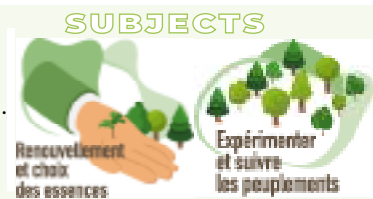


SUMMARY

Tender category: Call for proposals.
Coordinator: Ms Mélanie Court (ONF, RDI division).
Duration: 15 months (1 November 2023 – 31 January 2025).
Project partners: CNPF, INRAE, AgroParisTech, IEFC.
AFORCE grant amount: €40,000



PROJECT CONTEXT AND OBJECTIVES

French forests are subject to biotic (pathogens) and abiotic (droughts, fires) stresses that undermine their resilience. Mixed stands generally appear to be more resilient and productive than monocultures, although the literature remains mixed depending on the contexts studied. There are still many uncertainties surrounding their establishment: choice of tree species, proportions, planting patterns, stage of intervention and preferred combinations. Few references exist on the deliberate establishment of mixed stands, in contrast to the better-documented natural dynamics. Faced with climate and health challenges, forest managers are seeking appropriate silvicultural approaches. Several national and international projects have recently identified initiatives and encouraged the sharing of experiences. The ONF is also developing experimental schemes and a forthcoming silvicultural guide to support these practices.

Against this backdrop, the CALIFE project aims to **bring together stakeholders in the sector, build on existing knowledge and identify gaps**. It aims to **set up a working group and consider the need for new experimental schemes**.

KEY DELIVERABLES AND TARGET AUDIENCES

Category	Deliverable	Description	Target audiences
CALIFE Seminar 	Discussions on the establishment of mixed forests. 10 and 11 September in Orléans.	Partner presentations as part of the CALIFE project.	The sector as a whole, researchers and managers.
Summaries of knowledge 		Summary document of the working groups and the mid-term review seminar, setting out the discussions, and not just the points that were approved.	The sector as a whole, researchers and managers.
Accessible article for the general public 	Charline Henry, Mélanie Court, Jordan Bello. Installation of mixed fillers: experimenting to improve our understanding. ONF Technical Bulletin, 2024, 80, pp. 12–14.	Article from the ONF's Rendez-vous Technique magazine, Winter 2024 issue, in the special feature on Regeneration.	Managers

PROJECT PARTNERS



INSTRCUTIONS FOR USE

The approach adopted is based on a collaborative and step-by-step method, aimed at gathering, analysing and comparing the available knowledge on the management of mixed stands.
It has been structured into several complementary stages.

Bibliographic and technical inventory

As a first step, a bibliographic and technical review was carried out to compile existing work: scientific studies, experimental set-ups, management feedback and recent initiatives in France and internationally. This work made it possible to identify what is already known, as well as areas of uncertainty and gaps in the literature, particularly regarding the deliberate introduction of mixtures.

Inventory of operational initiatives

At the same time, an inventory of operational initiatives was carried out at various levels. It draws on several projects already underway (the ONF's DEDG, the EGIDE project in the Grand Est region, ENRICHIRR on private forests, schemes coordinated by the IEFC, and REGEFOR workshops). These initiatives were analysed to compare their objectives, implementation methods and initial results.



Figure 1: IDF experimental site: A 21-year-old mixed stand of Douglas fir and spruce, following four thinnings, pruned to a height of 8 m using a crane basket.
Philippe Riou-Nivert – IDF © CNPF

Thematic working groups

A third stage involved establishing a collaborative and interdisciplinary approach through **thematic working groups (TWG)** bringing together researchers, forest managers and forest owners. These groups developed common analytical frameworks (scenario matrices and decision-making diagrams), enabling a harmonised interpretation of the data and a comparison of different perspectives.

GT 1	GT 2	GT 3	GT 4	GT 5
Mixed plantations	Enhancing natural regeneration	A Guide to Silviculture for Mixed Stands	Mixed forestry with continuous cover (SMCC)	Modelling
- Typology - Density - Objective - Scale - Mixing effect	- Proportion - Context - Timing - Scale	- Scientific contributions - Key examples - Collaboration with the private forestry sector	- Effects on structure and composition - Long-term stability of the mixture - Resilience	- Existing models - Data set requirements
<i>Meetings on 25 March and 15 May 2024, with 11 participants.</i>	<i>Meetings on 24 April and 16 May 2024, attended by 11 and then 15 participants.</i>	<i>Meetings on 2 April and 16 May 2024, with 10 and then 12 participants.</i>	<i>Meetings on 28 March and 17 May 2024, attended by 10 and then 17 participants.</i>	<i>Meetings on 18 April and 23 May 2024, with 5 and then 10 participants</i>

National Seminar

A national seminar was held in September 2024. It brought together all the partners to share interim results, validate the typologies developed and identify priorities for research and experimentation. This collaborative session enabled the identification of concrete avenues for developing new schemes and drafting practical tools for managers (silviculture guide, technical data sheets, recommendations).

The seminar consisted of two distinct parts, with the first day devoted to the presentation of projects focusing on the establishment of mixed stands (COMFOR, MIXFORCHANGE, MELBAC, ENRICHIRR, EGIDE and the FORMIX network). The workshops, centred on the five priority themes, highlighted the results achieved and the challenges encountered, and formulated recommendations for action. At the end of the seminar, a working group, comprising members of the CALIFE groups and new participants, was formed to continue discussions on the creation of an experimental network dedicated to mixed stands and to establish its framework.

The CALIFE method is thus based on the interplay between knowledge consolidation, analysis of field experiences and the collective development of tools. This progressive and participatory approach is intended to ground the discussion in the diversity of French forestry contexts and to pave the way for the implementation of new experimental schemes tailored to the challenges of climate change.

RESULTS

Summary of the activities of the thematic working groups

Mixed plantations

His main task was to organise the knowledge and practices relating to mixed plantations, in order to facilitate the planning and implementation of diversified forestry projects. Its objectives centred on three key areas: defining a clear silvicultural objective prior to any choice of tree species to guide the design and organisation of plantations; identifying and structuring knowledge on mixed stands using a concise, standardised matrix table; and providing a tool to consolidate feedback, identify knowledge gaps and facilitate the planning of future projects.

Enrichment of regeneration

A meeting was held to make progress on the organisation and structuring of the typologies and scenarios for the enrichment of stand regeneration. The main objective of these meetings was to make progress on drawing up the scenario matrix, to define tree species typologies according to their light requirements, and to complete the joint working table. A decision-making framework was proposed to structure the process: starting with the context and objectives, selecting the type of enrichment, and then organising the monitoring and long-term sustainability of the interventions. The criteria to be taken into account include site conditions, the type of landowner, the nature of the stand and any potential constraints, as well as herbivore pressure and priority objectives. The decision-making principles recommend that financial aspects should not be included in the general guide. However, when adapting decisions, account must be taken of the potential of the sites and the available funding.

Silvicultural Guide to Mixed Stands

Its aim is to produce a silvicultural guide that will serve as a reference for managers and practitioners. The aim is twofold: to provide operational recommendations (definitions, planting schemes, compatibility tables, case studies) and to establish a sustainable working group capable of continuing to build on the project’s findings after its completion. The priority actions were of three types: to specify the list of silvicultural interventions according to stand types, identifying key timeframes and cost items; to complete and expand the table of tree species, then group these into functional categories (Fig. 2); drawing up specifications for minimum interventions and preparing illustrative case studies.

Mixed forestry with continuous cover

The methodological work focused on compiling a table or catalogue listing, for each stand type, the possible development pathways and the timing of interventions (regular or irregular thinning). This must be supplemented by a decision tree, with the objective pursued (thinning or regeneration) as the input, and by a matrix table enabling scenarios to be compared according to various criteria (productivity, biodiversity, economics, etc.). Another area of work focused on modelling and experimentation.

Modelling

It focuses its efforts on the structuring and utilisation of forestry databases, as well as on the analysis and adaptation of existing models to better understand and manage the establishment of mixed stands. The objective regarding modelling is to establish a structured framework for evaluating existing models and their ability to address the critical phases of forest dynamics (regeneration, early growth stages, mortality and competition). The group proposes selecting a broader set (10–15 priority models), identifying for each one the key information, available contacts and the potential to develop common modules. Work on the databases has focused on centralising metadata, with a view to avoiding duplication of past surveys and better distinguishing databases intended for scientific purposes. Beyond the tools themselves, the group seeks to identify critical areas where intervention is needed to support integration, to specify the types of possible actions and to place them within a clear pathway towards the intended objectives. Finally, collective organisation remains a key challenge.

1 ^{ère} essence plantée (70 à 80%)	chêne sessile	chêne pédonculé	chêne pubescent	hêtre	cédre	pin laricio	pin maritime	sapin pectiné	sapin méditerranéen	douglas	mélèze
2 ^{ème} ess. plantée (20 à 30%)	chêne sessile	chêne pédonculé	chêne pubescent	hêtre	cédre	pin laricio	pin maritime	sapin pectiné	sapin méditerranéen	douglas	mélèze
chêne sessile											
chêne pédonculé											
chêne pubescent											
hêtre											
cédre											
pin laricio											
pin maritime											
sapin pectiné											
sapin méditerranéen											
douglas											
mélèze											
	mélange facile (placeaux toutes tailles, bouquet)										
	mélange possible en grands placeaux ou bouquet										
	mélange uniquement en bouquet										
	mélange sans intérêt ou très peu probable										

Figure 2: Table showing the minimum pixel size for the introduced tree species in a mixture, according to compatible mixture combinations, for open-field planting and for the enhancement of natural regeneration. © ONF

■ KEY LESSONS

CALIFE opens up a wide range of opportunities:

- to consolidate a national experimental network of mixed stands, covering a variety of site conditions and management practices;
- to refine and harmonise databases in order to improve models and decision-support tools;
- to finalise and disseminate a flexible silviculture guide, incorporating feedback from both the public
- strengthen European and international cooperation to pool knowledge and resources.

In conclusion, CALIFE has been a pivotal step towards establishing a more resilient and diversified approach to forest management, one that is adapted to climate and health challenges. The sustainability of the collective, the expansion of the experimental schemes and the operational application of the project outputs will be key to long-term success.

■ CONTACT

The project leader is Ms [Mélanie COURT](#), a Research and Development Engineer at the ONF's RDI division.

For further information on the project, you may also contact:

FORMIX Network: Mr [Hervé JACTEL](#), Research Director at INRAE;

EGIDE Project: Mr [Eric LACOMBE](#), lecturer and researcher at AgroParisTech;

REGEFOR Workshops: Mr [Nicolas PICARD](#), Director at GIP ECOFOR;

ENRICHIRR Project: Mr [Loïc MOLINES](#), forestry engineer at the CNPF Occitanie Delegation;

Guide to silviculture in mixed stands: Mr [Thierry SARDIN](#), forestry engineer at the ONF;

MELBAC project and field trials: Mr [Thomas Cordonnier](#), forestry engineer at the ONF's RDI division;

MIXFORCHANGE and COMFOR projects Mr [Christophe Orazio](#), Director of the IEFC.

■ FOR MORE INFORMATION

Further information is available on the [page projet CALIFE](#) on the AFORCE RMT website.



References

¹ FORMIX Network. [>>>>](#)

² ENRICHIRR Project. [>>>>](#)

³ COMFOR Project. [>>>>](#)

⁴ MIXFORCHANGE Project. [>>>>](#)

⁵ EGIDE Project. [>>>>](#)

⁶ MELBAC Project. ONF, Technical Briefings No. 80, 2024. [>>>>](#)

PROJECT FUNDERS

