



**European Cooperation
in the field of Scientific
and Technical Research
- COST -**

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COST 039/14

MEMORANDUM OF UNDERSTANDING

Subject : Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action FP1403: Non-native tree species for european forests: experiences, risks and opportunities (NNEXT)

Delegations will find attached the Memorandum of Understanding for COST Action FP1403 as approved by the COST Committee of Senior Officials (CSO) at its 190th meeting on 14 May 2014.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as
COST Action FP1403
NON-NATIVE TREE SPECIES FOR EUROPEAN FORESTS: EXPERIENCES, RISKS
AND OPPORTUNITIES (NNEXT)

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4114/13 “COST Action Management” and document COST 4112/13 “Rules for Participation in and Implementation of COST Activities”, or in any new document amending or replacing them, the contents of which the Parties are fully aware of.
2. The main objective of the Action is to establish a multidisciplinary platform of researchers for a state-of-the-art knowledge transfer on non-native tree species in European forest ecosystems and in-depth analysis of the associated risk and challenges in growing these species within European forestry sector.
3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 84 million in 2014 prices.
4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.
5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of section 2. *Changes to a COST Action* in the document COST 4114/13.

A. ABSTRACT AND KEYWORDS

The management of tree species non-native to European geographical regions has a long tradition within forestry management practice. Their introduction to Europe (initially focussed on growing tree species) dates back to the 17th and 18th century when enormous demands were being made on natural resources to sustain the on-going industrialization of Europe. Today issues of biomass production and C sequestration as well as the question of whether these species could increase the adaptive capacity of forests to long-term climate change patterns have fuelled a growing interest in non-native tree species in Europe. In order to determine their full potential (and associated management options), but also to assess associated risks and challenges the need for a communication platform –allowing for discussions with stakeholder groups from within and beyond European borders – is argued.

Keywords: Non-native species, forestry, forest productivity, forest ecology, nature protection, biodiversity, forest management, climate change, adaptation, provenance trials

B. BACKGROUND

B.1 General background

The history of human influence on European forests and its resulting impact have strongly affected our current forest situation. Over the centuries communities have significantly reduced (i) forest cover (ii) have changed the distribution of species within and beyond their natural distribution range (Spiecker *et al.* 2004) and (iii) have actively promoted the introduction of ‘non-native’ tree species to Europe (Mason & Perks 2011, DeGomez & Wagner 2001, MacDonald *et al.* 1957, Wein 1930) to increase productivity.

There are various definitions for ‘non-native’ tree species (e.g. US Environmental Agency (2003), European Environmental Agency (2008)). This Action will initially take the Ministerial Conference on the Protection of Forests in Europe (MCPFE) interpretation as guiding the discussions developed through the Network. The MCPFE states ‘non-native’ species (synonyms: non-indigenous species, introduced species, exotic species, alien species) are species occurring outside their natural vegetation zone, area or region’ (MCPFE 2008). In addition, this COST Action will concentrate on those non-native tree species which do not originate from Europe.

Non-native tree species were promoted during the industrialization of Europe - a period in history

which drew on a huge level of forest resources that became the main energy source powering a social and economic revolution. To counter-balance the continuing exploitation of Europe's forests, one option (propagated by countries maintaining colonies) was the introduction of a number of fast growing non-native tree species (e.g. Sitka spruce (*Picea sitchensis*), Douglas fir (*Pseudotsuga menziesii*), Grand fir (*Abies grandis*), Lodgepole pine (*Pinus contorta*), Eucalypt (*Eucalyptus* sp.), Black locust (*Robinia pseudoacacia*), Red oak (*Quercus rubra*), Tree of heaven (*Ailanthus altissima*). By achieving notable success the economic reality as to the importance of producing timber for a number of sectors (e.g. construction sector, biomass and wood producers) was soon realized. These past economic objectives still strongly affect the current distribution of non-native tree species in Europe (e.g. Sitka spruce in Scotland, Eucalypt in Portugal, Black locust in Hungary).

While continuing to place this in a broader economic context (i.e. within sustainable development) non-native tree species also may have the potential to comprise an adaptation option as part of a response strategy to address the expected impact of climate change. Based on their eco-physiological heritage, certain non-native tree species are less susceptible to drought stress; a phenomenon associated with longer dry periods and increasing temperatures resulting from climate change. Douglas fir, Ponderosa pine (*Pinus ponderosa*), Black locust and Tree of heaven are non-native tree species which are capable of adapting to such conditions (Eilmann & Rigling 2012, Grünwald et al. 2009). In this context, France and Germany are currently supporting the testing and planting of such species to determine their potential for climate change adaptation.

Along with the economic position an ecological argument has become prominent (Schmid et al. 2014). Advocates presenting the ecological position argue that with the further introduction of new non-native tree species into our forests, forest ecosystems could change dramatically. This change could alter natural competition and succession, and present a number of ecological risks. Such ecological risks could include:

- negative effects on the multifunctional role of European forest ecosystems and their role in the provision of goods and services.
- adverse effects on nature conservation and devaluation of the habitat currently provided by forests, and
- a loss of biodiversity of European forest ecosystems.

While attempting to address such controversial issues in re-thinking the potential of non-native tree species in Europe, it is of utmost importance to consider the existing relevant, accurate and up-to-date knowledge on this topic. With such information, evident questions can be addressed such as

whether non-native tree species can be considered as a potential ‘adaptation option’ in order to tackle the impact of the expected climate change influences, what the potential invasiveness of these tree species are with respect to native plant communities, and whether further developments will lead to new pathogens and insects and eventually cause further loss in biodiversity within our forest ecosystems.

At present information on non-native tree species is mainly available at regional or country level and published reports are often limited to local language distribution networks. This fragmentation of knowledge illustrates that a European platform for knowledge sharing is necessary. This platform will provide information related to differences in theoretical positions, alternative multifunctional silviculture management strategies, nature conservation and biodiversity issues related to the non-native plantations in European regions. This information must be synthesized in order to be disseminated to a broader audience of environmental groups, timber industries, politicians, policy makers and the public across Europe.

The Mission of NNEXT is to establish a multidisciplinary platform of scientists to compile the most relevant, accurate and up-to-date knowledge for assessing an in-depth analysis of the associated risks and challenges in growing non-native tree species within the European forestry sector.

B.2 Current state of knowledge

An estimated 5.2 % (8.1 Mio ha) of the total European forest area (excluding the Russian Federation) is covered by non-native tree species. 10 % of this non-native tree species total is dominated by invasive species (MCPFE 2008). Invasive alien plant species (IAS) are non-native plants whose introduction poses a threat to biodiversity loss or have other unforeseen negative consequences (EEA, 2012a). However a major constraint is a concise definition of what scientists agree on as being ‘invasive’. Genovesi *et al.* (2012) and Ricciardi & Cohen (2007) argued that the term ‘invasive’ has been used to describe inter alia: (1) any introduced non-indigenous species; (2) introduced species that spread rapidly in a new region; and (3) introduced species that have harmful environmental impacts (particularly on native species). The second definition presented by these authors is commonly used by ecologists, while the third definition is likely to be referred to in policy papers and legislation (EEA -2012a,b). According to MCPFE (2008) the most important non-natives are conifers: Sitka spruce, Douglas fir, Western hemlock (*Tsuga heterophylla*) and various pine species (Lodgepole pine and Weymouth pine). The most common introduced broadleaved trees are Red oak, poplar (*Populus*) species and their hybrids, and Black locust. Black locust has been identified as one of the most invasive species in Europe (Nehring *et al.* 2013,

Petrova *et al.* 2012).

Among the non-native tree species *Eucalyptus* sp. and Sitka spruce have the highest coverage with more than 1 Mio. ha each (1.40 and 1.29 Mio ha) in Europe. The following five species cover more than 100.000 ha, Black locust (774.000 ha), Douglas fir (704.000 ha), Lodgepole pine (327.000 ha), poplar hybrids (300.000 ha) and Monterey pine (*Pinus radiata*) (226.000 ha) and Grand fir grows on about 5000 ha. (Köble & Seufert 2001).

Although the majority of non-native tree species were introduced to Europe around the 17th and 18th century (Kowarik & Säumel 2007, Krausch 1988, Wein 1931, Holubčík 1968, Bolle 1887, Willdenow 1796) the extensive plantings of these species didn't take place until the late 18th and early 19th century. The extent of this development depended on the tree species being planted and in which country the plantings took place (Petkova 2004, Kostov 1986, Holubčík 1974, Birner 1922).

The majority of non-native forest species, which have been brought to Europe (such as Grand fir, Lodgepole pine, Black locust, Douglas fir, Red oak, Sitka spruce, Red ash (*Fraxinus pennsylvanica*), Maple ash (*Acer negundo*)) are species with extensive natural distribution ranges. They come from different environments and often contrasting climatic conditions. The native distribution ranges of these tree species reflect their evolutionary history and dynamics including their responses to past geological and climate events (Mosca *et al.* 2012, Wei *et al.* 2011, Jaramillo-Correa *et al.* 2008, Jaramillo-Correa & Bousquet 2005, Swenson & Howard 2005). As a result of these complex processes numerous tree species (Grand fir, Douglas fir, Lodgepole pine, Maple ash etc.) have developed into subspecies and different varieties (Eckenwalder 2009, Hunt 1993).

The distribution of non-native tree species in Europe is artificial and thus not reflecting the natural evolution of these species. In addition, the origin of the plant material and seeds was not considered an issue of importance when many of these populations were established in the past. For example, all Douglas fir populations cultivated up to the 1980s are assumed to be of unknown origin in Europe (Bastien *et al.* 2013). Current studies on Douglas fir show that forests which naturally regenerate (some of these serve as marketable seed sources) might be intermixed by different varieties with different eco-physiological properties and therefore potential (Konnert & Ruetz 2006, Konnert *et al.* 2008). A concise understanding on the hybridization effects and the genetic composition of the genetic natural regeneration of these species is of utmost importance for determining the long-term adaptation of non-native species and their economic and ecological success. As varieties and subspecies of non-native tree species might hybridise; the stability of such forests is unpredictable.

Ignoring the origin of the plant material resulted in different performances of seedlings and young

stands with respect to growth, resistance to fungi etc. (Schwappach 1907). These insights initiated the start of extensive provenance trial research on non-native species. Research was conducted on Douglas fir (Barner 1973, Ruetz & Nather 1985, Ruetz 1987, Kleinschmit *et al.* 1991; Kleinschmidt & Bastien 1992, IUFRO 1995, Usta 2001), Grand fir (Rau 2011, Liesebach *et al.* 2008) Lodgepole pine (Stephan 1982), Black locust (Moshki *et al.* 2012), Red oak (Hubert & Cundall 2006), Sitka spruce (Hubert & Cundall 2006, Niedersächsische Forstliche Versuchsanstalt 2004), and Tree of heaven (Kovarik & Säumel 2007). The main goal of provenance trials has always been to select the best performing provenances with regard to growth and quality traits. Currently these provenance trials continue to be the hotbeds for determining a better understanding of the climatic adaptation potential (Eilmann *et al.* 2013, Kapeller *et al.* 2013).

This COST Action will synthesize the current regional coverage of different non-native tree species across Europe and develop a consistent knowledge base available to the public which includes their historic background, and if possible, the geographic origin of these non-native tree species.

Furthermore this COST Action will conduct an analysis of previous experiences in growth and production of silvicultural treatments, review the different management models hitherto developed for the production of non-native tree species. NNEXT will also assess the risks of an introduction of new and unknown pests and diseases as well as the associated ecological risks particularly to native species. (e.g. invasive behaviour, pests) across a number of regions in Europe.

B.3 Reasons for the Action

The management of non-native tree species currently varies significantly across countries and regions of Europe. While some have abandoned their introduction (e.g. Norway) other countries actively promote their establishment (e.g. France, Portugal, etc.). These different views are strongly driven by different objectives with regard to (i) nature conservation, (ii) biodiversity and (iii) productivity. These alternative positions have led to a controversy on how to come to a consensus on an ‘acceptable’ management strategy of non-native species in Europe. Recognizing that some native species maybe reaching their ecological limits (see COST FP 1202), achieving such a consensus is of the utmost importance. Scientists and policy makers have to agree on climate change adaption strategies. In this context non-native species are being identified as being of increasing importance.

Previously the ‘introduced material’ of non-native tree species was not well-considered in respect to planting location, variety and seed source resulting in their different performance concerning growth, adaptability, and resistance to fungi (Schwappach 1907). As a consequence many European

countries (Kleinschmit *at al.* 1979, Mason 2012) have established field research plots as well as provenance trials, and have introduced intensive monitoring studies under a variety of ecological conditions. Most of the results obtained from these experiments are only available at the local level and in local languages. A European-wide data and knowledge exchange on this topic is currently missing. Synthesizing all these information sources (containing data on nature conservation issues, biodiversity, productivity, etc.) is an important contribution to ensure the sustainability and competitiveness of the forest sector. It is also a strong contribution towards a reduction of the fragmentation of insights and research on non-native tree species.

B.4 Complementarity with other research programmes

The NNEXT COST Action builds on the COST Action FP0703 COST-ECHOES. This COST Action aimed to mobilise and integrate the existing scientific knowledge for European forest policymakers making decisions on adaptation options to mitigate for climate change scenarios. The project also relates to the following COST Actions and FP7 projects:

- FP1304 – PROFOUND: will strengthen the integration of forest modellers and data-providing experts across Europe, providing more reliable information about the uncertainty of model predictions to decision makers.
- FP1103 – FRAXBACK: will through a synthesis of available information, generate a comprehensive understanding of *Fraxinus* dieback in Europe. *Fraxinus pennsylvanica*, an introduced non-native tree species to Europe, is among the studied ash tree species.
- FP1202 – MaP-FGR: deals with marginal/peripheral forest populations and compiles the information on climate change impacts on these populations. Some of the non-native species occupy these regions as well.
- FP1206 – EuMIXFOR studies structure, dynamics and functioning of admixtures of tree species across Europe. Non-native species not only occur in pure but also mixed stands.
- EU-FP7-Infrastructure- TREES4FUTURE (<http://www.trees4future.eu/>) aims to integrate, develop and improve major forest genetics and forestry research infrastructures.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The main goal of this action is to build a platform for knowledge transfer where researchers can elucidate different aspects of non-native species in European forest ecosystems, considering the

procurement of reproductive material, silvicultural management models, assess ecological and economic risks, and evaluate suitability for climate change adaptation strategies. Of particular relevance is the transfer of knowledge to early-stage researchers on the experiences and results obtained from studies on provenance (conducted in the 1960/70's) and addressing issues of adaptation options for climate change scenarios.

C.2 Objectives

The COST Action will address head on the difference within economic and ecological positions held by multiple stakeholders. To do so the NNEXT Action will compile all relevant information on non-native tree species in Europe (available to the public) incl. the historic background and if possible, the geographic origin (provenance) of non-native tree species. It will also present an assessment of the geographic origin (provenance) of introduced plant material and its importance for silvicultural performance.

The COST Action will also conduct an analysis of previous experiences (i.e. growth and production etc.) from silvicultural treatments, review different management models for the production of non-native tree species and review the management of these species as well as the risk for an introduction of new and unknown pests and diseases. The COST Action will assess the associated ecological risks particularly to native species (e.g. invasive behaviour, pests, etc.) across a number of regions in Europe. This assessment will consider gradient of temperature and moisture, as well as the adaptation potential of these species in fulfilling ecological, economic and societal demands adapting to climate change conditions.

The key objectives of NNEXT can be summarized as follows:

1. **Collect, process and harmonise existing information on non-native tree species distribution in Europe.** This step includes an analysis of the historic reason in promoting species, maps, and existing data. Based on this initial step we may select certain key tree species for an in depth analysis across Europe.
2. **Assess introduction and distribution pathways (including geographic origin) of non-native species.** Defining the role of natural regeneration in the integration and persistence of non-native species in native forest ecosystems.
3. **Collect and analyse silvicultural management practices in Europe.** This will include the assessment of the growth performance, the multifunctional role of given non-native tree species as well as a review of existing management models for non-native tree

species. The management of these species for biomass production and for high quality wood materials as well as the profitability and performance of non-native tree sales at the wood markets will be addressed, as well as the possibilities for co-management of mixtures of native and non-native species.

4. **Assess the ecological risks for native tree species.** In particular we are interested in related changes on biodiversity and nature conservation issues associated with changes in the competitive situation of native tree species. New pests and pathogens which might be introduced and effect European forest ecosystems will also be addressed. For selected non-native tree species, their potential for spreading across Europe will be assessed. This assessment will be based on climate and soil data maps. These data sources will (i) provide information about the opportunities (climate change adaptation/mitigation, biomass production etc.) for promoting non-native tree species (ii) assess the risks (loss in biodiversity and sustainability, loss in ecosystem stability and thus an increase in ecosystem vulnerability) for the established native forest ecosystems.

NNEXT will provide the following deliverables:

1. A meta-database (collection of available reports, etc.) of non-native species and experimental plots of on-going research into non-native tree species (i.e. presenting national historical inventories and research data) and illustrated map/s of European regions.
2. Conceptual analysis of the ecology and silviculture of non-native species under changing site conditions.
3. Reports on seed-and plant material pathways and suggested seed provenances for comparisons at regional, national, and European level.
4. Reports on location and distribution of provenance tests and seed orchards of non-native tree species for the production and availability of seeds.
5. Literature review considering the most up-to-date information addressing:
 - a) The ‘invasive behaviour’ associated with a number of non-native trees species and in regards to their planting within native forest ecosystems.
 - b) The existing and potential biotic and abiotic risks to non-native and native tree species.
6. Reports on determining appropriate forest management practices (i.e. estimate economic and ecological inputs) for the selection and production of non-native species.

C.3 How networking within the Action will yield the objectives?

The objectives set out in C2 and the overall management of this COST will be achieved through six key activities. In relation to these activities COST partners, with the support of a number of identified stakeholders groups will complete the project objectives.

1. Working Group Meetings. They will allow for regular meetings to take place with the Action partners and other interested parties (scientists, social and political analysts and practitioners). These meetings provide the platform for discussing different views in managing non-native tree species in Europe. They will complete the scientific tasks and present an inter-disciplinary understanding to non-native trees in Europe and their associated risks and opportunities. Proceedings and/or papers of the work completed are planned to publish.
2. Two Summer Schools. These one week sharing and learning opportunities will take place in year two and four of the NNEXT Action. They are linked to graduate schools at participating institutions and will increase networking and establish ties with ongoing research/PhD projects among the participating institutions. Key researches in the field will give classes and participating students present their research.
3. STSMs (Short Term Scientific Missions). They will be determined yearly (NNEXT Management Committee) but are foreseen to take place between 8-10 times a year. They are seen exclusively as a platform for engaging young researchers in the NNEXT Action and involving them in the generation and transfer of new knowledge developed in relation to the objectives identified in C.2.
4. Dissemination Activities (public website, journal articles, NNEXT conference, and collaborative COST project meetings). They will provide the opportunity to make use of multiple communication channels to a diverse range of stakeholders. These opportunities of dialogue and deliberation will be initiated by the design and continued management of the NNEXT website and further enhanced with the completion of NNEXT reports, journal articles and presentations (scientific and policy oriented). Within NNEXT this activity is of high significance since our goal is to summarize, demonstrate and potentially resolve controversial opinions in managing non-native tree species in Europe. The Action plans to establish a kind of a public ‘drop box’ where COST participants can create a collection of relevant information and articles related to our topic.

5. Task Force on Public Perception. It will be compiled by MC representatives (and/or national contact points provided by the MC members) and will consist of national representatives. The task force will report on public perceptions on non-native tree species (in the various participating countries), how this topic is treated in the media, how this perception has changed over the last decade and how this is viewed in light of climate change.
6. Management Committee (MC). It will be determined at the initial meeting for the start of NNEXT and will convene annually (in conjunction with WG meetings and/or summer schools) will allow effective management of activities.

Jointly these activities will ensure the accomplishment of the NNEXT objectives, deliverables and this Action's milestones.

C.4 Potential impact of the Action

NNEXT will take a coordinated interdisciplinary approach in monitoring and determining the pathways of present and future potential use of non-native trees and their multifunctional and integrated use (i.e. biodiversity and nature conservation potential for Europe).

Scientific /Technical: As stipulated in Section B this COST Action provides opportunities for researchers and institutions to synthesize an understanding of the importance of certain non-native tree species in the context of adaptation potential of forests to climate change and biodiversity and nature conservation issues, associated with the competitive situation of native species and the potential introduction of new pests and pathogens. The role of genetics is of particular significance in this context, and will allow for the illustration of the important traceable links between 'introduction-and- distribution pathways' of non-native tree species in Europe. The information obtained from this scientific advancement will lead to a review of the non-native species and their integration into 'native' woodland regions across Europe.

Societal/Economic: The communication and networking opportunities described in C3 illustrate both a societal and economic impact. The Action will provide the synthesis (multidisciplinary perspective) on non-native tree species in Europe. The information obtained across WG activities and on the history and future potential of these species in Europe will influence a societal interpretation of their importance and how we 'use' trees and forests. Society's use can also be measured in economic terms and the results obtained from network activities associated with this Action will lead to changes in policies on the planting, harvesting and use of timber obtained from

non-native tree species.

C.5 Target groups/end users

Forests fulfill a range of ecosystem functions biodiversity conservation is one of these functions. The introduction of invasive non-native species may alter the balance of such ecosystems. It is therefore important to get an overview of the invasive nature of the non-native species and learn from past experiences of the managing of these species. With interdisciplinary approaches and cooperation of scientists of different backgrounds (ecologists, silviculturists, tree geneticists, forest pathologists etc.) this complex and controversial issue can be understood.

Target groups/end users of NNEXT include: scientists & data-providing experts, nature conservation professionals, biodiversity experts, foresters and land managers, nursery owners, tree seed distributors, NGOs and all people interested in sustainable forest management.

Scientists (ecologists, silviculturists, tree geneticists, forest pathologists etc.) and Data-Providing Experts (including policy makers): Data-providing experts and scientists will have the opportunity to share and obtain historical records, maps, and data on the origin of selected non-native tree-species across Europe. The collection, processing and harmonisation of such information will allow a more precise identification of non-native tree species and their importance for the development and management of sound economic and ecological assessments and strategies. Policymakers and environmental organizations will also gain comprehensive information with continental-scale coverage for political decisions concerning non-native species.

Foresters and Land Managers: Foresters and land managers will benefit from the analysis of different management systems for the production of non-native tree species and the growth performance of these species and economic revenues they may provide. This is particularly important when considering biomass production and the delivery of high quality wood materials as well as non-native ‘performance’ at the wood markets. Through this COST Action this target group will receive better information on the possibilities (and their economic consequences both positive and negative) for planting non-native species in their forests and the integration of data from long term experiments and expert knowledge has the potential to enhance forest management models.

Nursery Owners/Tree Seed Distributors/Sawmill Owners: Having access to relevant information on their present distribution patterns and knowing the potentials and risks of these species (e.g. on biodiversity) multiple stakeholder groups - nurseries and seed distributors - will directly benefit

from results obtained from the completion of objectives determined from this Action. Examples here are targeted sales of specific non-native tree species for planting an identified region/s of Europe. The COST Action will also offer possibilities to exchange experience between nurseries and scientists concerning this matter.

Nature Conservation and Biodiversity experts: NNEXT will provide maps, national statistics and management know-how related to non-native tree species in Europe. This information is essential for avoiding the potential negative biological effects in the further promotion of non-native tree species. Nature Conservation and Biodiversity experts will get an insight into (i) which tree species are growing in what regions of Europe (ii) what is their estimated spreading potential, (iii) what are current management experiences and (iv) how will the introduction of a given non-native tree species affect the natural habitat or competition situation for the native tree species. We trust that such assessments can be derived from existing long term experiments and studies.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

The mission of NNEXT is to provide and develop the infrastructure in order to establish and compile national forest inventories into a European inventory examining the associated potential ecological and economic risks of non-native tree species and their adaptation potential for climate change mitigation options.

To achieve this mission NNEXT will bring together foresters and land managers, nursery owners and tree seed distributors, scientists (ecologists, silviculturists, tree geneticists, forest pathologists etc.) and data-providing experts determining the knowledge on the current regional coverage of different non-native tree species across Europe. We will develop maps and compile statistical data relevant for the importance of future stable (in light of climate change mitigation strategies) silvicultural performance. Specific tasks include:

- Identification of historical and present seed-and plant material-pathways (i.e. from the stand to the nurseries and forest owners) and geographic origin (provenance) of introduced plant material.
- Review of the role and quality of natural regeneration for adaptation and integration of non-native species in native forest ecosystems.
- Assessing existing and potential biotic risks (pests and diseases) and abiotic risks (wind damage, snow damage, bark peeling, etc.).

- Assessing the present insights on the invasive behaviour of natural regeneration of non-native tree species and the effects on biodiversity.
- Analysing the potential spreading of non-native tree species in Europe by comparing the ecological range of a given species versus growing conditions (climate, soils etc.).
- Gathering data on positive biotic and non-biotic effects.
- Analysis of previous experiences in growth and production of silvicultural treatments and experiences in introducing new and unknown pests and diseases.
- The role of non-native tree species in providing goods and services in a multifunctional integrated forest management approach.
- Assessing the invasive behaviour of non-native tree species and their relevance for nature conservation and biodiversity issues.
- Making all the information collected and analysed available to the public.

This mission and the associated objectives of NNEXT are broken down into four main themes each addressed by one of the four Working Groups (WG) which will be established in the project.

D.2 Scientific work plan methods and means

NNEXT establishes a platform of scientists to gather information and data on the controversial views related to the management of non-native tree species in Europe. The COST Action will engage with all stakeholders interested in non-native tree species and their management. These groups range from nature conservationists, biodiversity experts, silviculturists, ecologists, geneticists as well as other interest groups (e.g. national park managers, nurseries, forest companies etc.). The key methods that the COST Action will employ are (i) collecting all the available historic information relevant to non-native species management in Europe, (ii) assessing the spreading potential of non-native tree species – completed by obtaining daily climate data and soil maps and (iii) analysing and researching available data and reports on the negative consequences non-native tree species maybe having on the competitive situation and regeneration potential of ‘native’ tree species in Europe.

Four Working Groups (WGs) will ensure that all tasks and deliverables identified are completed. A timetable (Section F) illustrates when WG activities are scheduled along the four year project and

the completion of the WG activities will determine the key milestones (see Section E.1) being accomplished in the project.

WG1: (MONITORING)

This WG is dealing with collection, processing and harmonisation of existing historical data (i.e. records, maps, and public statistical data) on the origin and distribution of non-native tree species across Europe. It aims for an assessment of the regional importance of non-native tree species and should result in a consistent mapping and information of non-native tree species across Europe.

Key Mission

Monitor the current regional coverage of different non-native tree species across Europe and provide maps and statistical information including their historical background in Europe.

Tasks

1. Review country statistics and available information related to non-native tree species.
2. Harmonize the collected information of Task 1 and develop regional and trans-European maps as well as statistics on non-native tree species occurrence.
3. Identify a selection of key non-native tree species by region or management practices, experiences etc.
4. Compile the results of Tasks 1 - 3 and assess the non-native species (selected number) distribution potential based on climate soil and ecological constraints.

The tools and/or results are available from the coordinating partner. These mapping tasks will serve as the necessary input for the other Working Groups assessing the risks and challenges of non-native tree species management in Europe. This step will help to get insights in the ‘invasiveness of non-native tree species’ and lead to an assessment on the associated biodiversity and nature conservation concerns.

Deliverables

1. Country reports on the distribution and importance of non-native tree species of each participating country.
2. Harmonized maps and information covering the historic development and general forestry statistics for non-native tree species growing in Europe.
3. A list of long term research plots and available data and reports for the identified most important non-native tree species.

4. Potential distribution maps of selected non-native tree species.

WG2: (PATHWAYS)

This WG deals with the traceability of geographic origin (provenance) and distribution pathways of selected non-native species (e.g. Black locust, Sitka spruce, Douglas fir, Red oak, Lodgepole pine, Grand fir). The identification of such ‘pathways’ is important for the selection processes and ensuring the ecological assessment of knowledge on their geographic origin. This WG also considers the role and genetic quality of natural regeneration for the persistence of introduced forest species in native forest ecosystems. An important partner are nurseries and their historic and current position in providing planting material. WG2 will also compile data on location and distribution of provenance trials.

Key Mission: Illustrate pathways for the introduction of non-native species; tracing back the origin of older plantations and defining the role of seed orchards and natural regeneration and information of the location and distribution of existing provenance trials. This knowledge will lead to potential adaptation and integration strategies for forest ecosystems management.

Tasks:

1. Identification of historical and present seed- and plant material- pathways from seed collection into nurseries and plantations in the forest. Including the assessment of geographic origin (provenance).
2. Compilation of existing information on appropriate and non-appropriate provenances according to the geographic origin.
3. Identification and compilation of available molecular methods and existing traceability systems for checking the origin of populations of introduced forest species.
4. Review on the role and quality of natural regeneration for adaptation, persistence and integration into native forest ecosystems.

Deliverables:

1. Review on the artificial distribution range of important non-native species in Europe including historical and present seed- and plant material- pathways.
2. Provenance recommendations for non-native species in different European countries and transferring the results to different regions in Europe, compilation of available provenance tests and seed orchards in Europe (meta-database).

3. Reports on available and already tested markers for non-native species for identification of subspecies, varieties and provenances and thus allowing tracing back their geographic origin.
4. Summarizing the role and quality of natural regeneration for persistence in native forest ecosystems.

WG3: (SILVICULTURE)

This WG will deal with the role of non-native tree species as relevant for a sustainable provision of goods and services. It will strongly focus on forest management issues addressing (i) biodiversity, (ii) nature conservation and (iii) production issues (biomass and timber) and will deal with the adaptation potential of non-native tree species to climate change. The growth performance (growth models) will be reviewed and collected management practices will be assessed as they are relevant for estimating biomass production and timber quality.

Mission: Compile information on management practices and experiences with non-native tree species and management models which allow for an integrated multifunctional forest ecosystem management approach - relevant for the sustainable provision of goods and services.

Key Tasks:

1. Compiling the current guidelines on the silviculture and management of non-native species in Europe. It is expected that most of this information is available in the local language and therefore the translation or harmonization of the different county guidelines is required for comparable and cross-border analysis.
2. Review of existing knowledge related to multifunctional forest management and modelling of non-native species in Europe.
3. Compiling data from long term experimental research plots and studies and selecting key non-native tree species (see also WG 1) for an in-depth analysis at the regional and/or European scale.
4. Analysis and assessment of silvicultural risks (pests, pathogens etc.) as they are important for non-native species management. This task will also establish a formal link between WGs3 and 4 (see below).

Deliverables

1. Collection of guidelines of existing regional experiences in management and production of non-native species across European countries. The guidelines should cover all tree species identified in WG 1.

2. List of available regional management models (growth and yield models or any other tools available) for non-native tree species management.
3. Report on existing long term research plots covering silvicultural experiences and data of key non-native tree species in Europe. How they address the integrated forest management needs (productivity, nature conservation, biodiversity) will be a key element of these reports.
4. SWOT analysis of risks and challenges in managing non-native tree species in European regions.

WG 4 (RISKS)

This WG will cover the ecological risks and opportunities related to non-native tree species. It will analyse the historic experiences and effects on biodiversity and nature conservation issues and will provide an in depth view of our current understanding in the interaction between introduced non-native tree species versus native tree species (**key word: invasive behaviour of non-native tree species**). Considering the fact, that the expected results of WG1, WG2, and WG3 may have a strong focus on productivity due to the outlined historic reasons, WG 4 is explicitly established to collect all the existing data, publications and grey literature which provide insights into the ecological risks and challenges for biodiversity and nature conservation when promoting non-native tree species. In short, this WG addresses the **invasive potential and/or behaviour of non-native tree species** and thus allows for an assessment on how the long term development of native communities may change as a result from promoting non-native species.

Mission: Synthesize the risks and effects associated with the introduction of non-native tree species in European forests: biodiversity, nature conservation, water resources, pest outbreaks, new pathogens (together with WG3), etc.

Tasks:

1. Gathering data and information on reported and/or existing potential biotic risks (pests and diseases) and abiotic risks (wind damage, snow damage, bark peeling, etc.)
2. Compiling existing information on invasive behaviour of the natural regeneration of non-native tree species and how this affects the competitive situation of native tree species.
3. Assessing non-native forest management and its effect on nature conservation biodiversity as well as the provision of other non-timber goods and services in Europe.

4. Assessing the future spreading of non-native tree species considering the fact that non-native tree species may be promoted as one adaptation option to prepare for climate change impacts.

Deliverables:

1. Synthesis review document and or meta-data base on existing potential biotic risks and abiotic risks.
2. Synthesis review on the invasive behaviour of natural regeneration of non-native tree species.
3. Analysis on the impact of the provision of non-timber goods and services including biodiversity and nature conservation issues in combination with non-native tree species management.
4. Assessment of the potential future spreading (see also Deliverable 4 of WG1) and the resulting (expected) biological risks for the provision of the non-timber goods and services of European ecosystems.

E. ORGANISATION

E.1 Coordination and organisation

COST Actions are a concerted effort (i.e. financed by participating countries and COST provides the coordination) and require a formal and transparent process of administration provided through the COST 4154/11 guideline. According to these guidelines NNEXT includes:

Management Committee (MC) - Members of the MC will all be nominated at the first NNEXT meeting where a Chair and Vice-Chair will be elected. The MC will meet annually (or when deemed necessary by the Chair/Vice-Chair) and will be responsible for the planning, execution and delivery of this Action. The assigned activities determined by the MC and required to be completed within a given period by NNEXT partners (or project associates) will be delegated to a **Steering Committee**.

Steering Committee (SC) - members of the SC will be the MC Chair and Vice-Chair and the four Working Group Leaders (WGL) of the Project and while this group will be responsible for the completion of the 'scientific' part of the Action, they will also be asked to advise and contribute to the discussions on the importance of multidisciplinary and cross-cutting themes to be addressed at MC meetings.

Working Group (WG) - The four WGs (Section E2) established for this Action (comprising of COST partners) will provide the platform for informative and focused interaction and will link existing research programmes with this Action’s activities, interested stakeholders and the wider research community. Meetings for the WG, or formed sub-group, will take place when deemed appropriated by the WG Leader.

STSM/Summer School Manager (SSM) - The role of the SSM position will be determined annually (MC meetings) where upon a NNEXT partner will be asked to take on the task of coordinating the STSMs and Summer School programmes for the coming year. Activities will centre on the targeting of young and talented researchers and the creation of multidisciplinary research teams (across COST partners). These teams will be asked to join NNEXT researchers (along with colleagues from other COST Actions) to design and participate in short-term scientific missions and summer schools.

With respect to the importance of maintaining good dialogue and debate, both within and across these groups, the NNEXT website will be a key communication tool. It will not only serve to inform NNEXT partners on work progress but will present (to interest groups and general public) scientific papers, conference presentations, reports and the NNEXT eNewsletter.

Milestones:

Milestones - Year One	Milestones - Year Two
<ul style="list-style-type: none"> • AB/MC/SC/WG/SSM groups and roles established and COST Memorandum of Understanding signed. • SC/WG tasks appointed and agendas for forthcoming meetings (Year 1) drafted. • SSM role delegated and core objectives determined. • STSM (Year 1) opportunities determined, visits completed and reports written. • Dissemination activities illustrate the progression of the project activities through mutiple (specificially NNEXT website) presentations and reports. 	<ul style="list-style-type: none"> • AB/MC and SC meeting/s completed and Year 1 project reports submitted to COST. • SC/WG tasks appointed and agendas for forthcoming meetings (Year 2) drafted. • SSM role delegated and core objectives determined. • STSMs/Summer Schools (Year 2) opportunities determined, visits completed and reports written. • Dissemination activities illustrate the progression of the project activities through mutiple activities and presentations.
Milestones - Year Three	Milestones - Year Four

<ul style="list-style-type: none"> • AB/MC and SC meeting/s completed and Year 2 project reports submitted to COST. • SC/WG tasks appointed and agendas for forthcoming meetings (Year 3) drafted. • SSM role delegated and core objectives determined. • STSM (Year 3) opportunities determined, visits completed and reports written. • Dissemination activities illustrate the progression of the project activities through mutiple activities and presentations. 	<ul style="list-style-type: none"> • AB/MC and SC meeting/s completed and Year 3 project reports submitted to COST. • SC/WG tasks appointed and agendas for forthcoming meetings (Year 4) drafted. • SSM role delegated and core objectives determined. • STSMs/Summer School (Year 4) opportunities determined, visits completed and reports written. • Dissemination activities illustrate the progression of the project activities through mutiple activities and presentations. • AB/MC and SC meeting completed and Year 4 project reports submitted to COST.
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E.2 Working Groups

As described in Section D.2, the COST Action will be implemented by four Working Groups (WGs). The tasks and subtasks of each working group will be coordinated by a working group coordinator. For specific tasks additional experts may be invited to the meetings of the working groups. These WG include:

Working Group 1 – ‘Monitoring’ will deliver on the collection, processing and harmonising of existing inventory data, historical records, maps, and data on origin of selected non-native tree-species across Europe.

Working Group 2 – ‘Pathways’ will investigate the historical background for the pathways of introduction for non-native species into Europe and the current status of importing seed and plant material. The possibilities of tracing plantations of non-native species to their native origins by the use of genetics will be evaluated as well as the role of natural regeneration in integrating and maintaining the species in the native forest ecosystems.

Working Group 3 – ‘Silviculture’ will consider growth performance and economic and social aspects of non-native species. It will review the different management models for the production of non-native tree species and management of these species.

Working Group 4 – ‘Risk’ will complete on the ecological risk assessment, effects on biodiversity and risks associated with currently distributed as well as potential pests and diseases of native and non-native origin.

E.3 Liaison and interaction with other research programmes

Identified as an important aspect of placing this COST Action into the wider context and developing space of this topic area an invitation to attend the NNEXT Kick Off meeting will be sent to other COST Action chairs (see Section B.4). The Management Committee will also be proactive in promoting a working synergy with NNEXT partners and those partners from other COST Actions. In addition invited speakers (from complementary Actions e.g. FP 1202 MaP-FGR) and related projects will be invited to attend STSM and Summer School programmes.

E.4 Gender balance and involvement of early-stage researchers

The two important aspects of **gender balance** and **inclusion of early-stage researchers** are addressed in the Action. As a key feature and in support of this MoU mandate*, the Management Committee will agree ‘indicators of success’ of which will include how gender balance and the inclusion of early-stage researchers are being addressed across program activities in the four years of the project. Four areas (presently) being considered are:

NNEXT Management Committee Members – In determining the two key roles of the MC (Chair/Vice-Chair) and the MC members every effort will be made to have both male and female country representatives. Determining factors will be based on scientific excellence, knowledge of the topic area and participants illustration of the importance of the work to be completed through the Action Network.

Steering Committee Members – The Chair, Vice-Chair and WG Leaders roles in this committee will have a representation from both male and female scientists and also illustrate the multidisciplinary aspects of the Action.

STSM / Summer School Manager – As an elected position this role allows both female and male (and early stage researchers) COST country participants the opportunity to take on a key task of the NNEXT Action.

Summer Schools Participants – Applicants chosen (open application process) to attend the two summer school programmes will be early-stage researchers, foresters, nursery managers/apprentices and students studying in this topic area. A gender balance will be sought.

** The NNEXT Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerably involve early-stage researchers. This item will also be placed as*

a standard item on all MC agendas.

F. TIMETABLE

The NNEXT Action will cover a four year period. The tables below illustrate the likely timetable of activities for this period. Management meetings, summer schools, STSMs as well as important dissemination activities are identified in Table 1. Working Group meetings and the completion of WG tasks, deliverables and milestones are shown across Tables 2-5.

	Year One				Year Two				Year Three				Year Four			
MC Mts.	MC				MC				MC				MC			MC
STSM Mts.		SM	SM			SM	SM			SM	SM			SM	SM	
Summer Sch.							SS								SS	
Dissemination																
Website	W*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Journal articles				JA		JA				JA				JA		JA
NNEXT Conf.									NC							NC
Collabor. Mts.					CM							CM				

* Website maintained throughout the four year period of the project

	Year One				Year Two				Year Three				Year Four			
WG Meeting/s	WG				WG				WG				WG			
T. completed			T1	T2	T3			T4								
Del. completed								D1	D2	D3					D4	
MS. completed	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4

	Year One				Year Two				Year Three				Year Four			
WG Meeting/s	WG				WG				WG				WG			
T. completed				T1		T2				T3	T4					
Del. completed							D1			D2		D3		D4		
MS. completed	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4

	Year One				Year Two				Year Three				Year Four			

WG Meeting/s	WG															
T. completed							T1			T2	T3	T3				
Del. completed								D1				D2		D3	D4	
MS. completed	M1	M2	M3	M4												

Table 5 - Working Group 4 (RISKS)																
	Year One				Year Two				Year Three				Year Four			
WG Meeting/s	WG				WG				WG				WG			
T. completed				T1		T2				T3				T4		
Del. completed					D1						D2	D3			D4	
MS. completed	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: AT, BE, BG, CH, CZ, DE, EL, ES, FR, HR, HU, IT, NL, NO, PL, PT, RO, SE, SK, TR, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 84 Million € for the total duration of the Action. This estimate is valid under the assumption that all of the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

H.1 Who?

The target audiences for dissemination of results from the NNEXT Action will include a wide range of stakeholders and interested parties. They include:

1. European and national policy makers and regulators.
2. Private forest nurseries, land owners, forest managers and forestry administrations.
3. Researchers (ecologists, silviculturists and geneticists).
4. Experts examining climate change influences.

H.2 What?

The findings from NNEXT will be disseminated through a series of methods in order to target the full range of interested parties.

-The NNEXT website will be a primary means of communication with both open access and password protected areas for working documents. The website will include background information on the Action and its members, documentation of Working Group findings, proceedings from workshops and minutes from Management Committee meetings, discussion forums, FAQs, experimental methodologies, field guides, up-to-date reference lists of journal articles and grey literature etc., and upcoming events advertised.

-Annual NNEXT Workshops will present an opportunity to coordinate the work being achieved by the WGs and members of the Action will be expected to promote NNEXT at national and international workshops and conferences.

-Results from collaborations within NNEXT will be published in peer reviewed journals but also in journals recognised by forest managers and other stakeholders.

-A NNEXT Best Practice Handbook - for the management of non-native trees in Europe will be produced and disseminated.

-NNEXT advisory papers – for potential use of non-native species under climate change options will be published.

-A final NNEXT Conference will be held. The proceedings will be published as part of the dissemination plan.

H.3 How?

The Management Committee will review progress of the Action, including the dissemination plan to ensure that all findings and all other relevant material are made available to all stakeholders through the most appropriate dissemination routes as outlined in Sections H.1 and H.2 above. Each Working Group will be responsible for the dissemination of results produced by the group. The dissemination on the website will be organised by the Website Coordinator (WC), who will upload all relevant contents such as minutes, proceedings, references, news and progress reports. Summer Schools will concentrate on selected relevant topics and will involve experts of all four Working Groups. The invitation of stakeholders (e.g. nursery owners, forest administration representatives etc.) to the WG meetings shall improve communication as well as dissemination and knowledge transfer from science to practice.