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Assisted Migration of Forests as a climate change economic mitigation strategy

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EUROPEAN COMMISSION
Research Executive Agency
Marie Curie Actions – Intra-European Fellowships for Career Development

Project No: 327778

Project Acronym: AMECO

Project Full Name: Assisted Migration of Forests as a climate change economic mitigation strategy

Marie Curie Actions

Final Report

Period covered: from 01/05/2013 **to** 19/11/2015

Start date of project: 01/05/2013

Project coordinator name:
Dr. Minh Ha-Duong

Version: 1

Date of preparation: 01/12/2015

Date of submission (SESAM): 22/12/2015

Project coordinator organisation name:
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

Final Report

PROJECT FINAL REPORT

Grant Agreement number:	327778
Project acronym:	AMECO
Project title:	Assisted Migration of Forests as a climate change economic mitigation strategy
Funding Scheme:	FP7-MC-IEF
Project start date:	01/05/2013
Project end date:	19/11/2015
Name, title and organisation of the scientist in charge of the project's coordinator:	Dr. Minh Ha-Duong CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
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Project website address:	

1. FINAL PUBLISHABLE SUMMARY REPORT

This section normally should not exceed 2 pages.

This is a comprehensive summary overview of results, conclusions and the socio-economic impacts of the project. The publishable report shall be formatted to be printed as a stand alone paper document. This report should address a wide audience, including the general public. Moreover, do not include in the summary report any confidential information, whose publication might undermine the protection of commercial interests, including intellectual property, or privacy and the integrity of the individuals, in particular in accordance with Community legislation regarding the protection of personal data.

Please ensure that it:

- Is of suitable quality to enable direct publication by the REA or the Commission.

- Is comprehensive, and describes the work carried out to achieve the project's objectives; the main results, conclusions and their potential impact and use and any socio-economic impact of the project. Please mention any target groups such as policy makers or civil society for whom the research could be relevant.

- Includes where appropriate, diagrams or photographs and the project logo, illustrating and promoting the work of the project.

- Provides the address of the project Website (if applicable) as well as relevant contact details.

Final Publishable Summary Report:

The main purpose of this proposal was to provide the necessary tools to address a particular case of adaptation and mitigation of forests to climate change in Western Europe: the translocation of tree population to compensate for climate change (Assisted Migration; AM).

Tree populations have been moved with different purposes before, and we started analyzing these particular cases in Europe. In particular, we analyzed a well-document failed case of population translocation of Pinus pinaster Ait from the Iberian peninsula to southern France, which entailed an enormous economic loss that led to the only case where the use of foreign tree populations was prohibited by the European Union, which otherwise promotes the free exchange of seeds between ecologically matched sites (EU Council Directive 1999/105/EC of 22 December 1999). An opinion paper (Restoration Ecology 2013) and a reply letter (Bioscience 2013) are related to these experiences analyzing translocations in the past.

A second step was devoted to propose new scenarios for translocations in the future based on climate data and the fitness (measured as the volume/year as recorded in NFI). To do that, we produced scenarios (theoretical representation) of assisted migration actions for two important candidates for AM in Europe: Pinus pinaster and Pinus halepensis. We harmonized the Spanish and French National Forest Inventories for standing volume and mortality, which allowed us to run models covering Western Europe. Target zones were selected from provenances with high sensitivity and seed zones from provenances with low sensitivity to climate change; the latter can be considered “seed refugia” as the climate changes. Three plausible scenarios for translocation to the target zone were developed on the basis of volume simulations calibrated with different planting Abies alba strategies: 1) seeds only from foreign provenances; 2) foreign provenances plus local seeds; and 3) only local seeds. Our results suggested that volume and mortality trends were not always correlated with seed sources and targets, that projected provenances mortality do not follow always a southern-northern pattern and that seed refugia, if any, may be useful for compensating for the effects of climate change only in a subset of provenances (this approximation has been published in the journal New Forests 2015).

To evaluate which native forests are likely candidates for AM we estimated the vulnerability of the native species in Western Europe including the sensitivity, the exposure and the adaptive capacity of the major tree species in ecological models for creating scenarios for current climatic conditions and future ones. The results of these simulations are considering for publication in the journal Ecological Applications. Our results suggest that management programs should be different for mountain conifers populations occurring at their rear-edge of their distribution that need to be sampled more intensively to preserve their genetic resources compared to lowland widespread temperate species where vulnerabilities seem lower and populations more homogeneous. Likewise, for rear-edge populations, ex-situ programs considering some compensation for climate change (assisted

migration) may be essential to preserve the populations for which conditions become too harsh but that may have a better chance in higher latitudes and altitudes.

The adaptation of socio-ecological systems to climate change depends not only on the evolutionary potential of natural populations but on the decisions taken by social actors that mediate natural processes. To succeed in moving trees to compensate for climate change the development of a decision framework based on variations in tree fitness in relation with climate is a priority. In trees, provenance trials provide new insights to understand the future of populations under climate change. We use data from an European network of 33 provenance tests of Abies alba planted in 5 sites in France to predict spatial variation in tree height at 9 years old in the present and in the near future. We integrated the outputs of the height tree model in combination with the ones of habitat suitability for each of the climate scenarios in a decision framework to guide assisted colonization to compensate for climate change. We apply three decision rules to cope with the uncertain states of the world represented by four climate change scenarios showing that there is no unique 'best decision' and that the general recommendation of mixtures of populations, although probably not the most productive, can reduce uncertainty in the long term by allowing natural forests to evolve.

2. USE AND DISSEMINATION OF FOREGROUND

Section A (public) – DISSEMINATION MEASURES

This section should describe the dissemination measures, including any scientific publications relating to foreground and specify any applications for patents etc. Its content will be made available in the public domain thus demonstrating the added-value and positive impact of the project on the European Union.

Dissemination activities

Comments:

We have presented the results of this research in several scientific, stakeholders and dissemination forums.
For instance, in August 2015 we were invited to present our results on the use of decision theory in AM in forests social-ecosystem in the 100th Ecological Society of America Conference in Baltimore, US.

Our results on proposing translocation of provenances for P. pinaster and P. halepensis based on the expected volume of the different populations of these trees in the future was presented at the 2nd Conference on Restoration Ecology that held in La Fayette (Indiana), US in October 2014.

The propositions of assisted migration scenarios in particular for France were presented at the brainstorming meeting of the INRA (National Institute for Agricultural Research) and ONF (Office National des Forêts), a forum between stakeholders and scientists for understanding the adaptation of forests to climate change (1-2 July 2015, Nancy, France).

Publications

The list of scientific publications (see article II.11 of the grant agreement) starting with the most important ones, should specify:

- publication name,

- date and page in order to be able to identify it (see proposed template).

LIST OF SCIENTIFIC PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
No.	Title / DOI	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Date of publication	Relevant pages	Is open access provided to this publication ?	Type
1	Habitat Restoration and Climate Change: Dealing with Climate Variability, Incomp lete Data, and Management Decisions with Tree Translocation s 10.1111/rec.1 2032	Marta Beni to-Ga rzón , Minh Ha-Duong , Na thalie Frascari a-Lacoste , Juan Fernánde z-Manjarr és	Restoration Ecology	Vol. 21/Is sue 5	Blackwell Publishing	United Kingdom	01/09/2013	530-536	Yes	Peer revie wed
2	Extreme Climate Variability Should Be Co nsidered in Forestry Assisted Migration 10.1525/bio.2 013.63.5.20	Marta Beni to-Ga rzón, Minh Ha-D uong, Nath alie Frascari a-Lacost e, a nd Juan Fe rnánde z-Ma njarr és	BioScience	Vol. 63/Is sue 5	American Institute of Biological Sciences	United States	01/05/2013	317-317	Yes	Peer revie wed
3	Assessing global biome exposure to clima te change through the Holocene-Anth ropocene transition	Marta Beni to-Ga rzón , Paul W. Leadl ey , Juan F. Fe rnánde z-Ma njarr és	Global Ecology and Biogeography	Vol. 23/Is sue 2	Blackwell Publishing	United Kingdom	01/02/2014	235-244		Peer revie wed
4	The effects of phenotypic plasticity and local adaptation on forecasts of species ran ge shifts under climate change	Valladare s F, Matesanz S, Guilhaumo n	Ecology Letters	17	Blackwell Publishing		01/11/2014	1351-1364	No	Peer revie wed

		F, Araujo MB, Balaguer L, Benito Garzón M, Cornwell W, Gianoli E, van Kleunen M, Naya DE, Nicotra AB, Poorter H, Zavala MA								
5	Testing scenarios for assisted migration of forest trees in Europe 10.1007/s11056-015-9481-9	Marta Benito-Garzón , Juan F. Fernánde z-Manjarrés	New Forests	Vol. 46/Issue 5-6	Springer Netherlands	Netherlands	01/11/2015	979-994	No	Peer reviewed
	Assisted migration to adapt forests to climate change, is uncertainty too deep to decide?	Minh Ha-Duong Ankur Shah Delight	LEF Biennial Workshop: Economics of carbon, climate change and forest.		Laboratoire d'économie Forestière	Nancy	24/10/2014		Yes	Conference
	Forest assisted migration and decision making under climate change	Marta Benito GarzónNathalie Frascaria-Lacoste Minh Ha-Duong Juan Fernande z-Manjarres	European Climate Change Adaptation Conference (ECCA), Integrating Climate into Action		University of Hamburg	Germany	19/03/2013		Yes	Conference

Section B (confidential) - EXPLOITABLE FOREGROUND AND PLANS FOR EXPLOITATION

This section should specify the exploitable foreground and provide the plans for exploitation. It will be kept confidential and will be treated as such by the REA and the Commission.

The applications for patents, trademarks, registered designs, etc. shall be listed according to the template B1 provided hereafter.

The list should, specify at least one unique identifier e.g. European Patent application reference. For patent applications, only if applicable, contributions to standards should be specified.

LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS,UTILITY MODELS, ETC.					
Type of IP Rights	Confidential	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant(s) (as on the application)

OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND								
Type of Exploitable Foreground	Description of Exploitable Foreground	Confidential	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for commercial use or any other use	Patents or other IPR exploitation (licences)	Owner and Other Beneficiary(s) involved

ADDITIONAL TEMPLATE B2: OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND	
Description of Exploitable Foreground	Explain of the Exploitable Foreground

3. SCIENTIST IN CHARGE QUESTIONNAIRE

RESEARCH TRAINING ASSESSMENT:

What is the size of the hosting research group?	70

How many researchers have you supervised, within the past 10 years? Of which funded by:	
EC/Marie Curie actions	01
EC Other Funding	05
University fellowships	0
National public bodies	02
Industry	0
Other	0
Other, please specify:	

How many researchers have you supervised within this project?	02
Corresponding to how many person months?	40

Number of publications resulting directly from the research project:	
Recruited researcher(s) and yourself	2
Recruited researcher(s) alone	0
Recruited researcher(s) with authors other than yourself	3

Participation of the recruited researcher(s) at conferences (number):	
Passive	5
Active	8
How do you rate the overall success of the research training?	Very good

General assessment:

I am extremely satisfied with the production of the recruited researcher. Active conference participation includes organizing special sessions.

RESEARCHERS ASSESSMENT:

Rate the overall level of the recruited researcher(s) integration in the research team and the host organisation with regards to:	
participation in meetings/seminars	Good
discussions of results and project-related topics	Good
co-operation with other team members	Fair

co-operation with other researchers of the host institution	Good

Rate the overall performance of the recruited researcher(s) with regard to:	
capacity to develop new skills and to benefit from training	Very good
productivity (research results/publications/international conference attendance)	Very good
communication skills	Very good
group leader skills (collaboration with other groups/project management)	Very good
training and/or teaching skills	Very good

Comment:

I did not assess training and/or teaching skills, but all answers seem mandatory.

RESEARCH TRAINING OUTCOMES:

Has this project provided additional links with other research groups or institutions?	Yes

If yes, indicate the number of contacts in each case	
Universities	02
Research Centres	0
Industry/private companies	0
Others	0

If Other, please specify:

Rate the importance of the following outcomes of the research training:	
results of the research	Very good
number of publications	Very good
development of research	Very good
establishment of international collaborations	Very good
transfer of knowledge/technology	Very good
training of students/researchers	Very good
further academic qualifications (PhD, habilitation etc.) for fellows	Very good

Comments:

I knew the trainee was very good, but she exceeded my expectations repeatedly.
The result of the training is that she obtained an Excellence Chair position at her university of choice.

YOUR OPINION ABOUT THE MARIE CURIE ACTIONS:

Comments:
This is action worked impressingly well. Keep it as it is !

Did you have previous knowledge of the Marie Curie actions?	No

If yes, what sort of image do you think that the Marie Curie actions have among the scientific community in your research area?

Attachments

The content of this report has been approved by the researcher and the scientist in charge assigned to this project. The electronic submission of this report shall replace their signatures.

This declaration was visaed (signed) electronically by Minh HA-DUONG (ECAS user name nhadumin) on 22/12/2015