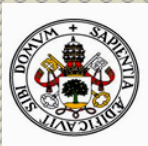


2014



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

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



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y Tecnología Agraria y Alimentaria

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PREFACE

Networking and ideas exchange is in the heart of Science development. As a consequence, there is a need for space and time to foster scientific ideas exchange. By developing our annual Young Researchers meeting we try to concentrate our energies in this goal so as during the last eight years, one more time we meet jointly students from different masters (scientific, professional and MEDfOR) and doctorate studies on Conservation and Sustainable Use of Forest Systems at University of Valladolid (Campus of Palencia). During these meetings, University of Valladolid students present and discuss their ideas and findings with colleagues and professors from our program and beyond.

This time Professor Fouad Mounir, from *École Nationale Forestière d'Ingénieurs-ENFI* (Morocco) and Professor Robert Wagner from University of Maine (USA) will accompany us to deliver talks and discuss with our students their research advances and goals.

Our meeting is now 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 65 students from 16 countries and four continents (from China to Argentina and from Bangladesh to Morocco including Portugal, México, Japan, Ucrania or Spain among others) will participate. The wide geographic distribution of the participants along with the diverse ecosystems studied, allow us to cover main forestry topics.

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 and the Erasmus Mundus Action 1 (through the MEDFOR consortium) have collaborated to make this event a success.

Also I would like to acknowledge 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.

I wish you an enjoyable read as we have had a nice time in our meeting at Valsain.

Prof. Dr. Felipe Bravo
Director
Sustainable Forest Management Research Institute, Universidad de Valladolid-INIA

The Organization Committee of the *VIII Young Researchers Meeting on Conservation and Sustainable Use of Forest Systems* welcomes all the participants and authorities to this event.

In this edition, 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 is defined in the setting of the Master and PhD. degrees taught jointly by CIFOR-INIA and the School of Agricultural Engineering of the University of Valladolid in which the students following the Winter School from the MEDfOR Erasmus Mundus Program have been invited.

In this book we have collected the abstracts of all the scientific contributions presented as keynote and invited conferences, 28 short talks and 25 posters. A digital edition of this Abstract Book will be available at the web page of the Institute (<http://sostenible.palencia.uva.es>).

One of the particularities of this Meeting is that the organization is carried out mostly by our Masters students, which participate not only in programming and all logistic tasks of the congress, including the edition of this book, but also acting as chairpersons and moderators of the scientific sessions.

Here we want to emphasize the active and enriching participation of those students accepting to be Chairpersons and Poster Session organizers and helping in hall tasks. We also want to thank all the Professors of the different Masters for their guidance and supervision of the presentations and abstracts which support the results discussed in this Meeting.

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

Prof. Dr. Elena Hidalgo
Coordinator of the Organization Committee

WELCOME CONFERENCE

PATTERNS OF NATURAL REGENERATION IN THE ACADIAN FOREST: 3 QUESTIONS

Dr. Robert Wagner

**Director of the Center for Research on Sustainable Forests (CRSF) and Cooperative
Forestry Research Unit (CFRU). University of Maine (USA)**

INVITED CONFERENCE

PUBLISH OR PERISH?

Dr. Juan José Luque Larena

Associated Professor (Zoology) E.T.S.I.I.A.A. University of Valladolid

PATTERNS OF NATURAL REGENERATION IN THE ACADIAN FOREST: 3 QUESTIONS

Robert Wagner

University of Maine. Orono, Maine, USA

Maine's Acadian Forest is largely managed using natural regeneration. This is possible because a wide range of commercially important softwood and hardwood species regenerate prolifically after nearly all forms of harvesting. The challenge to managing natural regeneration is understanding the driving variables and predicting the outcome. Our research group has been involved in a variety of experiments over the past decade that seek to better understand the process of natural regeneration following various forms of silvicultural manipulation.

In this presentation, I describe what we have learned by asking three specific questions:
What factors are driving the germination and survival of native and exotic tree species?
Does gap harvesting influence the spatial pattern of natural regeneration?
How does partial harvesting affect hardwood regeneration?

In the first study, we quantified the effects of forest canopy, vertebrate seed predation, grass competition, and season of dispersal on seed emergence and first growing season survival for three Boreal tree species, three species from temperate ranges, and three potentially invasive non-native tree species. We found that sowing date and predation were primary drivers affecting seed emergence of all tree species. Seed predation rates were correlated with seed weight, except for balsam fir, which was not affected by predation and helped partially explain why it regenerates so prolifically relative to other species. Grass and overstory modified seedling microenvironment, but not enough to affect emergence during a wet year. No correlation was found between species origin (boreal, temperate, exotic) and patterns of seed germination and survival under the various treatments. Patterns established during emergence stage by sowing date and predation generally determined survival through 1st growing season. Growth chamber results examining effects of temperature and moisture were not well correlated with field results.

Using a long-term experiment examining the effects of an expanding-gap harvesting system (Femelschlag), we tested how strongly the spatial pattern of natural regeneration was correlated with the pattern of gap creation. We tested the hypothesis that the grain of understory spatial pattern in tree regeneration and canopy openness will increase in stands treated with gap harvesting and as the size of the harvest gaps increase. A repeating pattern, cyclical sampling design was used. Semivariogram estimation and spatial autocorrelation were used to describe the spatial patterns of the natural regeneration. Results indicated that gap harvesting generated a more coarse-grained spatial pattern in natural regeneration relative to the unharvested control, and that the ranges of spatial dependence increased with increasing canopy gap diameter. Despite the correlation of regeneration spatial pattern with gap size, the location of the regeneration patches was not spatially correlated with the locations of gaps. Thus, gap harvesting

imposed a new spatial pattern of regeneration over a background pattern of regeneration events before gap harvesting was initiated.

By analyzing the results from several studies that used a range of canopy removal levels, we examined whether any inferences could be made about the pattern of hardwood regeneration under various levels of canopy removal. We concluded that: 1) Harvesting as a form of ecological disturbance favors regeneration of intolerant hardwood species; 2) Softwoods are recruited and maintained under a wide range of overstory removal levels; 3) As the degree of overstory removal increases, however, hardwood recruitment and growth are favored over softwoods; 4) Hardwoods increase steadily over many decades with low frequency, higher intensity harvests; and 5) Current patterns of partial harvesting in Maine's forest are likely to promote higher hardwood dominance over time.

PUBLISH OR PERISH?

Dr. Juan José Luque Larena

Associated Professor (Zoology)
E.T.S.I.I.A.A. University of Valladolid

In research, the worst consequence of publishing at any price is to not learn anything. And this can happen because publishing and discovering or progressing are not the same, although some people may get wrong with such terms. Nowadays, the career and recognition of scientists principally rely on their publications. In this context, the rules of doing science can be seen at some point as hurdles to fast publishing; and the temptation to take shortcuts appears. Often, the publication is no more considered as a mean of disseminating results but as an end in itself: thus, we end up working to publish and not to truly increase knowledge. No publications, no scientific career.

This talk will summarize and review some peculiarities and even social pathologies arising from this pressure for publications that seem to worsen year after year with the support and encouragement of academic authorities and rating agencies.

MANAGEMENT

Oral communications

SOIL ORGANIC CARBON AND SOIL NITROGEN STOCK, CONCENTRATION AND BULK DENSITY UNDER CHILIMO NATURAL FOREST AND ADJACENT LAND USES IN CENTRAL HIGHLANDS OF ETHIOPIA
Mehari Alebachew Tesfaye

PREDATION ON *Pinus pinaster* Ait. GROUND SEED BANK IN CENTRAL SPAIN
Irene Ruano Benito

A METHODOLOGICAL APPROACH TO MODEL THE GRASS-TREE RELATIONSHIP IN *Quercus suber* MEDITERRANEAN ECOSYSTEM
Slim Jarradi

FOREST INVENTORY WITH LIDAR AND PHOTOGRAMETRIC METHODS COMPARED TO TRADITIONAL TECHNIQUES
Sara Uzquiano Pérez

THE BIOLOGICAL ACTIVITY OF THREE FOREST SPECIES JEBEL ZAGHOUAN
Wafa Ben Brahim

EVALUATION OF TOURISM IMPACTS TOWARDS SUSTAINABLE CO-MANAGEMENT: A CASE STUDY AT SATCHARI NATIONAL PARK, BANGLADESH
Rupa Mehzabin

RESPONSE TO THINNING AND PRUNING OF BLACK PINE
Daniel Moreno Fernández

PLANT-PLANT INTERACTIONS AFFECT DEMOGRAPHY OF TWO COEXISTING GYPSUM SPECIALIST CHAMAEPHYTES
Ana Isabel García Cervigón

BIOMASS ALLOCATION OF NORWAY SPRUCE [*Picea abies* (L.) KARST.] TREES IN MANAGED AND UNMANAGED MIXED STANDS
José Juan Mena Costa

Posters

**FOREST MANAGEMENT PLAN IN “DEHESA EL REBOLLAR” CALZADILLA, CÁCERES
(SPAIN)**

David Cuelo Pablo

**ASSESSING FOREST MANAGEMENT AT THE LOCAL SCALE
A CASE STUDY FROM TUNISIA**

Abdelaziz Ben Abdallah

**DIVERSIFICATION OF *Pinus halepensis* FORESTS BY DIRECT SOWING *Quercus ilex*
ACORNS**

Marta Manrique Cobián

APPLYING LANDSCAPE ECOLOGY STRATEGY TO FIRE MANAGEMENT

Yu Ishida

GUM ARABIC IN SUDAN

Abdalmoniem Fadul

**CHARACTERIZE CAMPO GRANDE (LISBOA) VEGETATION USING WORLDVIEW-2
IMAGERY**

Cátia Traça

SOIL ORGANIC CARBON AND SOIL NITROGEN STOCK, CONCENTRATION AND BULK DENSITY UNDER CHILIMO NATURAL FOREST AND ADJACENT LAND USES IN CENTRAL HIGHLANDS OF ETHIOPIA

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About 40 % of the earth's tropical and subtropical landmass is dominated by forests. Dry forests accounted 70-80 % of the total forested area of Africa and around 50 % of the land area of existing forest in the Ethiopian highlands is covered with afro-montane vegetation, of which dry-afromontane forests account the largest part. Understanding soil organic carbon (SOC) and soil organic nitrogen (SON) stock and concentration is important for carbon management. However, information in this regard in Ethiopia is scanty. Thus, this study was conducted in Chilimo dry afro-montane forest and adjacent land uses in central highlands of Ethiopia, with the objective to investigate SOC and SON stock, concentration and bulk density of mineral soil and forest floor following an altitudinal gradient, land use types (natural forest, plantation forest, cultivated land and degraded land) and species (*Cupressus lusitanica*, *Eucalyptus saligna* and *Pinus patula*) along four soil depths (0-10, 10-30, 30-50 and 50-100cm). A total of 140 mineral soil and 140 cylinder samples (144 natural forest, 88 plantation forest, 24 cultivated lands and 24 degraded lands) were collected. 1006 stump samples and 41 piled dead wood and log samples were counted and measured. 40 (humus, litter, fine twig) samples were also collected in the forest floor where available. Chemical analysis of the soil was performed following a standard procedure. The statistical analysis results revealed that, SOC and SON stock and concentration and bulk density found in mineral soil were statistically significant along soil depth, altitudinal gradient, land use type and species ($p < 0.05$). The maximum value were found in mid altitudinal gradients and natural forest and minimum value were found in lower and peak altitudinal gradients and abandoned degraded land as compared to others. However, the highest bulk density was found in abandoned degraded land and the lowest were found in the natural forest. Consequently among the introduced tree species, soils sampled under *Eucalyptus saligna* had higher values as compared other two species. Thus, appropriate soil management options should be investigated to maintain sustainability of the Chilimo dry afro-montane forest. Furthermore, timely monitoring and temporal variation of soil organic carbon concentration should be made to provide updated information for local, regional and international users.

Keywords: Forest floor, mineral soil, stock, soil depth, altitude

PREDATION ON *Pinus pinaster* Ait. GROUND SEED BANK IN CENTRAL SPAIN

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Natural regeneration is a complex process driven by multiple factors during the different component processes: seed production, seed dispersal, ground seed bank, germination and establishment; each of which is dependent upon particular biotic and abiotic influences. The problem is to identify which particular influences are determinant for the success of the regeneration. Dynamic and size of seed bank could be a key component of natural regeneration, especially in Mediterranean ecosystems. Dormancy seed has been identified in *Pinus pinaster* Aiton delaying germination so during this period of time until germination dormant seeds can be predated by rodents, birds and insects. The objective of this study was to analyze the effect of predation on ground seed bank of *Pinus pinaster*. To accomplish this objective, seed rain has been controlled under four different levels of coverage in the experimental site in Cuéllar (central Spain). At the same time, the same amounts of seeds collected from seed rain were put on the ground to control predation, irrespective of the predator. In this way the effect on ground seed bank was analysed considering seed rain. Moreover seed predation could be analysed along the time because the experimental site was visited every month during three years. A generalized linear model was fitted considering seed bank of next spring as response variable and seed rain, different variables of micro-site conditions and annual variability as explanatory variables. After fitting different generalized linear models the following variables were selected: seed rain, distance to the nearest stump, basal area 200 m² around seeds, Walter's drought index and percentage covers of herbaceous species, pine needle and woody species with a positive effect and number of trees 200 m² around seeds with a negative effect on seed bank. If seed bank is estimated from seed rain data without considering predation this amount of seeds for germination during next spring is overestimated. Post-dispersal seed predation can be considered one of the bottle-neck in natural regeneration for *Pinus pinaster*. Although final seed bank is not null, it could be not enough because the difficult conditions to germinate and establish later generate a high mortality. Regarding biotic and abiotic influences, seed rain, summer drought and micro-site conditions are key questions to know the effect of predation on final seed bank.

Keywords: *seed dispersal, post-dispersal predation, natural regeneration, Mediterranean ecosystem, generalized linear model.*

A METHODOLOGICAL APPROACH TO MODEL THE GRASS-TREE RELATIONSHIP IN *Quercus suber* MEDITERRANEAN ECOSYSTEMS

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Livestock is socially and economically an important component for the livelihood of resource poor farmers in North Africa. A portion of livestock feed resources, is in fact a forest rangeland. Unfortunately, the sustainability of this resource is threatened by anthropogenic pressure. In this study a number of silvo-pastoral management systems were proposed to maintain the ecosystem balance, and to cope with Mediterranean climate variability and the negative impacts of human pressure. For this reason it was important to examine the major relations within the North African forest ecosystems, which is composed mainly of *Quercus suber* trees. The aim of this work was to develop models relating fodder production as the dependent variable to the independent variables; *Quercus suber* canopy cover, ecological factors, and human pressure. This paper presents the methodological approach used in Mamora (Morocco) and Kroumiry-Mogody Mountains (Tunisia). Initially, a forest inventory based on stratified sampling was conducted looking at density, height, and canopy cover. A comparative study was later established. In parallel, a survey was conducted in the surrounding agglomerations to assess the impact of human activities. The buffer technique was used to establish the relationship between fodder production and distribution, canopy cover, and human pressure. The methodology involved the creation of a specific zone around each agglomeration, which was mainly a function of the distance to the forest, the topographical features, and the number of domestic animals. The proposed approach will provide forestry managers with the ability to determinate different levels of anthropogenic pressure and to respond with contingency measures for each of these levels.

Key words: *Silvo-pastoral management; anthropogenic pressure, vegetation charting, VegMeasure, Quercus suber.*

FOREST INVENTORY WITH LiDAR AND PHOTOGRAMMETRIC METHODS COMPARED TO TRADITIONAL TECHNIQUES

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The location and weather where the trees grow make them to take different and characteristic shapes. The traditional method of measuring to achieve both the tree's dendrometry and canopy characteristics (forest mensuration) has been based on the use of caliper to record every trunk diameter at 1.3m high and on different techniques mainly based on trigonometry or aerial photography to determine the height of the tree. Nowadays new technologies such as LiDAR and digital photogrammetry are taking an increasingly large role in forestry management due to their ability to remotely sense height and diameter information for forest inventory purposes, making large data collection easier and faster. For this study, carried out in Cuellar (Segovia, Spain), with 7 plots sized 70m by 70m of *Pinus pinaster*, a survey have been conducted with different methodologies such as terrestrial LiDAR, photogrammetric images and in-field traditional inventory. In each plot, scans from 25 station points with a terrestrial laser scanner were conducted. 25 target spheres were used as tie points in order to allow the alignment of all scans in a common reference system. Once all point-clouds have been unified we will be able to measure every single tree. Also, two sets of aerial images were obtained by using a small unmanned multicopter (a quadrotor) that flew over the crop that encloses the 7 test plots taking vertical pictures at 60m and 160m height respectively. With this information, we have been able to measure the canopy cover. Finally, traditional measurement fieldwork (diameter at breast height, height at crown top and base as crown width) were conducted in each tree. In this paper we depict the comparison of the results of applying two different measurement methods by statistical analysis (chi-square test and linear regression) of the variables studied.

Keywords: *Pinus pinaster* Forest Mensuration, Dendrometric measures, unmanned aircraft vehicle (UAV), scanning.

THE BIOLOGICAL ACTIVITY OF THREE FOREST SPECIES JEBEL ZAGHOUAN

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The aim of this research is to study biochemical composition and antioxidant activity of extracts from the leaves of *Pistacia lentiscus*, *Phillyrea angustifolia* and *Globularia alypum*. In this study, we find that the results of all tests showed significant differences ($P < 0.05$). The contents of phenolic compounds ranged from $175.67 \pm 5.61 \mu\text{gEAG/gMS}$ (*P.angustifolia*) to $91.42 \pm 25.60 \mu\text{gEAG / gMS}$ (*G.alypum*) for methanol extracts and $206, 17 \pm 24, 46 \mu\text{gEAG/gMS}$ (*P. angustifolia*) to $111.08 \pm 8.89 \mu\text{g EAG / gMS}$ (*G.alypum*) for hexane extracts. Flavonoids are phenolic compounds majority, the highest level is in *P. angustifolia* with $(1117.11 \pm 3.7483 \mu\text{gEQ / gMS})$ and lowest among *G.alypum* with $(100.39 \pm 1.66 \mu\text{g EQ / gMS})$. The antioxidant activity differs from one plant to another. The results of the antiradical activity (DPPH) are significantly different ($P < 0.05$), the percentages ranged from 85.04% (*P. lentiscus*)% to 49.43% (*G. alypum*) for extracts methanolic and 82.35% (*P. angustifolia*) to 47.35% (*G. alypum*) for hexane extracts. The results of the present study indicate that the selected plants are rich in antioxidants such as phenolic compounds which have the property of trapping free radicals and reduce oxidative.

Keywords: *Pistacia lentiscus*, *Phillyrea angustifolia*, *Globularia alypum*, polyphenols, flavonoids, antioxidant activity,

EVALUATION OF TOURISM IMPACTS TOWARDS SUSTAINABLE CO-MANAGEMENT: A CASE STUDY AT SATCHARI NATIONAL PARK, BANGLADESH

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Tourism is an increasingly important component of the economies of many countries. For some countries including Bangladesh it is a significant source of income, employment and investment. Tourism expansion creates both positive and negative impacts on the destination area. It is a good source of revenue for Bangladesh and important to its economy. The purpose of this study is to understand the socio-cultural, economic, institutional and environmental impacts of tourism development on the residents in and around the Park Forest. This area is potential for nature tourism because of its beauty and proximity to capital, a feel of luxuriant vegetation of evergreen forests and good landscape with rolling hills and interspersed valleys and particularly for those that love bird watching. People from home and abroad gather in large number during the peak season (from November to March). A survey was conducted in May, 2011 in SNP and its surrounding villages. Among a purposive sample of IPAC officials and residents of landscape zone, 55 questionnaires, with 20 tourism impact statement to know the residents' perceptions, were administered with a response rate of almost 100%. The results show that respondents strongly agree with the idea that tourism provides many economic and socio-cultural benefits, but the residents are ambivalent about its costs. The residents also mentioned some negative consequences on social, cultural, economic, institutional and environmental sides. It was also found that residents tend to recognize tourism benefits. Therefore the findings from this research are valuable at least in helping to develop strategic management plans for SNP tourism in the way that the local residents are to be taken as tourism development partner and the positive impact surfaced from this research should be reinforced for manifold benefits to the tourism stakeholders including the local community. And the negative impact of tourism as found out in this study should be ameliorated for the greater benefit of the local community and tourism in SNP as a whole.

Key words: Stakeholders, IPAC, Protected area, Alternative Income Generation (AIG), Ecotourism, Community based tourism.

RESPONSE TO THINNING AND PRUNING OF BLACK PINE

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Pruning treatment allows to obtain knot-free timber to increase the value of the highest-value wood products. Also, in Mediterranean areas, pruning is often carried out to reduce the risk and severity of forest fires reducing the amount of biomass and break the fuel vertical continuity between the surface and crown. However, the effect of pruning on growth is discussed and the knowledge about the tree response to the simultaneous development of thinning and pruning scarce. The objective of this study was to analyze the effect of the interaction of thinning and pruning on tree and stand level and annual radial growth of black pine (*Pinus nigra* Arn.) in Central Spain. We used long-term data from a trial installed in Guadalajara in 1993 when the stand was 26 years old. At the installation moment, four treatments of thinning and pruning with four repetitions in 16 plots (0.1 ha) were evaluated: thinning from below pruning the best trees, thinning from below without pruning, selective thinning pruning crop trees and control treatment. The second thinning was applied in 2006. Five dasometric inventories have been carried out so far. Additionally, at the beginning of 2013, we collected ten cores per plot which were used to register the ring-width, the annual radial growth, in order to find differences between pruned and not pruned trees. For the analysis of the data from dasometric inventories, we used a repeated measures analysis of variance mixed model to evaluate the effect of the thinning and pruning on diameter, height and basal area increment, including an independent-distance competition index. Moreover, we used a semiparametric approach, smooth penalized splines including climatic covariates to describing the trend of the annual radial growth with time of each treatment. Both the results of the analysis of variance and the smooth penalized splines showed that pruning did not reduce the height growth, diameter increment or annual radial growth. Also, trees subjected to thinning, both with or with pruning reached larger annual radial growth and larger diameter increments than those subjected to control plots. Regarding, basal area increment we did not find statistical differences among treatments. Therefore, we recommend the development of this treatment in order to get clear-wood and increase the value of the products. Furthermore, the amount of biomass and the fuel vertical continuity between the surface and crown can be reduced to decrease the risk of crown fire without a loss of yield.

Keywords: *knot-free timber, smooth penalized splines, climate, mixed models, BAL.*

PLANT-PLANT INTERACTIONS AFFECT DEMOGRAPHY OF TWO COEXISTING GYPSUM SPECIALIST CHAMAEPHYTES

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Plant-plant interactions are one of the main forces driving community structure because of their effect on individual performance and demography. However, most approaches in plant population ecology usually model vital rates without considering the effect of biological interactions. Our aim was to cover this gap by modelling the main vital rates of two species that coexist in the same community considering their mutual effect to account for intra- and interspecific interactions. In order to accomplish this aim we monitored two small shrubs inhabiting semiarid gypsum environments during 9 years (2004 to 2012). The study area was located in one of the main Iberian gypsum outcrops at Belinchón (Cuenca province, 40°3'20" N, 3°3'31" W, 720 m a.s.l.). Climate is semi-arid Mediterranean with an extreme summer drought. Our target species were the gypsum specialists *Helianthemum squamatum* (L.) Dum. Cours. and *Lepidium subulatum* L. Two areas (blocks) located 300 m apart were selected and 50 sampling plots of 0.5 x 0.5 m were established at each one. Every *H. squamatum* and *L. subulatum* individual in the plots was marked and monitored, taking its status (alive or dead), size (height and two perpendicular diameters) and flowering intensity. Number of seedlings per plot was also counted to estimate fecundity. We constructed Generalized Linear Models (GLMs) for survival, probability of reproduction (both with binomial error distribution) and fecundity (quasi-Poisson error distribution) of both species. As explanatory variables we included focal plant size, block, cover of biological crust, shrubs, and individuals of the same and the other species, averaged minimum winter temperature, spring rainfall and summer water deficit. We combined these variables in an additive way and selected the more informative model following the Akaike Information Criterion (AIC). *Helianthemum squamatum* vital rates were affected by conspecifics (survival increased but the probability of reproduction and fecundity decreased with higher intraspecific cover). *Lepidium subulatum* survival was affected positively by its conspecifics. *Helianthemum squamatum* exerted a negative effect on *L. subulatum* survival, suggesting interspecific competition, whereas the effect of *L. subulatum* on *H. squamatum* fecundity was positive, suggesting interspecific facilitation. Summer drought and winter temperature exerted detrimental effects in survival and fecundity of both species, but spring rainfall had species-specific response. Our results show that considering intra- and interspecific plant-plant interactions play a crucial role in determining demographic response of species, providing a more accurate view of population dynamics in the community context.

Keywords: fecundity, interspecific interaction, model selection, reproduction, survival.

BIOMASS ALLOCATION OF NORWAY SPRUCE [*Picea abies* (L.) KARST.] TREES IN MANAGED AND UNMANAGED MIXED STANDS

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This study is focussed in the experimental stand 113A6 situated in Klepačov, Forests District Olomučany, Training Forest Enterprise Křtiny. It lies 17 km North of Brno, Czech Republic. Climate in the area of study is considered mild temperate. This stand can be considered as a single tree mixture formed by spruce, pine, fir, larch and beech. Natural regeneration was performed predominantly in 1928 to 1933. In this stand was established a control plot (C) in which only dead trees were removed; other thinning plot with positive selection from above (A) approach and other thinning plot with negative selection from below (B). Dendrometric basic were measured and recorded for all trees on five years. Stem wood volume under bark, growing stock and stand density was calculated to assess production potential of spruce, fir, pine and larch on the control plot from 1961 to 2001. Also, aboveground biomass (AB) was calculated using Biomass Expansion Factors (BEF) and Biomass Equations (BEq) at stand level, at tree level and only for Norway spruce trees by compartments. Nonparametric tests were performed to compare between the two biomass estimation methods and between plots. BEF overestimated aboveground total biomass. The statistical differences in the total aboveground biomass of the plots showed that thinning from below approach improved the biomass accumulation in this stands. By species, Norway spruce trees presented the most dynamic production in volume and in biomass in all plots. Its relative stand density was the higher in all plots and the removal of trees was the lowest, either by intentional cutting or salvage cutting. Also this tree species is able to survive as a subdominant tree for a long time. At an age of 30 years the biomass proportions by compartment were similar. 1:1:2:4 was the approximately rate of this the dry matter for needles, dead branches, branches and stem, respectively. This proportion suffered different changes within the plots in the pass of the years but between management approaches, AB proportions had not significant differences in all the compartments.

Keywords: *Aboveground biomass, Biomass Expansion Factors, Biomass Equations, thinning from above, thinning from below.*

REGENERATION INDEX FOR DEHESA SYSTEMS

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The real problem of regeneration in Dehesas has motivated this study to know how we could improve the forest management and animal husbandry because of the lack of regeneration and forest management plans in this area, and the situation of this Mediterranean ecosystem. To beginning with, a division should be made in the study area in Calzadilla, Cáceres. This division takes into account different type of vegetation, annual plant growth, erosion, regeneration, tree density and diameter at 1.30 meters. Three main species are oak, cork oak and green oak. With all this data a general index was elaborated, working with every feature and five previous index, one with each data. First regeneration area is the surface who has the maximum index, which is this, that has no trees. Four different regeneration areas was made with a quarter of total surface, bound with haunting mesh during ten years, so total length for this plan is forty years. The three remaining quarters was used to feeding cattle and wild animals. After this, a new cork oak management plan was made to bring about more profits in a three years turn, with three different stands, instead only one. In the last part of the study a plant was made and the road improvement should be done every six years. The final result pretend a 40 trees per acre density, with younger age classes and improve the soil erosion protection and natural regeneration.

Keywords: *regeneration, excess livestock, cork, bound area, improvement.*

ASSESSING FOREST MANAGEMENT AT THE LOCAL SCALE: A CASE STUDY FROM TUNISIA

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Sustainable forest management (SFM) calls for balancing diverse ecological, social, and economic values over space and time that express sometimes conflicting management objectives. In Tunisia, forest managers are under intense pressure to manage forest lands for a variety of purposes, and multiple users. The need for studies assessing the forest management sustainability and the difficulties associated with the identification of pertinent local criteria and indicators of forest management sustainability prompted us to carry out the present study. Its objective is to identify and select appropriate sets of local criteria and indicators that can objectively assess the trend and the extent of achievement of sustainability. Through a case study, in addition to evaluating forest management sustainability, the goal of this study was to focus on the importance of improving forest governance. We want to prove that forest governance should be more effective than a single strategy focusing on law enforcement to face the problem of illegal acts and conflicts over resources, it should also offer concepts that reinforce and strengthen the implementation of sustainable forest management on the ground at local level. While good forest governance is important at all levels, from international to local, it is particularly so at the local level, where a large number of higher level decisions can be implemented, ignored or even contradicted.

Keywords: *Criteria, indicators, Forest governance, sustainability, Local.*

DIVERSIFICATION OF *Pinus halepensis* FORESTS BY DIRECT SOWING *Quercus ilex* ACORNS

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The holm oak is considered one of the most emblematic and representative species of the Iberian Peninsula, but the natural regeneration of this species in Mediterranean ecosystems is constrained by abiotic factors (e.g. hydric stress) and biotic factors (e.g. seed predation). Generally, forest restoration programs have used plants from forest nursery with low percentages of success. Direct sowing of acorn offers advantages over the plantation, but the main limitation of this technique is the depredation of seed by mammals, usually wild boar, roe deer, rabbits and rodents. The aim of this investigation is to offer a solution to this problem with the installation of a seed individual protector (patent number A01G13/02), limiting access to the seedling and the acorn, and that will allow us to analyze the feasibility of direct sowing. Trial plots are located in the province of Valladolid under pine stands of Aleppo pine (*Pinus halepensis*) that come from artificial afforestations. There, we have a comparison study, between direct sowing and plantation with plants from forest nursery. This way can learn, in addition, microclimatic conditions, at the level of individual, that allow the development of the seedlings under these stands and deliver improvements to diversification of the pine forests.

Keywords: *Holm oak, Regeneration, Acorn predation, Seed protector, Aleppo pine stands.*

APPLYING LANDSCAPE ECOLOGY STRATEGY TO FIRE MANAGEMENT

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Forest fire is one of the major issues to be considered in Mediterranean region. Although in some cases fire promote the evolution of ecosystem, increase in the number of fire and area burned the 20th century has created the perception that fires are disasters. In fact predicting occurrence of fire has been a challenge but development of new techniques such as GIS helps monitoring and understanding the changes of dynamics of landscape. The main objective of my work is to observe the landscape of Alto Mijares, the region of Castellon in Spain. In this area there was a big disaster of fire in 1994 and it caused its landscape to change. Four raster layer images of Landsat from different years (1984, 1991, 1995, 1998) are used for a study case. The specific study area is Middle-Western part of Alto Mijares. The area is composed of seven classes which are Non-combustible, Ligneous Farming/Burned areas, Low shrubland (Juniperus), Medium shrubland (Cistus), Maquia, Aleppo pine forest, and Holm oak forest. A computer program Idrisi is applied to compose maps and later Fragstats is applied to calculate all the matrices of the landscape. Comparing all the matrices from different years clearly showed influences of fire. After this observation post-fire management is considered to prevent and to minimize the impact of fire.

Keywords: *Mediterranean ecosystem, disturbance, dynamics, post-fire management, landuse change*

GUM ARABIC IN SUDAN

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The total area 1 861 484 km², about 69,949,000 ha of Sudan is forested; it is bounded on the east by the Red Sea and is surrounded on the other sides by six African nations. Its terrain is characteristically flat, except for a few mountain areas, The River Nile is composed of two main branches, and the two rivers unite in Khartoum to form the River Nile that runs to the Mediterranean Sea. Gum Arabic is the most important NWFP to Sudan because of its sizable Contribution to economy. Being central to country's economy it deserves specific policy guidance. About 87% of the land allocated to gum production is privately owned. The focus of policy options on gum Arabic is the increase of the share of benefits for the owners of the land and workers in the production activities of the commodity. Incorporation of producers in local trade groups, production cooperatives and Producer Associations will be encouraged and the development of local enterprises and processing capacity will be enhanced. The government will promote the free operation of the private sector and will limit its interventions to the supplying of services and developing of infrastructures supportive to production and marketing. The government will maintain a regulatory framework to protect product quality and apply certification and labeling practices that indicate products origin to protect the product positioning and brand value in international markets.

The role of gum farmers is contained in growing the acacia tree gardens and collecting the gum and selling it to retailers, while the role of the gum company is to promote the gum marketing. Private enterprises (like Jandail) and communities benefited from these out-growers developments, which could be directed to rural development. Though the rights and responsibilities of the different partners in the gum Arabic out-growers system is not documented it is institutionalized in the sense that the FNC is guarding and enhancing the system towards satisfactory production conditions and gum marketing, particularly in connection with gum producers' association, The major part, almost 90%, of forest land is under government control while limited forest lands are owned by communities and the private sector. at communal level, most of the tenure rights for forest, tree and pasture resources.

Keywords: *Forest areas, Management systems, Production, Export, the economic importance.*

CHARACTERIZE CAMPO GRANDE (LISBOA) VEGETATION USING WORLDVIEW-2 IMAGERY

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Accurate information in vegetation classification is still very dependent of aerial photographs. Although, is believed that recent launched satellites as Worldview-2 with higher resolution data mitigate the limitations of automatic processing techniques and address feature classification challenges. Worldview-2 images have eight multispectral bands at 2.08m off-nadir resolution and a radiometric 11-bit extension corresponding to 2048 digital levels providing the highest resolution images. It was expected that Worldview-2 resolution levels differentiate the main urban components at the third level by allowing the definition of its spectral profiles. This preliminary analysis was conducted at sensor launch (2009) and aims to check its spectral performance for classification of urban elements in Lisboa. The use of supervised pixel classification methods had result on 14 CORINE land cover classes differentiation with 95% accuracy and high concordance (Kappa coefficient=0,94) using maximum likelihood algorithm. Polygon shapes of four vegetation taxon were crossed with its vegetation index (Normalized Difference Vegetation Index) in GIS environment to characterize their chlorophyll content.

Keywords: *Worldview-2, vegetation spectral profile, maximum likelihood, NDVI, GIS.*

CONSERVATION

Oral communications

**FOOD TREE SPECIES: USE AND THREAT PERCEPTION IN TWO AGROECOLOGICAL
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Maria Dolores Agúndez Leal

**RESTORATION EFFECT ON VEGETATION DYNAMICS IN THE PEATLAND COMMUNITIES
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**EARLY DYNAMICS OF NATURAL REVEGETATION ON ROAD SLOPES IN THE
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**HYDRAULIC AND BIOLOGICAL EVALUATION OF A VERTICAL SLOT FISHWAY IN VEGAS
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DIMP 1.1: FRESHWATER FISH POPULATION DYNAMICS SOFTWARE

Víctor Manuel Salgado González

***In vitro* ORGANOGENIC RESPONSE OF *Nolina parviflora* (H.B.K.) HEMSL.**

Andrés Flores García

**DYNAMIC OF SACRED VEGETATION IN THE CONTEXT OF THE EVOLUTION OF
LANDSCAPE OF THE PROVINCE OF LARACHE (NORTHERN MOROCCO)**

Houda Bensalah

FOOD TREE SPECIES: USE AND THREAT PERCEPTION IN TWO AGROECOLOGICAL REGIONS IN NIGER (WEST ÁFRICA)

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Forest tree species play a fundamental role in feeding of rural populations in Niger, especially in periods of scarcity. It is important to understand how local people use and manage these species. The study focus on the period of scarcity of food, the importance of the products of spontaneous woody species as ingredients in the diet, in its mode of use, as well as in the appreciation that local populations have on the forest environment and on the conservation status of priority species, seeking for any differences due to gender. The communities of the two agro-ecological zones studied are highly dependent on forest species at the time of food shortage, by its use of leaves for the preparation of dishes and fruit consumption as snacks. This dependence is higher in the Sahelian zone. Anza (*Boscia senegalensis* (Pers.) Lam. ex Poiret) deserves special attention as staple food especially in this area. The food tree species are found in semi-natural status. The rural populations practice some kind of conservation, while management of food forest species is practically reduced to its use. The populations surveyed identify certain species in regression and all species cited are under some kind of threat. The intensity of threats varies by region, species and the factor studied. The role of women and men is not the same in food production; even though, they have the same criteria in prioritizing forest species as food and in the assessment of their conservation status. The information obtained in this study is of great value to design a program of conservation and sustainable management paying attention to the real needs of the local population. The paper concludes on the importance of focusing efforts on those species most valued by local communities affected by food insecurity. A participatory method is proposed to design a conservation program. For this purpose, some activities are needed to be undertaken: the development of a potential mapping, a herbarium, a lexicon – guide, the establishment of conservation parcels, and the study the reproductive biology and genetic diversity, as well as the installation and adaptation of these species to extreme drought conditions.

Keywords: food security, tree, forest management, conservation, Sahel.

RESTORATION EFFECT ON VEGETATION DYNAMICS IN THE PEATLAND COMMUNITIES OF THE EBRO RESERVOIR SURROUNDINGS (BURGOS, SPAIN)

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Peatlands represent a spatially restricted habitat in Spain and they are home to a rich flora, including several rare plant species (*Myrica gale*, *Sphagnum* spp., *Eriophorum vaginatum*, *Drosera rotundifolia*). Peatlands in northern Spain have been specially affected by intensive human land use where they may be drained for peat extraction or simply disappeared under urban and industrial development. Accordingly, the fragmentation and loss of these habitats might have a significant impact on local and regional biodiversity. They are valuable ecosystems that usually do not have a good conservation state and there is a lack of knowledge on the restoration effect of such sites. We assess whether restoration has changed vegetation composition on degraded peatland communities. The study is carried out in central-northern Spain and we compare species composition and diversity of vascular plants and bryophytes on three sites: a restored peatland, an unrestored peatland and a natural peatland. Pristine peatlands provide a reference point for assessing the restoration effect of the degraded peatlands. During the course of succession, we predict that species composition and plant diversity in restored peatlands may stabilize at levels similar to pristine peatlands.

Keywords: Peat extracton, degraded, bryophytes, diversity, succession.

EARLY DYNAMICS OF NATURAL REVEGETATION ON ROAD SLOPES IN THE SALAMANCA PROVINCE (CW SPAIN)

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The increasing global rate of road construction is leading to a parallel increase of environmental degradation, which is causing the increase of our environmental awareness, and thus the need to restore affected areas is increasingly important. Revegetation of road slopes has an undeniable interest both from a landscape point of view as from soil protection and erosion control, but this interest collides with the lack of information on spontaneous colonization and subsequent dynamics of vegetation in them. Natural revegetation studies over time allow us to classify species according to the successional stage in which gain importance and to select the most suitable species for revegetation of a particular area. In this context, this study, based on the hypothesis that successful spontaneous colonizers are the most suitable species for revegetation of these degraded areas, try to analyze and improve our understanding of the factors that control the natural processes of colonization, establishment and early dynamics of vegetation on semiarid Mediterranean road slopes in the province of Salamanca (Spain). We selected 52 road slopes varying in time since construction (≤ 1 year to 10 years) on the three dominant lithologies (tertiary sediments, slates and granites) and on two aspects (north/south). Environmental factors were monitored and related to species cover using a combination of multivariate analysis and Huisman-Olff-Fresco modeling. We found that most represented taxa were Poaceae, Asteraceae and Fabaceae both in species richness and cover, and also prevailed therophytes. Lithologie, surrounding vegetation and proximity between slopes had a great effect on the floristic composition of plant communities during succession. The age influence was not equally evident on all lithologies, as the steepness, and height and type of slope, only significant when lithologie is considered separately, and no influential on granites, where succession was slower. There was a tendency for taxonomical group, life-form and dispersal-mode replacement during early succession, although anemochorous therophytes continue to be the most common species. Our results indicate that in a relatively short time, vegetation communities spontaneously installed on road slopes are rich in species.

Keywords: *Ecological restoration; Semi-arid Mediterranean climate; Cut slopes, Forward selection; Correspondence analyses; Species colonization patterns*

HYDRAULIC AND BIOLOGICAL EVALUATION OF A VERTICAL SLOT FISHWAY IN VEGAS DEL CONDADO, LEÓN (SPAIN)

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Rivers all around the world are interrupted by a wide diversity of structures; the most important are dams. Therefore, human been has developed different systems to try to mitigate the consequences of their impact. Fishways are one of them. In this study we try to evaluate the efficiency of a fishway in Vegas del Condado. The evaluation was executed by two different methods. The first was hydraulic evaluation based on a flow into the fishway. We measured the flow, discharge coefficient, water speed and power dissipated into the fishway. The second method was a biological evaluation based on the application of a radiofrequency dispositive on a sample of *Salmo trutta* from a fish farm and another sample from the river, both are from the river where is placed the studied fishway. We analyzed the movements of the fishes into the fishway with the considered flow for the hydraulic evaluation (244.88 m³/s) and other two different flows (339.42 m³/s and 384.92 m³/s). Discharge coefficients measured were between 0.506 and 1.045. These values are found out of the set of previous consulted studies. On the other hand, values measured for the dissipated power in the fishway were between 52.305 W/m³ and 170.363 W/m³. These values are between the set of values found in other publications. During biological evaluation, we usually observed the same results for all considered flows. With all these results, we can conclude: hydraulic evaluation lets us establish this fishway works in appropriate conditions for *Salmo trutta*. Biological evaluation gave us enough information to conclude that, for this situation, fishes from this river are less active than fishes from the considered fish farm, males studied are more active than females and in this case, usually, fishes from river are faster than fishes from fish farm ascending the fishway. Finally, it was observed that higher flow foments more movements into the studied fishway.

Keywords: *Fish pass, fish ladder, Salmo trutta, fish farm, radiofrequency.*

PHYLOGEOGRAPHY OF *QUERCUS VARIABILIS* BASED ON CHLOROPLAST DNA SEQUENCE IN EAST ASIA: MULTIPLE GLACIAL REFUGIA AND MAINLAND-MIGRATED ISLAND POPULATIONS

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The biogeographical relationships between far-separated populations, in particular, those in the mainland and islands, remain unclear for widespread species in eastern Asia where the current distribution of plants was greatly influenced by the Quaternary climate. Deciduous Oriental oak (*Quercus variabilis*) is one of the most widely distributed species in eastern Asia. In this study, leaf material of 528 *Q. variabilis* trees from 50 populations across the whole distribution (Mainland China, Korea Peninsular as well as Japan, Zhoushan and Taiwan Islands) was collected, and three cpDNA intergenic spacer fragments were sequenced using universal primers. A total of 26 haplotypes were detected, and it showed a weak phylogeographical structure in eastern Asia populations at species level, however, in the central-eastern region of Mainland China, the populations had more haplotypes than those in other regions, with a significant phylogeographical structure ($N_{ST} = 0.751$, $G_{ST} = 0.690$, $P < 0.05$). *Q. variabilis* displayed high interpopulation and low intrapopulation genetic diversity across the distribution range. Both unimodal mismatch distribution and significant negative Fu's F_S indicated a demographic expansion of *Q. variabilis* populations in East Asia. A fossil calibrated phylogenetic tree showed a rapid speciation during Pleistocene, with a population augment occurred in Middle Pleistocene. Both diversity patterns and ecological niche modelling indicated there could be multiple glacial refugia and possible bottleneck or founder effects occurred in the southern Japan. We dated major spatial expansion of *Q. variabilis* population in eastern Asia to the last glacial cycle(s), a period with sea-level fluctuations and land bridges in East China Sea as possible dispersal corridors. This study showed that geographical heterogeneity combined with climate and sea-level changes have shaped the genetic structure of this wideranging tree species in East Asia.

Keywords: *Quercus variabilis* population, Phylogeographical Structure, cpDNA, Eastern Asia, Quaternary.

DISTRIBUTION PATTERNS OF THE PALENCIA FOREST SPECIES ALONG A LATITUDINAL / ALTITUDINAL GRADIENT USING DATA FROM THE NFI 3

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In this study, we combined the analysis of a coenocline with Huisman-Olff-Fresco (HOF) modeling of species behavior to describe the distribution patterns of forest species into the Palencia province (central-northern Spain), from data of the 3rd National Forest Inventory (NFI). We hypothesize that landscape variation in abiotic factors along the altitudinal/latitudinal gradient that appears from the north to the southern of the Palencia province affects the floristic composition of its forests. To understand these factors, we analyzed changes in floristic composition and abundance of the main forest species according to the spatial variability of some topographic, edaphic and climatic parameters. Our results showed how the primary coenocline extracted from DCA1 reflected a gradient in environmental conditions influencing the floristic composition of forests, from the more Atlantic, cold and moist forests on the moderately acid and rich soils of the mountains of the northern of the province to the sub-humid and semi-arid Mediterranean forests of the middle and the southern. This distribution pattern is affected by landscape variation in abiotic factors such as the increase in altitude, steepness, rainfall, organic matter and soil moisture, and the decrease in pH, temperature, light and salinity, from the south to the north. 87% of trees and shrubs species HOF modeled showed symmetric or skewed unimodal responses reaching their optima at different points along the environmental gradient extracted; being *Fagus sylvatica* and *Quercus petraea* are the species more abundant in the Atlantic mountain forests, and *Quercus ilex* and *Quercus faginea* on the limestone moorlands of the south. The pine reforestations, present along the whole environmental gradient, are mainly of *Pinus sylvestris*, *Pinus pinaster* and *Pinus nigra* at the northern end of the gradient, and of *Pinus halepensis* and *Pinus pinea* at the southern end one on gypsum soils of the moorlands. Tree species with their optima in the middle of the gradient such as *Q. ilex*, *Q. faginea*, *Q. pyrenaica* and *P. nigra* have wider niches than those on both ends such as *Q. Petraea* and *P. pinea*, probably because they occupy transitional environments.

Keywords: *coenocline, Detrended Correspondence Analysis, species composition, HOF modeling, niche range.*

STATE AND REGENERATION OF *ARAUCARIA ARAUCANA* IN IX REGION OF ARAUCANÍA (CHILE)

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Araucaria belongs to temperate forests which conservation is extremely important because of different factors, emphasizing the economic, socio-cultural and ecological. Its longevity has allowed the establishment of forests with stunning ancient trees that support high biodiversity. Despite legal protection, currently, natural regeneration is scarce and forest of *Araucaria* remains under continued pressure, decreasing its area. The main aim in this study is to determine the present state of regeneration of *Araucaria araucana* in Chile in both coastal (Nahuelbuta and Caramávida) and Andes range (Icalma, Conguillío, Nalcas and Lolco). The methods involving measurements such as distance between the center point of the plot and the distance between regeneration and regeneration plants are used. It is important, complementary to define the phytosanitary status and major threats that regeneration is sampled in each area. Topography and climate, but also human interventions affect forests; however, there are not significant differences between both population coastal and Andes distribution. Results show that *Araucaria* in Lolco (Araucanía region) is significantly different to the other scenarios regarding population density. In this location, the species present a lower density, presumably due to grazing and other secondary factors. In this study is also provided and updated summary of the forest management of *Araucaria araucana* species by the Mapuche pehuenche tribe, in which the species is a fundamental pillar for their culture. A table is presented as a summary, regarding environmental knowledge of the etnia, regeneration, use of fire and harvesting and market.

Keywords: *monkey-puzzle tree, conservation, forest management, phytosanitary status, pehuenche.*

EVALUATION OF THE STATE OF CONSERVATION OF TWO PRIORITIZED FOREST SPECIES IN QUIJOS RIVER SUB-BASIN, NAPO, ECUADOR

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Quijos river sub-basin is an environment of high ecological-value. Its forests, rivers, national parks and great diversity play a part on the great natural richness Ecuador possess. Furthermore, this richness constitutes an essential tool against climate change, as its forests work as a carbon sink, and are a veritable source of indispensable resources for future conservation endeavors. However, this richness is being threatened mainly by deforestation, which since more than five decades ago, is spoiling the natural heritage favoring livestock expansion: degrading forest and hydrological resources, impoverishing diversity and reducing the response capabilities against climate change. In addition to this there is a lack of information about the real situation of forest resources. In this context, a research that brings trustworthy information about those resources situation and the measure of this natural loss is necessary; this ought to begin with the study of the state of conservation of the most important species for local population, which will give us information about the threat that each taxon must face, resulting in sound arguments with which to sustain future protection and conservation projects. Participative rural surveys taken by local spokespersons of each sub-basin town, produced a list of the ten most appreciate forest species, from which the most valued two were selected for the study: *Cedrela montana* Moritz ex. Turcz (cedro), and *Erythrina edulis* Triana ex Micheli (porotón). A database was elaborated with georeferenced information of collected samples of each species, given by different herbariums all over Ecuador, plus free online information available at www.tropicos.org. Combining this database with climate information available at www.worldclim.org, a specific distribution probability-based map was designed using MaxEnt and GIS programs. Based in these maps, after the studied area had been stratified as: primary forest, impacted forest and pastures, a stratified sampling was conducted in those areas with more probability of occurrence. Over said area, the National Forestry Evaluation Guidelines were applied for sampling, including georeferenced information, phenology, structure and health conditions of those targeted species individuals. In addition, by comparison of abundance and diameter distribution, correlation and multivariate analysis of the obtained information, the anthropogenic level effect on characteristics and phenology of the different populations and its impact on these two species future conservation will be assessed. Finally an analysis of MaxEnt results will reveal which environmental factors influence the most in each targeted species distribution.

Keywords: forest resources, deforestation, climate change, probability of occurrence, stratified sampling.

THE USE OF NURSING PLANTS FOR RESTORATION IN MEDITERRANEAN LANDSCAPES

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After many centuries in the history of exploitation, most of the natural forests located in the Mediterranean basin have disappeared or degraded which, in turn, has driven to other problems associated with the degradation of the landscape such as the increase of erosion processes, loss of soil or the decline of biodiversity. Together with the advanced state of degradation of many Mediterranean landscapes, the extreme climate conditions which appear in semi-arid or mountainous areas of the Mediterranean basins prevents the natural succession of the ecosystems, blocking it in an early successional shrub-dominated community stage. For this reason, it has been done a large number of reforestation projects during the last decades. For a long time, reforestation techniques have been based on the removal of these shrub-dominated communities and the planting of the new tree seedling. This reforestation method was based on the presumption that the relationships of competition between shrubs and seedling in stress environments could avoid the survival and growth of the seedlings. In contrast to this approach, different empirical experiences based on plant-plant interactions have shown that the net effect of shrubs over the target plant seedlings can become positive in stress prone environments, demonstrating the “nurse” effect that the shrubs can play in reforestations. The nurse effect can enhance the survival and the growth of the target seedlings through the creation of microenvironments. This relatively new approach supported by positive plant-plant interactions can become an interesting tool for reforestation due to the economic and ecological implications. However, this kind of approach must be used carefully because the plant-plant interaction balance can change from facilitation to competition and *vice versa* depending of different factors. Here, it is explained the main tasks related to the role of nursing effects of the plants, the mechanisms of facilitation and how the plant-plant balance can shift in order to show the implications of this approach for carrying out ecological restoration procedures that improve the results of these projects.

Keywords: *Plant interactions, facilitation, nurse effect, Mediterranean ecosystems, reforestation.*

FOREST MANAGEMENT AND THE CHALLENGES OF INTEGRATING BIODIVERSITY CONSERVATION IN CAMEROON

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Cameroon has a Tropical Forest Ecosystem that has multiple functions including a source of livelihood to the indigenous people as they derive a wide range of socio economic and environmental benefits from forests and trees. There is thus the need for the proper conservation and wise use of forests and biodiversity for the greater benefit of the rural people who depend heavily on the services and resources generated from them. Contrarily enough, the use and exploitation of Cameroon's tropical forests has been undertaken with very little care that has compromised its ability to sustain the rural population and its own biodiversity. Poor management systems has led to the disappearance of a large portion of the country's forests in a relatively short period and eventually a great loss in the country's once rich biodiversity that is supported by these forests ecosystems. Due to this poor use of the country's forestland, its sustainability is becoming a major concern and now more and more people are realizing the urgent need for sustainable forest management in order to secure the aptitude of the forest to perform their multiple functions now and in the future. A major objective in any attempt to manage the country's moist tropical forests is to embark on the protection biodiversity. This presentation looks at the forest sector of Cameroon, the classification of different forest types, logging activities and forest certification. It also makes and insight to the present state of biodiversity in Cameroon, biodiversity and planning, the institutional and legal framework that surrounds its activities. It finally creates a link between logging and biodiversity planning. Heavy machinery use for timber extraction, uncontrolled and illegal timber uplifting has helped in degrading the country's biodiversity. Direct impacts of logging include damage to vegetation, reduction of the potential of genetic improvement of logged species and natural regeneration potentials. Logging operators and supervisors most of the time lack the environmental awareness and don't see the need to integrate biodiversity conservation into their activities. Recently, as a solution to this problem, Reduced Impact Logging (RIL) has been considered as a strategy to encourage sustainable forest management in order to meet ecological criteria including biodiversity conservation. Pre-harvesting activities have also included a number of obligatory species drawn up in an inventory map just in a bit to foster biodiversity conservation.

Keywords: *Legal regulations, forest, logging, national forest estate, certification.*

EVALUATION OF THE HYDRAULIC PERFORMANCE OF NATURAL-LIKE FISHWAYS

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Natural-like fishways are structures to allow fish to move across obstacles in rivers. In contrast to other fish passes there are able to provide a suitable aquatic biotope and an appropriate landscape conditions. The main objective of this study is to evaluate the hydraulic performances of this type of passes in order to define the best way to design them, that is to say, the best equations to represent their hydraulics. For this purpose it has been conducted a deep review of the relevant literature about the calculation method as well as the design criteria. Based on field measurements in three locations, corresponding to the most common types of natural-like fishways, the degree of effectiveness of the collected methodologies has been analyzed. Among other measurements, discharge (via area-speed method and chemical flow), velocity (using a velocimeter), geometry and water levels (through topographic survey) have been determined. After processing and analyzing of the collected data, the hydraulic performance of the fishways on the basis of the equation proposed by the methodologies has been checked, determining the agreement of them. In addition, more accuracy coefficient for the formulas involved in the hydraulic performance and design has been proposed, comparing them with the specialized literature. Finally, the efficiency on the measured structures both from the point of view biological as geometric and hydraulic has been evaluated by checking applicable design criteria.

Keywords: *fish passes, hydraulics, fish migration, longitudinal connectivity, discharge coefficient.*

METHODOLOGY FOR HYDRAULIC CONNECTIVITY ANALYSIS OF FISH POPULATIONS IN RIVERS USING GEOGRAPHIC INFORMATION SYSTEM (GIS)

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A characterization of a hydraulically altered river reach have been analysed with Geographic Information Systems (GIS), in relation to the hydraulic connectivity for fish populations. Two zonification systems were developed in order to predict the preferred migration pathways for each life stage (fry, juvenile and adult) of the target fishes. Similarly, a set of hydraulic alteration indicators (inter – hydrological and intra – hydrological) have also been defined.

Keywords: *Migration pathways, critical step, depth, preferential, probability.*

DIMP 1.1: FRESHWATER FISH POPULATION DYNAMICS SOFTWARE

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Iberian freshwater fishes have been always in a second place in management, conservation and research. Evidence of that is that one quarter from the one hundred of the known species were discovered since 2005. Fishing management is a difficult and hard task, especially during inventory and data processing phases. Nowadays, we have acquired a deep knowledge about effective sampling methodologies but there are a few computer tools to elaborate reports and therefore apply conservation strategies. This problem may come from the low technical skills among the fisheries managers and because some methodologies are rejected due to its complicated usage. Dimp 1.0 was released 2 years ago to ease and homogenize measurement procedures from fisheries inventories. The feedback accumulated from the users' surveys (students, who will be the future managers and fishing associations, both well-known agents from this valuable resource) has been analyzed, implementing these suggestions and solving difficulties found to optimize and improve this free tool released by the Hydraulic and Hydrology department from the University of Valladolid. In this line of work, trying to facilitate the data process from fisheries inventory oriented to the management and research from this animal group, a software update in F sharp language has been developed which supports the same population dynamics variables estimation, the ability to import and export data from many sources, obtaining customizable graphical outputs as an aid to understand the results in a friendly graphical user interface (GUI). F# language has been chosen because it includes Unicode Standard (UTF-8), scientific measurement units to erase any inconsistency within the code, simple instructions to avoid any syntax failures. Finally, the main change from the previous version is the addition of a new module: the Mortality estimation. The formative background relied on an intensive bibliographical review to check the advantages and disadvantages of different methods and its complexity to be coded, fulfilling the main objective: Design the software DimP 1.1 with those methodologies implemented and visually adapted to the final user needs.

Keywords: *Functional programming, Growth, Ichthyology, F# Language, WPF.*

***In vitro* ORGANOGENIC RESPONSE OF *Nolina parviflora* (H.B.K.) HEMSL.**

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The genus *Nolina* is used as raw material in drylands by manufacturing straw brooms, hampers and house's roofs. This genus has great value due to his uses ornamental, medical and ethnobotanical. Although there are studies about *in vitro* propagation there are not reports about *Nolina parviflora*. The main objective was to do trials about *in vitro* propagation using different concentrations of auxins and cytokinins to determine the better combinations, which gave organogenic responses. Was used as explants stem's segments of 0.7 to 1 cm length, which were produced in basic medium of inorganic salts of MS-100%. During multiplication of buds the cytokinins used were: Benzyladenine (BA) and Kinetin (KIN) in concentrations 0.0, 0.1 and 1.0 mM, and auxins were: 2,4-Dichlorophenoxyacetic acid (2, 4-D), indole-3-butyric acid (IBA) and Naphthaleneacetic Acid (NAA) to concentrations 0.1 and 1.0 mM. During rooting was tested the auxins: 2, 4-D, AIB, NAA and indole-3-acetic acid (IAA), in concentrations 0.0, 0.1, 1.0, 10.0, 15.0 and 20.0 mM. During multiplication and rooting were used MS medium-100 % inorganic salts with 3 % thiamine, 3 % inositol, 1.5 % nicotinic acid, 3 % pyridoxine, 3% saccharose and 7% agar. During multiplication was utilized a completely randomized experimental design and was evaluated quantitatively roots and buds produced measuring: a) length (mm); b) diameter (root) and width (bud) (mm); c) volume (mm³); d) amount; e) wet weight (mg) and f) dry weight (mg); while in the rooting was used a randomized blocks design and was evaluated in root: a) length (mm); b) diameter (mm); c) volume (mm³); d) amount; e) wet weight (mg) and f) dry weight (mg). Was did an analysis of variance in twice experiments to determinate significant differences between treatments and the comparison of medium throughout SMD test with $\alpha=5\%$ significance level. In the first stage (multiplication), the χ^2 -test determined that had differences in all variables except in amount of buds; the better response was during the combination that IBA and 2, 4-D with KIN. In the second stage (rooting), only had differences in the length and diameter; and the better response was during to use that IBA and NAA. In this investigation was proved that is possible to promote somatic organogenic in *Nolina parviflora* throughout *in vitro* culture through stem's segments using auxins and cytokinins.

Keywords: Propagation, 2, 4-D, IBA, NAA, IAA, BA, KIN

DYNAMIC OF SACRED VEGETATION IN THE CONTEXT OF THE EVOLUTION OF LANDSCAPE OF THE PROVINCE OF LARACHE (NORTHERN MOROCCO)

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The intensification of changes in land use under various natural and anthropogenic pressures submits natural areas to high degradation and alteration of ecological services. In this context, sacred groves are often the last places whose sacredness allowed the maintenance of natural formations. Sacred natural groves exist in all continents in different forms; they include a wide variety of habitats and have significant potential for the management of biodiversity. In Morocco; they are ancestral religious sanctuaries, called *Marabouts* or *Khalouas* and form islands of Mediterranean ecological diversity well individualized in the agricultural landscape matrix. In these traditional nature reserves, these are the places where grows these mythical forests which are revered and not the trees themselves. Biodiversity thus protected without being the real object of protection. Sacred natural sites are now exposed to the decline of respect for mythical beliefs and the erosion of traditional customs and practices as a result of global cultural change. These sites are also exposed to other socio-economic pressures that occur at changes in land uses. According to their abundance, the degree of conservation of the natural vegetation they contain and their spatial structure, we assume that sacred groves can be ecological indicators of the ecological integrity of the landscape and may represent reference sites for restoration policies. The objective of this work is firstly to establish a spatial database to analyze the distribution of sacred groves based on the characteristics of the physical and human environment and secondly to study these sites in comparison with recent dynamics and changes ecological landscape. Such study may indicate the relative importance of traditional spiritual values in the current territorial dynamics. The study area is the Province of Larache in northern Morocco. The data used for develop this work have been extracted from topographic maps 1/50 000 and 1/25 000. Land uses were digitized from aerial photos of 1986 and 2003. The software used is distributed by ESRI; ArcGIS 9.3 for analysis of spatial data and Idrisi 32®. The topographic cartography used (1/25 000) has allowed the location of 102 sacred sites with 68 of them possessing sacred forests. The results found in this study should be developed and suggest that in the absence of a national strategy of conservation and valuation traditional ecological knowledge, access to basic social services is detrimental to the conservation of sacred sites.

Keywords: Sacred groves, Geographic Information Systems, Northern Morocco, Ecologic knowledge, conservation.

PROTECTION

Oral communications

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EVALUATION OF THE SALINITY TOLERANCE OF SOME VARIETIES OF HARD WHEAT, COMMON WHEAT AND BARLEY GROWN IN TUNISIA

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IS *Tomicus piniperda* THE MAIN VECTOR OF *Fusarium circinatum* IN SPAIN?

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Fusarium circinatum is the causal agent of pitch canker disease which is currently affecting *Pinus radiata* plantations in northern Spain. The main symptom of the disease is the presence of pitch soaked cankers in trunks and big branches. *Fusarium circinatum* needs a wound to infect the tree, as those caused by insects. Species from the Subfamily Scolytinae, as *Pityophthorus pubescens* or *Hylurgops palliatus*, have been reported as vectors of this pathogen. The aim of this study is to know the role of *Tomicus piniperda* as a vector of this fungus in *P. radiata* plantations in Cantabria (Spain). For this purpose 954 shoots with *T. piniperda* feeding gallery were collected during 2011 and 2012 from five *F. circinatum* affected plots. Moreover, an experiment was set in the laboratory for testing the capability of *T. piniperda* in transmitting the disease as they had been previously inoculated with the pathogen. Inoculated insects were feeding in healthy shoots. Feeding gallery and necrosis reaction length were measured. Ethanol and α -pinene baited funnel traps were also set in affected plots. Vegetal tissues and insects were cultured in Potato Dextrose Agar media. *Fusarium circinatum* was isolated from both field (11.42%) and lab shoots feeding galleries. Lower rates of *F. circinatum* presence were isolated from insects collected in funnel traps. *Tomicus piniperda* becomes an important candidate for transmitting the disease, since it is a primary pest as it feeds on *P. radiata* healthy crowns.

Keywords: Pitch canker, Monterey pine, Scolytinae, Shoots, Feeding galleries.

APPLICATION OF SPECTRAL VEGETATION INDICES FOR DETECTING DEFOLIATION CAUSED BY INSECT OUTBREAKS IN A BROADLEAF FOREST

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The use of Remote Sensing technology to monitoring forest health in a cost-effective manner has been a challenge to try. Research on **spectral vegetation indices** (VIs) is aimed to the spectral identification, detection and quantification of forest health. Defoliation and discoloration, not related to plant phenology, are taken as indicators of the plant stress that may be caused by insect defoliators, but not always this is an easy site monitoring task as in the case of attack by the beech weevil (*Rhynchaenus fagi* L.) to beech forest (*Fagus sylvatica* L.) in some areas of "Picos de Europa", a range of mountains inland from the northern coast of Spain. In this study, we correlated differences in spectral responses using data from satellite sensors and ground based data from Forest Damage Inventories to detect defoliation in the beech forest studied zone. Also a bio-window period was previously determined to select the appropriated multispectral satellite images. The previously correction and calibration of spectral data is a key factor to allow the needed change detection analysis. We analyzed changes on differences among the red (R), near infra-red (NIR), and short wave infra-red (SWIR) wavelengths with mathematic algorithms of these bands that conforms the VIs closely related to the foliage vigour associated to plant health. Thus, these algorithms account for the morphological and physiological changes in the forest canopy occurring before, during and after defoliation outbreaks. As the VIs performance may vary from site to site, we explored and test several robust VIs for selecting in order to choose the ones that better detect the case studied. Besides the commonly used Normalized Difference Vegetation Index (NDVI) we are testing other vegetation indices, which have been successfully reported in literature for defoliation insect detection, from which we will present some progress.

Keywords: *remote monitoring, inventory data base, satellite imagery, change detection, spectral algorithms.*

SEVERITY AND INCIDENCE OF *Gremmeniella abietina* IN SPAIN

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Gremmeniella abietina (Lagerberg) Morelet is a pathogenic fungus that 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. In 2001, when the fungus was detected for first time in Spain, forty-one *Pinus halepensis* stands were evaluated in the provinces of Palencia and Valladolid in order to know the distribution and the incidence of the pathogen. *G. abietina* was detected in 5 plots although 25 stands showed the typical symptoms of infection. During August 2012, the same 41 stands were revised for its sanitary condition. In every stand a circular plot of 10 m radius was established and all the trees inside this area were evaluated. The plots were established in areas with symptoms of decline (i.e., defoliation and discoloration of needles) and four trees in each stand were sampled in order to know which fungi were responsible for this damage. The results showed that after 11 years, the fungus has not spread over the region. *G. abietina* fruiting bodies were observed in 3 of the 41 stands evaluated although most of the stands showed symptoms of decline.

Key-words: *Defoliation, discoloration, decline, pathogenic fungi.*

ETHNOBOTANICAL INVESTIGATION OF MEDICINAL PLANTS IN OUADHIAS AND BOGHNI AREA, TIZI OUZOU, ALGERIA

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In the Mediterranean region, the traditional knowledge about uses of medicinal plants is rich and various the same as the biological resources diversity. It was accumulated and developed in all continents and transmitted from generation to another in every rural population. Indeed, the extinction of this oral and ancestral know-how would be an irremediable loss for the humanity, because effort deployed to preserve it is insufficient. This situation incited us to achieve an ethnobotanical investigation (via 500 questionnaires) in the field, with 152 inhabitants of Boghni and Ouadhias district (in 35 villages and 8 chief-towns) of Tizi-Ouzou department, Algeria. The aim of this survey is to collect the maximum of information dealing with the traditional medicinal uses and the exploitation of natural flora of this region, including mountainous and forested area enabled us to identify 114 vascular plants belonging to 52 families, of which 70 % are spontaneous and grown in forested and wet habitat. The ancestral know-how in traditional phytotherapy is an oral family heritage predominating, in particular, among old illiterate women (51 to 60 years old). On the contrary, the age classes of less than 20 years old and over 80 accounts scarcely for 5 %. This is an indication of unawareness of the new generation to the traditional and medicinal uses of the plants, as well as a memory loss of this know-how for the older people. That is why the preservation of this neglected heritage is more than essential. These medicinal species prepared through 265 recipes can be remedies for 110 current diseases. The following species are those which seem "new" and not yet used to our knowledge: *Ampelodesma mauritanica*, *Cedrus atlantica*, *Daphne laureola*, *Magydaris pastinacea*, *Orobancha aegyptiaca*, *Origanum floribundum*, *Phlomis bovei* and *Quercus suber*. It would be interesting to complete it by other works in respect to the huge floristic biodiversity of Algeria and also to deepen the knowledge of the traditional and medicinal use of each plant species in each country of Mediterranean region to achieve a regional, overview on traditional phytotherapy.

Keywords: *Mediterranean biodiversity, traditional phytotherapy, flora, kabylia, preservation.*

MONITORING FRUIT DEVELOPMENT AND PHENOLOGY OF PRE-IMAGINAL INSTARS OF PRE-DISPERSAL PREDATORS ON *Juniperus thurifera* L. IN CENTRAL SPAIN

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Juniperus thurifera pseudofruit (hereafter fruit) is attacked by a complex set of arthropods, with three main taxa with direct effect in seed loss: moths (*Pammene juniperana*, Lepidoptera, Tortricidae), mites (*Trisetacus quadrisetus*, Acarina, Nalepellidae) and chalcid wasps (*Megastigmus* spp, Hymenoptera, Torymidae). Previous studies have evaluated in French and Moroccan woodlands the phenology and feed behavior of pre-dispersal predators. In this study we present a quantitative phenological monitoring at Villaciervos (Soria, Central Spain) of the fruit development and pre-imaginal instars of predispersal predators on *J. thurifera* for 2013 pseudofruit cohort. Twenty trees – five branches per tree – were selected to monitor the evolution of flower and fruits plus ten selected trees – one branch per tree – to collect 20 – 30 fruits per date to monitor the pre-dispersal predators' development and incidence. The sample site was visited twice a month. A total of 3,800 flowers were monitored during 2013. Pollination took place in March, and 74.65% of the flowers started to develop fruits. Fruit growth was rapid; in June fruits reached 3.70 mm ± 0.05 (Mean ± S.E.) and in October 36.11% of the initial fruits reached mature size 9.11 mm ± 0.08. Mites entered the seed in a very early phase of fruit development (already present in May). Moths laid the eggs on the cone surface and larvae made a gallery to approach the seeds. Moths sp1 are seed-eaters that entered the seeds in early June and fed on seed coat during the first larval instars to enter the seed gametophyte during late August. Moths sp2 are conospermatophagous that enter the cone in early July (fruit size 6.70 mm ± 0.05) and fed on pulp and seeds and stay inside of a seed. Chalcid wasps laid eggs inside a seed during mid-August (fruit size 8.53 mm ± 0.09) and the larvae emerged in late August-early September to feed on developed gametophyte. Mites infested 10.9% of fruits, moths sp1 8.1%, moths sp2 5.4% and chalcid wasps 7.6%. Other species present were the pulp sucker *Carulaspis juniperi* (Hemiptera, Diaspididae) (infesting 23.3% of fruits) and pulp eater Cecidomyiidae (Diptera) (4.6%) but their role on seed loss has not been elucidated yet.

Keywords: Feed behavior, *Megastigmus*, *Trisetacus quadrisetus*, Moth, fruit evolution.

ANALYSIS OF NITROGEN FORMS IN SOILS UNDER EXPERIMENTAL MODIFICATION OF RAINFALL IN NATURAL ECOSYSTEMS

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The impact of climate change on natural ecosystems is evident; nevertheless, the question is how strong it is and what is the response on it. The response of terrestrial ecosystems on climate change is thought to be nonlinear (Burkett et al., 2005; Zhou et al. 2008), which is the main problem in policy and decision making. To monitor changes of terrestrial ecosystems in early stages it is proposed to use observations of water, carbon, and nitrogen cycles which might depend on altered precipitation. Understanding these mechanisms within ecosystem and their change due to altered precipitation helps to model the impact of climate change. Numerous studies have been conducted in order to depict a picture of terrestrial ecosystems' response on climate change in terms of water and carbon cycles, though view of them were devoted to soil nitrogen amount. Getting more or less quick results of terrestrial ecosystems' response to projected climate change can be possible while conducting field experiments with artificial modification of the mode of precipitation. Today, such experiments are often jointly implemented by several countries and aimed to clarify the possible changes in the processes occurring within the ecosystem. This work was conducted as part of the first joint study between Ukraine and the United States (by Kyiv-Mohyla Academy and the Agency for Environmental Studies, University of Oklahoma) in Karadag Reserve (Crimea, Ukraine) and was aimed to clarify the impact of artificial rainfall regime modification on the content of mineral forms of nitrogen (ammonium nitrogen and nitrate) in soils of the experimental site. The experiment was built in such a way that it allowed setting 20, 40, 50 % of precipitation simulating drought and additional rainfall. Data were collected every season of experimental years using methodology general accepted in soil science. The result revealed that the content of ammonium and nitrate in soils varied depending on the season, nature of vegetation, soil moisture regime and depth of soil horizons.

Key words: *climate change, ecosystem, precipitation regime, ammonium, nitrate, moisture, horizon.*

EFFECT OF DEFORESTATION AND ITS IMPLICATION ON CLIMATE CHANGE IN ETHIOPIA

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The total forest area in the world is estimated at 3,952 billion ha (FAO,2005).In coverage 30 % of the land area (FAO,2005).From this African forest area is 635,412 million ha and in terms of coverage 16% of the global forest area (FAO,2005). In Ethiopia, natural forests and woodlands covered 15.1 million ha in 1990. This area declined to 13.7 million ha in 2000. In 2005, the forest cover had further declined and was estimated to cover 13.0 million ha. In other words, Ethiopia lost over 2 million ha of her forests, with an annual average loss of 140 000 ha between 1990 and 2005. Currently, the area is estimated at 12.3 million ha, 11.9 % of the total land area. Of this, the remaining closed natural high forests is 4.12 million ha or 3.37% of Ethiopia's land area (FAO, 2010) . The thematic area, try to assess the major activities of deforestation and its implication on climate change. In Ethiopia, the major forest conversion in the country is mainly due to agricultural expansion: land Grabbing (since 2008 about 3,619.509 ha of land have been leased out (OI, 2011 pg1) for bio fuels, sugarcane, cereals and livestock production. In addition, shifting cultivation, timber harvesting, fire wood collection and fire contribute for the deforestation of the remaining forest. Carbon in their biomass alone, and that the carbon stored in forest biomass, dead wood, litter and soil together is more than the amount of carbon in the atmosphere. But carbon in forest biomass decreased in Ethiopia, owing to continued deforestation and forest degradation, partly offset by forest expansion (including planting) and an increase in growing stock per hectare in some regions (Gobena M, 2010).Deforestation and agricultural expansion resulting with release of carbon dioxide, nitrous oxide, methane other green house gases into the atmosphere and soil erosion, flooding ,desertification and loss of biodiversity are the implication of climate change happing in Ethiopia. To overcome the problem, rather than horizontal agricultural land expansion, it is better to increase vertical production and productivities per unit of area. Increase production and productivity by using different agro forestry practices based on each agro ecological zones. Land tenure security and afforestation are crucial element to reverse the situation.

KEYWORDS: *Agricultural expansion; land grabbing; biomass; green house gas; forest expansion.*

PATHOGENICITY OF SPANISH ISOLATES OF *Heterobasidion annosum* IN *Pinus pinaster* SEEDLINGS

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Pine decline associated with the presence of the fungus *Heterobasidion annosum* has recently been observed in several *Pinus pinaster* stands in the centre of the Iberian Peninsula. The characteristic decline symptoms, which include unusual crown transparency, small needles, foliage discoloration and early tree death, are associated with a high mortality rate in this species. The aim of this study was to test the pathogenicity of two Spanish isolates of *H. annosum* in two-year-old *P. pinaster* seedlings. Two types of inoculum (woodchips and sawdust) were used to infect the seedlings by two different routes (stem inoculation and soil infestation). The mortality rates of the stem-inoculated seedlings differed significantly, but those of the seedlings infected via soil infestation did not differ. For both types of inoculation, the lesions were longer and wilting symptoms were more severe in the seedlings inoculated with *H. annosum* than in control seedlings. For stem inoculation, biomass allocation did not differ significantly between the infected and control seedlings. However, the percentage of fine roots was lower in seedlings infected via soil infestation than in the control seedlings. To our knowledge, this is the first pathogenicity test with *H. annosum* isolates and *P. pinaster*.

Keywords: lesion length, wilting symptoms, mortality, root biomass, root and butt rot.

***Fusarium circinatum* HOSTS TWO NOVEL SPECIES OF MITOVIRUSES**

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Fusarium circinatum Nirenberg & O'Donnell (teleomorph = *Gibberella circinata*) is the causal agent of the pitch canker disease on pines. Since 2004 it has been present in Europe, particularly in northern Spain, affecting *P. radiata* and *P. pinaster* in plantations and nurseries. Nowadays, the disease has also spread to other European countries, such as France, Italy and Portugal. In this report we describe three novel virus strains belonging to two species of the genus *Mitovirus* obtained from a Spanish isolate of *F. circinatum*: *Fusarium circinatum* mitovirus 1 (FcMV1), FcMV2-1 and FcMV2-2. Using mitochondrial translation table, the complete genome of FcMV1 of 2419 bp encodes an RNA dependent RNA polymerase of 731 amino acids (GC-content *ca* 30%). The partial genomes of FcMV2-1 and FcMV2-2 (2193 and 1973 bp, respectively) share *ca* 48% RdRp sequence similarity at the aa level, and might be regarded as conspecific, while FcMV1 is clearly distinct, showing 32-35% polymerase similarity compared to the other strains. However, FcMV1 shared 46% protein level similarity with *Thielaviopsis basicola* mitovirus. This is the first study which reports viruses in *F. circinatum*, as well as the first time that mitovirus genome sequences are described from *Fusarium* spp.

Keywords: Pitch canker disease, *Pinus radiata*, virus, *Narnaviridae*, dsRNA.

PINE PROCESSIONARY MOTH IN PORTUGAL

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The process by which species diverge into different strains that become reproductively isolated and evolutionarily independent is well known and documented for several cases of spatial isolation as allopatric speciation. Sympatric speciation occurs when reproductive isolation is observed while the different populations still exist in the same area. Yet, sympatric speciation can also occur because of separation of populations by breeding time, a process known as allochronic speciation. Such a situation occurs when populations reproduce in different years, in different seasons of the year or in different times of the day. The reproductive isolation can occur if there are differential, no overlapping reproductive seasons and if these phenologies are heritable. So, allochronic speciation refers to a mode of sympatric speciation, in which the divergence between populations is mainly due to phenological shift without habitat or host change. In August 1997, an unusual population with summer larval development of *Thaumetopoea pityocampa*, Pine Processionary Moth (PPM) was found in the southern region of the Mata Nacional de Leiria (MNL), Portugal, in a huge outbreak situation. This population was named as summer population (SP) and it's restricted to MNL. Since then, the two types of population of PPM [normal life cycle (Winter Population) and SP] co-occur in the same place and in the same host. This is a rare case of sympatric speciation, showing changes in some morphologic characteristics (eggs) but not in olfactive communication and also in sexual attraction. In consequence, in MNL we have 2 annual defoliations in different seasons by PPM. This situation results in a reduction of tree growth and severe or repeated defoliation can lead to tree mortality, particularly in young stands. To reduce these impacts it's urgent to implement a solid program of Integrated Pest Control, using at the same time but in an efficient way, several techniques compatible with monitoring and management of the forest.

Keywords: *Sympatric speciation; Allochronic speciation; Thaumetopoea pityocampa; Mata Nacional de Leiria; Forest*

APPLICATIONS OF MULTISPECTRAL AIRBORNE SENSORS (UAVS) IN FOREST PROTECTION

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Climate change directly affects forests and its dependents, causing effects that can be positives or negatives, simple or complex, and, it can occur suddenly or in a long term. Regarding to the economic scenario, especially forest products in the Mediterranean region, the issue happens to have even more importance. The aim of this work is to present an interdisciplinary methodology, between the forest health's subject and remote detection studies, supported in forest remote sensing. In relation to Pine Pinaster decaying in Spain, given the economic importance of that species and the few researches that seek to interpret this phenomenon. The information we intend to take from the results working with unmanned aerial vehicle (UAV), correlating with the field measurements about the health condition of the masses. This study will contribute to forest management as possible tools to help on investigating the effects of climate change on the forests. It has to be take into consideration that there might be other factors involved, from fungal diseases, even the own specific climate and other agents that damages the masses. Forest management is already a challenge in particular ecosystem functioning and ecosystem services, thus requires innovative approaches both for better understanding and for better controlling the forests.

Keywords: *forest management, UAVs, teledetection, forest health.*

***In vitro* ACTIVITY OF *Quercus suber* MICROBIOTA ON *Phytophthora cinnamomi* MYCELIA GROWTH**

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The aim of this work is to determine the *in vitro* activity of *Quercus suber* microbiota present in “Montado/Dehesa” ecosystems, on *Phytophthora cinnamomi* mycelia growth. This work is part of a wider integrative study aiming to assess the risk and the ecological sustainability of *Quercus suber* in Montado ecosystems (RESCOE - PTDC/BIA-BEC/102834/2008). *P. cinnamomi*, *Serratia ficaria*, *Dickeya dianthiocola*, *Burkholderia ambifaria*, *Gibbsiella quercinecans* were isolated from cork oak trees in typical productive Montado ecosystems. *Serratia ficaria*, *Dickeya dianthiocola*, *Burkholderia ambifaria* and *Gibbsiella quercinecans* were cultured in V8A, the most appropriate culture media for the growth of *P. cinnamomi*. Two methodologies were used: drop inoculation method and spread inoculation method. For *Trichoderma* spp., isolated from *Q. suber* roots in greenhouse experiments, four 5-mm replicate plugs, taken from the edge of an actively growing culture were placed on the perimeter of each Petri dish on V8A. A 5-mm plug of *P. cinnamomi* was transferred to the center of each V8A Petri dish. Bioassays using other culture media, namely, CMA, PDA and MEA, using method 1, were performed. The best results were obtained with PDA where *Gibbsiella quercinecans* exhibited the highest inhibition of *P. cinnamomi*. Pathogenicity tests of *Phytophthora cinnamomi* isolates alone and in association with *Tuber borchii* (fungus) and *Burkholderia ambifaria* towards *Quercus suber* were also performed. Ten *Q. suber* plants one-year-old were used for each of the seven conditions tested: *B. ambifaria*, *P. cinnamomi*, *B. ambifaria* with *P. cinnamomi*, *T. borchii*, *T. borchii* with *B. ambifaria*, *T. borchii* with *P. cinnamomi*, and *T. borchii* with *B. ambifaria* and *P. cinnamomi*, making a total of 80 plants including the control. In the associations *B. ambifaria* with *P. cinnamomi*, and *T. borchii* with *B. ambifaria* and with *P. cinnamomi*, the oomycete was never isolated from roots and there were no significant differences compared to control, which means that *B. ambifaria* protected *Q. suber* against *P. cinnamomi*.

Keywords: Plant protection; Cork oak; Pathogen; Growth inhibition; Pathogenicity tests

EVALUATION OF THE SALINITY TOLERANCE OF SOME VARIETIES OF HARD WHEAT, COMMON WHEAT AND BARLEY GROWN IN TUNISIA

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Salinity is the major environmental factor that influences vegetable production around the world. In Tunisia, Area affected by salinity is near 1.5 million Ha till 2007. In the reason of limited water potentialities, the research of tolerant genotypes to salinity remains the sustainable way to meet the food needs and may permits durable production. Responses of plants to salt stress are variable. Research tolerant genotypes among existing populations provide opportunities for the study and improvement of genetic resources. Thus, this study was interested in testing three cereal species namely durum wheat, bread wheat and barley. Each specie is represented by four varieties, in which are applied four saline treatments (fresh water and fresh water to which are added amounts 3g, 6g and 9g of salt per liter). Evaluation of varietal responses have been focused on seed germination, root and shoot biomass during grain filling and levels of sodium, potassium and chlorophyll. The results showed variation among species and varieties tested. The Haidra and Om Rabiaa varieties maintain germination rates exceeding 60% up to 9 g NaCl / l. The biomass ratio between the roots and shoots is less than 1. Sodium levels are higher in the roots and decreases continuously at the stems and are lower in the leaves. Those of potassium are more important in terms of stems, leaves, but lower in the roots. The ratio K^+ / Na^+ is higher than 1. The durum wheat varieties Maali and Salim were indifferent toward increasing levels of salt stress at the chlorophyll **a**. Chlorophyll **b** is stimulated by salt to 6g / l in the durum wheat variety Om Rabiaa.

Keywords: *Cereals, salt, water, stress, sodium.*

SOIL & CLIMATE

Oral communications

EFFECTS OF MYCORRHIZA HELPER BACTERIA IN THE SYNTHESIS BETWEEN *Boletus edulis* (Bull.) AND *Cistus ladanifer* (L.)
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EFFECTS OF MYCORRHIZA HELPER BACTERIA IN THE SYNTHESIS BETWEEN *Boletus edulis* (Bull.) AND *Cistus ladanifer* (L.)

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Boletus edulis (L.) is one of the most valuable fungi worldwide, both for its edibility and economic importance, moving large amounts of money in global markets. Occasionally, mushroom production can provide higher economic returns than any other forest product in many Mediterranean forests. Until now, controlled cultivation of *Boletus* sporocarps has not been achieved, whereby this is a challenge for many researchers in the fungal scientific community. After observing natural associations between *Boletus edulis* and *Cistus ladanifer*, capable of producing sporocarps three years after the establishment of the shrub, we optimized in a previous work, *Cistus ladanifer* plants inoculated with *Boletus edulis* through mycelia inoculation methods. Several authors have found that the formation of ectomycorrhizal symbiosis can be significantly improved by mycorrhizosphere bacteria, stimulating the effect on the mycelia growth and mycorrhiza formation. Thus, inoculation of mycorrhizal fungi jointly with mycorrhiza helper bacteria on forest plants can be used as a technique to improve the morphological and physiological quality of the plants, promoting at the same time higher ratios of mycorrhizal root tips. The aim of this study is to enhance the mycorrhization between *B. edulis* and *C. ladanifer* by inoculating spores of mycorrhiza helper bacteria in the substrate. According with previous results, we hypothesized an increase in the number of mycorrhiza, using different mycorrhiza helper bacteria.

Keywords: *enhancer bacteria, mycelia inoculation, mycorrhizal synthesis, symbiosis, edible mushroom.*

PROSOPIS CALDENIA PHYSIOLOGICAL RESPONSES TO CLIMATE CHANGE: GROWTH DYNAMICS AND STABLE CARBON AND OXYGEN ISOTOPES ^{13}C

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The argentinean semiarid pampas has undergone major changes in water regime. These changes led to the region in the last 100 years to suffer a period with significant wind erosion processes (associated with water deficit) to a period of water erosion due to an increase in the rainfall. The aims of this work are to analyze the physiological response and the water dynamics consumption of *Prosopis caldenia* (calden) to the climate fluctuations. For pursuing this objective was necessary to establish dendrochronological analysis in representative dendrochronological samples of calden; to process pit to bark analysis of tree-ring $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ analysis; to calculate series of annual aridity indexes; to cross-correlate tree-ring $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ with annual droughts and with wood ring width fluctuations. Three sample sites along the calden natural distribution were set. All sites have a different water dynamics i) site 1 is located in the northern limit of the natural distribution and the groundwater level is located at 8 m belowground; ii) site 2 present natural lagoons connected with water table, so the groundwater level is at surface in the edge of the lagoons and as a deep as 15 m in the highest dune crest; and finally the southernmost iii) site 3 where the groundwater level is located at 150 m belowground. A total of 30 trees were sampled, 10 for each site. Dendrochronological analyses were carried out in each cross section and wood samples were collected of each annual ring of all trees to analyze the $\delta^{13}\text{C}$ concentration. Aridity index based in Walter- Lieth climate diagrams for each site were developed in order to identify the years with droughts events and define the period in which oxygen isotopes were analyzed. The $\delta^{18}\text{O}$ concentration was also analyzed in water samples of sites one and two.

Keywords: *calden, drought, dendrochronology, groundwater, aridity index.*

PLANT WATER USE AND WATER USE EFFICIENCY: PERSPECTIVE FROM STABLE ISOTOPES COMPOSITION

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A field trial was conducted to study the C-13 composition in the leaves of *Pinus halepensis*, *Quercus ilex* and *Arbutus unedo*, three typical Mediterranean species. We compare the C-13 compositions in the leaves of the species within same year and between different years with relation to water availability. An ANOVA was conducted to analyze the influence of species and environmental conditions on the composition of C-13 within the plant tissues (data of two years differing in water availability, 2012 and 2013). The relationship between the C-13 composition in the plant tissue and water use efficiency (WUE) has also been discussed. The result has been compared with the photosynthesis and respiration efficiency.

Keywords: C-13, Photosynthesis, Stomatal conductance, Water stress, Carbon Discrimination.

CARBON SEQUESTRATION FOR DIFFERENT MANAGEMENT ALTERNATIVES IN SWEET CHESTNUT COPPICE IN NORTHERN SPAIN

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It is widely recognized that forests play an important role in carbon sequestration and in mitigating climate change. However, forest carbon pools are in fact influenced by different forms of forest management and a useful tool for evaluating how carbon storage progresses under different silvicultural practices is the development of predictive models. The goals of the present study were to evaluate the baseline carbon capture of sweet chestnut coppice (*Castaneasativa* Mill) in the north of Spain, and to evaluate the effect of forest management (thinning) on carbon storage by using the CO2FIX model. The study area is located in Asturias (Northern Spain). The CO2FIX model was used to estimate carbon content in different forest components: aboveground and belowground biomass, soil and wood products. Model parameterization was made as a function of stand age, through growth data of stems, foliage, branches and roots, climate data, litterfall rates, sawmill wood processing data, life span of products (long-, medium- and short-term) and their final end. Two different management scenarios were simulated: (1) final cutting set at 40 years (cutting age) and (2) one thinning at 15 years and final cutting at 40 years. Validation was carried out for biomass and soil carbon content using 15, out of a total of 70, permanent plots located in Asturias. In both scenarios, there was an increment in total carbon at the end of the simulation (305.9 and 313.7 MgC/ha, in scenarios 1 and 2, respectively): the carbon content of biomass remained constant, that of soil showed a slight increment while the biggest accumulation was observed in products. Scenario 1 (baseline) demonstrated higher carbon stock in biomass and soil. However, scenario 2 was most effective as regards carbon stock in products although total carbon in long- and medium-term products was higher than in short-term products. In contrast, carbon levels in short-term products were higher in scenario 1, due to the effect of thinning on product quality. We observed a significant correlation between observed/predicted carbon values for aboveground ($R^2=0.68$), belowground ($R^2=0.57$) and total biomass ($R^2=0.52$), but not for soil ($R^2=0.07$), because the model strongly underestimated this parameter. The CO2FIX model enabled observation of storage and capture dynamics depending on the silvicultural treatment applied.

Keywords: CO2FIX model, wood products, tree biomass, soil carbon, carbon baseline.

COMMUNITY BASED ADAPTATION (CBA) TO CLIMATE CHANGE THROUGH AGROFORESTRY PRACTICES BY THE ETHNIC COMMUNITIES IN LAWACHARA NATIONAL PARK OF BANGLADESH

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Forest dependent ethnic communities rely heavily upon agroforestry practices but at the present time, alarm bells are ringing in relation to the negative impact of climate change on their farming. The present study looks into the community based adaptation (CBA) to climate change through agroforestry by the three ethnic communities in Lawachara National Park of north-eastern Bangladesh. Study observed that communities have few options and resources to adapt themselves with the fateful changes through their indigenous knowledge. Study found more than 15 CBA measures e.g., crop diversification, planting seedlings with covering, using more pesticide, hybrid variety and organic fertilizers, mulching/covering soil with litter, planting trees in heap, increase drainage facilities and watering frequency, rain water harvesting, digging well and tube well also setting water pump, etc. were practiced meaningfully by the communities that changes with season and all the measures were well accepted and easy to apply with their limited resources and strengthen the community resilience. Results reveal that CBA system reduces the risk and increase the benefits of community farmers. So, the results of this study might be helpful for the policymakers, researchers, NGOs and donor agencies concerned with climate change and it's adaptation in the forested areas.

Keywords: Perception; Vulnerability; Impact; Indigenous knowledge; Khasia, Tripura and Garo community.

FUNGAL COMMUNITIES IN DIFFERENT NATURAL AND ARTIFICIAL MEDITERRANEAN HABITATS

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The aim of this work was to study and describe fungal communities in different natural forests and artificial reforestations in dry Mediterranean areas. Reforestations were dominated by *Pinus pinaster*, *P. sylvestris* and *P. halepensis* whereas natural forest stands were dominated by *Quercus pyrenaica*, *Q. faginea* and *Populus nigra*. Sporocarp sampling was performed on a weekly basis during autumnal mushroom production season in 2003. All the individuals were identified, and fresh and dry weighted. We collected 7841 sporocarps belonging to 136 taxa. Fungal taxa were classified according to the mycorrhizal or saprotrophic ecology, edibility, and commercial importance. Differences were found for richness variables, comparing mean values for host genus. Thus, values in *Pinus* plots were higher than in *Quercus* plots. In relation with fungal production, an average plot yield of 340.51 kg ha⁻¹ fresh weight was found in *Pinus* plots. Fresh weight average plot production was 56.6 kg ha⁻¹ and 226.2 kg ha⁻¹ in *Quercus* and *Populus* plots respectively. Fresh weight production of edible taxa was found to be higher in *Pinus* and *Populus* plots than in *Quercus* stands. These results could provide ecological and economic implications for forest management in marginal areas. In order to recover the original forest dominated by *Quercus*, *Pinus* artificial reforestation established as intermediate stage might play an essential role in restoring degraded or marginal areas. Thus, these artificial reforestations are very important in Mediterranean ecosystems avoiding soil losses and desertification. They also may provide fungal production and diversity as high as those found in natural forest stands.

Keywords: fungal production, fungal diversity, artificial reforestations, natural forests, Mediterranean ecosystems.

MUSHROOM HARVEST PLANNING IN FORESTS OF CASTILLA Y LEÓN REGION

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Mushroom harvest planning is a tool which allows ensuring sustainability and conservation of wild fungal resources and guaranteeing the satisfaction of mushroom pickers. Moreover, it organizes spatially and temporally the mushroom harvest and highlights the economic importance of this resource. Factors affecting mushroom picking were studied to create mushroom harvest planning in the Castilla y León region. They include analysis of infrastructure and access, the type of forest ownership, mushroom production and mushroom harvesting pressure. This information was mapped by means of a geographical information system and the forest land was classified according to five types of forest aptitude for mushroom harvest. These types of mushroom harvest aptitude served to make decision for assigning a determinate mushroom harvest modality on a particular territory. Thereby some classes of mushroom harvest aptitude types were grouped to determinate mushroom harvest modalities: a commercial or local mushroom harvest (in the best aptitude types where a vigilance plan would be necessary) and episodic mushroom harvest (worst aptitude areas due to awkward access or low mushroom production). Advantages and disadvantages to assign a determinate mushroom harvest modality on the territory must be born in mind according to social and local opinion and with other stakeholders (forest ownership, forest managers, mushroom pickers, mushroom commercial enterprises, tourism enterprises, etc.)

Keywords: *mushroom picking, mushroom harvest aptitude, mushroom harvest modality, commercial mushroom harvest, episodic mushroom harvest.*

DENDROCHRONOLOGY IN THE NEOTROPICAL OMBROPHILOUS WOODLANDS OF ARGENTINA: SEX-RELATED, GROWTH-CLIMATE ASSOCIATION OF *ARAUCARIA ANGUSTIFOLIA*

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Araucaria, pino Paraná or curý (*Araucaria angustifolia* (Bertol.) Kuntze) is a dioecious tree that dominates the mixed neotropical ombrophilous forests in Brazil and Argentina, South America, known as araucaria forests. The species is nowadays critically endangered by deforestation and global climate change. The goal of this study was to analyse the dynamics of radial growth in this species and its association with climatic variables, according to the sex, at its western range boundary in Argentina. Standard dendrochronological techniques were applied on stem disks from female and male trees. An analysis of variance (ANOVA) was performed to detect differences in mean radial growth between sexes. Chronologies were divided in 10-year periods (decade) to detect differences between sexes over time. Tree-ring widths were transformed using natural logarithms to assess the normality and the homogeneous variability of variance. The DENDROCLIM2002 program was used to analyse the dependence of residual chronologies of female and male trees on climate variables. 24 female and 21 male trees, out of the 60 trees initially sampled, were accurately cross-dated and then retained for subsequent analyses. Xylem anatomical anomalies, such as false rings, lenses, narrow rings, wedging rings, and missing rings made the tree-ring dating process difficult. Female and male trees showed growth patterns that changed over time, not being significant in the 1950-1990 period and highly significant from the 1990s onwards ($p < 0.1$) when female trees had a higher growth rate. Female and male trees showed a different association with climatic variables. No significant effect of temperature and precipitation was identified on female trees. For male trees, rainfall had a positive effect in August, before the growing season, and a negative effect at the end of the growing season (March). Temperature had a negative effect on male trees, before and during the growing season (February and January, respectively). No effect of SOI was detected on both sexes. Results emphasised the usefulness of *A. angustifolia* for dendrochronological studies and the value of dioecious species for the study of sex-related growth-climate association.

Keywords: tree-ring, dioecious, dendroclimatology, araucariaceae, gender-related.

AGROFORESTRY AND CONSERVATION OF SOIL AND WATER AS STRATEGIES TO STRENGTHEN THE RESILIENCE OF THE MOUNTAIN ECOSYSTEM BOUMAAD AND ADAPTIVE CAPACITY OF THE LOCAL COMMUNITY

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Located in the Eastern Rif (Morocco), a few kilometers from the Mediterranean coast, the community Boumaad lives mainly in traditional mountain agriculture and ranching. The village, situated on top of a mountain, surrounded by rivers, suffers from a high isolation and a lack of basic infrastructure that lead majority of the population to emigrate. The baseline climate, typically Mediterranean, gradually changes as a result of climate change, increasing of temperatures and heat waves, intensified drought, and intensification of drought and an increase in the frequency and unpredictability of extreme precipitation. Consequently, primary resources of the community are highly impacted by drought, flooding and erosion risks. Identified and developed from the results of the research program ACCMA (Adaptation of Climate Change in Mediterranean), this project aims to reinforce the resilience of the local ecosystem and adaptation of Boumaad community, especially women capacities to cope with these risks, through the implementation of three complementary strategies: adaptation the protection and conservation of water resources, soil fixation, strengthening agroforestry and income diversification. Therefore, strengthening community capacity promotes sustainability. The elaboration of the project was based on participatory approach; all proposals and priorities expressed and debated by the community and partners have been considered in the planning of activities and evaluation of the project (workshops Vulnerability Reduction Assessment), through regular meetings in the village. The project activities helped people to secure their living conditions, to decrease poverty and household vulnerability to the adverse effects of climate change, and therefore reduce the rural exodus, which itself contributes to the weakening of the ecosystem and community. In addition, the project will serve as a basis for the development of new economic activities that will permit in the future the community to increase revenues.

Keywords: *Climate change, vulnerability, adaptation, sustainability, rural exodus*

GROWTH ANALYSIS OF *ERYTHRINA EDULIS* IN FUNCTION OF THE BIOTOPE AND CULTURE ASSOCIATIONS IN BARRANCA PROVINCE IN PERÚ

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Erythrina edulis is a tree from the *Fabaceae* family. His pods and leaves were an important source of food and proteins for the humans and cattle a few centuries ago in the regions of the Andes and its neighbourhood. Nowadays, for several reasons, the benefits of this tree are no longer part of the Andes culture. In that context, the Yacuñahui Association would like to revalue this tree's production and exploitation, especially in the region of Caral's archeological site (Province of Barranca). The archeological site of Caral is considered as the oldest civilization since the years 1990. Today the site is still not very famous, but it has a great touristic potential for years to come. The surrounded region is mostly rural and there is a weak economic activity. The touristic burst could have a positive effect on local economy. However it can also bring unwanted effects like criminality if there are no flourishing economic activities in the zone. So it is important that this region have an economic stability to prevent the arrival of those phenomenons. This work is an introduction to the study of *Erythrina edulis* in his environment. The expectations of the study are on multiple levels: analysis of the best plantation method (seed, cutting,...), study of the most adapted biotope (altitude, soil, ...) in the latitudes of this region, and possible cultural associations. Since the internship is not done yet, research will be performed during the period between February and May 2014. In this seminary's context, information will be collected from existing bibliography. It is possible that all answers cannot be found since this research has not been done yet.

Keywords: *plantation method, altitude, cultural association, economy, Caral*