Course teaching guide

Course	Genetic Resources Conservation and Molecular Markers (A11)		
Subject area	Bloque I		
Module	Optative		
Degree	Máster en Gestión Forestal basada en Ciencia de Datos - Forest Management based on Data Science & Master in Mediterranean Forestry and Natural Resources - MEDFOR		
Curriculum	572	**Code**	54277
When taught	1º cuatrimester	**Type/Category**	Optional
Level/Cycle	University Master's degree	**Year**	2º
ECTS Credits	6		
Language of instruction	Inglés-English		
Teacher/s in charge	Dr. Rosario Sierra de Grado: Course responsible (2 ECTS) Dr. Elena Hidalgo Rodríguez (2 ECTS) Dr. José Climent Maldonado (2 ECTS)		
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Tutorial hours	See at www.uva.es > Masteres >Título correspondiente>Tutorías		
Department	1.-Producción Vegetal y Recursos Forestales; 2- CIFOR- INIA INSTITUTO UNIVERSITARIO DE INVESTIGACIÓN EN GESTIÓN FORESTAL SOSTENIBLE (IUGFS)		

Course: Name of course
Subject area: Indicate the name of the subject area to which the course belongs
Module: If the degree is organised in a Module/Subject Matter/Course structure, indicate the name of the module to which the course belongs.
Degree: Name of the degree to which the course belongs.
Curriculum: Identification number of the curriculum
Level/Cycle: Bachelor's degree/postgraduate (university master's degree/doctorate)
ECTS Credits: Number of ECTS credits
Language: Language in which the course is taught.

Teaching staff: Professor or professors in charge of the course
Contact details: At least one email address of the professor or professors in charge of the courses should be provided.
Tutorial hours: Link to the webpage where the tutorial hours are detailed.
Department: Department in charge of the course.
Code: Course code
Type/Category: FB: Basic Training / OB: Compulsory / OP: Optional / TF: Final Bachelor's or Master's Degree Project / PE: External Placement
Year: Year in which it is taught

1. Situation /Relevance of the Course

1.1 Contextualisation

Long-term stability of forest ecosystems is based on the preservation of the adaptability of forest trees to changing environmental conditions. A precondition, both for the sustainable management of forests and for the conservation of their genetic resources, is to understand the diversity of forest species at the specific, genetic and functional level. During last decades, a huge amount of information and data has been published, both from molecular traits─thanks to the fast progress of sequentiation tools─ and from phenotypic traits. In forest species, there are still few studies combining molecular and quantitative approaches, but the need and reach of this synergy is widely recognized. Based in this knowledge, a set of strategies and tools for conservation of genetic resources has been developed.

1.2 Relation with other subject areas

Genetic Resources Conservation and Molecular Markers is an optional course closely related to the compulsory courses **Fundamentos de investigación e innovación**, **Cambio Global y Bosque** and **Estadística avanzada**, as they work theoretical bases and tools of fundamental importance for the scope of work of the course. In addition, courses of the optional module are linked to the subject, being remarkable:

Métodos de Gestión Forestal, **Multifuncional silviculture**, **Learning by doing: adaptive Management**, **Forest Pest and Diseases**, **Conservación Flora y Fauna**, **Dinámica sistemas forestales**, **Geographical Information Systems** and **Geospatial analysis**.

The application module can be attached to Genetic Resources Conservation and Molecular Markers depending on the choice made by the student on their TFM and Internship.

1.3 Pre-requirements

Indicate whether these are prior requirements which need to be met in order to access the course (only if these are contained in the verification report in the planning section of the teaching) or whether they are merely recommendations.

The general prerequisites of the Master.

2. Skills

2.1 General

G1 Knowledge of the basic elements of professional work in a practical way, analyzing and synthesizing relevant data and organizing and planning teams and processes

G2 Ability to communicate orally and written, both in specialized forums and for non-experts.

G4 Ability to work both as a team and independently in a local, regional, national or international context.

G5 Ability to take initiatives and develop entrepreneurship.

2.2 Specific

In this course students will develop the following specific competences:

E7 Ability to apply different methods and techniques of analysis to address interdisciplinary problems in forest systems.

E11 Ability to search, select, generate and manage appropriate databases to obtain information relevant to the problems of forest management

3. Aims

The students will acquire a global vision of the main problems facing by the forest genetic resources, and will learn how to:

1. Evaluate the need of conservation and use of particular genetic resource
2. Decide on the more suitable strategy of conservation
3. Decide on the molecular tools suitable to identify genotypes and measure diversity in forest species
4. Understand the interplay between conservation and breeding in different contexts
5. Manage information on the main databases related with these topics

4. Table of student's dedication to the course

ONSITE ACTIVITIES	HOURS	OFFSITE ACTIVITIES	HOURS
(T/M)/Theory	30	Individual study	70
(A)/Practical work (Problems,…)	10	Group study	20
(L)/Labs	8		
Field trips	4		
(S)/Seminars	4		
Evaluation	4		
Total onsite	**60**	**Total offsite**	**90**

5. Thematic blocks[1]

Block 1: "Complex phenotypic traits and data associated"

Work load in ECTS credits: 2

a. Contextualisation and justification

Currently the main bottleneck in genetic association studies used in genetic conservation and breeding are the relevant phenotypic traits. Two main problems are frequent: first, the need of high-throughput phenotyping methods and, second, the need of assessing traits closely linked to fitness. Moreover, most traits depend on the environment to some extent, and they interact in a complex way within alternative strategies to cope with either stress, competition and perturbations. This knowledge of what is "adaptive" depending on the objective and the main environmental limitations is key in conservation and use of forest genetic resources, including breeding for commercial purposes.

b. Learning objectives

To understand the concept of (adaptive) phenotype
To classify traits into groups of biological consistency
To know how to define (and work with) protocols and databases
To acquire reasonable skills in quantitative genetics, including plasticity and g x e
To understand how complex traits combine in meaningful life history strategies

c. Content

1. Concepts and drivers of evolutionary change
2. Morphological / functional traits and life history features
3. The problem of homogenizing protocols
4. Quantitative genetics
5. Phenotypic plasticity, g x e interaction and trait correlation (integration)
6. The adaptive phenotype in conservation and deployment of forest genetic resources

d. Method of teaching

See general description below.

e. Work plan

See general description below.

f. Assessment

[1] *Add as many pages as thematic blocks may be required.*

See general description below.

g. Basic references

Falconer DS, Mackay FC (1996) Introduction to Quantitative Genetics (4th Edition). Pearson Education Limited. 480 pp.

Garnier E, Lavorel S, Poorter H, et al. (2013) New handbook for standardised measurement of plant functional traits worldwide. Australian Journal of Botany 61: 167–234.

Cornelissen JHC, Lavorel SB, Garnier EB, et al. (2003) A handbook of protocols for standardised and easy measurement of plant functional traits worldwide. Australian Journal of Botany 51: 335–380.

Schlichting CD, Pigliucci M (1998) Phenotypic evolution - A reaction norm perspective. Sunderland, MA.: Sinauer Associates. 387 pp.

h. Complementary references

Alberto FJ, Aitken SN, Alia R, González-Martínez SC, Hänninen H, Kremer A, Lefèvre F, Lenormand T, Yeaman S, Whetten R, Savolainen O (2013) Potential for evolutionary responses to climate change - evidence from tree populations. Global change biology 19: 1645–61.

Alpert P, Simms EL (2002) The relative advantages of plasticity and fixity in different environments: when is it good for a plant to adjust? Evolutionary Ecology 16: 285–297.

Chambel MR, Climent J, Alia R, Valladares F (2005) Phenotypic plasticity: a useful framework for understanding adaptation in forest species. Investigación Agraria: Sistemas y Recursos Forestales. 14: 334–344.

Grivet D, Climent J, Zabal-Aguirre M, Neale DB, Vendramin GG, González-Martínez SC (2013) Adaptive evolution of Mediterranean pines. Molecular Phylogenetics and Evolution 68: 555–66.

Kremer A, Potts BM, Delzon S (2014) Genetic divergence in forest trees: understanding the consequences of climate change (J Bailey, Ed.). Functional Ecology 28: 22–36.

Lortie CJ, Aarssen LW (1996) The specialization hypothesis for phenotypic plasticity in plants. International Journal of Plant Sciences 157: 484–487.

Matesanz S, Valladares F (2014) Ecological and evolutionary responses of Mediterranean plants to global change. Environmental and Experimental Botany 103: 53–67.

Matyas C (1996) Climatic adaptation of trees: rediscovering provenance tests. Euphytica 92: 45–54.

Pausas JG, Bradstock R, Keith D, Keeley JE (2004) Plant functional traits in relation to fire in crown-fire ecosystems. Ecology 85: 1085–1100.

Petit RJ, Hampe A (2006) Some evolutionary consequences of being a tree. Annual Review of Ecology, Evolution, and Systematics 37: 187–214.

Pigliucci M, Marlow ET (2001) Differentiation for flowering time and phenotypic integration in Arabidopsis thaliana in response to season length and vernalization. Oecologia 127: 501–508.

Torices R, Muñoz-Pajares AJ (2015) PHENIX: An R package to estimate a size-controlled phenotypic integration index. Applications in plant sciences 3.

Sampedro L, Moreira X, Zas R (2011) Costs of constitutive and herbivore-induced chemical defences in pine trees emerge only under low nutrient availability. Journal of Ecology 99: 818–827.

Santos-del-Blanco L, Alía R, González-Martínez SC, Sampedro L, Lario F, Climent JM (2015) Correlated genetic effects on reproduction define a domestication syndrome in a forest tree. Evolutionary Applications 8: 403–410.

Stearns SC (1980) A new view of life-history evolution. Oikos 35: 266–281.

Voltas J, Chambel MR, Prada MA, Ferrio JP (2008) Climate-related variability in carbon and oxygen stable isotopes among populations of Aleppo pine grown in common-garden tests. Trees - Structure and Function.

i. Resources required

Sample databases from GENFORED (www.genfored.es), available without cost, under request

Block 2: "Molecular tools to evaluate intraspecific diversity and support decisions"

Work load in ECTS credits: 2

a. Contextualisation and justification

This block focuses in why tree (and other forest species) genetic diversity matters, to what extent should we be worried about its conservations and what are the basic strategies of genetic conservation. We learn through study cases the criteria to decide what strategy or combination of strategies are more suitable and efficient.

b. Learning objectives

To understand how diversity arises at molecular level;

To know the molecular tools available to assess intra and interspecific diversity

To understand the uses of molecular markers in breeding (MAS)

To explore molecular genetics Databases and to practice its use.

c. Content

1. Molecular basis of biodiversity and potential consequences of mutations
2. Molecular markers & tools in detecting intraspecific biodiversity
3. Uses of genetic maps in breeding FGR
4. Basis for Molecular Genetic & Genomic Databases uses

d. Method of teaching

See general description below.

e. Work plan

See general description below.

f. Assessment

See general description below.

g. Basic references

Bozeman Science: http://www.bozemanscience.com/ap-biology

SSR Database Evoltree (INRA) http://ssrdatabase.pierroton.inra.fr/login/login

GenBank https://www.ncbi.nlm.nih.gov/genbank/

Specific updated resources for each section will be available weekly on UVA-Moodle platform

h. Complementary references

Specific updated resources for each section will be available weekly on UVA-Moodle platform

i. Resources required

None

Block 3: " Main problems and strategies for conservation of the forest genetic resources"

Work load in ECTS credits: 2

a. Contextualisation and justification

In the current global context several factors are causing an important genetic erosion in many ecosystems, including forest all over the world. This block analyse the different strategies and tools that can help in the conservation of forest genetic resources and the criteria to select the more suitable combination of them.

b. Learning objectives

To know the concept of forest genetic resources (FGR), their importance and main concerns for their conservation.

To understand how to assess the need for conservation of a particular FGR.

To know the basis and main strategies for conservation of FGR.

To understand how to decide the more suitable strategy of conservation.

c. Content

1.- FGR: concepts, state of the world's FGR, main threats.

2.- Insight of population genetics to support the conservation of FGR.

3.- Distribution of the genetic variability in forest populations. Management of the geographic variability.

4.- Strategies of conservation of FGR: in situ, ex situ, circa situm.

5.- Main databases related to conservation of FGR.

d. Method of teaching

See general description below.

e. Work plan

See general description below.

f. Assessment

See general description below.

g. Basic references

Eriksson G, Clapham ED 2006 An introduction to forest genetics. http://www.slu.se/Forest-Genetics-online

FAO, FLD & IPGRI. 2004. Forest genetic resources conservation and management. Vol 1: Overview, concepts and some systematic approaches. Rome.

FAO, D. IPGRI (2001) Forest genetic resources conservation and management, vol 2, In managed natural forests and protected areas (in situ). International Plant Genetic Resources Institute, Rome, Italy.

FAO, FLD, IPGRI. 2004. Forest genetic resources conservation and management. Vol. 3: In plantations and genebanks (ex situ). International Plant Genetic Resources Institute, Rome, Italy. http://www.fao.org/forestry/fgr/publications/en/

Bozzano M, Jalonen R, Thomas E, Boshier D, Gallo L, Cavers S, ... Loo J (2014). The state of the world's forest genetic resources–thematic study. Genetic considerations in ecosystem restoration using native tree species. FAO, Rome. The State of the World's Forest Genetic Resources

Rao NK, Hanson J, Dulloo ME, Ghosh K, Nowell D, Larinde M (2006). Manual of seed handling in genebanks. Handbooks for Genebanks No. 8. Bioversity International, Rome, Italy (p. 4). ISBN 978-92-9043-740-6 Bioversity International Via dei Tre Denari, 472/a 00057 Maccarese Rome, Italy Bioversity International.

Multilingual Glossary Forest Genetic Resources

http://iufro-archive.boku.ac.at/silvavoc/glossary/1_2en.html

h. Complementary references

i. http://www.fao.org/forestry/fgr/64623/es/

http://www.euforgen.org/links.html

http://www.diva-gis.org/documentation

http://www.bioversityinternational.org/e-library/

http://www.iucn.org/es/

https://www.genesys-pgr.org/es/welcome

http://www.gbif.org/

Resources required

- None.

6. Method of teaching

This course will rely on theoretical/practical lessons (with presentations), individual and group works based on case studies and extant databases, technical visits, hands-on seminars and lab practice.

7. Work plan

Classes will take place during the second period of 5 weeks of the first semester according with published schedule. A combination of theoretical classes and study of cases will be follow, with the necessary individual and group work that will allow the active participation of the students in the course.

Lab practice (~6h) will consist on DNA Extraction; PCR Amplification and derived markers; Electrophoresis, molecular hybridization and cloning devices; Amplicons analysis.

Technical visits will be held at the middle of the period, consisting in a field trip to a common garden experiment and a visit to an in vitro collection of germplasm.

Individual and group works will be carried out during the all the period.

8. Timeframe (in thematic blocks)

From the 6th to the 10th weeks of the first semester.

9. Summary table of instruments, procedures and assessment/marking/grading systems

INSTRUMENT/PROCEDURE	WEIGHT IN THE FINAL MARK/GRADE	REMARKS
Continuous evaluation (active participation in the course)	25%	
Personal and group projects presentations:	35%	
Final exam	50%	The exam includes both theoretical and practical aspects

10. Curriculum vitae