use change is the main driver of the increases in the number of wildfires and area burning. Assuming that the landscape structure may affect wildfire propagation and size, the study of the landscape, its structure and its dynamics is a strategic approach in terms of fire behavior study and risk prevention. This study aimed at analyzing the changes that occurred in a Mediterranean landscape during a certain period of time, focusing on the vegetation dynamics and the occurrence of fire. The objectives of the study are: *i)* to study the structure and analyze the changes that took place in the considered landscape; *ii)* to investigate the implications of these changes on fire occurrence and risk. The study area is the North-Western part of the *Alto Mijares*, a rural mountainous interior area in the province of Castellón, Valencian Community, Spain. Our approach consisted in quantifying the landscape structure to analyze the associate characteristics and dynamics, in particular regarding vegetation communities, from class and landscape metrics derived from classified remote sensing data, over a 15-year period (1994, 1991, 1995 and 1998).

Keywords: *Landscape Ecology, Mediterranean landscape, vegetation, Remote Sensing, Fragstats.*

ENVIRONMENTAL REGENERATION IN THE MAGRO RIVER (VALENCIA)

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Rivers are one of the most valuable ecosystems for its great diversity of natural values and functionality. However the quality of the water and the riparian vegetation of these rivers are suffering degradation processes that significantly reduce the overall quality. The Magro river runs from the town Caudete de las Fuentes until Yátova where flows into the Forata reservoir and flows through the towns of Utiel and Requena (province of Valencia). Currently, the majority of urban and industrial areas submit their wastewater to important purification treatments, allowing an improvement in water quality. However, until recently most of the discharges were made directly or indirectly to the river, which has led to an accumulation of highly contaminated sediments in bed that create major barriers to natural regeneration of the river ecosystem.

The area of the project covers a length of 72.38 km of channels in the municipalities of Yátova, Requena, Utiel and Caudete de las Fuentes. The main purpose of this project is to reduce the contaminants burdens in order to allow the natural capacity of the regeneration to be able to recover the natural characteristics of the river. For this reason reforestation activities have been designed in those areas where its beneficial effect as pollution filter may be more important, as well as collaborating in the recovery and improvement of the ecological quality of the ecosystem and enhance the availability of habitat for wildlife. The project also aims to contribute to the elimination of accumulated pollution in the riverbed. After carrying out several studies of the channel and the composition and characteristics of his material, different actions have been decided for their decontamination; applying biological treatment injected into the sludge for decontamination and mechanical selective removal of insufficiently biodegradable organic sludge and contaminated with toxic. All of these activities directly influence the improvement of water quality.

Keywords: *riparian, degradation, reforestation, decontamination, biological, biodegradable.*

STUDY OF REGENERATION AND DEVELOPMENT OF *Taxus baccata* L. IN THE YEW FOREST OF TOSANDE (PALENCIA, SPAIN)

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The main goal of this document is to evaluate the herbivory and some physiographic (canopy cover, stand basal area) and structural (slope, stoniness) variables effect in the natural regeneration of *Taxus baccata* L., and also to compare the differences in the development of yew seedlings originally coming from the same study stand or grown in a nursery with stand collected seeds. The field work has been done in the Yew Forest of Tosande (Fuentes Carrionas y Fuente Cobre Natural Park in the North of Palencia, Castilla y León region, Spain), in the summer of 2011. This study is based on the development of microclausures and other test plots established in different microambiental conditions in 2008 by Fundación Patrimonio Natural de Castilla y León. In those plots we measured and compared the herbivory and other feature effects in the natural regeneration of the yew and the development of the two kinds of yew seedlings classified by their different origin (same stand or nursery) and transplanted method (bare root or root ball transplant). The features (area, physiographic and structural variables, GPS coordinates, species composition...) of each plot were described before taking the different field measurements.

From the obtained results, we highlight the high regenerative potential founded in the Yew Forest of Tosande, the effectiveness of the enclosure against the herbivory for the natural regeneration of the yew, its capacity to establish in stands with a high slope thanks to its morphology coexisting with other species in a canopy cover similar to the 80%, or its tendency to germinate in lands with a low level of stoniness, although later on it will produce a slower growth rate and a worse settlement. It has also been deduced that a root ball transplant with a seedling germinated in a nursery guarantees better results than a bare root transplant with seedlings germinated in the same stand. Finally, we suggest some silvicultural advises to benefit the recovery and conservation of the yew forests. Some of them are the maintenance of a canopy cover of around 80% in not very stoniness areas, the promotion of the shrub layer to protect the yew seedlings, conserving the adult yews and other palatable species in the surrounding areas as well as the fauna related with its propagation and, in case of a harvesting, choose a method in which only small gaps are opened, like the wood selection system.

Keywords: *Herbivory, microclausure, seedling, transplant, growth.*

MIGRATION PHENOLOGY AND STOPOVER DURATION OF THE AQUATIC WARBLER (*Acrocephalus paludicola*) IN LA NAVA WETLAND (PALENCIA, SPAIN)

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Aquatic warbler (*Acrocephalus paludicola* Vieillot, Sylviidae) is a globally threaten migratory bird. It breeds in the West Palearctic, selecting wetland and *Phragmites* spp. marsh to set its territory. In spring, aquatic warblers migrate from S-W Sahara countries. During migration, especially in autumn, breakpoints located in Centre Europe, Iberia and North Africa, are believed to be important as areas for rest and fuel replacement. However, biology, phenology and migration strategies for this species are still poorly known. La Nava wetland (Palencia, North Spain) is a very important for autumn of aquatic warblers. Every year, hundreds of birds use this protected area. We are analyzing a long term banding dataset through capture-recapture statistical analysis, to investigate in detail migration phenology, stopover duration and fuel replacement importance of this wetland. We intend to correlate these variables with sex, age and physical state. Results will help to understand the ecology of aquatic warbler migration and to design management guidelines for the species.

Keywords: *Migratory strategy, breakpoints, protected area, banding, marsh habitat.*

EFFECT OF GRAZING EXCLUSION ON THE FLORISTIC COMPOSITION, SOIL PARAMETERS AND PASTURE PRODUCTION IN RESTORED COAL MINES IN NORTHERN SPAIN

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Although grazing effect on ecosystems has been widely studied, many of results have often been contradictory. This ambiguity is partially due to the herbivores ability to shape natural systems, favouring particular plant species and having indifferent or negative effect on others. The understanding of this behaviour is essential not only for analysing plant-herbivore relationships but also for its implications on rehabilitation or management conservation of areas where grazing can be a key factor limiting revegetation. In this context, the aim of this study is to asses the effect of herbivory exclusion on the above-ground biomass (g/m^2) and composition of plant communities, and their relation with soil parameters in a restored coal mine in Muñeca ($42^\circ 47' 9,24'' \text{ N}$, $004^\circ 48' 7,71'' \text{ W}$), (near Guardo, Palencia; northern Spain). To test these objectives a north-facing slope at an incline of ca. $22\text{-}25^\circ$ was selected. Grazing was excluded in February 2008 into a $50 \times 50 \text{ m}$ area, considering a similar surface without grazing exclusion as control. In both areas, five plots parallel to the slope gradient were establish, and into ten 1m^2 sampling points per plot, the cover (%) of all species present was estimated visually in June of 2010. The herbaceous above-ground biomass was also collected, within a $20 \times 20 \text{ cm}$ quadrat located in the center of each 1m^2 sampling point. Results showed clear differences in floristic composition between plots with and without grazing, with 30% of exclusive species in each case. Total organic matter, and available K, Mg and Na are the main soil parameters responsible of these differences, reaching higher values where grazing was excluded (OM: 4.58 ± 0.79 vs 1.86 ± 0.07 mean (%) \pm SE; P: 208.40 ± 8.96 vs 139.80 ± 10.41 mean (ppm) \pm SE; Mg: 1.84 ± 0.17 vs 1.40 ± 0.09 mean (meq/100g) \pm SE; Na: 0.17 ± 0.02 vs 0.15 ± 0.01 mean (meq/100g) \pm SE). The total aerial biomass was also higher without grazing (357.52 ± 33.06 vs 147.10 ± 25.75 ; mean (g/m^2) \pm SE), being Poaceae and Fabaceae the main taxonomical groups; Poaceae biomass higher without grazing (64.28% vs 57.17%) and Fabaceae biomass higher with grazing (40.67% vs 29.72%). Therefore, since, by selective browsing, herbivores may promote changes in the structure of plant communities the knowledge of different functional groups response to grazing and grazing influence on soil parameters is crucial to ensure the restoration success, in general and in particular in coal mines of northern Spain.

Keywords: large herbivores, sheep, roe deer, red deer, above-ground biomass, plant species

PRODUCTIVITY OF A SEASONAL MEDITERRANEAN WETLAND: LAGUNA DE LA NAVA (PALENCIA, SPAIN)

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Trowel areas are one of the most threatened ecosystems of the Biosphere and therefore they have a high environmental importance. Over half of our wetlands and natural lakes have been degraded mainly over the last decades. Nowadays, 70% of our wetlands have been modified in an irreversible way. Wetlands systems are easily changeable, highly heterogeneous, and over all very dynamic and fluctuating, which grant them with very peculiar characteristics, structurally and functionally talking. These ecosystems show a wide natural, geological, hydrological and biological richness, as well as they has a highly valuable function as a main component of the diversity of the Biosphere. On the one hand, it is recommended to take the following actions: (i) inventorying all species in the area, (ii) investigating their ecological values, (iii) preserving and restoring, as much as possible, degraded wetlands through an adequate maintenance of the ecosystem. In these sense, the province of Palencia is being very successful in the organization and preservation of the temporal wetlands such as "Laguna de la Nava" and "Boada de campos". It is important to mention that both are considered typical steppen pools which have been degraded over the last fifty years. All in all, this study is focused on Laguna de la Nava (a wetland area recovered since 1990) in order to understand both original and existing ecological particularities, and yearly vegetal productivity of the system. Apart from this, the aims of this study are to evaluate control methods for vegetation, its evolution over the time and to provide a floristic catalog of the area in order to elaborate an adequate planning to attemp the preservation of this particular system.

Keywords: *Threatened, Diversity, Vegetal productivity, Vegetation, Preservation.*

MYCORRHIZAL SYNTHESIS BETWEEN *Cistus ladanifer* (L.) AND *Boletus edulis* (BULL.)

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Edible ectomycorrhizal fungi have acquired an increasing importance both in the economic and the social fields, the *Boletus edulis* Bull. being a major commercial mushroom consumed worldwide and harvested in a natural way only in the countryside. All this, together with a decrease in the mushroom productions over the last years, has led to a search of alternatives based on the controlled cultivation of plants mycorrhized with this fungus. After observing several associations between *B. edulis* and some species belonging to *Cistus* sp. genus, overall in the Northwest of the Iberian Peninsula, I studied the possibility of optimizing *Cistus ladanifer* plants mycorrhized with *Boletus edulis* through myceliar inoculation methods. Thus, this study seeks to obtain a plant which produces edible mycorrhizal fungi, and furthermore, to improve the quality and vigour of the plant. The aim of this work was to produce *Cistus ladanifer* plant mycorrhized with *Boletus edulis* Bull. To obtain this, a mycorrhizal protocol was developed. A monitoring was carried out, starting from the sporocarps harvest and the plant inoculation with the mycelium, and leading to the evaluation of the roots of the plant, in search of the mycorrhizas and/or possible polluters. Besides, an essay was carried out to test the growth of the different fungal available, with their growth at different pH levels being analysed to be able to optimize its production. Finally, the growth of inoculated and non-inoculated plants was tested to clarify significant differences between both treatments. It was possible to obtain the *Cistus ladanifer* plant mycorrhized with *B. edulis* in *in vivo* conditions. This is a success, due to the fact that until now mycorrhizas had been exclusively synthesized in laboratory conditions. This allows us to be closer to commercially producing plants in nursery conditions. Regarding the pH of the type of crop growing, it was found that it is of the utmost importance in the behaviour of ectomycorrhizal fungi species *in vitro*. This will have great significance in the selection of the different fungi available to produce mycelia inoculo in great quantities to be applied in mycorrhizal programs. Moreover, the trial testing the growth of inoculated plants versus non-inoculated plants yielded positive outcomes, with significantly bigger growth being shown in inoculated plants.

Keywords: *ectomycorrhizal, edible fungi production, myceliar inoculation*

STUDY OF THE BASIC PEATLAND OF CERRATO VALLEY (PALENCIA, SPAIN) AND ITS POSSIBLE RECOVERY AND RESTORATION

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Basic peatlands are unique ecosystems which play an important role in flora conservation in our Mediterranean area. Special climatological, geological and hidrological factors allow particular endemic and threatened species to live in these habitats. Low precipitations, severe droughts and calcareous rocks in Eastern Spain and peatland water retention capacity must be taken into account in order to focus on vegetation study of these ecosystems. On the other hand, basic peatlands have important scientific and archaeological values, since many biological and paleobotanical registers are found on these areas, so they work as authentic archives of the past. Number of basic peatlands in Spain is quite low. Actually, the presence of peatland communities in Cerrato Valley is an exception: most of the basic peatlands are located in more southern areas of Iberian Peninsula than this one. Nowadays, this peatland is almost disappeared due to several drainages that were made in the watershed of Franco river and a non-care of the habitat. Also, twenty years ago an extraction of peat was almost done here, which could have altered the vegetation cover even more. Different species of *Cyperaceae* family such as *Carex cuprina*, *Carex divisa*, *Carex divulsa*, *Carex hordeistichos*, *Carex riparia* and *Eleocharis palustris* are found at some parts of the habitat, which means that despite of the destruction of the peatland, there is still remaining typical vegetation. *Juncus* sp. and *Phragmites australis* were also inventoried in huge quantities in peatland's shores, and riparian vegetation like *Ulmus minor*, *Sambucus nigra*, *Salix fragilis*, *Populus alba*, *Prunus spinosa* or *Crataegus monogyna* is found in good conditions. This fact might mean that river proximity is totally related to the existance of the peatland.

The inclusion of some endemic species which were supposed to be in the area some years ago would be one interesting reason to maximize restoration of the basic peatland of Cerrato Valley; *Butomus umbellatus*, *Cladium mariscus* and *Epipactis palustris*, which are included in "Catalog of Protected Flora of Castilla y León", would fit perfectly in the studied ecosystem. All of the families these species belong to were found in some previous palynological studies of the area, so it would not be such a problem to try to introduce them again because their presence is scientifically supported and biotope conditions are suitable.

Keywords: *mediterranean, Carex, Cladium mariscus, endemic, palynological*

VEGETATION DYNAMICS ON MOTORWAY SLOPES IN THE SALAMANCA PROVINCE

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Road infrastructure construction, spreading due to the increase in world population density and in transportation needs, causes a serious environmental degradation and loss of biodiversity. Its impact is not limited only to the area occupied by the infrastructure but also to adjacent areas, altering both the soil structure and the plant and animal communities living there. Therefore, road slope restoration presents a great interest, encouraging the development of a stable vegetation cover to halt erosion processes and contributing to the conservation of biodiversity. Although the road slopes can be stabilized in part by physical means, these techniques are expensive and often short-lived. Thus, the alternative is to cover roadside slopes with vegetation (a long-term target) by hydroseeding, planting, positioning of geotextile meshes or spreading topsoil. However, the effectiveness of these proceedings in obtaining a stable vegetation cover remains much debated by the scientific community, especially in Mediterranean environments with frequent droughts and high water stress. Methods such as hydroseeding work well in environments of northern and eastern Europe, whereas frequently have poor or even inadequate results in our climate, mainly due to use of non-native species. Therefore, a good alternative would be to promote the restoration of degraded areas from the resources of the surrounding matrix, favouring spontaneous processes of colonization, regeneration and succession, which will lead to more sustainable long-term ecosystems. The study of these processes can be an excellent tool for identifying the most suitable species for restoration of these degraded areas. Natural revegetation studies over time allow us to classify species according to the successional stage in that become important, letting us ultimately to select the most suitable species for revegetation of those road slopes, a key aspect to ensure success of the restoration. However, no a big progress has been made in this regard and there is little information on spontaneous colonization of road slopes and even less on subsequent plant dynamics which become established. An advance in the ecological knowledge of these emerging ecosystems, and a better understanding of "native" species selection from the local flora (able to overcome the specific limitations of the disturbed area to be restored) is needed to improve restoration activities. In this study, we intend to increase the existing knowledge and to understand the dynamic of natural vegetation of road embankments in the province of Salamanca.

Keywords: *natural revegetation, Mediterranean climate, plant colonization, species selection.*

BIOPHYSICAL PARAMETERS OF TROPICAL SPECIES ANALYZED BY SPECTRORADIOMETRY COMBINED WITH NDVI AND PRI

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The Plants adapt its internal and external structure to enable to photosynthesis. This structure and its interactions with electromagnetic energy has a direct relation on how leaf respond spectrally. The knowledge of the spectral signature of the species of specific biome helps the understanding the interaction these with the site conditions. This study aims to analyze Biophysical parameters of tropical species from an Atlantic Forest reserve of Brazil parsed with spectroradiometry. Leaf samples were collected of species. So, with the spectroradiometer, ASD, were recorded spectral responses of each leaf sample, covering the wavelength range 325 to 1075nm, who correspond to the visible and near infrared. Subsequently defined the spectral curves, relating to conditions in which the plants were found. The Properties were correlated with individual levels of chlorophyll. Then, was calculated two reflectance index: Photochemical Reflectance Index - PRI [531 nm; 570 nm], and Normalized Difference Vegetation Index - NDVI [750 nm; 620 nm], obtained through spectral signature. Rates were applied to obtain the levels and activities of photosynthetic pigments, allowing comparative analysis among species. Both spectral curves, the values of the indices showed that the genotypic difference among the species studied showed a strong influence on the response of spectral signatures. One should be careful when taking universal conclusions in research forestry and with climate changes all about vegetation types based merely measurements of PRI and NDVI, knowing that reflectance varies between species. So, we propose measures on site, applications of other indices and models and the comparison of the spectral responses between individuals of the same species. All this can be useful for the development of methodologies capable of identifying stress levels from the plants until severities of diseases, thus helping in the management and protection of forest species.

Keywords: *Spectroradiometry, Environmental Monitoring, Remote Sensing, Vegetation.*

QUANTIFYING FOREST BIOMASS CALDEN (*Prosopis caldenia*) USING SATELLITE IMAGERY

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Prosopis caldenia woodlands are located at the southern region of the Espinal. These forests have suffered a significant qualitative and quantitative degradation either by fire, logging, poor management of livestock and agriculture. At the present, only 18% of the original forests remain. Ecosystem services provide the ability to allocate resources to the forests for the services they provide within which include carbon sequestration. To quantify the carbon biomass, it is a must to know the forming species in the ecosystem. Recent studies have quantified aboveground and belowground biomass of *P. caldenia*, in which the basal area (BA) is the best independent variable that adjusts for this evaluation. Moreover, the BA is directly related to the crown area for this specie. Moreover, the use of satellite imagery (SI) is becoming a widespread application to determine remotely parameters with remarkable precision. From the stated above the aim of my work is to quantify caldén biomass using SI. If possible this work proposal would become a valuable tool for the rapid quantification of forest biomass in these ecosystems.

MAPPING SOIL WATER EROSION OF AREAS MANAGED BY THE MCA PROJECT (SOUTH MOROCCO)

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Worldwide, water erosion is a major environmental threat to the sustainability and productive capacity of agricultural land. It is the process of land degradation most active and also degrades the most important resource for the survival of humanity: water. The runoff causes erosion, in particular, an irreversible loss of arable land, a loss of storage capacity of natural and artificial lakes and water pollution by materials transported during floods. In fact, the past 40 years, almost a third of the world's arable land has been lost by erosion and continues to be at about 10 million ha / year. Soil erosion in Morocco is the main threat to the soil capital. According to FAO estimates, 12.6 million ha of cropland and grazing are threatened by this phenomenon and two-thirds of the cultivated land require strict conservation measures. Front of the irregularity and complexity of erosion-transport-sedimentation and for the rational management of water resources and soil, modeling as a tool for study and decision support has become necessary. The present work, which is part of the axis of soil conservation research program Project Millennium Challenge Account (MCA-Morocco) aims to develop a cartographic database in order to study the Moroccan soil's erodability and to investigate the extent and causes of soil erosion at the regional scale, extrapolating the future and, therefore, identify priority areas of intervention measures for soil conservation. The methodology adopted for the evaluation of the water erosion is based on the application of the model " Universal Soil Loss Equation" (USLE) to estimate the production of sediments yield by sheet and channel erosion and mapping areas susceptible to erosion for the south of Morocco with the software ArcGIS 9.3 which allows you to overlay layers of information (card rainfall erosivity, card soil erodibility, topographic map factor, card cover management and card support practice) and restore representative synthetic mapping areas susceptible to erosion. Using auxiliary data, including remotely sensed data and digital elevation models, can improve the efficiency and precision when predicting soil loss. The improvement depends on density of ground data, correlation between the ground data and auxiliary data, interactions between the variables, mixture pixels, and limitations of existing methods.

Keywords: *Water erosion, modeling, mapping, USLE, database.*

MAPPING SOIL WATER EROSION OF AREAS MANAGED BY THE MCA PROJECT (RIF OF MOROCCO)

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Water erosion is a real danger for natural resources sustainability; surface waters mobilization and the socio-economic development of rural area. However studies of this phenomenon have received much more attention at local than regional scale. The present work, which is part of the axis of soil conservation research program Project Millennium Challenge Account (MCA-Morocco) aims to develop a geographic database in order to study the Moroccan Rif's soil vulnerability to water erosion, by an estimation of the main factors involved in water erosion, using the model: Universal Soil Loss Equation (USLE). The methodology adopted consists in mapping areas susceptible to erosion for the Rif of Morocco with the software ArcGIS 9.3 which allows you to overlay layers of information (card rainfall erosivity, card soil erodibility, topographic map factor) and restore representative synthetic mapping areas susceptible to erosion. All these data and maps will constitute a database for water erosion in Rif of Morocco that can be updated by the current and future research on this phenomenon.

Keywords: *Water erosion, modeling, mapping, USLE, database.*

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ARE THINNINGS INFLUENCING CARBON STOCKS IN MEDITERRANEAN MARITIME PINEWOODS?

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We have studied a long-term trial thinning experiment in a 60-years-old *Pinus pinaster* Ait. (Mediterranean maritime pine) stand, in order to know what are the forest management effects in carbon stocks, considering the above and belowground biomass, soil carbon (forest floor and mineral soil) and fine and coarse woody debris. Three different intensity thinnings were applied in the stands, including unthinned treatment, moderate thinning and heavy thinning. An 8-year rotation period was established between the first and the second thinning and a 13-year period between the second and the third thinning. The method used in the tree thinnings was the whole tree harvesting. Forest management has not affected the soil carbon stocks, although decreasing values were found from unthinned to heavy thinned. Total carbon stock present in unthinned plots (317 Mg C ha⁻¹) was significantly different than of thinned plots (256 Mg C ha⁻¹ in moderate thinning plots and 234 Mg C ha⁻¹ in heavy thinning plots). But, if we considered the carbon stock removed in thinning (considering as forest products), significant differences appear between unthinned and thinned stands, with 373 and 379 Mg C ha⁻¹ as total carbon stock for moderate and heavy thinning respectively.

Keywords: biomass; carbon sequestration; forest management; *Pinus pinaster*; soil carbon.

COST BENEFIT AND COST EFFECTIVENESS ANALYSIS OF A CORK OAK PLANNING MANAGEMENT PROJECT (MAAMORA FOREST)

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The forest planning-management is a tool characterized by a long term planning and short middle term programming. Given that the programming period is about 20 to 30 years, the management plan has to be evaluated and reviewed. It is in this context that the action plan of the Maamora oak forest has to be evaluated in order to identify and avoid any deviations from the initial strategic management objectives. This study is a participation in the mid-term management evaluation of the present management plan (1993-2012) conducted by the Direction of Forest Development. The objectives of the study are evaluation of artificial regeneration, cork production in quality and quantity, and biodiversity and environmental goods and services (externality). This analysis will be by the quantification of the costs and benefits / effectiveness of the present management plan (1993-2012), and by the comparison of different options about land exploitation for a rational use of financial resources. The first step of this work consists of an evaluation of the forecasts and the realizations in artificial regeneration and ecosystem restoration and evaluation of quantitative and qualitative production of cork. The second phase will be focused on the establishment of a value for biodiversity and environmental services, and evaluating its contribution in financial resources. The final phase will be about the planning-management future prospect of cork oak. This study will allow responsible persons to make the better decisions about land use based on the quantification of their impacts and permit the evaluation of compromises between different options.

Key words: *planning-management, evaluation, reviewed, externality, biodiversity.*

EARLY EFFECTS OF DIFFERENT SILVICULTURAL TREATMENTS ON FUNGAL PRODUCTION AND DIVERSITY IN *Cistus ladanifer* L. SCRUBLANDS

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Mediterranean *Cistus ladanifer* scrublands can provide an important fungal production, often in high demand. However, due to the pyrophytic characteristics of this species, forest fires are the main threat to these ecosystems. This work has been requested by forest managers of the area. The aim of this study is to analyze the early effects of different fuel reduction silvicultural treatments on *Cistus ladanifer* scrublands on production and diversity of fungal communities in order to enhance mushroom production and prevent forest fires. Sporocarp sampling was performed on a weekly basis during autumnal production periods in the years 2010 and 2011. Twenty seven plots (100m²) were established in different stands on which different silvicultural treatments were performed. All the individuals were identified and fresh and dry weighted. A total of 31126 sporocarps belonging to 123 taxa within 50 genera were collected. Generally, higher total fungal production was found in middle-aged compared with senescent scrublands. Manual 50% clearing seemed to be the most appropriate treatment for the production of edible species, especially *Boletus edulis*. Furthermore, production and diversity of saprotrophic species was increased by the total clearing treatments. Therefore, the rejuvenation of senescent scrublands and a mosaic management in middle-aged stands alternating different fuel reduction treatments seemed to be the best management guidelines for the sustainable management of this resource.

Keywords: Sustainable management, fire prevention, mushroom production, diversity, rockroses.

A RESEARCH ON FROST STRESS RESISTANCE OF THE SCOTS PINE (*Pinus sylvestris* L.), ANATOLIAN BLACK PINE (*Pinus nigra* ARN. SUBSP. *pallasiana* (LAMB) HOLMBOE) AND LEBANON CEDAR (*Cedrus libani* A. RICH)

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Scots Pine (*Pinus sylvestris* L.), Anatolian Black Pine (*Pinus nigra* Arn. subsp. *pallasiana* (Lamb.) Holmboe) and Lebanon Cedar (*Cedrus libani* A. Rich.) were subjected to the artificial freezing tests. The plants were exposed to 3 different freezing temperatures (-15°C, -25°C and -45°C) for 16 hours. The damages occurred at -25°C in Lebanon Cedar and -45°C in Anatolian Black Pine when we were subjected artificial frost. But in these two temperatures there had been no important damage determined in Scots Pine. Electrolyte leakage analyses were used for assessment of damages on the needles of seedlings. The results exhibited that, cold damage affected electrolyte leakage and chlorophyll fluorescence (F_v/F_M) of needles and they showed good correlation.

Keywords: *Artificial freezing tests, Frost resistance, Electrolyte leakage, Chlorophyll fluorescence*

RADIAL GROWTH PATTERNS OF *Pinus pinaster* Ait. IN RESPONSE TO CLIMATE VARIABILITY OF STANDS IN THE PROVINCE OF CIUDAD REAL

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The Mediterranean region is defined as a climatic transition zone with high sensitivity to the effects of climate change. The different responses induced in the growth forest stands can be evidenced by analyzing the relationship between radial growth and climate change in recent years. This paper intends to perform a dendrochronological analysis of two stands of *Pinus pinaster* Ait., around 25 and 50 years old, located in the province of Ciudad Real. Cores was taken in the mature stands and cross-section disk in the young stands of 10 trees along the stem: at the base, breast height, crown base, smaller end (7 cm), at the midpoints between the breast height and crown base, and between the crown base and smaller end. The main is to compare the initial radial growth among the stands in different periods and determinate the effect of climate change patterns; in the other hand to identify different responses in the growth patterns between stands with age lag during the period from 1962 to 2012.

Keywords: *tree rings, dendrochronology, Pinus pinaster* Ait., *climate variability.*

EFFECT OF CLIMATIC AND LITHOLOGICAL VARIABLES ON HEIGHT GROWTH IN *Pinus nigra* Arn STANDS

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Climate, lithology, among others, are key factors affecting dominant height tree growth. By including, in growth and yield models, variables that represent these factors researches can explain the variability between regions and forest types. The use of dynamic models derived for generalized algebraic difference approach (GADA) allow simultaneous estimation of site-specific parameters. Additionally, this approach shows desirable characteristics in tree growth and yield models such as polymorphism, asymptotes variables, base-age invariance, etc. It would be appropriate to incorporate climate variables and lithological and adequately predict dominant height of a stand. This technique is applied to a data set obtained from 50 *Pinus nigra* Arn permanent plots measured from 1963 in Cazorla-Segura, Serrania de Cuenca, Els Ports and Sierra de Gúdar Javalambre (Spain). Different models were checked (Korf, Weibull, Richards, Hosfeld,...) and the best one was selected on the base of accuracy (pseudo-R², RMSE), bias (error) and biological consistency. Once the best model form was selected, climate variables were incorporated to expand the original parameters and the model was fitted again. In this way the fitted model has as independent variables: age, size (dominant height at the beginning of the growth period analyzed), climatic parameters and lithological origin of the substrate.

Keywords: *site quality, soil, climate, GADA.*

REDD+ PROJECT DESIGN AND IMPLEMENTATION IN WIRE HILLS, NYANZA PROVINCE, KENYA: A PRE-FEASIBILITY STUDY

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The limited climate impact of the Kyoto Protocol has driven lots of scientists to move to further possible instruments for climate change mitigation and adaptation. Projects for Reducing Emissions from Deforestation and Forest Degradation (REDD+) have emerged as one of the key choices for the years coming. With the present study I would like to draw, as clear as possible, the several aspects that need to be considered to design and implement a REDD+ project in the Wire Hills area in Kenya. After a general overview of the REDD+ mechanism, the analysis is focused on the selected case-study. The choice of Wire Hills area is connected to my personal experience and to the possibility to directly collect research data during a three-months period in the field. The general aim of this presentation is to provide a clear framework on the major environmental, economic, socio-operational and legal aspects that need to be designed and implemented under a REDD+ project. Moreover in this area is already undergoing a SFM (Sustainable Forest Management) project. This is an important step that could provide facilities implementing a REDD+ plan. This research intends to provides information and data for future projects and for better understanding the REDD+ mechanism in Wire Hills area.

Keywords: *Forest, Climate Change, Deforestation and Forest Degradation, Sustainable Forest Management, Community-Based Forest Management.*

RELATIONSHIP BETWEEN ENVIRONMENTAL PARAMETERS AND *Pinus sylvestris* L. SITE INDEX IN PALENCIA AND LEÓN ACIDIC PLATEAU STANDS (NORTHERN SPAIN).

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Pinus sylvestris L. is the most widely distributed *Pinus* species and Spanish stands constitute the southern limit of its distribution where it occupies 1,28 million hectares. It is the most common species used in reforestation in Castilla y León region where Palencia and León are located. Site productivity determination is needed to carry out a sustainable management of these stands. Productivity estimation at early stages allows to choose which is the most suitable silviculture to be applied. Site productivity may be determined through repeated measurement of stock, extracted volume and mortality over the rotation but this is an expensive and time-wasting method. That is why productivity is usually estimated using intrinsic or extrinsic stand factors. Stand height is one of the most common intrinsic factor used because it is strongly correlated with wood production. When dominant height (average height of 100 thickest trees per hectare) at a base age is used, the quality index is called site index. Dominant height is not only well correlated with wood production but also very easy to measure and it is not affected by usual silvicultural practices such as systematic, semisystematic or low thinning. However, other kind of practices modify the dominant height of the stand and then site index is underestimated. In these cases, the use of extrinsic stand factors such as edaphic, physiographic or climatic parameters is more suitable to estimate site quality. The aim of this study was to develop a discriminant model to predict site index in Scots pine (*Pinus sylvestris* L.) in León and Palencia stands using 68 physiographic, edaphic (physical, chemical and biochemical) and climatic parameters. To meet this objective, data from 35 stands classified into three different site index classes were used. After analyzing 15 discriminant models by cross-validation, a model containing Lang index, porosity, exchange acidity, microbial biomass carbon and organic horizon thickness as predictors was selected. This discriminant model classifies correctly 77.14 % of cases, which is a good value for this kind of studies.

Keywords: *Pinus sylvestris* L., soil-site method, site index, site productivity, edaphic factors, physiographic factors, climatic factors.

DENDROMETRIC PARAMETER ESTIMATION USING VERY HIGH RESOLUTION SATELLITE IMAGES

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Effective management of forest resources requires reliable and timely information on their status. In this regard, remote sensing techniques have played an important role, as they allow collection of data on extensive, remote and inaccessible areas. To ensure proper management of natural resources, the continuing need for high quality information is needed. The forest inventory allows a precise knowledge of timber resources and their evolution to their sound management. It aims to evaluate these resources and provide new qualitative and quantitative information. It allowed acquiring information on forest ecosystems (stands area, ages, standing volume...), it also provides, via the information collected, the possibility of mapping its ecosystems and to plan development activities. Traditionally, the data collection is done by measurements in the field. However, these measures are expensive, time consuming and labor intensive and difficult to achieve, especially in the mountains and dense forests. Management of natural resources requires a better knowledge of resources and accurate measurements. The new space technologies and multispectral remote sensing, allow obtaining digital information, regular and precise. To this end, they are increasingly used as a means of natural resource inventory. Through interpretation of satellite images and processing of multispectral data, we can monitor forests and assess their potential and, consequently, contribute to their sustainable and reasonable management. This study examines the possibility of extracting information on forest stands using very high spatial resolution satellite images (QuickBird images). We show their adaptation for forest stand type classification and for retrieval of several dendrometric variables in coniferous stands with an accuracy similar to that of field sampling.

Keywords: *remote sensing, QuickBird, natural resources, space technologies, dendrometric variables.*

***Boletus edulis* YIELD MODEL IN *Pinus sylvestris* STANDS IN URBION MODEL FOREST: AN OPTION TO DEAL WITH AN EXCESSIVE NUMBER OF ZEROS WHILE CALIBRATING WITH WEATHER VARIABLES**

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Edible mushrooms represent one of the main forest goods that sustain the local economy in the Urbion Model Forest region. In despite of the well recognized influence of meteorological conditions (and other wide range of factors) on fruit-body emergence, the prediction of mushroom yield is a complex task, and only a few models for mushroom yield have been published so far. The study of potential effects of climate change on the edible mushrooms yield in this region becomes relevant given that it could help to identify some anticipated actions to face plausible changes in the historical patterns of mushrooms yield. A yield model of *Boletus edulis* that includes silvicultural variables as well as climate variables was fitted for this pinus forest region, using data collected annually from 18 permanent plots during 17 years in Pinar Grande (Soria). A two-step approach (conditional model) was used. The first part uses logistic regression for predicting the occurrence of Boletes. The second part of the model - conditional on the presence of Boletes – predicts the yield of Boletes using a Multiple Linear Regression (kg. of fresh mass of sporocarps). This approach was selected in order to deal with an excessive number of zeros that characterize the variables “mushroom yield”, which derives in a poor model adjustment with traditional distribution of probability. The results of joint validation of the two-step model suggest that this approach is useful in yield prediction of *B. edulis* sporocarps in *P. sylvestris* stands using both stand and weather variables. Mushroom yield models calibrated using both silvicultural and weather variables could be used in conjunction with prediction models of future climate for different climate change scenarios, allowing the estimation of future changes in Boletes yield. It could be a useful planning tool for the silvicultural regime in order to mitigate the potential negative effects in the regional economy.

Keywords: *Forest Modeling, Conditional Model, Logistic Regression*

ANALYSIS AND DESIGN FOR GEOGRAPHICAL INFORMATION SYSTEM TO SUPPORT IFRANE NATIONAL PARK MANAGEMENT

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The protected areas constitute an effective means for the preservation and conservation of the biodiversity, and a powerful tool for the promotion of the local development; it is what justifies the particular attention which they enjoy on behalf of the HCEFLCD. It is within this framework that this study is integrated in which we are fixed the objective of equipped the National Park of Ifrane with a geographical information system (GIS) allowing storage, the update and the synthesis of the data relating to management of the Park, ensuring the flow-up and the visualization of principals components of the Park and helping the manager in his daily task of decision-making. The work was realized on two stages. The first stage of our study consisted to make a comprehensive diagnosis by analyzing existing data, resources available and the system of management of the park via the documentation, visits and interviews with future users of the system. The second stage refers to the development of the GIS using some tools. The data base, the heart of the system, was created using the Microsoft Sql Server, whereas the user interface was developed with Visual Basic.NET, and we used ADO connection to achieve the data base. For the cartographic shutter, we used ArcGis10 and putting OLD BE Connection between the maps and data stocked in database Microsoft Sql Server. The result of our work is a application with convivial and easy access interface, allowing to the users a better manage and make safe information and to carry out tasks such as the information storage, the follow-up of the natural resources and the actions, the interactive interrogation of the Data Base and the maps developed. As well as various syntheses information graphs and output states of the data stored in the database.

Keywords: *Protected areas, National Park of Ifrane, geographical information system, data base, Visual Basic.*

EFFECTS OF FIRST THINNING ON CONE PRODUCTION OF STONE PINE (*Pinus pinea* L.) STANDS IN THE NORTHERN PLATEAU (SPAIN)

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Edible stone pine (*Pinus pinea* L.) nut is the forest product which renders the highest incomes to the owners of stone pine stands. Despite of this, there is a lack of knowledge concerning forest management alternatives when the main stand objective is edible nut. The objective of this work is to evaluate the effect of first thinning on cone production in an artificially regenerated stand located in Northern Plateau (Spain) in order to determinate optimum intensity. To this end, a thinning trial with nine permanent squared plots (50x50 m) was installed in the *Pinar y Dehesa de Abajo* forest (Valladolid province, Northern Plateau) in 2004. The trial is located in a *P. pinea* pure 20 years old stand established through artificial regeneration. Three treatments were tested: heavy thinning from below (goal density: 275 trees/ha), moderate thinning from below (goal density: 350 trees/ha) and control (no tree felled). Cones of 30 trees per plot proportionally situated throughout the diametric distribution trees were collected, counted and weighted each autumn between 2005 and 2011. On the one hand, we modeled the probability that a tree under one treatment produced at least a cone in a year by applying a logistic regression. On the other hand, logarithmic transformation of non-zero weight cone values were used to evaluate the thinning effects on cone production by applying mixed models. At the end of the study period, selected trees of control, moderate and heavy thinned produced 80 cones (17.55 kg), 149 cones (34.65 kg) and 153 cones (37.66 kg) respectively. We observed great cone production variability between years. Probability of finding a cone in heavy (probability=31.1%) and moderate (probability=31.7%) thinned plots was significantly different (p-value < 0.0001 for both contrasts) from control plots (probability=16.8%). Moreover, there was a significant effect of treatment (p-value = 0.0488) on the logarithm of non-zero weight cone values. The most productive treatments were heavy and moderate thinning. However, statistically differences only appeared between sampled trees of heavy and control plots (p-value=0.0482). Cone production increased by employing early thinning treatments. Our results allow us to recommend early silvicultural treatments in stone pine stands to favor trees development and larger edible pine nut production.

Keywords: early treatments, non-wood products, logistic regression, mixed models, edible nut.

DEVELOPING A TAPER EQUATION FOR *Fagus sylvatica* L. IN CASO, (ASTURIAS), SPAIN

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One of the most representative trees in Asturias (Spain) is *Fagus sylvatica* L., but, in spite of this, there is not inventory data for this tree, in this part of Spain, and is necessary to resolve this limitation. Accordingly, we had measured, in all our land parcels, with the purpose of this study, the height and the diameter at breast height of the trees. After we have chosen de sample trees, according to the top height and the top diameter, these were fell and cut up in logs (one log every meter), until the end of the stem, including one of the stump. For each log, we had extracted a slide, and we had measured the diameter over and under bark, with a measuring tape. At this point, with the results for each sample trees, we had made a dendrochronological study with the WinDENDRO® software, which allows making a tree ring analysis in each slide. Thanks to the results, and for each sample tree, we had made, in Microsoft Excel®, a data table and a graphic, for the increase of size along the time, in each slide. In the other hand, we had developed the best taper equation for our sample trees, using the results related to the last year, therefore, we can calculate the increase in diameter along the trunk, which will facilitate their scaling for any purpose.

Keywords: *beech, dendrochronology, tree ring, management, scaling.*

ADDRESSING FOREST MODELLING TO SUPPORT MANAGEMENT PLANNING PROCESSES: THE PORTUGUESE EXPERIENCE

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In Portugal, forests cover about 30% of the territory. Although a relatively small country in size, the territory encompasses wide range of biophysical characteristics and therefore a wide variation of forest properties and, within, a wide range of growth rates. In order to support forest management planning, forest models are essential to provide adequate local forest growth information for different management alternatives to cope with different challenges. Forest modelling evolved in the last decades, from empirical to process based allowing not only the understanding of forest growth under future climate scenarios, but also the understanding of the physiological responses of the forests in terms of plant-water-soil-atmosphere relationships. This talk builds on the Portuguese experience regarding existing models, in particular the SIMfLOR platform (Portuguese Forest Simulator available @ <http://www.isa.utl.pt/cef/forchange/fctools/>), but also the rationale for using either empirical or process based, their use for management alternatives projection at stand level, with and without climate scenarios and, in a more advanced context, the usage of the models to supply information at landscape scale to supply a decision space for decision support systems.

Keywords: *Portugal, Forest Modelling, Management Alternatives, Pareto frontier.*

INTEGRATION OF FUNGAL PRODUCTION IN FOREST MANAGEMENT USING A MULTI-CRITERIA METHOD

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Some non-timber forestry products, such as mushrooms, have not typically been included in forest management plans, creating a scenario whereby timber production is the main objective and fungal resources are an afterthought. However, in certain forests, wild mushrooms reach a significant level of production. This paper researches a strategic forest management plan that would include the production of both timber and mushrooms as principal objectives while still adhering to constraints normally considered within forest management. A case study is provided featuring two main groups of edible wild mushrooms, where the two aforementioned objectives have been optimised individually. Lacking a satisfactory solution for the decision-maker, a model based on multi-criteria decision analysis (compromise programming) has been constructed to yield more attractive solutions. Information regarding mushrooms is based on the actual amount collected in the forest and not on potential production. Measured in monetary terms, mushroom production can be easily compared with timber production. Income associated with mushroom production is equal to approximately 20 % of that generated by timber throughout the planning horizon when final inventory and regulation constraints are imposed.

Keywords: *Edible wild mushrooms, Compromise programming, Forest management, Strategic planning, optimization.*

CLIMATE, PODS PRODUCTION AND RADIAL GROWTH OF *Prosopis caldenia* IN SEMIARID WOODLANDS OF CENTRAL ARGENTINA

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Prosopis caldenia Burkart (Caldén) pods are a key forage supplement for cattle ranching in the semiarid argentinean pampas. Caldén pods production is highly variable, both between and within years and individuals. The reproduction demands resources that cannot be intended to other aspects like growth or biomass accumulation. Our objective was determinate the relationship between Caldén pods production and radial growth under different climate conditions. In the present work we have used annual fruit data of 195 caldén trees. During four non consecutive years (1983-2003-2011 and 2012) four samples of one square meter located in the middle of crown projection oriented to each cardinal point in five different sampling sites were collected, oven dried and weighed. In each tallied tree diameter at the base and at breast height, total and crown height and crown diameter were recorded. The possibility of adjusted a simultaneous model ZIP (*Zero-inflated Poisson*) or a bietapic conditional model (binomial logistic and lineal) were studied, in order to estimated the harvest probability and the pods production. According to previous studies, maximum temperature of October and relativity humidity of December, January and February were used like environmental factors that most affect Caldén pods production.

Keywords: ZIP, fruit production, Caldén, silvopastoral systems.

ANALYSIS OF PEZOLLATO 900/660 CHIPPER: PRODUCTIVITY, COSTS AND CO₂ EMISSIONS

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The energy potential of forest products is widely recognized as an alternative to fossil fuels. The study and development of efficient forest-fuel systems has become one of the biggest challenges. There is an important need to study chippers productivity and quantify CO₂ emissions to enable the development of technologies that maximize yields to compete with conventional sources of energy in terms of costs and production. The aim of this study was to determine the productivity, costs and CO₂ emissions of PEZOLLATO 900/660 chipper in a whole-tree chipping case at roadside. It was conducted in Asturias (North of Spain) during May and June of 2008. A discontinuous time study was conducted to calculate productivity with a total of 22.57 hours of timing. All time elements were recorded on a predetermined time interval (1 minute) with a hand-held field computer running the UMT time study software. Furthermore, we also estimated costs per productive time and total time. Finally, CO₂ emissions in the whole-tree harvesting system were calculated. To do that, it was necessary to consider the standing tree within the mass, which must be cut, forwarded and chipped at roadside. Basic data for felling and forwarding operations were collected from previous field studies. The results revealed that organizational delays influenced productivity (11.06 t/PMH and 7.29 t/SMH) which deals directly with the importance of operation management. Costs were 156.41 €/PMH and 135.00 €/SMH. The emissions were evaluated to be 7.60 kgCO₂/MWh_{chip}, checking the influence of productivity and fuel consumption in these emissions. The calculations show that fuel chips production from felling, forwarding and chipping was very efficient from the viewpoint of energy because an energy input of 3% of the produced energy was needed. This study provides the value of identifying what factors affect to reduce CO₂ emission by using forest products as alternative energy resources.

Keywords: *time study, whole-tree, kgCO₂/MWh_{chip}, forest fuel, performance.*

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THE ROLE OF JUNIPER FORESTS TOWARDS THE WELL BEING OF COMMUNITIES IN ZIARAT, PAKISTAN

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Forests and mankind are two terms which cannot be separated from each other. From times immemorial forest has been the chief source of different services to mankind. There are still many countries in the world where people mostly depend on forests for their daily needs. Forest in these countries provide to communities water, fuel wood, fodder for animals, medicinal Plants, wood for construction etc. But the people who depend still on forest for their survival are in developing and poor countries, and the problem is that these forests are in severe stress from the communities living near or in the forests. Pakistan is also a developing country and has got different kinds of forests i.e. from Mediterranean type of forests to Temperate Forests. One very unique forest which is also called the living fossils is the Juniper forests of Ziarat, are in the province of Baluchistan. It has trees more than 5000-7000 years old. These forests are providing different type of services for communities living near to them for thousands of years ago, from clean drinking water to medicinal plants. These forests also have a very unique biodiversity i.e. Himalayan bear, Markhor, Chiltan markhor etc. But as like other developing countries, the Juniper Forests of Pakistan are under severe stress from the communities living near to these forests. The main problem is unsustainable harvesting of these Forests i.e. from Timber to Medicinal plants and very slow natural regeneration of these forests, conversion of Juniper forest land for fruit orchards. Population of Pakistan is growing very fast and especially in the arrears where juniper forests are located the, the population growth rate is double than country average. Secondly the Natural regeneration of Juniper Forests is very slow, due low seed germination rate and also very harsh environmental conditions i.e. regular droughts. Keeping in view the uniqueness of these forests in world, there is immediate need to take some protective measures steps for these forests. People living around this forest use wood from these forests for fulfilling the demand of their energy. By simply providing them solar panels, a lot of pressure for fuel wood from these forests can be reduced. Secondly research studies should be taken to improve the Regeneration capacity of these Forests for long-term conservation of these forests.

Keywords: *Forest, Mediterranean forest, Temperate forest, Regeneration.*

EFFECT OF THINNING ON PHOSPHORUS DYNAMICS IN FOREST SOIL OF AMPUDIA, PALENCIA (SPAIN)

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The management of a forest stand involves performing a series of treatments and the success mainly depends on the type of management imposed. One of the management practices that have been practiced worldwide is thinning. Thinning in forestry is the selective removal of trees, primarily undertaken to improve the growth rate or health of the remaining trees. With objective of determining the effect of thinning on phosphorus dynamics, a study was conducted in forest soils of Ampudia, Palencia developed below *Pinus halepensis*. The treatments considered three plots (with 30 and 45% of thinning, and a control plot without thinning). Thinning plots were subdivided into two subplots of 20x20 m, in one of these subplot thinning remains were extracted out and in the other the plant remains has been crushed and distributed evenly across the soil surface. Soil samples were randomly collected from two depths of 0-10cm and 10-20 cm. According to the method proposed by (Tiessen and Moir, 1993), phosphorus was fractionated and the different forms were quantified in the soil for the above treatments.

Keywords: *Thinning, soil phosphorus fractionation, , management.*

USING DEMAND SIDE MANAGEMENT TO ADAPT TO WATER SCARCITY AND CLIMATE CHANGE IN THE SAISS BASIN, MOROCCO

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The Saiss Basin is located in the upper eastern reaches of greater Sebou Basin of Morocco. It contains about 1.8 millions people and represents 11 percent of Morocco's annual water endowment. The basin's surface covers over 2,200 square kilometres and includes about 8,000 commercial and subsistence farms that represent about 37,000 hectares of irrigated land. Therefore, its ecological decline will influence the country as a whole. This region is characterized by the scarcity of water resources as well as the high variability of rainfall. Declining levels of precipitation in the Saiss Basin, as measured by the Sebou Basin Agency (*Agence du Bassin Hydraulique du Sebou, Fès, ABHS*) over the last forty years, accompanying a 1 degree Celsius increase in average temperature, suggest that climate change, along with increased water demand from population growth and economic development have led to unsustainable levels of an over-exploitation of the Saiss aquifer. As a mean of reducing water use within the area and thereby contributing to aquifer sustainability, Al Akhawayn University worked in a partnership with the Sebou Basin Agency as well as other stakeholders to study scientifically the water resources in the basin. This study came in response to the decline of the water table in the region. This study, which was supported by the International Development Research Center of the Canadian government (IDRC) and the UK Department of International Development (DFID), examined how Demand Side Management (DSM), with multiple stakeholders, could provide a solid basis for integrated water management and climate adaptive capacity in the Saiss Basin for the benefit of all, especially vulnerable and disadvantaged communities.

Keywords: *Climate Change, Adaptation, Water, Agriculture, Morocco*

IV SESSION: GLOBAL PERSPECTIVES OF MANAGEMENT

Oral communications

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REINFFORCE (REsource INFrastructure for monitoring and adapting European Atlantic FORests under Changing climatE): INSTALLATION OF TRIAL PLOTS IN CANTABRIA AND CASTILLA Y LEÓN

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The European Union Project (INTERREG IVB) REINFFORCE gives the opportunity to install a network of arboretums and demonstration sites unique in the world, located between latitudes 37° and 58° for monitoring the adaptation of European Atlantic forests to climate change through the study of the tree growth, its phenology and the forest health. For this reason is a key issue for sustainability of Atlantic forest resources, as the trees that are now being planted, will be harvested in 50 years facing new climatic conditions. This project is justified because the reality of global warming is recognized worldwide, and most of the climatic models in the optimistic scenarios of IPCC, predict a 4°C temperature rise over the next 50 years. Nevertheless, the regional consequences are still unpredictable, because there are many unknown factors like the climatic, economic and environmental conditions at regional level. However, some specific threats are appearing such as, disturbances in the life cycle of tree species, the introduction of new pathogens, or the mis-adaptation of tree species to new climatic conditions. The goals of the REINFFORCE project are: i) to establish protocols for the installation of infrastructures and data collection; ii) to perform the technical and administrative evaluation of the work; iii) to create a network of arboretums to anticipate the effects of climate change; iv) to implement a network of demonstration sites to compare usual silviculture with other adaptative measures; and v) to develop databases to share online. To achieve these objectives, The University of Valladolid is responsible to install and monitor; two arboretums and two demonstration sites located in Cantabria and three arboretums and two demonstration sites located in Castilla y León. Thirty two tree species with 3 to 9 provenances of each specie, are going to be tested in these arboretums. On the other hand, the demonstration sites are Nelder wheels mixed plantations designed to evaluate the influence of the density on the mortality, the growth and the pathogenic damages.

Keywords: *Arboretums, Demonstration sites, Pathology, Silviculture, Protocols.*

NATURAL REGENERATION IN MEDITERRANEAN ECOSYSTEMS: CURRENT SITUATION AND CHALLENGES AHEAD

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Mediterranean ecosystem is a high heterogeneity ecosystem characterized by summer drought, soils poor in nutrients and a high interannual climatic and spatio-temporal variability. Most of the Mediterranean species are adapted to these conditions but there is a new situation for forests because of global change, which can compromise the future of the Mediterranean stands.

Natural regeneration is a key process for stand persistence because it can guarantee the continuity of the forest. However it is a complex process where different biotic and abiotic factors affect during its phases: seed production, seed dispersal, seed storage, germination and establishment. In some cases some of them can be a bottleneck and compromise the success of the process so it is necessary to know the response of the species to different factors (water availability, temperature, genetic origin, silviculture applied...). Due to the importance of natural regeneration our objective is to analyse the effect of biotic and abiotic factors on *Pinus pinaster* and *Pinus halepensis* natural regeneration, two of the main species of the Mediterranean basin.

Pinus pinaster natural regeneration has been analysed in different ways. One of them is carried out in the experimental site of Mata de Cuéllar (Segovia, central Spain) since 2004. Experimental design consists in ten permanent plots of 70x70 m where three different levels of harvest intensity were applied. Different studies have been carried out in this experimental site: seed production counting mature cones, seed rain in the different harvest intensity plots, seed predation on the seed storage and germination and survival of seedlings. Most of the studies about *Pinus halepensis* deal with post-fire natural regeneration but there is a lack of information about naturalized stands. A similar experimental site has been installed in Sierra Espuña (Murcia, south-eastern Spain) in 2012. Nine permanent plots of 50 x 50 m have been carried out with two different levels of harvest intensity. The aim is to do an integrated monitoring of seed dispersal, germination and establishment of these stands. It is necessary to know the effect of the factors at each stage of natural regeneration and the interactions between them to model natural regeneration as a whole process and define appropriated alternatives to forest management. Moreover this knowledge about both species allows us to know their response to the global warming. This contribution will present the current state of knowledge and the main objectives pursued by this research program.

Keywords: *Pinus pinaster*, *Pinus halepensis*, global warming, experimental sites, modelling.

THE SITUATION OF DOUM PALM (*Hyphaene thebaica*) CASE STUDY: AKURDET, GASH-BARKA REGION, ERITREA

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Doum palm (locally called Arkobkobay) is one of the most important riverine forest resources, which has a number of usefulness to the livelihood of the people in Akurdet and its surrounding communities. Doum leaves are used for making handicrafts such as baskets, mats, fan, and many other decorative materials. The stem of the palm is strong and is used for construction of houses. Doum palm also have a fruit locally called Akat, which is also a traditional wild food and still play an important role in peoples' diet. For pastoralists and their livestock the palms offer shade, an important natural service particularly during the hot seasons. During drought seasons the young leaves of the palm are also used by the pastoralist to feed their livestock. Study done by Ammering *et al* (2006) indicated 23% of the total income of people in Akurdet and its nearby villages come from the sales of doum palm leaves and products. The degradation of doum palm, however, is increasing from time to time. Factors which affect doum palm destruction in Akurdet and its nearby areas.. Over exploitation: The increase in population is creating pressure on the doum palm exploitation for the purposes mentioned above. Expansion of the commercial farms: doum palm grow on the fertile soils of the river banks. Commercial agriculturalists, on the other hand, are looking constantly for the best fertile forest land which results in the clearing of the doum palms.. Uncontrolled cutting: Due to the lack of adequate forest guard, there is a lot of poaching of the doum palm tree. . Livestock feeding: The central part of the doum palm's shoot (locally called *Nagi* in Tigre) is edible by livestock and many pastoralists cut that part to feed their livestock. This hinders the regeneration of the plant. Recognizing the importance of the riverine forests and their trend of destruction, the Ministry of Agriculture (MOA), Eritrea has drafted a regulation for their control. Among others, the regulation requires all commercial farms should be established at least 700m apart from the riverine areas.

Keywords: *Gash-barka riverine forest degradation*

RANGE MANAGEMENT OF THE MEDITERRANEAN FOREST AREAS: THE ROLE OF GRAZING IN MEDITERRANEAN FORESTS

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The Mediterranean region has an old history with grazing by herbivores dating back to 10000 and 6000 BC, despite its role in maintaining diversity and stability, the ecological role of livestock grazing is not sufficiently highlighted. Forest grazing has shown an important potential in reducing fire risk by reducing fuels, especially in abandoned forests, if managed correctly, forest grazing is very important in preserving biodiversity. Grazing can favor tree growth since the removal of understory vegetation reduces the competition for water and nutrients, it has also an important economic value as it is a source of livelihood for many communities, However!! If mismanaged, grazing can have a drastic impact on forest regeneration (saplings, seedlings). Our field trip was to an area called Finca Ferreres, in 1994, part of this area was devastated by a wildfire, mostly affecting the *Q. humilis* zone, the need for a fire prevention planned there to avoid similar incidents and Bovine grazing was a tool for fire prevention in such Mediterranean forest dominated by: *Q. ilex*, *Q. humilis* and *P. mugo*, The main species grazed was *Brachypodium phoenicoides*, in addition to shrubs. In conclusion, applying Grazing helped reducing fuels, a main factor in fire spread, Therefore the high risk of fire spread facilitated by herbaceous species was reduced, Natural forage from grazing (60-70% of requirements) showed to have a higher quality and nutrient value than the silage (i.e. barley straw). The field trip helped us to notice that grazing capacity is crucial for a proper forest management (livestock/ha) and the livestock owners should comply with a certain management plan, hence allowing to graze only a few months each year and perhaps not in all years (threatening natural regeneration) for that reason a close collaboration among foresters, range managers, animal scientists, and shepherds is needed.

Keywords: *fire, livestock, shrubs, herbaceous, regeneration.*

MAPPING AND ANALYSIS OF PRESSURE FACTORS ON ARGAN STANDS IN THE AMSITEN AREA (ESSAOUIRA PROVINCE)

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Faced with the threat that weighs heavily on the argan forest in southwestern Morocco, local people are worried about the current situation of argan forests in the region. Therefore, decision-makers are thinking about developing alternative approaches in order to balance between conservation and development. Studies that have been conducted in this area have generated an enormous amount of data. The flexible and efficient management of these data required a tool allowing managers to better manage the natural resources of the region. It is in this framework that integrates the study whose main objective is to map the pressure factors on populations of argan trees in order to have a global vision and clear sensitive areas most affected by the degradation which requires an urgent intervention. Another purpose is to provide policy makers, planners and stakeholders with maps containing relevant information on degradation factors of the argan stands. The first step of this work consisted of a comprehensive diagnosis analyzing existing data and resources through documentation and interviews with policy makers in order to determine the different factors of pressure on populations of argan. The second phase will be focused on the factors that can be modeled and develop the processes of modeling of these factors using the new space technologies (remote sensing) and geographic information system (GIS). The results will be maps that clearly show the area's most affected by degradation factors and require urgent actions.

Keywords: *degradation, conservation, development, modeling, remote sensing.*

THE OVERVIEW OF THE FOREST SECTOR AND ITS PROBLEMS IN UKRAINE

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Ukraine forests have mostly environmental (water protection, safety, sanitary, esthetic and others) functions and limited operational significance. The total area of forest land is 10.8 million hectares, among which area covered with forest vegetation has 9.5 million hectares; it is 15.7 % of the area of Ukraine. It is needed to create more than 2 million hectares of new forests in order to reach optimal forestry rate in Ukraine (20%). Forests grow in the different natural zones (forest area, forest-steppe zone, steppe zone, Ukrainian Carpathians and Crimean Mountains), which have significant differences in site conditions, forest management practices, the use of forest resources and useful properties of the forest. It is a quite high percentage of protected forests (14.0%) in the country, which tends to increase. Half of Ukraine's forests are artificially created and require intensive care. Forests of Ukraine formed more than 30 species of trees, dominated by pine (*Pinus silvestris*), oak (*Quercus robur*), beech (*Fagus sylvatica*), spruce (*Picea abies*), birch (*Betula pendula*), alder (*Alnus glutinosa*), ash (*Fraxinus excelsior*), hornbeam (*Carpinus betulus*), fir (*Abies alba*). In silviculture system of Ukraine there are two main types of cuttings: major harvesting cuttings and cutting for improving the quality of the forest. There are such types of the major harvesting cuttings as selective, progressive, combined and clearcut systems. Among cuttings for improving the quality of the forest is distinguished sanitary, supervision, forest renewable, rearrangement and landscape cuttings. However, forest sector has some problems concerning management system and environmental conditions. One of the biggest one is radioactive pollution. Large area of forests is contaminated by radiation and it has a significant negative impact on the non-forest goods. Deforestation is a big problem, especially in The Carpathian mountains due to illegal logging. This process is a reason of erosion, flood risk and landslide in this area. Also there is a legislative problem, because forest law is intricate and imperfect; often one current document contradicts with another, which leads to the ineffectiveness of forest management. However, implementation of the principles of sustainable forest management and the ecosystem approach in forest management, the usage of modern techniques and technologies will ensure the growth of the environmental, economic and social functions of forests in sustainable development of the country.

Keywords: *silviculture system, radioactive contamination, illegal logging, deforestation.*

ANALYSIS OF THE IMPACT OF CLIMATE CHANGE IN THE PRODUCTIVITY OF *Eucalyptus globulus* IN PORTUGAL: A PROCESS-BASED MODEL APPROACH

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It is not called into question that the Mediterranean region faces in the coming decades a great challenge due to increasing temperature patterns. Portugal is being specially affected by this increment as temperatures have astonishingly risen in the last decades in comparison with the world's average. In this way, a major concern should be placed in the studies that focus on the repercussion of these anthropogenic climatic variations in order to come to proper conclusions on future decisions. The aim of this paper is to analyze the differences in productivity of *Eucalyptus globulus* in several important regions, in terms of density, in Portugal. Different climate scenarios have been chosen to evaluate the impact that climate change may have in the mentioned species regarding biomass pools. For that purpose, a process-based model (3PG) has been used to evaluate above and below-ground biomass. It uses available long-term site specific forestry data that allow us to predict the time course of stands development.

Keywords: *Eucalyptus globulus*, biomass pool, process-based model (3PG), stand.

USING FLUORESCENCE SPECTROSCOPY TECHNIQUES TO CHARACTERIZE DISSOLVED ORGANIC CARBON IN THE VESDRE CATCHMENT IN BELGIUM

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It is known that composition and concentration of dissolved organic matter (DOM) have direct and indirect impact on most biogeochemical processes occurring in aquatic ecosystems; nevertheless, characterization of DOM quality, in river waters, from a watershed perspective has not been extensively studied. Fluorescence spectroscopy techniques have been applied in this study to explore the spatial variability of fluorescence character of DOM from diverse land use types in the Vesdre catchment, and along the longitudinal gradient of the river. Surface water samples from a total of 29 sites were collected once in January 2011. Sampling sites were located along the main stem of river (14 sites), in tributaries (13 sites) and reservoirs (2 sites); each sampling site representing a unique combination of four major land use types: peat, forest, agriculture and urban. The samples were analyzed for fluorescence and absorbance spectra and, DOC concentration. EEMs (excitation-emission matrices) were obtained from the fluorescence spectra and further were fitted in a 13-component parallel factor analysis (PARAFAC) model of Cory and McKnight, (2005). DOC concentration among the sites ranged from 2 to 14 mg C L⁻¹ with mean (7.3±0.41 mg C L⁻¹). A decreasing trend was observed in DOC ($r^2=0.48$, $p<0.01$, $n=13$) and SUVA₂₅₄ ($r^2=0.48$, $p<0.01$, $n=13$) along the length of the river. High concentrations of DOC and high intensities of fluorophore C (humic-like fraction) in upstream of the catchment were associated with forested and peat lands, whereas low concentrations of DOC and high intensities of fluorophore T (tryptophan-like fraction) characterized agriculture and urban areas in downstream of the catchment. Results from a multivariate analysis showed that fluorescence can be useful to predict land use changes. Various significant correlations were found that associate fluorescence measurements, indices, and PARAFAC components with land use; among others: agriculture land was positively associated with fluorophore T intensities ($r^2=0.52$, $p<0.001$, $n=28$); urban areas were positively related to component 8 (tryptophan-like) of PARAFAC model ($r^2=0.45$, $p<0.001$, $n=28$); increase in peat coverage was associated with increase of component 5 (humic-like component of high aromaticity) of the PARAFAC model ($r^2=0.47$, $p<0.001$, $n=28$); finally, a negative correlation was found between forest areas and component 8 ($r^2=0.59$, $p<0.001$, $n=28$). The results of the study suggest that river processing as well as external contributions from diverse land use type can alter the chemical composition of DOM quality in watersheds.

Keywords: Absorbance, Dissolved organic matter, Excitation-emission matrix, Land use, PARAFAC.

BIOMASS BRIQUETTING: A PROSPECT OF FOREST RESOURCES MANAGEMENT

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Biomass energy is an important source of energy as nearly half of the world's population and almost all in developing countries depend on these resources. Traditionally, biomass in its raw form has been used for cooking and heating purposes, however it has been limited in industrial purpose due to lower heating value of loose biomass. With the present crisis of fuel wood shortages, the rural population is depending more and more to the burning of loose agricultural and forest residues and cow dung for domestic cooking and other purposes. This is a highly polluting practice associated with health hazards. To solve the problem of fuel wood and associated deforestation, these agro-forest residues should be upgraded to convenient and smokeless fuels. The forest residues such as pine needle which is the sources cause of the forest fire can be converted in to the efficient energy sources and can be used in industrial and domestic sector. In the study a simple technology is developed for the production of beehive briquettes by the carbonization of the agro-forestry residues and mixing of the char with binders followed by briquetting. It provides smokeless domestic fuel easily ignitable with sustained uniform combustion.

Keywords: *Biomass, beehive briquette, agro-forest residues, carbonization, char*

MONTADO: A MULTI-FUNCTIONAL ECOSYSTEM

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Montado (in Portuguese equivalent to *dehesa* in Spanish) is a savannah-like agro-forestry-pastoral ecosystem dominated by evergreen oaks (such as the cork oak *Quercus suber* and holm oak *Q. rotundifolia*) with pastures and agricultural fields playing the undercover. The emblematic mosaic landscape can be found mainly in the Western Mediterranean region. Here, it not only plays a key role in ecological processes such as water retention, soil conservation, and carbon storage, but also has a great impact at socio-economical level by creating thousands of direct and indirect jobs associated to the cork extraction and transformation as well as non-wood services (mushroom production, recreation activities such as hunting and grazing activity).

Keywords: *biodiversity, ecosystem, management, environment, society.*

FOREST SECTOR IN TUNISIA AND SUSTAINABLE MANAGEMENT OF FORESTRY RESOURCES

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Since its independence, Tunisia has set a policy oriented towards the conservation and the continued development of the various resources available and the operation of all its national potential. Enormous efforts have been invested in developing appropriate forestry sector. The broad guidelines and programs defined have formed the framework for the development of sectorial policies in our country. However, an insufficiency of the involvement of the forest population of the private sector and the civil society to the management of the forest spaces, a weakness on the forest administration to adapt the requirements of the sustainable management and the partnership were noted. During the last decade, improved management of forest ecosystems and Pastoral was one of the main objectives of the new forest policy. The reconciliation of forest peoples with their environment and with the administration Forestry has been a major concern of the latter.

Keywords: *conservation, development, environment, ecosystem, policy.*

FOREST POLICIES IN CHINA

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Whenever socio-economic stage is, the forest policy can certainly influence the evolution, utilization, conservation and development of forest resources. This presentation briefly introduces the past, present and future forest management and forest policy in China, and discusses an overview about new forest trends, forest policy changes and challenges to achieve a sustainable forest management in China. For recent decades, China has implemented many forestry policies to improve the forest management, utilization and conservation. We can see that on the one hand, some policies have operated to promote economic development, such as the Western Development Programme. On the other hand, the Natural Forest Protection Programme is aiming to restrict domestic wood production. This presentation will present an assessment of dynamical forest policies on China's forestry development over the last decades.

Keywords: *Forest management, Forest products, Resources, Economic development, China.*

WATER AND FORESTS IN MEDETRANEAN CONTEXT: A CONVENIENT RELATIONSHIP?

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The availability and quality of water has been decreasing due to various inter-playing factors like overuse, miss use, pollution etc. Forests has been reported to improve the quality and quantity of water by different mechanisms like increasing infiltration, sediment trapping, etc. Due to Climate change, where reduced precipitation and more evapo-transpiration due to increase in temperature are expected, water scarcity has become more, specially in the semi-arid and arid regions of the world. It has been reported that the concrete impact of forests on water resources are influenced by numerous factors; therefore, site-specific evaluation of the interaction of forests and water resource is necessary. For example, If we consider a forest in temperate area where the annual precipitation is far more than the actual evapo-transpiration and a forest in semi-arid area (e.g. Medetrranean) where the annual precipitation is less than the actual evapotranspiration the interaction of forests and the water resource would be quite different. Due to land use change pattern like land abandonment the forest cover in Mediterranean regions (e.g. Spain) has increased. Scarcity of water in this area in one hand and the high demand of water by the forest and also by human population for irrigation, drinking and other purposes demand critical evaluation of the scenario. The evaluation will enable us to understand the water use of the forest and the interaction with the available water resource which intern help us to design forest management strategy that would enable us to improve the water availability for trees in the forest. This paper first focus on, prevailing quantitative results that showed forests in the Mediterranean region are growing under water stress condition. Second providing practical examples of forest management practices implemented to manage the water use by forests. Reduction of tree density has been shown to improve the water use by the trees and improved the tree survival. The positive performance of the trees in the reduced density is not only due to their immediate response to reduced competition; however, results from physiological measurements has proved that the trees are also showing better physiological performance after the forest management practice as compared to the trees in the control forest with high tree density. Site specific understanding of the interaction between forests and water will enable us to implement management strategy to find harmony among our forests, our water demand and the available water resource.

Keywords: *Mediterranean, tree density, precipitation, evapo-transpiration, forest management.*

DESIGN AND DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM FOR MANAGEMENT AND MAKE DECISIONS FOR THE NATIONAL PARK OF TALASSEMANTANE

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The protected areas became, more than ever, the means more used for the conservation of natural resources on a worldwide scale, the administrations in charge of their management, in the event the HCEFLCD in Morocco, did not cease to work by all the means to ensure the effectiveness and the profitability of this management. It is within this framework that this study is integrated in which we are fixed the objective of equipped the National Park of TALASSEMANTANE with a geographical information system (GIS) allowing storage, the update and the synthesis of the data relating to management of the Park, ensuring the flow-up and the visualization of principals components of the Park and helping the manager in his daily task of decision-making. The first stage of our work consists of a visit to the Park to take note of existing, to know the needs of the managers and to define the details of the objectives of our study. It also allowed us to understand the field of study and to make diagrams of packages and use cases for our application according to UML design. The second stage is the development of the GIS of Park (SIGPNTLS), it consist at the making of the diagrams of classes, the implementation of the Data Base under ACCESS 2007, at the choice and the realization of the maps under ArcGis 9.0, at the connection between these maps and their descriptive data in the data base ACCESS and finally at the development of the graphic interface under VB.net and personalization of that of ArcMap. The result of our work is a data-processing application with convivial and easy access interface, allowing to the users to better manage and make safe information and to carry out tasks such as the information storage, the follow-up of the natural resources and the actions, the interactive interrogation of the Data Base and the maps developed and various syntheses in graphs and outputs of the information stored in the data base.

Keywords: *Protected areas, Needs for managers, SIGPNTLS, Data Base, ArcGis 9.0 .*

FORESTRY IN MACEDONIA

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JP "Macedonian Forests" (1998-2008), business publication, COBIS.MK-ID 75250442

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Forests are the found of the ecosystem. People and forests have always been linked with unbreakable connection of mutual dependence and supplement. The economic, social and ecological function of the forests is of a great importance for the sustainable development of the society and for life quality improvement, especially in the rural and mountain region, (JP Macedonian Forest). The Macedonian forestry is formed with complexity, multifunction and sustainability in production with special care and treatments for healthy relationship with forests. The legal successor for managing the forests is the enterprise "Macedonian Forests", established with a decision of the Government, December 15.1997. Relying on forests multifunction uses Republic of Macedonia preserves them as a national wealth and inheritance. A confirmation for this is the Constitution of the Republic where: "All natural resources in the country, flora and fauna, amenities in common use, as well as objects and buildings, have significant cultural and historical value, justified by the law are goods of common interest for the country and are treated with specific protection". The natural conditions in this area enable the existence of great number of plant and animal relics and endemic as well. Because of that, Macedonia belongs to countries with rich biodiversity. In the past, the territory of Macedonia and the whole Balkan was covered with dense and impassable forests. The demographic development of the population had a leading force for consistent exploitation of the nature. In this way, forests were destroyed with burning, digging and hoeing with a purpose to transform them into agricultural land. Moreover, after the Second World War the country experience an inevitable crash and things had to be solved and somehow put into function again. Forestry was organized as a modern economic branch which assumes full and intense responsibility in forest management. The real conditions today, are dictating the need of an efficient forest management system development and modern wood industry following high standards. The country orientation to the European Union demands harmonization in the forest political sector and the responsibilities in it.

Keywords: *Forestry history in R.M, biodiversity, protection and regulations, forest management.*

MEASURING & PROMOTING THE URBAN FOREST OF BALTIMORE, MARYLAND, USA

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Remote sensing and GIS have been used as urban forest analysis tools in Baltimore, Maryland, USA over the last twenty years. In recent years, collaborative projects between the municipality, U.S. Forest Service, and the University of Vermont have resulted in new monitoring and measurement techniques and analyses. The latest analysis projects take advantage of higher resolution land-cover data products interpreted from satellite and Lidar data. A sampling of urban forest analysis projects from Baltimore, Maryland is presented, along with a specific project which focused on the public school property parcels spread throughout the city. The majority of the projects, while quantitative in nature, are most commonly used in public outreach initiatives and to engage the general public in urban forestry related interests as related to different parts of the city and current political initiatives.

Keywords: *Remote sensing, GIS, Schools, Land Cover*

STUDY OF EUCALYPTUS FOREST PRODUCTIVITY IN LATAKIA, SYRIA

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The aim of this research is to study and analyze the environmental and forestry data and parameters for two types of Eucalyptus in a specified area as well as to record several forestry measures for a number of specimens in the studied location, in order to attain sufficient records and information regarding the productivity and the utility of the Eucalyptus in the studied location, in addition to the potentials of developing this area from aspects of recreational and sustainable forestry development. In this regard, the research conclude by addressing the current difficulties and problems facing this area and also by suggesting some of the ground rules and foundations for a better management and organization for this forestry area in the future. The research was based on studying two main types of Eucalyptus in a forestry area near Lattakia, Syria. Throughout analyzing and examining these types while highlighting the growing significance and impact of Eucalyptus in particular, and forestry areas in general both for local economy and society. For that reason, these forestry areas require more protection and constant concern as well as better planning for a stable development, especially since the rapid deterioration and decline of the Syrian forests and the lack of sustainable organization as well as the numerous abuses, all of which caused to damages and tear down the forestry areas. In this regard, the research stressed on the numerous ways of improving sustainable management and organization which represents a crucial necessity in order to protect and maintain the Syrian forests; for that reason, the research sought to study and analyze the related significant factors affecting Eucalyptus and its forestry area, in order to conclude on the results regarding of developing the best environment to protect and get the best benefits of such local forestry areas.

Keywords: *Environmental parameters, forest productivity, protictive forest, Eucalyptus camaldulensis, Eucalyptus gomphociphala.*

V SESION: PROTECTION

Oral communications

RELATIONSHIP BETWEEN FOLIVORY AND SOME SELECTED PHYSICAL AND CHEMICAL
PROPERTIES OF LEAF OF SOME SELECTED TREE SPECIES AT RATARGUL FRESH
WATER SWAMP FOREST, BANGLADESH
Habibur Rahman Salman

OAK GALLS
Sacha Khoury

DEVELOPMENT IN REMOTE SENSING TO ADDRESS FOREST INSECT DEFOLIATION, A
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Cristóbal Daniel Rullán Silva

Monochamus galloprovincialis FEEDING, OVIPOSITION AND DEVELOPMENT RESPONSE
DIFFERENCES BETWEEN *Pinus pinea* AND OTHER PINE SPECIES
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FUNGAL ENDOPHYTES REDUCE NECROSIS LENGTH CAUSED BY *Gremmeniella abietina*
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IN VITRO ANTAGONISM OF FUNGAL ENDOPHYTES OVER THE PITCH CANKER
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CORK OAK HEALTH AND HARVESTING MONITORING IN MAMORA FOREST
Aimad Elmansouri

RED PALM WEEVIL-A SERIOUS THREAT TO THE CANARY DATEPALM
Hafiz Umair Masood Awan

RELATIONSHIP BETWEEN FOLIVORY AND SOME SELECTED PHYSICAL AND CHEMICAL PROPERTIES OF LEAF OF SOME SELECTED TREE SPECIES AT RATARGUL FRESH WATER SWAMP FOREST, BANGLADESH

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From the time immemorial, plants have been severely affected by insects to meet their nutritional needs. If we quantify damage incurred by insects in the forest ecosystem, serious scenery of damage is revealed. Insects account for about 70 percent of the total herbivory in the tropical forests (Coley and Barone 1996). In arctic shrub tundra and boreal forests, folivory by insects on different species can range from 0 to 100 percent during outbreak of herbivore population (Coley et al. 1985). I have taken insects as the concern of my study because insects cause the major portion of herbivory damage (Coley and Barone 1996). Leaf damage by insects is called folivory. Plant defense against folivory is the strategic adaptation that can improve the growth and reproduction of plants. An array of physical and chemical defense is seen in the plants as the defensive weapon against folivores. The type and mechanism varies from species to species and from ecosystem to ecosystem. Understanding the defense mechanism requires diversified study from different plant of different ecosystems. As a tropical ecosystem, fresh water swamp forest possesses great importance in the biosphere. To the best of my knowledge, I found no literature on the plant-insect interaction in such forest in tropical region. Considering the scientific motif ahead, I have conducted my study at Ratargul Fresh Water Swamp Forest (RFWSF), the one and only of its kind in Bangladesh. I found mining effect of lepidopteran folivores at this forest which removes a significant amount of leaves every year. I suspect, there might be a significant hamper in the system due to this devastating folivory. The main objective of the study was to find out how the infected leaves vary in some selected physical (fresh weight, moisture content, specific leaf area, and leaf size) and chemical (amount of NO_3^- -N, and presence of various organic functional groups) properties from uninfected leaves within and between some selected tree species (Karach (*Pongamia pinnata*), Hijal (*Barringtonia acutangula*), Meruk (*Ficus hispida*), Panijam (*Syzygium formosum*) and Barun (*Crateva magna*)) at RFWSF. Both plants and their leaves were selected purposively and together qualitative and quantitative approach was carried out to find the result. No significant variation was observed in the traits of infected and non-infected leaves within species. Significant mean differences between species were found in leaf fresh weigh, moisture content (%), specific leaf area (SLA) and amount of NO_3^- -N whereas leaf area showed no significant difference. All the considered organic functional groups were present in all sampled leaf. The findings of the study support and contrast that those of other studies at the same time. The study will play the role as baseline information in the field of its interest in the studied fresh water swamp forest ecosystem.

Keywords: insect-plant relationship, plant defense, physical defense, chemical defense, organic functional group

OAK GALLS

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Oak trees are the most common hosts for gall producing organisms (mostly insects of the family Cynipidae and mites). Galls are teratological structures resulting from cell hypertrophy (increase in size) or hyperplasia (increase in number), following the bite or egg laying of these organisms, during a specific period of the year. Very diverse oak tumor, in form and size, were observed on the leaves, bark, flowers, buds, acorns and roots of oak trees, in forests around Lebanon. A little field study was conducted to understand the cycle of these irregular tissues growth and the secret of their diversity, something that would be interesting for future actions against this parasitism. Galls were collected from different parts of the trees during October and dissected. Most samples collected had developing larva, being nourished by the provided tissue of the plant. In fact the introduction of the initial egg, induced a hormonal disequilibrium in the meristematic cells of the normal plant tissue, causing the development of spectacular forms to receive one or more larva. Those parasite will grow slowly and hibernate waiting for the right moment to destroy their protective house and start a new cycle as adult insects. Specific to the parasite specie and the tree part infected, those galls have different levels of effectiveness, from being harmless to causing the death of heavily infested trees; leaf galls are the less harmful ones. Knowing that galls depend on the genetic heritage of both host and parasite, the control of this phenomena is hard, because each insect have a timing for egg laying. Using insecticide needs then more information about the insects in question and their cycles. The collection and destruction of the infested material is also a way limiting the number of the new generation, however the tree would have already suffered the extra work and energy required to build these various larva cocoons.

Keywords: *host/parasite, Cynipidae, oak tumor, levels of effectiveness, hormonal disequilibrium, specific.*

DEVELOPMENT IN REMOTE SENSING TO ADDRESS FOREST INSECT DEFOLIATION, A BRIEF REVIEW

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Forest pests affect the forest health and forestry production, insect infestation mapping is one of several applications where remote sensing has been used in forest health. Especially monitoring defoliation by insects in the forest by visual estimates in field samples have had only limited success due to its subjectivity, high cost and time requirement mainly to use before and after a major outbreak. Remote sensing can offer a data extraction more objective, automated, periodic and accurately at different resolutions and scales. However some trade-offs must be taken into account. Done this, the monitoring of forest pests by remote sensing has great advantages and potential. This work present a briefly review of the major developments in remote sensing techniques for monitoring insect defoliation.

Keywords: *Forest health, defoliator, imagery, monitoring, trends.*

***Monochamus galloprovincialis* FEEDING, OVIPOSITION AND DEVELOPMENT RESPONSE DIFFERENCES BETWEEN *Pinus pinea* AND OTHER PINE SPECIES**

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Transmission of the pinewood nematode (PNW) *Bursaphelenchus xylophilus* (Steiner & Bühner) Nickle (Nematoda: Aphelenchoididae), between *Pinus pinaster* Aiton trees in Portugal is known to occur either during *Monochamus galloprovincialis* (Olivier; Col.: Cerambycidae) adult feeding on twigs of healthy trees or during female oviposition on branches and trunks of dying or dead trees. The recently introduced pine wood nematode in Portugal and the serious risk that it means for Spanish pine stands demands the knowledge of the suitable hosts for its insect vector, *Monochamus galloprovincialis* (Olivier; Col.: Cerambycidae). *Pinus pinea* L. a common species in the Iberian Peninsula seems unaffected by the disease. Several experiments were realized to study the acceptability of Stone pine as a host for *M. galloprovincialis* feeding, oviposition and offspring development. Feeding responses were studied in two-choice experiments pairing *P. pinea* twigs with *P. pinaster*, *P. halepensis* Miller, *P. sylvestris* L., *P. uncinata* Miller, and *P. nigra* Arnold. Oviposition preferences by *M. galloprovincialis* females between *P. pinaster*, *P. pinea* and *P. sylvestris* were also studied in two-choice tests. Finally, suitability of Stone pine as a substrate for the development of *M. galloprovincialis* progeny was tested. Results showed that *P. pinea* could be an acceptable host for feeding and oviposition for the pine sawyer under lab conditions. *Pinus sylvestris* seems to be the preferred host following by *P. pinaster* on feeding. The percentage of successful egg laying wounds was significantly higher on *P. pinaster* following by *P. sylvestris*. *Monochamus galloprovincialis* progeny completed its development to adult on *P. pinea*, but emergence was lower than on *P. sylvestris*, likely due to a higher mortality during egg and early larval stages.

Keywords: Stone pine, *Bursaphelenchus xylophilus*, nematode, preferences, survivorship.

FUNGAL ENDOPHYTES REDUCE NECROSIS LENGTH CAUSED BY *Gremmeniella abietina* IN *Pinus halepensis* SEEDLINGS

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Gremmeniella abietina (Lagerberg) Morelet is a pathogenic fungus which causes severe damage in coniferous forests, producing the death of the trees, in Central and Northern Europe, North America and Japan. In Spain, where *G. abietina* has only been isolated from symptomatic *Pinus halepensis* trees, the fungal infections have not lead to epidemic outbreaks. Biological control (*i.e.* the use of biological antagonisms) is being considered an alternative and eco-friendly method to deal with plant diseases. Among such organisms several fungal endophytes have been successfully used to reduce or inhibit the growth of the pathogens. Thus, the aim of this study was to test the capacity of fungal endophytes to reduce the *G. abietina* advance on seedlings. The experiment was carried out under greenhouse conditions, on two-year old *P. halepensis* seedlings. Five fungal endophytes obtained from healthy *P. halepensis* trees were used to evaluate their effect on six *G. abietina* isolates. The pathogen and the endophyte were both inoculated in every seedling leaving a space of 2 cm between them. Two months after the inoculation the visual severity was assessed by following a severity scale (from 0 healthy to 5 dead). At the end of the experiment, seedlings were cut and brought to the laboratory where the necrosis length was measured. We evaluated the results in terms of visual severity and necrosis length produced by the pathogen. There were no significant differences in visual severity among inoculated plants with endophytes and the control ones. Nevertheless, control plants had a lower visual severity than the plants inoculated with pathogens. In addition, the presence of endophytes reduced significantly the necrosis caused by *G. abietina*. Those results may suggest that fungal endophytes could be an effective way of protection against *G. abietina* infections.

Keywords: biocontrol, antagonistic organisms, seedlings, greenhouse.

IN VITRO ANTAGONISM OF FUNGAL ENDOPHYTES OVER THE PITCH CANKER PATHOGEN

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Fusarium circinatum is the fungus causing Pitch Canker Disease of pine. Since its official detection in Spain in the year 2004 the pathogen has been found causing damages in nurseries as well as in pine plantations. Until now an effective method to control the disease does not exist, and the use of chemicals in the forest is day by day more restricted. On the other hand, fungal endophytes, those living within plant tissues without causing any damage to the host, has been used as biological controllers of some plant diseases. The aim of this work was to find endophytes showing antagonist effect against the pathogen to be used as biological control agents of the Pitch Canker Disease in the future. A total of 155 isolates were selected after a preliminary assay in which the antagonism against *F. circinatum* of more than five hundred fungi isolated from different pine species was tested. Several methods were carried out to quantify the effect of those endophytes over the pathogen growth in vitro. The most effective isolates were selected for future in vivo assays in which its ability to control the disease will be tested.

Keywords: *Fusarium circinatum*, biological control, *Pinus radiata*, dual culture, competition.

BARK BEETLES AND FUNGI ASSOCIATED TO PITCH CANKER DISEASE CAUSED BY *Fusarium circinatum*

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Fusarium circinatum is the causal agent of pitch canker disease (PCD) on pines. This fungus is a threat to *Pinus radiata* plantations due to the high susceptibility of this pine species. Several bark beetle species have been implicated as important vectors of spreading this pathogenic fungus in northern Spain and in California and they are also well-known for their association with other endophytic or pathogenic fungi. We hypothesize that the role of the different insect species has not the same importance in the disease spreading in our forests due to the differences in their ecology. The aims of this study are (1) to know what the role of Scolytinae species is, regarding *Fusarium circinatum* transportation and transmission in *P. radiata* plantations in Cantabria (Spain) and (2) to study the fungal diversity associated to both bark beetles and *P. radiata* affected forests. For these purposes, 3 kinds of traps were displayed in a *P. radiata* plot affected by *F. circinatum*, four Pityol baited funnel traps, six ethanol and α -pinene baited funnel traps and 12 baited logs. For better understanding the role of *T. piniperda* in *F. circinatum* transportation and transmission, fresh green shoots with *Tomicus* feeding gallery were collected from the ground. Both, insects from the traps and tissues (xylem and phloem) from the logs and shoots, were plated in culture media. The presence of *F. circinatum* was confirmed by PCR with primers CIRC1-CIRC4. Other fungi species were identified by ITS region sequencing, but in the case of *Fusarium* spp. α -TEF region was also analyzed. *Hylastes attenuatus*, *H. ater*, *H. angustatus* and *Ips sexdentatus* were the species most frequently found in the logs whereas *H. ater* and *Xyleborinus saxeseni* were the more abundant species collected in ethanol and α -pinene traps. *Fusarium circinatum* was isolated from 1.05 % of the *P. pubescens* specimens and from the 3.5 % of the shoots with *T. piniperda* feeding gallery. These results showed the important role of *T. piniperda* in *F. circinatum* transmission comparing with other bark beetles. *Fusarium* spp., like *F. oxysporum*, appeared in high proportion in tissues and insects. Furthermore, several endophytic species that commonly appear in pines were isolated from both insects and tissues. Some of them, like *Trichoderma* spp., are known for their role in biological control of *F. circinatum*.

Keywords: vectors, scolytids, *Pinus radiata*, endophytes, Cantabria.

RECAPTURE OF DISPERSING PINE SAWYER BEETLE, *Monochamus galloprovincialis* (COLEOPTERA: CERAMBYCIDAE) IN PHEROMONE-KAIROMONE BAITED TRAPS

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The pine sawyer beetle *Monochamus galloprovincialis* is a secondary pest of pine trees in Europe and North Africa. It has become a priority issue since it was reported as vector of the pine wood nematode, *Bursaphelenchus xylophilus*, the causal agent of the Pine Wilt Disease, in Portugal. Precise knowledge on the dispersal range by this insect is necessary for a sound management of stands with detected nematode infections, thus three different dispersal experiments were carried out in 2009, 2010 and 2011 in different pine stands: homogeneous stand with host breeding material (2009), very little host breeding material (2010) and some host breeding material (2011). 28, 56 and 64 12-funnel traps were placed respectively in concentric rings (2009) or grid pattern covering a distance from 500m (2009) up to 990m (2011) in the largest experiment. Traps were baited with kairomonal and the *M. galloprovincialis* specific pheromone lures. Escape of insects from the traps was prevented with a small piece of DDVP insecticide (2009) or nonstick substance on traps which were provided with a little piece of food. Insects were individually numbered using bee-tags. 174, 350 and 223 insects were released from the center of the set up traps, which were checked weekly over 15 weeks thereafter. Last experiment also compared behaviour between sexually mature and immature insects. 33.9%, 29.1% and 29.6% of the released insects were recaptured respectively. Most of insects were captured up to 200m from release point, although some of them were caught by farthest traps. Time required in reaching these traps varied from 2 weeks (2010) to 11 weeks (2009), result that is probably related with particular forest conditions as availability of host material. While mature insects were captured already the first week after release, immatures were so between the second and the fourth week, showing that *M. galloprovincialis* does not respond to these lures before sexual maturation. Some insects were captured twelve and thirteen weeks after release, showing a high life span of *M. galloprovincialis* adults in natural conditions. Data from 2009 experiment were analyzed by fitting Taylor and Hartstack & Witz power regression models, which have been used previously in other insect dispersal studies. After fitting, models provided information on the proportion of released insects that should be captured at a given distance from release point besides information about the trap efficiency, effective radius and interaction effect between dispersing insects.

Keywords: *Bursaphelenchus*, *Pine wilt disease*, *marked-released*, *Taylor*, *Hartstack & Witz*.

WILDFIRE PREVENTION IN THE MEDITERRANEAN WITH CASE STUDY IN TUNISIA

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Forests and other wooded lands are highly integrated into Mediterranean rural areas. Over the millennia, the civilizations that have followed each other around the Mediterranean rim have made use of the multiple social, economic and environmental goods and services provided by these territories, including food security. Since Mediterranean societies stopped living with fire, which they used as a tool for many purposes, and started to fight it, when the fire became a threat, the defence against wildfires became a priority. Wildfires can further have negative effects on human life and health, human property and wellbeing, cultural and natural heritage, employment, recreation, economic and social infrastructures and activities. This is why wildfires are already a preoccupation in the Mediterranean, managers are faced with a general trend of increased burnt areas and a rise in the frequency, intensity and severity of fires. One of the greatest challenges of sustainable forest management in the Mediterranean Basin is the fight against wildfires, a threat ever present and increasing because of Climate Change. Prevention of wildfires is the most effective tool in a context of limited resources investments on prevention are needed for the adaptation of Mediterranean forest. Given that Tunisia is a Mediterranean country which is also affected by the fires, assigning considerably its natural patrimony.

Keywords: *fires, forest, management, prevention, climate change*

ANALYSIS BASED ON TELE-DETECTION FOR GEOGRAPHIC INFORMATION SYSTEM FOR CORK OAK HEALTH AND HARVESTING MONITORING IN MAMORA FOREST

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The cork oak forests in Mâamora is affected by several environmental perturbation such as cork oak stripping, wildfires, pests and the lack of natural regeneration (due to human intervention) leading to its destruction and degradation. Studies conducted in this forestry area generated a huge amount of data. In order to compile efficiently all this data, we applied for several tools. The main objective of this study is to develop a geographic information system in order to assist the manager of the natural resources of the area, and thus influence the decision making. The first phase of our study consists a comprehensive diagnosis by existing data analyzes and resources available through bibliography, field work and interviews with the future users of the system, in order to monitor the forest areas. During the second phase, we generated the system based on object-oriented approach. This allowed us to develop the package diagrams, diagrams of use cases, class diagrams and sequence diagrams according to UML notation. In the third phase, the database was implemented in Microsoft SQL Server 2008 and there it was used the Visual Basic. Net. For mapping, we elaborated different indicators of forest health status. These maps produced SPOT image processing in ENVI 4.5 and ARCGIS 10. In addition, they were integrated with other potential maps of the area resulting in the SIGRN-Mâamora final output. From the metadata analysis result it is expected an application with convivial interface which will allow to stock, update, query and synthesize data relating with forest health, socio-economy and forest management. At the end, it gives the possibility of map consulting, surfing the internet, sending messages, printing and exporting the outputs of the information stocked in it.

Keywords: *Mâamora, natural resources, UML, database, SIGRN-Mâamora.*

RED PALM WEEVIL-A SERIOUS THREAT TO THE CANARY DATEPALM

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The red palm weevil (*Rhynchophorus ferrugineus* Olivier), member of *Coleoptera: Curculionidae* family has its origin in Southern Asia, where it was a serious pest of coconuts palms. Presently, the pest is reported in almost 50% of the date palm-growing countries apart from 15% of the global coconut-growing countries. It was first reported in the eastern region of the Kingdom of Saudi Arabia in 1985 and in the northern United Arab Emirates also in the same year. In 1992, the pest arrived to Egypt and it reached Spain in 1994. Later in 1999, it was also found in Israel, Jordan and Palestine. During last decade, the presence of red palm weevil has been detected in Italy (2004), Turkey (2005) and in Cyprus, France and Greece (2006) (Ferry & Gómez., 2002). The import of infected palm trees from North African countries had a significance and severe impact especially in the south-east Spanish communities, where palm tree has been considered as an important ornamental tree in the touristic urban areas (Maria J., 2012). The red palm weevil damages on the trees result from larval activities. The base of young leaves and wounds in the trunks are the main entrance and disposal areas for females (200 eggs approximately per clutch). The larva generally weaves a pupal case at the base of the palm fronds within the frond itself or at the center of the base of the plant. A life cycle can be completed within 3 months (3 or 4 life cycles per year). Generally, the adult weevils present in a palm will not move to another one, while they can feed on it (EPPO, 2008). It is very difficult to detect *R. ferrugineus* in the early stages of infestation. When symptoms (fallen crown leaves, for instance) are visible in the palm, infestation is already at an advanced stage and plant generally does not have ability to recover. The insect become invasive and aggressive with aid of incompetent governments from Asia to Africa and because of the transport of infested (primarily date) palms. The insect's reclusive ways, the need for acoustic equipment and skilled interpretation to detect active larva, the dilatory display of damage and the cost of current treatment, well beyond the reach of many in its path to Europe; have also militated in its favor. The danger presented by the weevil will only be overcome by concerted efforts in all areas where it is found.

Keywords: *Pest, infestation, clutch, symptoms*

VI SESION: GENETICS

Posters

KINEMATICS OF APICAL REGION IN TILTING STEMS OF FOUR PINE SPECIES

Nayla Rodríguez Mora

THE IMPORTANCE OF GENETIC VARIABILITY IN FOREST FOR CONSERVATION

Araceli Ruiz Guillamón

KINEMATICS OF APICAL REGION IN TILTING STEMS OF FOUR PINE SPECIES

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The study of active straightening of the stems after suffering an inclination has recently provided an interesting approach to the processes involved in controlling the straightness of the stem. Studies carried out with provenances of *Pinus pinaster* Ait have shown differences in righting ability in both the magnitude and speed of response. The straightening process has two phases: gravitropic curvature and autotropic decurvature, which in turn have two components, depending, respectively, of primary and secondary growth. In this paper we study the primary autotropic and primary gravitropic responses of four pine species (*Pinus pinaster*, *Pinus nigra*, *Pinus radiata* and *Pinus halepensis*). One year-old plants were tied to stakes at 45° to the vertical for two months and then released. This treatment was repeated during two consecutive years. Photographs were taken of each plant just after tilting, 24 hours later, and then every seven days. Variations in the apical curvature were measured on the photographs.

Keywords: *Pinus*, gravitropism, autotropism, grow kinematics, stem straightening.

THE IMPORTANCE OF GENETIC VARIABILITY IN FOREST FOR CONSERVATION

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Forests are complex ecosystems that cover a very important surface of the planet. Forests are vital to livelihoods and the economic and social development by providing food and raw materials for shelter, energy and manufacturing. They are also essential for environmental protection and natural resource conservation. Genetic diversity provides the foundation for the evolution of forest tree species. This diversity has allowed forests and trees to adapt to changing and adverse conditions for thousands of years and has resulted in a variety of unique and irreplaceable genetic resources of forest trees. However, the vast majority of forest genetic diversity remains unknown, especially in tropical forests. Survival in some species is linked on the degree of adaptation of the species to site conditions. In addition, the environmental component is a factor that can influence the genetic variability.