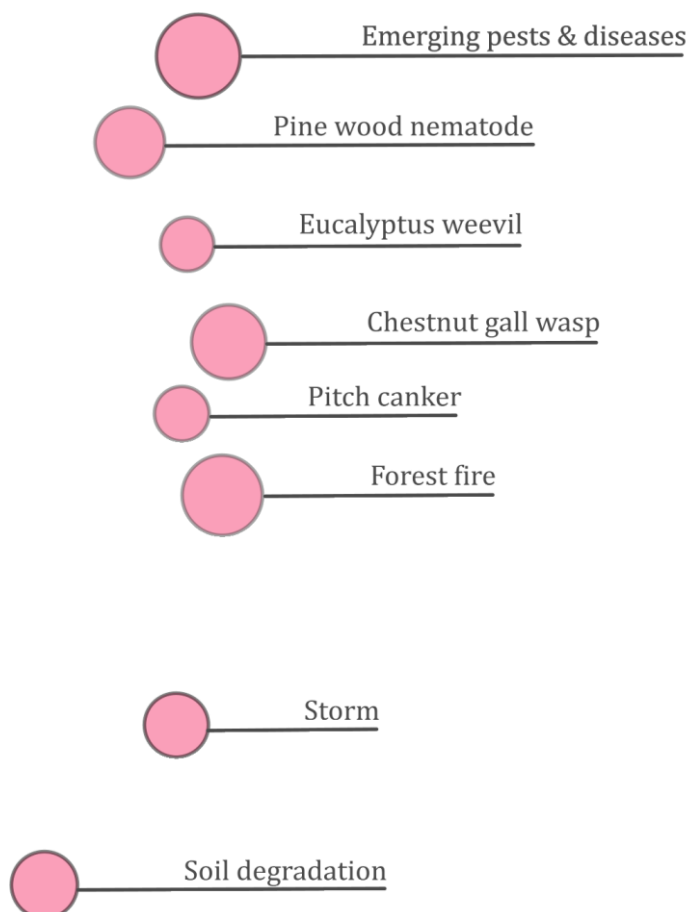


Summary report

WP1



January 2017

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Authors of the interviews:

Regions ^a	Affiliations	Authors	Risks
Aquitaine	EFIATLANTIC	Eduard Mauri Barry Gardiner	Storm
	INRA	Hervé Jactel	Pine wood nematode Emerging pests and diseases
Euskadi	HAZI	Alejandro Cantero	Storm Forest fire
	NEIKER	Ander Arias Nahia Gartzia	Soil degradation
		Amaia Ortiz	Emerging pests and diseases
Cantabria	Universidad de Valladolid	Julio Diez Jorge Martín Carmen Romeralo	Eucalyptus weevil Pitch canker
Asturias	CETEMAS	Elena Canga	Forest fire
		Marta González	Soil degradation
		Andrea Hevia	Eucalyptus weevil
		Juan Majada	
		Covadonga Prendes Sandra Sánchez	
Galicia	CIF/INGACAL	Cristina Fernández	Forest fire
		Enrique Jiménez	Soil degradation
Castilla y León	TRAGSATEC	Roberto Bodes	Pine wood nematode
		Jorge Casado	Chestnut gall wasp
Portugal	ISA	Francisco Rego Liliana Bento Conceição Colaço	Forest fire
		Manuel Madeira	Soil degradation
		Manuela Branco Helena Santos	Eucalyptus weevil Emerging pests and diseases
	INIAV	Edmundo Sousa	Pine wood nematode
		Luís Bonifácio	Chestnut gall wasp
		Helena Bragança	Pitch canker

^a Regions always appear in this same order, from east to west and from north to south.

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Glossary

Risk management plans are usually composed of four phases, generally called prevention, prediction, crisis management and rehabilitation. These are the terms used in this report. However, the following risk-specific expressions (or similar forms) have also been used:

Risk	Prevention	Prediction	Crisis management	Rehabilitation
Storm	Prevention of damage caused by storms	Prediction systems and weather warnings	Crisis management during and just after storms	Rehabilitation of the affected areas and of the forest sector
Forest fire	Fire prevention	Fire prediction, surveillance and emergency warning	Firefighting and crisis management	Rehabilitation of burnt areas and of the forest sector
Soil degradation	Soil degradation prevention	Soil degradation prediction, surveillance and emergency warning	Management of degraded soils	Degraded soil rehabilitation
Biotic risks (pests and diseases)	Prevention against pests and diseases	Surveillance, monitoring and early warning of pests and diseases	Eradication, control and contingency of pests and diseases	Rehabilitation of affected forest sector by pests and diseases

STORM

General plan information

The current situation is:

- **Nouvelle-Aquitaine:** the storm risk management plans for the forest sector, at national and regional scales, is currently under development. The plans should be released on July 2017. This report will focus on the regional risk management plan.
- **Euskadi:** there is no storm risk management plan specific to the forest sector. But plans exist for civil security in the case of a storm. Each province in Euskadi has its own plan, though they are very similar. Differences among provincial plans will be indicated where relevant, otherwise plans are considered together.

Interviewed organisations

Most of the interviewed organisations in **Nouvelle-Aquitaine** and all three in **Euskadi** are public administration bodies responsible for forest policy at regional level, or organisations that support them (Table 1).

Table 1. Interviewed organisations in charge of the storm risk management.

Region	Person interviewed	Organisation	Address
Nouvelle-Aquitaine	Marion Grua Responsable de l'unité gestion durable et risques Hugues Cruse Chargé de mission risques et développement forestier	Service Régional de la Forêt et du Bois – Direction Régionale de l'Alimentation, de l'Agriculture et de la Forêt Nouvelle- Aquitaine (DRAAF)	51 rue Kiéser, 33077 Bordeaux CEDEX
Nouvelle-Aquitaine	Gaëlle Burlot Chargée de mission Christian Pinaudeau Secrétaire général	Caisse de Prévoyance et de Protection des Forêts du Sud-Ouest – Syndicat des Sylviculteurs du Sud- Ouest (SYSSO)	6 parvis des Chartrons, Maison de la forêt et de l'agriculture, 33000 Bordeaux
Nouvelle-Aquitaine	Pauline Cazes Chargée de mission	Bureau Gestion durable de la forêt et du bois – Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt (MAAF)	19 avenue du Maine, 75015 Paris

Region	Person interviewed	Organisation	Address
Nouvelle-Aquitaine	Sarah Fermet-Quinet Ingénieur d'études	Groupeement d'Intérêt Public Aménagement du Territoire et Gestion des Risques (GIP ATGeRI)	6 parvis des Chartrons, Maison de la forêt et de l'agriculture, 33000 Bordeaux
Euskadi	Aitor Omar Aspiazu Jefe de Sección de Protección, Experimentación y Mejora	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación de Bizkaia	Avda. Lehendakari Agirre 9, 48014 Bilbao
Euskadi	Ismael Mondragón Laskurain Jefe del Servicio de Montes y Gestión de Hábitats	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación de Gipuzkoa	Plaza Gipuzkoa s/n, 20004 San Sebastián
Euskadi	Marta Fernandez de Zañartu Beltran de Heredia Técnico del servicio de Montes	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación de Álava	Plaza de la Provincia 4, 1º izq., 01001 Vitoria- Gasteiz

Territorial scale and risk zones

In **Nouvelle-Aquitaine** there are two storm risk management plans: one for the forest sector (under development and the one that will be discussed in this report) and one for civil security. The former regional plan is derived from the French national plan, also under development as both are being developed in parallel and in collaboration between the national ministry responsible for forests (MAAF) and the regional department responsible for forests in Nouvelle-Aquitaine (DRAAF). The aim is that every French region will develop its regional storm risk management plan using the national plan as a template.

In **Euskadi**, provincial governments are responsible and have the resources for forest management. The Basque government intervenes only when a hazard covers more than one province.

Table 2. Territorial scales of storm risk management plans.

Region	Development scale of the plan	Application scale of the plan
Nouvelle-Aquitaine	National: it sets the structure for the regional plans Regional: the structure of the national plan is used to develop a regional plan	National: some aspects of the regional plan have a national scope Regional and local: is the main application scale of the plan, as the regional plan reflects the specific characteristics of the region
Euskadi	Regional: each Basque province has its own plan, except Araba, which has none	Regional: each Basque province has its own plan, except Araba, which has none

In **Nouvelle-Aquitaine**, the national plan is easily transferable to any other region of France. For the other PLURIFOR regions, the structure of the national plan and some technical parts could be transferred, with adaptation. Aspects of the plan concerning finance, aids and derogation of the legislation are specific to France, so they are more difficult to apply abroad.

The **Basque** plan is more simple and focused on civil protection: it is mainly a coordination protocol between the public administration and the technical personnel on the ground at the provincial scale.

There has been no previous characterization of risk zones in Nouvelle-Aquitaine or in Euskadi. Factors responsible for tree vulnerability against strong winds are known at the stand level. However, they have not been mapped transnationally.

Legislation

The **Nouvelle-Aquitaine** storm risk management plan will incorporate legal rules for the four phases of risk management (Table 3). This measure will avoid the situation following the 2009 Klaus storm, when exceptional regulation had to be established resulting in long delays in the implementation of plans to deal with the consequences of the storm. There is no specific legislation in Euskadi about storm risk management.

Table 3. Legislation on storm risk.

Phases of risk management	Regions with rules existing
Prevention	Nouvelle-Aquitaine
Prediction	Nouvelle-Aquitaine
Crisis management	Nouvelle-Aquitaine
Rehabilitation	Nouvelle-Aquitaine

Organisations involved

While in **Nouvelle-Aquitaine** organisations involved in storm risk management are mainly financed by the state government, in **Euskadi** the main budget source is the regional government (Table 4). In Nouvelle-Aquitaine, the second budget source is the European Union, through the European Regional Development Fund, for the rehabilitation of the forest. In both regions, in the case of severe storm damage, extra workers can be hired for rehabilitation of the forest thanks to local or regional exceptional budgets.

Table 4. Organisations involved in storm risk management.

Organisations involved in management plan creation and execution	Status	Main budget source
Direction Régionale de l'Alimentation, de l'Agriculture et de la Forêt Nouvelle-Aquitaine	Public	State government
Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt	Public	State government
Syndicat des Sylviculteurs du Sud-Ouest	Private	Membership fee
Servicio de Montes, Diputaciones Forales de Bizkaia, Gipuzkoa and Araba	Public	Regional government
Organisations involved only in management plan execution	Status	Main budget source
Groupeement d'Intérêt Public Aménagement du Territoire et Gestion des Risques	Public	State government, regional governments
Centre Régional de la Propriété Forestière d'Aquitaine	Public	1/3 state government, 1/3 local governments, 1/3 rural property tax
Association Syndicale Autorisée de Défense de la Forêt Contre l'Incendie	Private	-

In **Nouvelle-Aquitaine** the main organisations with numerous roles in all phases of storm risk management, are the public administration bodies responsible for forests at national and regional level. Organisations working for forest owners only take part in the crisis management and rehabilitation phases. In **Euskadi**, regional governments are only involved in the crisis management and rehabilitation phases (Table 5).

Table 5. Roles of the organisations involved in storm risk management.

Organisation	Prevention	Prediction and weather warning	Crisis management	Rehabilitation
Direction Régionale de l'Alimentation, de l'Agriculture et de la Forêt Nouvelle-Aquitaine	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Control of information
Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information

Organisation	Prevention	Prediction and weather warning	Crisis management	Rehabilitation
Syndicat des Sylviculteurs du Sud-Ouest	none	none	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information
Groupeement d'Intérêt Public Aménagement du Territoire et Gestion des Risques	Control of information	Control of information	Coordination Execution Support Control of information	Control of information
Association Régionale de Défense des Forêts Contre l'Incendie	Control of information	-	Coordination Execution Support	-
Centre Régional de la Propriété Forestière d'Aquitaine	Coordination	Control of information	Coordination Execution Support Control of information	Coordination Execution Support Control of information
Servicio de Montes Diputación de Bizkaia, Diputación de Gipuzkoa (Euskadi)	none	none	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information
Servicio de Montes Diputación de Álava (Euskadi)	DK/NR	DK/NR	DK/NR	DK/NR

Existing systems

Tools

Prevention of damage caused by storms

In **Nouvelle-Aquitaine** prevention tools are scarce, are not interconnected or coordinated and depend on the will of each organisation. The existing ones are:

- The recommendation to the forest owners, by the new storm risk management plan, to insure their forests to cover cleaning and replanting after storms.
- Existing wood stock areas (created in 2009 after Klaus storm) will be maintained: other uses that quickly allow their reopening are accepted. This is included in the new storm risk management plan.
- Some tree nurseries produce maritime pine plants in special buckets that allow the growth of the pivot root, which improves tree anchorage.
- Stand scale cartography of some forest variables for the whole region is available at the GIP ATGeRI that could be used to calculate tree vulnerability to strong winds.

There are no prevention tools in **Euskadi** forest sector for this risk.

Prediction systems and weather warnings

In **Nouvelle-Aquitaine** Météo-France and in **Euskadi** Euskalmet or the Agencia Estatal de Meteorología are the public organisations that produce weather forecasts and send weather warnings in case of a storm. In Nouvelle-Aquitaine, GIP ATGeRI is also responsible for relaying this information.

Crisis management during and just after storms

In **Nouvelle-Aquitaine**, the new storm risk management plan has a crisis folder and a guide containing support measures. The former contains the contact lists, the organigrams, and a scoreboard to record all events (actions, meetings, situations, etc.) and a series of summary information sheets. Its aim is to quickly allow consultation and integration of the information to build an action plan. The latter is a tool-box containing many technical instructions to ease and accelerate the tasks of the organisations involved.

On the ground, just after storms, CRPF and GIP ATGeRI daily make a damage assessment, a first evaluation of damaged volume, analyse and bring information to decision makers thanks to:

- Motorised teams of forest technicians and volunteers working in the field who are familiar with the area.
- Simple but quickly collected information in the field about location and characteristics of the damage is written on the ground into a paper atlas. This information is digitised daily and sent to the operational headquarters (at the GIP ATGeRI offices in Bordeaux) to help in decision making.

In **Euskadi**, the *Krisi Mahaia* website is used to share information between governments (regional and provincial), civil security and police forces during the crisis management.

Rehabilitation of the affected areas and of the forest sector

There are in **Nouvelle-Aquitaine** many wood stock areas created after the 2009 Klaus storm. Their aim was to regulate timber flow and stocks so that this timber could be transformed within the region instead of outside, therefore helping the local wood industry. They are now nearly empty and being used for other purposes, but they can be quickly re-established as stocking areas if a storm hits the region.

To assist the coordination of the forest rehabilitation (technically and financially), GIP ATGeRI has a tool to map the progression of cleaning and replanting (but only for forest management units under technical supervision, based on data provided by the administration). It was successfully used after Klaus storm. Also after the Klaus storm, training for forest workers in windthrown areas was set up.

There are no rehabilitation tools in **Euskadi** for this risk.

Procedures

Prevention of damage caused by storms

The **Nouvelle-Aquitaine** plan includes a planning document with silvicultural systems recommended to reduce stand vulnerability to strong winds (and also to other hazards), such as avoiding heavy thinning during winter (when most storms occur). There is also state aid for prevention, planting hardwoods around pine stands or genetically improved maritime pine to increase forest resistance to strong winds.

There are no precise prevention procedures in **Euskadi** for this risk.

Prediction systems and weather warnings

Storm warning by Météo-France is sent to the DRAAF mission head and to the Ministère de l'Intérieur and to GIP ATGeRI. Storm warning triggers the opening of the crisis valise and the guide of support measures, and starts the recording of all events on the scoreboard.

There are no precise prediction procedures in **Euskadi** for this risk.

Crisis management during and just after storms

During this phase, in **Nouvelle-Aquitaine**, procedures mainly focus on analysis of the situation, the re-opening of blocked roads, the regulation of timber transportation, and the treatment of road-side stocked timber against pests. There is also financial support from the administration towards companies responsible for wood transportation.

There are no precise crisis management procedures in **Euskadi** for this risk other than the protocols to coordinate governments (regional and provincial), civil security and police forces.

Rehabilitation of the affected areas and of the forest sector

In **Nouvelle-Aquitaine**, there is a convention about wood stocking areas so they can be quickly reestablished as stocking areas if a storm hits the region. The storm plan, under development, wants to change the legal rules to provide more aid to rehabilitation tasks including cleaning, timber transport, site preparation and restocking.

After a storm in **Euskadi**, provincial governments increase the budget for forest rehabilitation tasks (mainly planting), but there are no aids for timber transportation or stocking.

Procedures updating

In **Nouvelle-Aquitaine**, the storm risk management plan is under development, but it is intended that it will be completely updated after the next storm. Otherwise, it will be reviewed every three years at national and regional scales.

Prevention of damage caused by storms

There are no specific updated prevention procedures for this risk.

Prediction systems and weather warnings

In **Nouvelle-Aquitaine**, the civil security body is responsible for permanent updating of the contact lists.

Crisis management during and just after storms

In **Euskadi**, the storm plan states that there must be a periodical updating, without giving any more details.

Rehabilitation of the affected areas and of the forest sector

In **Nouvelle-Aquitaine**, the convention about wood stock areas between regional government and land owners is set for a certain number of years. It must be renewed within months.

Personnel coordination

In **Nouvelle-Aquitaine**, DRAAF coordinates emergency services, forest administration and professionals, and is the link between the state government and the region services. A storm committee is created, managed by DRAAF and SYSSO. This committee is composed of forestry sector stakeholders at national, regional and local levels. It advises on crisis management and rehabilitation, mainly concerning the distribution of aid and the implementation of rehabilitation tasks. It is wound up once the rehabilitation phase is finished.

Prevention of damage caused by storms

In **Nouvelle-Aquitaine**, DRAAF is responsible for the planning document containing silvicultural systems recommended for reducing stand vulnerability to strong winds, and it also manages the knowledge transfer from researcher to forest professionals.

There is no precise coordination in **Euskadi** for this risk.

Prediction systems and weather warnings

Météo-France is the responsible body to broadcast and disseminate weather warnings. It has its own protocols. Weather warnings are received by DRAAF and the Ministère de l'Intérieur, and it triggers the crisis management plan.

There is no precise coordination in **Euskadi** for this risk.

Crisis management during and just after storms

In **Nouvelle-Aquitaine**, DRAAF is the responsible body for coordination at the regional level, while MAAF plays the same role at national level. This coordination includes public and private organisations, as well as between DRAAF and MAAF. There are local headquarters and a regional headquarter located at the GIP ATGeRI offices in Bordeaux.

In **Euskadi**, the *Krisi Mahaia* website is the tool used to coordinate governments (regional and provincial), civil security and police forces during crisis management.

Rehabilitation of the affected areas and of the forest sector

DRAAF is the main responsible organisation for coordination of this phase in **Nouvelle-Aquitaine**. The storm committee is very active during the rehabilitation phase.

There is no precise coordination in **Euskadi** for this risk.

Past events recording

In **Nouvelle-Aquitaine**, the scoreboard is activated as soon as the storm warning is sent by Mété-France. All events, meeting, decisions, etc. are recorded there.

Prevention of damage caused by storms

There is no precise past event recording either in **Nouvelle-Aquitaine** or in **Euskadi** for prevention tasks. The new storm risk management plan in **Nouvelle-Aquitaine** would record insured forest management units against windthrow, areas planted with improved plants that better resist strong winds, and areas where silvicultural regimes providing better resistance against strong winds are implemented (only for areas receiving technical supervision).

Prediction systems and weather warnings

The scoreboard in **Nouvelle-Aquitaine** records weather conditions before, during and after a storm.

There is no precise past event recording in **Euskadi** for this risk.

Crisis management during and just after storms and Rehabilitation of the affected areas and of the forest sector

The scoreboard in **Nouvelle-Aquitaine**, and similarly in **Euskadi** but not centralised, records all crisis management and rehabilitation actions and situations through reports from forest agents and requests from forest owners asking for technical supervision, harvesting permits, or assistance: damaged area, volume of blowen down timber, harvested volume of this timber, cleaned area, planted area, etc. In both regions, only areas receiving technical supervision are recorded, however these represent the majority of the affected area. In **Nouvelle-Aquitaine** there is a record of the timber volume entering and leaving the timber stock areas. The quality and the selling price of this timber are also recorded.

Strengths and weaknesses analysis

Evaluation of the storm risk management plans

As the current storm risk management plan in **Nouvelle-Aquitaine** is under development, evaluation is expected only after the next storm. The evaluation will be done by analysing the records on the scoreboard, and looking for procedures and tools that failed or didn't perform as expected. The plan will be evaluated by the emergency services, the forest administration and forestry professionals.

In **Euskadi**, evaluation of the storm risk management plan is only expected in Gipuzkoa province; however it is not defined how or when. Bizkaia and Araba have not foreseen any evaluation of the plan.

Strengths

The main idea when developing the storm risk management plan for **Nouvelle-Aquitaine** was to evaluate the tools and procedures used during Storms Martin and Klaus storms in 1999 and 2009 respectively, and to keep those that performed well and improve the ones that performed least well. The major strength of the current plan is that this evaluation was done by all forest stakeholders, who could express their opinion on the management of the last two storm events. Consequently, the region is better prepared today than previously.

Many of the organisations interviewed appreciated the content of the crisis valise and the guide of support measures, especially the series of summary information sheets (currently under development). These summary information sheets allow a quick consultation of and integration of information on a specific subject.

Prevention of damage caused by storms

There is no specific strength for this risk regarding prevention.

Prediction systems and weather warnings

Both regions agree that weather warnings from national or regional weather agencies work correctly and are a main strength for storm risk management.

Crisis management during and just after storms

The storm risk management plan in **Nouvelle-Aquitaine** contains a list of the organisations that are responsible for damage evaluation. It includes a damage threshold above which government intervention is justified. The plan states that a digital tool to record timber transportation will be developed.

This region has many tools to evaluate the situation during crisis management phase: ground and aerial observations of the damage that provide quick situational analysis from simple indicators, regional shared cartography with daily updates that allows fast transfer of local information from the field to the decision makers, and a good knowledge of the local forest area through the forest technicians and forest fire fighting volunteers that also collaborate in storm events. Consequently, the first evaluation of the damage is completed very quickly. More detailed information to assist rehabilitation tasks is gathered afterwards.

In **Euskadi**, two main strengths are the coordination protocol and the on-line tool *Krisi mahaia* for real-time situational information sharing.

Rehabilitation of the affected areas and of the forest sector

Subsidized loans and aids for forest rehabilitation and timber transportation were seen as the main strengths during last storm crisis in **Nouvelle-Aquitaine**. They were transversal and offered to all forest stakeholders. Coordination tasks were also appreciated, as they allowed all stakeholders to share the same objective.

In Gipuzkoa province, **Euskadi**, government aid for forest rehabilitation is the main strength.

Weaknesses

The main weakness of the storm risk management plan in **Nouvelle-Aquitaine** is that it has not been used yet, so it is not known if it will work correctly. According to SYSSO, it is a big document that needs to be assimilated by all actors before the next storm.

Prevention of damage caused by storms

There is no specific prevention weakness for this risk in **Nouvelle-Aquitaine**.

In Gipuzkoa province, **Euskadi**, forest service doubts that any prevention measure could be implemented.

Prediction systems and weather warnings

There is no specific prediction weakness for this risk.

Crisis management during and just after storms

The CRPF, which does most of the post-storm damage surveys, lack the human resources to execute this task in **Nouvelle-Aquitaine**.

In Gipuzkoa province, **Euskadi**, the forest service complains that procedures for crisis management lack detail, especially with regard to amangement in the field.

Rehabilitation of the affected areas and of the forest sector

During the last storm in **Nouvelle-Aquitaine** a major weakness was the difficulty that DRAAF had to get loans from banks to support forest rehabilitation, even if the French state acted as guarantor. There is no proposed solution for this problem in the current plan.

In Gipuzkoa province, **Euskadi**, forest service complains that procedures rehabilitation lack of detail, especially about on the field management.

Potential for improvement

Improvements and updates

Yearly updates of the summary information sheets are the best opportunity to improve and update storm risk management plans in **Nouvelle-Aquitaine**. Each summary information sheet is under the responsibility of a working group, who should ensure that its content reflects the current situation in the forest sector.

Other general improvements include:

- Each organisation should have its internal storm risk management plan that reflects regional plan tools and procedures.
- Regional storm risk management plans in France (when available) should be disseminated and compared in order to ease collaboration between regions in the case of major storms.
- According to CRPF, forest management plans could be a way to implement improvements at the forest management unit scale, as they are frequently reviewed (every 10 to 15 years).

Prevention of damage caused by storms

Improvements proposed in **Nouvelle-Aquitaine**:

- A tool for real-time tracking of the state of the forest in order to create a vulnerability map at the resolution of the stand for the whole region. It could be used to locate high risk zones and to encourage preventive management and optimised mobilisation of human and mechanical resources.
- The creation or modification of silvicultural regimes that would decrease stand vulnerability to strong winds for maritime pine.

Improvements proposed in **Euskadi**:

- The interviewed organisation in Gipuzkoa did not know if the prevention phase of the plan needs to be improved.
- In Bizkaia: a storm risk management plan for the forest sector needs to be created, as there is none.

Prediction systems and weather warnings

Improvements proposed in **Nouvelle-Aquitaine**:

- The weather warning network needs to be more developed.

Improvements proposed in **Euskadi**:

- In Gipuzkoa there are no needs for improvement.
- In Bizkaia: a storm risk management plan for the forest sector needs to be created, as there is none.

Crisis management during and just after storms

Improvements proposed in **Nouvelle-Aquitaine**:

- The rapidity of aerial damage surveys and road opening should be increased.

Improvements proposed in **Euskadi**:

- In Gipuzkoa: the plan needs to improve the procedures to manage and coordinate teams in the field during the crisis and just after storms.
- In Bizkaia: a storm risk management plan for the forest sector needs to be created, as there is none.

Rehabilitation of the affected areas and of the forest sector

Improvements proposed in **Nouvelle-Aquitaine**:

- A tool should be developed for real-time tracking of rehabilitation of the forest at stand scale, including forest management units that are under technical supervision and those that are not. This tool should incorporate the current and future silvicultural regime for every stand to better evaluate its vulnerability to strong winds.

- There are still some questions to solve about the economic return from wood stock areas, about site choice of them and, some technical refinements.
- There is a need to decrease negative effects induced by storms, mainly increased pest damage and increased fire risk. Faster authorisation for pesticide treatment would be appreciated.
- Timber economic circuit after storms must be improved. It has been suggested to agree on a price matrix for blown down timber before the storm.

Improvements proposed in **Euskadi**:

- In Gipuzkoa: the plan needs improvements in the management of blown down timber.
- In Bizkaia: a storm risk management plan for the forest sector needs to be created, as there is none.

Collaboration with the PLURIFOR project

The **Euskadi** region is very interested in having a storm risk management plan similar to Nouvelle-Aquitaine's one. An interesting PLURIFOR collaboration would be to adapt the French national plan for Euskadi, as has been already done by adapting the national plan to the regional scale of Nouvelle-Aquitaine.

GIP ATGeRI proposes to extend its expertise in fire risk management and mapping to other risks, including storm risk. Thus, it would become a key player for the development of the following proposals to improve storm risk management planning in **Nouvelle-Aquitaine**.

Prevention of damage caused by storms

- A tool for real-time tracking of the state of the forest in order to create a vulnerability map at stand resolution for the whole region. It would be used to locate high risk zones and encourage preventive management and optimised mobilisation of human and mechanical resources. Predictive variables should be measured frequently to be keep update. Some ideas have been already identified: yearly airborne LiDAR surveys for tree height measurements and edges, continuous water table monitoring, and the use of topographical and soil variables.
- From the previous tool another should be developed to locate risk zones and foster preventive management and optimised mobilisation of human and mechanical resources for individual stakeholders.

Prediction systems and weather warnings

No specific collaboration with PLURIFOR has been identified.

Crisis management during and just after storms

- In Gipuzkoa (**Euskadi**) the plan needs to improve the procedures to manage and coordinate teams in the field during the crisis and just after storms.

Rehabilitation of the affected areas and of the forest sector

- In **Nouvelle-Aquitaine**, a tool should be developed for real-time tracking of rehabilitation of the forest at the stand scale, including forest management units that are under technical

supervision and those that are not. This tool should incorporate the current and future silvicultural regime of every stand to better evaluate its vulnerability to strong winds.

- In Gipuzkoa (**Euskadi**) the plan needs improvements in the management of blown down timber.

FOREST FIRE

General plan information

Interviewed organisations

Interviewed organisations cover the whole northern Spanish regions (except Cantabria), and Portugal (Table 6). The majority of them are public with 13 representatives of public institutions, which are complemented by 7 interviews representing the private sector. In **Portugal** there is a private company without any equivalent in Spain or France: AFOCELCA is a private company that fights forest fires in private corporate lands of The Navigator Company and ALTRI group. It produces its own forest fire risk management plan and supports public forest firefighters and the Autoridade Nacional de Protecção Civil (ANPC) on these corporate lands (220,000 ha).

Table 6. Interviewed organisations in charge of the forest fire risk management.

Region	Person interviewed	Organisation	Address
Euskadi	Aitor Omar Aspiazu Jefe de Sección de Proteccion, Experimentación y Mejora	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación Foral de Bizkaia	Avda. Lehendakari Agirre 9, 48014 Bilbao
Euskadi	Ibai Portu Zuloaga Jefe del Servicio Montes	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación Foral de Araba	Plaza de la Provincia 4, 1º izq., 01001 Vitoria-Gasteiz
Euskadi	Ismael Mondragón Laskurain Jefe del Servicio de Montes y Gestión de Hábitats	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación Foral de Gipuzkoa	Plaza Gipuzkoa s/n, 20004 San Sebastián
Asturias	Luis Alfonso Pérez Rodríguez Responsable de prevención y formación	Servicio Emergencias Principado de Asturias	
Asturias	Cristino Ruano de la Haza Responsable técnico de zona del Servicio de Montes	Consejería de Desarrollo Rural y Recursos Naturales, Servicio de Montes, Gobierno de Asturias,	
Asturias	Juan Garrote Jefe de sección	Servicio de Montes, Gobierno de Asturias,	

Region	Person interviewed	Organisation	Address
Asturias	Carlos Tejedor Mardomingo Director Técnico	Bosques 2.000 S.L. (Grupo Sniace)	
Asturias	Iván Castaño Fernández	Asociación de Propietarios Forestales de Asturias	
Galicia	Francisco Conde Pereiro Peón	Bombeiro forestal de Galicia	
Galicia	David Barreira Peón	Empresa Pública de Servizos Agrarios Galegos S. A. (Seaga)	Vía Marconi, 14. 15890. Santiago de Compostela
Galicia	Marcos Vega	SubDirección Xeral de prevención e Defensa contra os incendios forestais. Consellería do Medio Rural	San Lázaro s/n. 15781. Santiago de Compostela
Galicia	José Núñez	SubDirección Xeral de prevención e Defensa contra os incendios forestais. Consellería do Medio Rural	San Lázaro s/n. 15781. Santiago de Compostela
Portugal	Paulo Mateus Colaborador do INCF na proposta de elaboración do Plano Específico de Intervenção Florestal (PEIF) entre 2013-2015	Fundação Mata do Buçaco (Instituição coletiva de direito privado e utilidade pública)	
Portugal	Hugo Jóia Colaborador	OPAFLO	
Portugal	Fabíola Oliveira Técnica Florestal	Gabinete Técnico Florestal (GTF) de Viana do Castelo	
Portugal	António Louro Presidente	Fórum Florestal	
Portugal	Tiago Oliveira	The Navigator Company	
Portugal	Ricardo Marinho	Departamento de Desenvolvimento e Projetos – Associação Florestal de Portugal (FORESTIS)	Rua de Santa Catarina 753, 4000-454 Porto
Portugal	João Pedro Costa	AFOCELCA	

Region	Person interviewed	Organisation	Address
Portugal	Rui Almeida	Instituto da Conservação da Natureza e das Florestas (ICNF)	Avenida da República, 16 a 16B, 1050-191 Lisboa

Territorial scale and risk zones

There is a disparity of territorial scales for the development and the application of forest fire risk management plans in the area. In **Galicia** and **Asturias** the plan is applied to the whole region (autonomous community), while in **Euskadi**, which is smaller in area, the plan is developed and applied for each one of its three provinces because forest management is under provincial jurisdiction. The Basque government only intervenes if the same fire covers more than one province.

In **Portugal**, plans are applied locally (municipal plans) and regionally (district plans), following the directives of the national plan. All of them are integrated plans, covering the four phases of the wildfire management, namely prevention, prediction, crisis management and rehabilitation.

Table 7. Territorial scales of forest fire risk management plans.

Region	Development scale of the plan	Application scale of the plan
Euskadi	Regional: each Basque province has its own plan. They are based in directives and criteria from the Spanish and Basque civil protection plan.	Regional: each Basque province has its own plan
Asturias	National	Regional (comunidad autónoma de Asturias)
Galicia	National	Regional (comunidad autónoma de Galicia)
Portugal	National, regional and local: the national plan sets the structure and regional and local plans are based on it	Regional and local

Although provincial **Basque** forest fire risk management plans are based on directives and criteria from the Spanish and Basque civil protection plan, according to the interviewed agents it would be difficult to apply them to other PLURIFOR regions as they reflect the organizational and territorial characteristics of each province. In **Asturias** and **Galicia**, their regional plans could be adapted to other regions as they are derived from the Spanish national plan. For instance, in Galicia, the plan is developed at regional level. The plan could be applied to other PLURIFOR regions with similar environmental conditions and wildfires frequency.

There is a major difference between previous characterisation methodologies to locate fire risk zones between Spain and Portugal. Northern **Spain** is more humid (higher precipitation and lower potential evapotranspiration) than Portugal and most of the fires are manmade ignitions set by farmers to clear new grasslands. Consequently, fire prone areas are identified using historical data (mainly location, frequency and cause). Although in Euskadi fuel maps exist (but not in Asturias and Galicia),

historical data has been proven to be more efficient for fire prediction than fuel maps. In Galicia, the Plan for Prevention and Defense against Forest Fires of Galicia (PLADIGA), the areas with high forest fire risk are mapped every year according to the fire frequency and severity, and the importance of threatened areas. Moreover, the spatial variation of the forest fire risk (Forest Fire Weather Index) is calculated every day, based on meteorological parameters.

In **Portugal**, in some specific plans like in the case of “Mata do Bussaco”, they use the FlamMap simulator to locate forest fire hotspots. The majority of wildfire municipal (local) plans are based on the available cartographic information which includes: land use, fuel load, road network (for access to the forest but also as a source of ignition), firefighting facilities, slope, aspect, danger of a potential fire, climate, etc. While the Municipal Wildfire plan is a more strategic plan which is revised every 5 years, it exists the Operational Municipal Plan which is done once a year before the start of the fire season. Human and mechanical resources for surveillance and forest firefighting are then located at the hotspots. There is also a national map for fire danger, with 3 levels of risk: low, moderate and high.

AFOCELCA, the private forest firefighting group, creates its own maps to identify fire risk zones and potential loss zones in the case of a fire. They integrate weather information. They also map zones as a function of fire frequency and the expected fire progression.

Legislation

On the one hand, the first three phases of forest fire risk management plan (prevention, prediction and crisis management) are the most represented in the legislation for the whole studied area. On the other, rehabilitation is usually not considered in the legislation, except in **Galicia** (Table 8). In the Spanish regions of **Euskadi** and **Asturias** fires are mainly either accidental or deliberate man-made ignitions by farmers to create or regenerate grasslands. They are of small area but frequent, so authorities do not consider that the rehabilitation of the forest is an issue, as it will burn again in a short time. **Portugal** rehabilitation after fire is mainly concentrated on avoiding erosion, but there are no legal rules to foster reconstruction of the forest or of the forestry sector.

Table 8. Phases covered by the present forest fire risk legislation (number of respondents).

Region	Prevention	Prediction	Crisis management	Rehabilitation	Total number of respondents
Euskadi	2	2	1	1	2
Asturias	2	1	5	3	5
Galicia	4	4	4	4	4
Portugal	7	7	7	0	8

Organisations involved

In **Spain**, forest fire risk management plans are under the responsibility of regional governments, and the creation of the plans and their execution are financed by them (Table 9). In Galicia, the execution of the plan is under the responsibility of the regional government (Xunta de Galicia). In **Portugal** the

execution of forest fire risk management plans is financed by the state, by municipalities, and by forest owners associations. AFOCELCA is an exception to this, as it is financed by The Navigator Company and the ALTRI group to fight forest fires on their private corporate lands.

Table 9. Organisations involved in forest fire risk management.

Organisations involved in management plan creation and execution	Status	Main budget source
Servicio de Montes, Diputaciones Forales de Bizkaia, Gipuzkoa and Araba	Public	Regional government
Servicio Emergencias Principado de Asturias	Public	Regional government
Xunta de Galicia	Public	Regional government
Portuguese municipalities, Forest Authority (ICNF)	Public	National and local governments, European Funds, Petrol taxes.
AFOCELCA	Private	Corporations

In **Euskadi**, the Servicio de Montes from each provincial government is the responsible body for all four phases. In the case of Asturias, from the regional government, the Servicio de Montes is in charge of the tasks of prevention, prediction and rehabilitation of forest stands and the Servicio de Emergencias del Principado de Asturias is the responsible of the crisis management of forest fires, as well as the management of the forest fire risk management plan (INFOPA) approved by the government. In **Galicia**, the plan (PLADIGA) is designed, coordinated and executed by the regional government (Table 10), however other organizations are involved in activities of prevention, prediction and crisis management: MAPAMA (national government), provincial and local governments, forest owners, security agencies, army, and volunteers.

Table 10. Roles of the organisations involved in forest fire risk management.

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
Servicio de Montes, Diputaciones Forales de Bizkaia, Gipuzkoa and Araba (Euskadi)	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information
Servicio Emergencias del Principado de Asturias (SEPA)	Support (firefighting facilities)	Coordination Execution Support Control of information	Coordination Execution Support Control of information	-

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
Subdirección de Defensa contra incendios, Xunta de Galicia	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information

In **Portugal**, the situation is more complex as there are public plans at national, regional, local level, and private plans at national and regional levels. The National System for Forest Fire Defence designates Institutions that have the responsibility to coordinate each phase: prevention (Forest Authority - ICNF), Prediction (coordination from the National Republican Guard which is a police force), crisis management (Civil Protection Authority), Rehabilitation (Forest Authority). However all the organizations work together including some others that provide important inputs like the Meteorological Services (IPMA), municipalities among others.

Existing systems

Globally, risk management plans in the **Spanish** regions include the four phases, although in **Asturias**, one respondent specifies there is no rehabilitation phase in the plan. In **Portugal**, there is a lack of planned rehabilitation (Table 11). Generally, when rehabilitation is not specified in the plan, forest restoration is planned after the fire event, without any previous guidelines.

Table 11. Phases covered by the present forest fire risk management plan (number of respondents).

Region	Prevention	Prediction	Crisis management	Rehabilitation	Total number of respondents
Euskadi	2	2	2	2	2
Asturias	3	2	3	1	4
Galicia	4	4	4	4	4
Portugal	yes	yes	yes	no	8

Tools

Fire prevention

Resources for prevention tasks are almost non-existent in **Spain**. Silvicultural treatments that could help to reduce fire risk (mainly vegetation control and thinning) are available to foresters, but they receive nearly no funding for execution, most of it being designated to firefighting. No other tools for forest fire risk prevention have been specified. In Galicia, the PLADIGA defines every year areas with high forest fire risk and localities with high firing activity to establish protection measures against wildfires and to intensify the activities of surveillance and dissuasion.

In **Portugal**, prevention actions that need to be executed are defined in the municipal forest fire risk management plans. Municipal plans are used to produce the regional plans. One of their main issues is protecting built areas in the wildland urban interface from forest fires. Their main tool for that is to create strips of land cleared of vegetation around inhabited areas and along major roads, silvicultural treatments to create vegetation discontinuities, and awareness campaigns aimed at the population. These tasks are supported by GIS mapping, crew members with GPS receivers, and mechanised tools for creating the strips. The same cartography system is used to locate firefighting facilities, road networks, land use, vegetation cover, fuel load, etc. Fire behaviour is simulated to take decisions on fuel management. The final product is a map of fire danger zones. It can be used to plan preventive measures, although it is mostly used to plan urban development.

Finally, during the last few years it has been realised that many fires originate from a reingition of previous fires that were considered extinguished. Nowadays, firefighters are trained to monitor the real extinction of a fire and they are better coordinated through a municipal operational plan to avoid or attack reingitions.

Fire prediction, surveillance and emergency warning

In **Portugal**, the same cartography used for prevention is also used for prediction, and in some specific cases and not in general, FlamMap simulator is used to locate forest fire hotspots. There are lookout towers, fire surveillance vehicles, surveillance programs with volunteers, and even protocols in which wind farms share real-time weather information to predict fire risk. Weather forecasts are produced daily by the Instituto Português do Mar e da Atmosfera and are used to place firefighting resources on the ground.

Tools for forest fire risk prediction have not been specified in **Spain**, other than fire frequency mapping to locate accidental and deliberate man-made ignitions. In Galicia, the spatial variation of the forest fire risk (Forest Fire Weather Index) is calculated every day, based on meteorological parameters.

Firefighting and crisis management

In **Portugal**, there is a part of the municipal operational plan that specifies providing cartographic information to firefighting teams to support decision making. However, this tool (in the form of digital cartography on GPS receivers and tablets) is often too complex to be used by most of the firefighters and need to be adapted.

Tools for forest fire crisis management have not been specified in **Spain**. In Galicia, application of the protocol defined in the PLADIGA. There are tools to support decision making during firefighting (cartographic information, fire behaviour simulators, GPS to locate firefighters, software for human resource management, etc.).

Rehabilitation of burnt areas

There are no rehabilitation tools in the forest fire risk management plans. In **Galicia**, there is a protocol defined in the PLADIGA with rehabilitation activities to carry out in burnt areas.

Procedures

Fire prevention

In **Euskadi** there is some financial support for forest treatments designed to reduce fire risk based on the fire risk level of the zone and ecological or socio-economic value. Man-made fires for open or regenerated grasslands require an authorisation (to reduce the risk of accidentally escaping to the forest), however the request is not always made. No other procedures exist. In **Galicia**, the Prevention Plan of PLADIGA considers different actions focused i) on the population (burning authorisations, sociological actions, environmental education), ii) on the territory (forest management, fuel treatments).

In **Portugal**, in addition to the silvicultural practices for forest fire prevention, there are awareness campaigns aimed at the population and the history of fires is used for decision making.

Fire prediction, surveillance and emergency warning

No specific forest fire prevention procedures other than protocols of information transfers from national or regional weather agencies about meteorological conditions and forecasts, and protocols to coordinate warnings from surveillance crew to the authorities and onto the population.

Firefighting and crisis management

No specific forest fire crisis management procedures other than protocols of coordination between authorities, firefighting crews and civil security crews. In **Euskadi**, even though the forest fire risk management plan, approved by the Basque civil security commission, specifies the procedures in case of fire, they are deliberately ignored and the protocol is not followed in small fires because the lack of flexibility of the protocol in such small events.

Also in Euskadi, an example of public-private collaboration in this section is to be cited. This is the existence in Gipuzkoa of several trucks of mountain (called "Uraskas") that participate in tasks of extinction with deposits of 8000 litres that are loaded with the pen. The staff who lead them are accustomed to walking on forest tracks and there is the possibility of requesting their services also in prevention. These teams are a consequence of the initiative of private forest ownership in the Territory of Gipuzkoa within the project Recite I Compostela Bosques, concluded in 1995 and which was led by the Southern European Foresters Union (USSE) together with the Conference of the Regions of South Atlantic Europe (CRSEA).

Rehabilitation of burnt areas

There are no rehabilitation procedures in the forest fire risk management plans. The only mention is in Araba province (**Euskadi**), where tree planting on burnt areas is subsidised by the provincial government. In **Galicia**, the PLADIGA defines the procedures to be implemented for rehabilitation activities in burnt areas.

Procedures updating

Procedures updating is very irregular among the regions. In **Galicia**, the PLADIGA is updated every year. In **Asturias** there is no information on this point. In **Euskadi**, updating is done *a posteriori*: if at the end of the fire season a particular area shows an unusual number of ignitions or burnt area,

procedures (mainly on prevention) are updated to adjust priorities and resources allocated to this zone.

In **Portugal**, operational municipal plans are updated every year because they present the strategic actions and also list firefighting equipment and facilities. Municipal and regional forest fire risk management plans are updated every five years, although operational instructions (regional and municipal) have a validity of one year. Fire risk maps are also updated every five years. The national forest fire risk management plan is updated every ten years, as well as forest management plans. Local organisations may update their local plans more often if they wish in order to improve their applicability.

Personnel coordination

Asturias, **Galicia** and **Portugal** seem to have personnel coordination systems through the Estrategia integral de prevención y lucha contra incendios forestales and the Plan de Protección Civil de Emergencia por incendios forestales del Principado de Asturias (INFOPA) in Asturias, the Subdirección de Defensa contra incendios, Xunta de Galicia, and the municipal forest fire risk management plans and the municipal operational plans in Portugal. These documents or organisations set the objectives to be achieved, the coordination between different organisations involved in forest fire risk, and keep the personnel contact list updated. They cover the prevention, prediction and crisis management phases and, in Galicia, the rehabilitation phases. In Portugal, the ICNF coordinates the prevention phase and the use of prescribed burning. There is no planned coordination for the rehabilitation phase.

In **Euskadi**, the Servicio de Montes is the responsible body that coordinates personnel working on prevention, prediction and firefighting. Coordination exists also between the Servicio de Montes and forest owners associations for fire prevention forest treatments.

Past events recording

In general, there is good recording of prediction and crisis management phase events, and poor recording of prevention and rehabilitation tasks (but in the case of Galicia).

Fire prevention

In **Spain**, regional forest services record forest fire prevention actions (cleaning, preventive silvicultural treatments, water basin construction and maintenance, forest road maintenance, etc.) that receive technical support. However, in many cases this information is scattered among different management plans, so it becomes impossible to list all the preventive measures undertaken.

In **Portugal**, the creation of vegetation discontinuities, strips of cleared vegetation along roads and built-up areas, and other fire risk prevention facilities and actions are recorded and mapped. Portuguese law enforces forest fire prevention measures in the wildland urban interface, mainly through vegetation control. However, a major gap is the lack of registration of most of the forest management units. This prevents the government from forcing forest owners to undertake treatments for fire risk reduction.

Fire prediction, surveillance and emergency warning

Weather conditions before and during the fire, fire detection characteristics, and civil security services actions are the main events recorded during this phase in all regions.

Firefighting and crisis management

The number of fires, date, and the map of burnt areas by vegetation type are the best recorded data from forest fires in **Spain** and **Portugal**. This information is collected by regional authorities, firefighters or civil security members, and it is stored at national level (Ministry of Agriculture in Spain and ICNF in Portugal). This information is recorded yearly usually through GPS mapping of the fire perimeter on digital orthophotomaps.

In **Portugal**, in parallel, land use changes are also recorded through cartography. This is used to identify urban-forest interfaces to foresee the need for new forest fire prevention measures and firefighting infrastructure.

Rehabilitation of burnt areas and of the forest sector

There is no record of rehabilitation tasks after forest fires. In **Asturias**, the Servicio de Montes undertakes action plans in large burnt areas, and in **Euskadi** and **Galicia** there are reports on forest rehabilitation tasks; but this information lacks centralised recording.

Strengths and weaknesses analysis

Evaluation of the forest fire risk management plans

In **Euskadi**, evaluation of the forest fire risk procedures is undertaken through a review of the legal rules, or by adapting new knowledge to the procedures of the Servicio de Montes. Consequently, there is no frequency set for the evaluation of the plan. In Bizkaia, the crisis management phase of the plan needs to be reviewed and updated. In **Asturias**, the Estrategia integral de prevención y lucha contra incendios forestales is evaluated every three years. In **Portugal**, the regional forest management plans are updated every two years, the municipal operational plan every year and the National plan is evaluated every two years. In **Galicia**, the PLADIGA is updated every year, including elements to be improved in different scopes (crew safety, adapting legislation, improvement of coordination between institutions, adapting to TICs, improvement of resources for fire suppression...).

Strengths

The general opinion of the interviewed organisations is that they have access to technical tools and to advanced technology in prevention, prediction and crisis management phases. In **Euskadi**, the Servicio de Montes appreciates the legal power of the regulation and that it contains the procedures and tactics in case of an emergency. In **Galicia**, the PLADIGA counts with a high amount of human and material resources, apart from elevated funds to carry out the activities defined in each phase. This plan clearly defines the roles and the scheme of coordination of the different institutions and personnel involved in the forest fire plan.

Fire prevention

The **Portuguese** strength in forest fire prevention is the amount of forest sappers to execute prevention tasks and they have a significant range of preventive measures. Funds for fire prevention measures are enough to achieve their goals.

Fire prediction, surveillance and emergency warning

In **Portugal**, organisations responsible for forest fire surveillance (e.g. municipalities) can have contracts with the army to increase their surveillance personnel during the fire season. These experiences have achieved good results and this formula could be spread elsewhere.

Some municipalities will develop a project to install a video surveillance network for real-time smoke detection, allowing faster reaction in the critical initial phase.

Firefighting and crisis management

In general, the perception from all the interviewees is that firefighting and crisis management is sufficiently funded, maybe too much in comparison with prevention measures. **Asturias** is reducing the annual burnt area, and firefighting teams, especially the aerial support, is better coordinated.

In **Portugal**, the main strength is a computer tool that stores geographical information useful for firefighting, allows quick location of firefighting facilities, and provides real-time mapping of firefighting vehicles by GPS, all this to support coordination of field teams during a fire event from the command post.

Rehabilitation of burnt areas and of the forest sector

There is no strength on rehabilitation, as this phase is not covered in the forest fire risk management plans of the studies regions (but in the case of Galicia).

Weaknesses

Prevention and rehabilitation phases are the weakest ones, the latter being completely absent from the plans. This opinion is shared by the all interviewed organisations in the four regions. Prediction is judged adequate, and crisis management, mainly firefighting, is perceived efficient and well equipped. However, in **Portugal**, the civil security priority is to save lives and should be better integrated to protect also forests. This is probably the most important problem related to forest fire crisis management: civil protection concentrates on protecting people and not on fighting forest fires.

Consequently, most of the weaknesses are not technical, but procedural or organisational. Because in **Portugal** and northern **Spain** forests are mainly private and forest management units are small and generally have low value, investment in forest management is low. If we add the forest area increasing due to natural reforestation of abandoned marginal agricultural areas, the landscape becomes a continuous forest with high amounts of fuel. A common problem in **Spanish** regions is that forest management is not connected to forest fire risk management, resulting in a poor information flow and a lack of coordination in silvicultural actions related to the prevention and rehabilitations phases.

Fire prevention

It is generally perceived that the main prevention weakness is the lack of awareness about fire risk among specific groups using fire in the forest: farmers, shepherds and forest managers. It is difficult to reconcile farmers' and shepherds' requirements for extensive grazing with forest protection. Man-made non-authorised ignitions are not prosecuted hard enough and subsidies to extensive grazing encourage uncontrolled burns. Globally, people do not adjust their practices according to fire risk, and there is a lack of efficiency measure from the awareness campaigns. Finally, despite having information recorded about executed prevention tasks, there is poor coordination and information transfer between units responsible for prevention measures and firefighting teams.

Other main weaknesses specific to **Portugal** related to fire prevention are:

- The lack of a register of forest because in about two thirds of the forest area land ownership is not related to a geographical database. This prevents the implementation of compulsory fire prevention measures such a vegetation control.
- The lack of funds to execute prevention plans (although procedures and tools exist).
- Bureaucracy burden that discourages the two-year updating of regional forest fire risk management plans.
- Legal obligations that make it difficult to implement the prevention measures.
- Poor training of staff in new technologies that are used in fire prevention tools (GIS, fire behaviour modelling, etc.).

In **Asturias**, man-made ignitions to regenerate grazing areas are a problem that has not been addressed because of a lack of political will. There is no protocol to help in the conciliation of farmers' and shepherds' interests and the protection of the forest. Any achievement in this conciliation comes from the good will of regional foresters that establish arrangements with farmers and shepherds to create or maintain grazing areas through silvicultural treatments. In **Euskadi**, the Servicio de Montes from Araba assumes that the province does not have a prevention plan. In **Galicia**, there is a scarcity of tools to define priority areas based on a more accurate spatial forest fuel characterization to carry out preventive activities. There is also a lack of analysis of past wildfire to establish a typology a fires in the region in order to facilitate suppression activities and to design fuel treatments areas.

Fire prediction, surveillance and emergency warning

In **Portugal** there exist two particular problems on fire prediction and surveillance:

- Due to the coordination of warnings a single ignition generates many alerts and false alerts because of inaccuracies in fire location. This produces a dispersion of firefighting resources.
- Geographical data to generate forest fire risk maps is usually not updated, resulting in inaccurate fire prediction.

No fire prediction, surveillance and emerging warning weaknesses have been communicated from **Spanish** regions.

Firefighting and crisis management

In **Euskadi**, the main weakness in crisis management is the poor coordination in the case of small fires. When they are small at the moment of detection and they are assumed easily controllable, the crisis protocol is voluntarily not activated, though it should be, and decisions are taken “on the fly”. The coordination problem appears if the fire spreads to a larger area: then the crisis protocol is activated after crucial time was lost. In Bizkaia, according to the Servicio de Montes, firefighting resources should be optimised and updated, while the Servicio de Montes in Araba complains about the lack of resources.

The main weaknesses in **Portugal** related to crisis management are:

- Poor coordination between different municipal forest fire risk management plans in fires that spread over different municipalities.
- Poor coordination and information transfer between units responsible for prevention measures and firefighting teams: firefighters do not know where prevention measures have been previously executed resulting in inefficient coordination and decision making.
- There is lack of training to avoid reignitions. Fires originating from reignitions represent a third of the area burnt annually.

Rehabilitation of burnt areas and of the forest sector

There is generally a lack of rehabilitation plans following fires in **Spain** and **Portugal** (except for some planned measures to reduce soil erosion after fire in **Galicia**, which are treated in the soil degradation chapter). In **Asturias**, the Servicio de Montes only undertakes action plans in large burnt areas.

In **Portugal**, there are few rehabilitation tasks that are executed, and most of them are related to soil erosion more than forest recovery. In 2003 a commission for the recuperation of arid areas was created with the role of guiding recovery measures after large forest fires. However, because of poor coordination in implementing rehabilitation measures and due to long delays to authorise them, some tasks are not executed before the first autumn rains and there is a lack of efficiency.

Potential for improvement

Improvements and updates

A general improvement for forest fire risk management plans would be to enhance the integration of the four phases of the plan: prevention, prediction, crisis management and rehabilitation; and also to integrate forest management with forest fire risk management.

In **Portugal**, it would be necessary to increase the importance of regional plans: they should be developed to support municipal plans, locate risk zones at the regional level, and prevent large forest fires occurring. The approval process of the plans should be uniformly accelerated.

Additionally, the four studied regions expressed different needs for improvements in each phase of risk management:

Fire prevention

Euskadi:

- Improve the knowledge about the road and firefighting facilities networks, in order to quickly have access to fires and to put them out.
- Map and characterise forest fire prevention priority zones.

Asturias:

- Improve the dialogue between authorities and primary sector actors and develop legal rules to solve the land use conflicts that currently lead to man-made fires.
- Promote financial support and regional planning for prevention.

Galicia:

- Develop or improve decision-making tools for planning forest fire prevention especially in the location of risk zones and for setting the priorities for preventive tasks.

Portugal:

- Some features related to fire prevention that are registered in municipal plans should be redefined and presented in regional plans: as forest fires become larger, burning on more than one municipality, municipal plans are not enough since their area has been surpassed
- Develop measures to stimulate forest management, as an opportunity to introduce forest fire risk management to abandoned forest stands
- The structure of municipal forest fire risk management plans should be reviewed: some sections have too much detail, while other should be developed further. Major points to be improved are related to fire danger zones and building rules.

Fire prediction, surveillance and emergency warning

Euskadi:

- Improve and update coordination.

Asturias:

- More dynamic surveillance systems.
- Develop or improve forest fire danger index.

Galicia and Portugal:

- No forecasting improvements suggested.

Firefighting and crisis management

Euskadi:

- Improve road network information.

Asturias:

- Improve post-fire surveillance.

Galicia:

- No crisis management improvements suggested.

Portugal:

- Improve the integration between municipal and regional risk management plans. Information at local scale should be developed towards a more regional scale. The current fragmentation into many municipal plans becomes a handicap when managing large fires.
- Develop a tool to link municipal plans together and with the regional plans so that they could be quickly consulted and assimilated at the command post (e.g. centralized server).
- Train firefighters in the use of new technologies, especially digital cartography.
- In the municipal operational plans simplify cartographic information for decision making, because currently there is too much information and it is difficult to read it all.
- Provide automatic weather stations in areas where there are none.

Rehabilitation of burnt areas and of the forest sector

In **Spain**, no rehabilitation improvements have been suggested, but two of the three Spanish regions need to develop a plan covering this phase.

Portugal:

- Develop a network of pilot projects on forest rehabilitation.
- Prepare a less fire prone landscape through rehabilitation measures on burnt areas. The new forest cover should be planned according to historical fire events in the area.
- Accelerate the execution of rehabilitation tasks, so they can be executed before the first autumn rains.

Collaboration with the PLURIFOR project

These are global improvements that could be developed by PLURIFOR for the whole area. Generally, PLURIFOR should:

- Optimise current resources for forest fire management and increase their integration.
- Promote continuous training of firefighters and support teams.
- Support application of projects related to forest fire risk management to Rural development program 2020 (PDR2020).

Fire prevention

- Develop a national or trans-national awareness program in fire prevention (integrated into the risk management plan), and integrate primary sector actors' interests with forest conservation in order to reduce man-made ignitions.
- Develop or improve decision-making tools for planning forest fire prevention, especially the location of risk zones and to set the priorities for fire prevention tasks.

Fire prediction, surveillance and emergency warning

- Develop or improve real-time forest fire prediction using dynamic fire propagation models based on fuel load, topography, weather, and the history of ignitions in the area, among other variables.
- Improve coordination in forest fire prediction, surveillance and emergency warning.

Firefighting and crisis management

- Improve coordination in firefighting and crisis management.
- Develop forest firefighting management plans and the necessary tools and procedures, adapted for different sizes of forest fires.

Rehabilitation of burnt areas and of the forest sector

- Develop a national or trans-national rehabilitation plan, as this phase is absent from forest fire risk management plans in the four regions (but in the case of Galicia).

SOIL DEGRADATION

General plan information

Currently, there are no soil degradation risk management plans in any of the regions. The only existing plan is from RAIZ - Instituto de Investigação da Floresta e Papel, which manages the corporate forests of The Navigator Company. RAIZ has its own soil degradation risk management plans at a regional scale. They are developed and applied only by and for the private company, with a local or regional focus.

Interviewed organisations

In **Euskadi** the only organisations interviewed were the public administrative bodies responsible for forest management. In the **Asturias**, **Galicia** and **Portugal** we find a more diverse representation of both public and private sectors.

Table 12. Interviewed organisations in charge of the soil degradation risk management.

Region	Person interviewed	Organisation	Address
Euskadi	Aitor Omar Aspiazu Jefe de Sección de Protección, Experimentación y Mejora	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación Foral de Bizkaia	Avda. Lehendakari Agirre 9, 48014 Bilbao
Euskadi	Ismael Mondragón Laskurain Jefe del Servicio de Montes y Gestión de Hábitats	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación Foral de Gipuzkoa	Plaza Gipuzkoa s/n, 20004 San Sebastián
Euskadi	Luis Alfonso Quintana	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación Foral de Araba	Plaza de la Provincia 4, 1º izq., 01001 Vitoria-Gasteiz
Asturias	Carlos Tejedor Mardomingo Director Técnico	Bosques 2.000 S.L. (Grupo Sniace)	
Asturias	Ivan Castaño Fernández	Asociación de Propietarios Forestales de Asturias	
Galicia	Agustín Sevilla		
Portugal		ALTRI group	
Portugal		Associação de Produtores Florestais (APFC)	

Region	Person interviewed	Organisation	Address
Portugal		Instituto da Conservação da Natureza e das Florestas (ICNF)	Avenida da República, 16 a 16B, 1050-191 Lisboa
Portugal		Instituto de Investigação da Floresta e Papel (RAIZ)	
Portugal		Direção-Geral de Agricultura e Desenvolvimento Rural (DGADR)	
Portugal		Associação Florestal de Portugal (FORESTIS)	Rua de Santa Catarina 753, 4000-454 Porto

Territorial scale and risk zones

There are no soil degradation risk management plans in **Euskadi** and **Asturias**. However, in Euskadi, regional (at autonomous community and at provincial levels) rules set the norms for sustainable forest management that prevent soil degradation (mainly through regulation of machinery). In **Galicia**, there is a regional plan for soil erosion prevention after forest fires but it does not cover other forms of degradation such as compaction or fertility loss.

In **Portugal** there is no soil degradation risk management plan for public or small private forests. Recommendations and guidelines exist, and some forest management plans include a chapter about soil degradation, mainly concerning erosion and where sensitive areas are located. On the other hand, some corporate forests (the Navigator Company, for example), do have their own soil degradation risk management plans at a regional scale. They are developed and applied only by and for the companies, with a regional or local focus (Table 13).

Table 13. Territorial scales of soil degradation risk management plans.

Region	Risk management plan	Legal forest management rules, recommendations or guidelines
Euskadi	None	Legal forest management rules at autonomous community and at provincial levels
Asturias	None	None
Galicia	Regional (just for erosion after forest fire)	Regional recommendations and guidelines
Portugal	Regional plan, sometimes local, only on corporate forests	Local recommendations and guidelines

The protocol of the **Galician** regional plan could be easily applied to other regions, but it only concerns soil erosion after forest fires. **Basque** technical legal forest management rules could also be adopted in other regions with similar ecological features.

There are some attempts to characterise the region to locate soil degradation risk zones. The most developed one is the **Basque** potential erosion map (at scale 1:25.000) using the universal soil loss equation. It does not locate hotspots and could be improved in order to be used as a decision-making tool. Hotspots are located in the Basque territorial plan for agriculture and forestry. In 1:25.000 scale maps, areas under soil erosion risk and where water tables are vulnerable are located. Also in **Euskadi** and **Portugal**, management plans for protected areas also locate areas sensitive to soil degradation.

In **Portugal**, soil degradation hotspot maps exist only for corporate forests. They cover erosion, compaction and fertility loss risks. They are used to preserve forest productivity. Elsewhere, the Observatório Nacional de Desertificação (ICNF) has mapped hydric erosion and soil organic carbon content. This cartography could be used to locate soil degradation hotspots. However, these soil degradation maps are associated with forest fires, and consequently this perturbation is the best indicator of soil degradation problems.

Legislation

Although in **Euskadi** a soil degradation risk management plan does not exist, technical rules in provincial legislation is very detailed. It mainly regulates mechanised forest operations to prevent soil erosion and compaction. Early warning and crisis management legislation also exist for the three Basque provinces. This legislation is detailed in the Basque regional report.

In **Portugal**, according to DGAR, there is too much legislation on soil degradation, but no risk management plan. The main legal rules enforce the production of risks maps at local level and regulate actions that can produce soil degradation (Table 14). There is no legislation for rehabilitation.

Table 14. Legislation on prevention of soil degradation.

Region	Erosion	Compaction	Fertility loss	General (any degradation)
Euskadi	Yes, mainly in Gipuzkoa	Yes, mainly in Gipuzkoa	None	-
Asturias	None	None	None	-
Galicia	None	None	None	-
Portugal	Regulate actions that can produce soil degradation	Regulate actions that can produce soil degradation	Regulate actions that can produce soil degradation	Produce risks maps at local level

Organisations involved

Soil degradation risk is mainly managed by public organisations. However, in **Portugal**, big corporate forested areas are managed by private companies, with private funding, that produce their own soil degradation risk management plans (

Table 15).

Table 15. Organisations involved in soil degradation risk management.

Organisations involved in soil degradation management^a	Status	Main budget source
Servicio de Montes, Diputaciones Forales de Bizkaia, Gipuzkoa and Araba (Euskadi)	Public	Regional government
Xunta de Galicia	Public	Regional government
Instituto de Investigação da Floresta e Papel (RAIZ)	Private	Private funding
ALTRI group	Private	Private funding
Associação de Produtores Florestais (APFC)	Private	Associated forest owners
Associação Florestal de Portugal (FORESTIS)	Private	Associates forest owners
Instituto da Conservação da Natureza e das Florestas (ICNF)	Public	State
Direção-Geral de Agricultura e Desenvolvimento Rural (DGADR)	Public	State

^a Bosques 2.000 S.L. (Grupo Sniace), a private company in Asturias, is not involved in soil degradation management.

Euskadi is the region where all the roles in soil degradation risk management are handled by the forest service, although they cover mainly soil erosion. **Portugal** has a larger spectrum of soil degradation problems, but some roles are lacking (Table 16).

Table 16. Roles of the organisations involved in soil degradation risk management.

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
Servicio de Montes, Diputaciones Forales de Bizkaia, Gipuzkoa and Araba (Euskadi)	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information
Principado de Asturias	Design, coordination and execution of reforestation tasks to prevent soil erosion	-	-	Design, coordination and execution of reforestation tasks to control soil erosion and to ecosystem rehabilitation after forest fire

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
Instituto de Investigação da Floresta e Papel (RAIZ)	Design (erosion, compaction, fertility) Control of information (erosion, compaction, fertility)	Design (erosion, fertility) Control of information (erosion, fertility)	Design (erosion)	Design (erosion)
ALTRI group	Design Execution Control of information	Design Execution Control of information	Design Execution Control of information	Design Execution Control of information
Instituto de Investigação da Floresta e Papel (RAIZ)	Design Execution Control of information	Design Execution Control of information	Design Execution Control of information	Design Execution Control of information
Associação de Produtores Florestais (APFC)	Design Execution Control of information	Design Execution Control of information	Design Execution Control of information	Design Execution Control of information
Associação Florestal de Portugal (FORESTIS)	Support	Support Control of information	Support Control of information	Support Control of information
Instituto da Conservação da Natureza e das Florestas (ICNF)	Coordination Support Control of information	Coordination Support Control of information	Coordination Support Control of information	Coordination Support Control of information
Direção-Geral de Agricultura e Desenvolvimento Rural (DGADR)	Coordination Support Control of information	Coordination Support Control of information	Coordination Support Control of information	Coordination Support Control of information
	General (all plan)			
Xunta de Galicia	Coordination (erosion) Execution (erosion)			

Existing systems

Tools and procedures

Euskadi and **Portugal** are the regions with the greatest number of tools and procedures. However, whereas in Euskadi these measures seem to be well integrated into the regional (autonomous community) and provincial legislation, in Portugal these measures seem to be scattered and not integrated. In **Galicía**, legal measures only consider reducing soil erosion after fires, and, in **Asturias** there are no coordinated measures for this risk.

Prevention

Prevention tools and procedures are the most developed measures for soil degradation risk.

In **Euskadi** and **Portugal**, the main prevention procedure is the set of laws (at different territorial levels) that authorises particular uses of machinery or specific forest management practices (mostly during site preparation and tree planting) according to environmental conditions (including weather) and soil potential erosion zones. However, whereas in Euskadi prevention is mainly focussed on soil erosion, in Portugal the tools and procedures also tackle soil compaction and fertility loss. Legal rules exist to protect soil organic matter, to incorporate vegetal organic matter into the soil, to reduce unnecessary organic matter exportation through forest management, to prevent nutrient depletion, and to regulate the use of fertilisers.

Cartographic tools available for soil degradation risk prevention are:

- the Basque potential erosion map (at scale of 1:25.000), using the universal soil loss equation,
- the Basque territorial plan for agriculture and forestry, also at a scale of 1:25.000, mapping areas under soil erosion risk and vulnerable water tables,
- the Portuguese national cartography for soil erosion prevention covers the entire country with a resolution applicable to the local scale and it highlights sensitive soil erosion zones,
- soil maps are used to foresee potential soil compaction in Portugal.

Prediction

In **Euskadi**, soil fertility surveillance is done by a permanent plots network called BASONET. Since 2001, it tracks soil fertility on 428 plots (mainly on radiata pine and eucalyptus plantations) where physical and chemical soil properties are tested regularly (last test was in 2011). Any decrease in soil fertility found on these plots would trigger the adoption of early silvicultural measures on similar stands to avoid fertility decrease.

Soils degradation surveillance, mainly for apparent erosion, compaction and landslides, is regularly done by forest service crew. Moreover, in Gipuzkoa, forest managers must communicate to the forest service the characteristics of the machinery used in forest operations to get their approval, and authorised companies to execute mechanised site preparation tasks must be registered. There is also a procedure for land use change to monitor possible soil erosion risks.

In **Portugal**, RAIZ combines environmental variables (precipitation, lithology and slope) and produces digital maps to evaluate potential soil erosion. In the field, crew members verify the sites where soil

erosion events are initiated, register them, and evaluate them in order to take appropriate measures. Prediction of fertility loss is monitored by soil and vegetation sampling. In the forest areas managed by RAIZ fertility maps exist. They are used to re-establish the nutrients removed by the trees during their rotation. DGAR is the responsible body in Portugal to produce national cartography for soil erosion prevention. The extent is national, and the resolution is at the local scale.

Management of degraded soils

In **Euskadi**, legislation enforces the restoration of eroded areas by the forest owner. Inspections are done by a forest service crew. In **Galicia**, the main aim of crisis management is to stabilise soils after forest fires to reduce erosion risk. The Centro de Investigación Forestal de Lourizán evaluates soil conditions after fires (in private and public lands) and proposes erosion mitigation measures. They are executed by forest managers and subsidised by the Galician government. In **Asturias**, crisis management is the only phase of the risk management where measures are taken (not specified), and only in the most severe cases.

In **Portugal** any situation resulting from forest management operations that can provoke important erosion or compaction must be corrected immediately, by manual or mechanical equipment. This can include runoff water deviation from the site or other mitigation measures. Soil stabilisation projects after large forest fires are subsidised by the Rural development program 2020 (PDR2020).

Rehabilitation

In **Euskadi**, rehabilitation of eroded or potentially erodible areas is supported through the of funding tree planting.

In **Portugal**, RAIZ has its internal procedures to detect erode soil rehabilitation needs, and tools to help with eroded soil rehabilitation.

Procedures updating

In **Euskadi**, legislation concerning soil degradation risk is only updated when it is considered by the provincial forest service. There is no established updating frequency.

In **Galicia**, where soil degradation risk measures mainly concern soil erosion prevention on burnt areas, the Centro de Investigación Forestal de Lourizán is responsible for technical monitoring and knowledge transfer aimed at the forest managers that carry out the proposed erosion mitigation measures.

In **Portugal**, RAIZ conducts yearly updates of prevention and prediction phases of its soil degradation risk management plan by adding new information and knowledge.

Personnel coordination

In **Euskadi**, soil degradation risk is coordinated by the provincial forest service agents and crew members. They decide on the criteria to follow in order to apply the legislation.

In **Galicia**, where soil degradation risk measures mainly concern soil erosion prevention on burnt areas, the Centro de Investigación Forestal de Lourizán coordinates knowledge transfer aimed at forest managers that carry out the proposed erosion mitigation measures.

Past events recording

In **Euskadi**, there is no specific methodology to record past events related to soil degradation risk management. Consequently, actions are registered in the same way as all other forest management operations. In **Asturias**, there is no recording of events related to soil degradation risk. In **Galicia**, the evaluation of the potential soil erosion risk after forest fires and the execution of prevention measures are recorded and compiled by the Dirección Xeral de Ordenación Forestal (Consellería do Medio Rural de la Xunta de Galicia). This is done in a similar way in Portugal with soil stabilisation projects after large forest fires (crisis management and rehabilitation phases) being recorded.

In **Portugal**, only RAIZ continuously records past events related to soil erosion, compaction and fertility (not only after forest fires). These records cover the four phases of their soil degradation risk management plan: prevention, prediction, crisis management and rehabilitation events. Information is collected and registered in databases and GIS.

Strengths and weaknesses analysis

Evaluation soil degradation risk management plan

There are no soil degradation risk management plans. For the actions related to this risk, there is no proposed evaluation in **Spain**, unless the need is raised. In **Portugal**, prevention and crisis management phases and the RAIZ plans are evaluated every five years.

Strengths

Euskadi:

- BASONET is a useful tool to track forest soil fertility and associate any fertility loss to silvicultural practices,
- in Gipuzkoa, the legal power of the provincial government to remove authorisation of forest companies to execute mechanised site preparation tasks that do not respect legal rules on soil conservation,
- technical criteria are similar in the three Basque provinces, despite having different legislation,
- the application of the legislation is done on all forest harvesting and tree planting settings, and are evaluated by provincial forestry officers.

Galicia:

- crisis management response to stabilise soils after forest fire to reduce erosion risk. The Centro de Investigación Forestal de Lourizán evaluates soil conditions after fires (on private and public lands) and proposes erosion mitigation measures. They are executed by forest managers and subsidised by the Galician government

Prevention

In Gipuzkoa (**Euskadi**), there is a register of authorised companies to execute mechanised site preparation tasks. There is also a procedure for any land use change. If the change can provoke soil erosion it can be denied.

Prediction

In Gipuzkoa (**Euskadi**), a commission for quality control of forest operations (composed of the provincial forest service, the provincial government, forest companies and the forest owners association) evaluates forest practices in relation to soil degradation.

Management of degraded soils

In Gipuzkoa (**Euskadi**), the provincial government has the capacity to withdraw operational permits to companies that do not respect legal rules on soil conservation when using forest machinery. For **Galicia**, the quick evaluation of potential soil erosion after forest fires, the prescription of measures to reduce this risk, and the subsidised execution of these measures with a posterior audit are regarded as strengths.

Rehabilitation

In Gipuzkoa (**Euskadi**), compulsory tree planting after clearcutting is considered a major strength.

Weaknesses

The main weakness is the absence of soil degradation risk management plans for forestry in any of the regions, except those performed by RAIZ. Moreover, when soil degradation is considered according to legal rules, only soil erosion and soil compaction (the latter during forest management) are taken into account. Fertility loss, soil pollution, soil salinization, or soil sealing are not treated. **Euskadi** and **Asturias** explicitly stated that it is not expected that a soil degradation risk management plan would be created. **Portugal** has local plans concerning soil degradation, but their aim is civil protection mainly concerned with landslides. These are not useful for regional or national forest management. Euskadi suffers a similar problem because landslides after heavy rains can cut access to isolated buildings. However, there is no established objective protocol for these cases. More regional weaknesses follow:

Euskadi:

- there is a lack of evaluation of the applied measures.

Asturias:

- there is a lack of training and awareness about this risk among foresters and farmers,
- soil loss costs are not evaluated.

Portuguese weaknesses are listed by phase:

Prevention

- the existing cartography (mainly regional and national soil maps) is dispersed, difficult to access, and difficult to use (there is a lack of information to make it usable),

- regional and national information is not compatible with local scale maps: there is a lack of information standardisation between scales that prevents the location of sensitive areas for soil degradation within a region.

Prediction

- there are no prediction and warning system either at regional or at national scales for soils erosion and soil compaction,

Management of degraded soils and rehabilitation

- soil erosion problems are only evaluated and treated when the forest is certified,
- soil degradation problems often affect areas larger than the ownership and there is a lack of information for the correct management solutions,
- soil degradation crisis management is done case by case at the local level, company by company, outside of any forest management plan. Therefore, the response is reactive. This is not helped by the lack of soil degradation problems. The only protocol existing for soil stabilisation is after forest fire (as in Galicia).

Potential for improvement

Improvements, updates and collaboration with the PLURIFOR project

The main expected contribution by PLURIFOR would be to develop a soil degradation risk management plan including soil erosion, soil compaction, and fertility loss (loss of nutrients and loss of organic matter). Current tools, procedures and technical rules in some regions could be improved and then extended to other regions. They are:

Strengths from **Euskadi** to be improved and extended:

- Technical rules to regulate mechanised forest operations on harvesting and tree planting to avoid soil degradation. They could be extended to other operations, be more context-specific and include livestock activities (like grazing and silvopasture).

Strengths from **Galicia** and **Portugal** to improve and extend:

- Extend emergency measures for soil preservation after a forest fire to other soil degradation critical situations.

General improvements common to many regions follow:

Prevention

- Increase soil degradation risk awareness and knowledge among forestry and farming stakeholders.
- Develop new tools for prevention decision making at regional or national level. They could include appropriate application procedures for forest operations (mainly harvesting, site preparation, and tree planting).

- Update or create regional and national cartography with potential soil degradation risks, and a procedure to keep it updated with new information and with new variables describing the state of the soil. This mapping should be usable for forest management decision making.
- The new management plan and cartography should be disseminated through good practice guidelines and methodologies to identify and evaluate soil degradation.

Prediction

- Develop new tools for quick detection of soil degradation, including degradation due to extreme events (like forest fires or storms). Link this tool to an early warning system.
- Results from soil monitoring and soil conservation assessments should be made publicly available and support forest certification applications.
- In **Euskadi**, conduct a new campaign to measure BASONET sample plots in order to evaluate soil fertility changes

Management of degraded soils and rehabilitation

- Improve current tools used to evaluate post-fire soil erosion risk.
- Funding must arrive on time to support crisis measures against soil degradation.

PINE WOOD NEMATODE

General plan information

The studied regions represent three different situations regarding pine wood nematodes. In **Portugal** the pest is endemic in the whole country, in **Castilla y León** it has been detected in one location that is currently under eradication, and in **Nouvelle-Aquitaine** pine wood nematode has not yet been found.

Interviewed organisations

Interviewed organisations are mostly regional public administrations in charge of forest and agriculture (Table 17).

Table 17. Interviewed organisations in charge of the pine wood nematode risk management.

Region	Person interviewed	Organisation	Address
Nouvelle-Aquitaine	Sigrid Launes Mission Santé des Forêts Emmanuel Kersaudy Mission Santé des Forêts	Service Régional de la Forêt et du Bois – Direction Régionale de l'Alimentation, de l'Agriculture et de la Forêt Nouvelle-Aquitaine	51 rue Kiéser, 33077 Bordeaux CEDEX
Castilla y León	Ana Belén Martín Hernández	Centro de Sanidad Forestal de Calabazanos – Consejería de Fomento y Medio Ambiente de Castilla y León	Polígono Industrial de Villamuriel s/n, 34190 Villamuriel de Cerrato
Portugal	Ricardo Marinho	Departamento de Desenvolvimento e Projetos – Associação Florestal de Portugal (FORESTIS)	Rua de Santa Catarina 753, 4000-454 Porto
Portugal	José Manuel Gomes Rodrigues	Instituto da Conservação da Natureza e das Florestas (ICNF)	Avenida da República, 16 a 16B, 1050-191 Lisboa

Territorial scale and risk zones

There is a common scheme in **Nouvelle-Aquitaine** and **Castilla y León** to base their national plan on the Commission Implementing Decision of 26 September 2012 (2012/535/UE), and develop a regional plan from the national one (Table 18). This is not the case in continental **Portugal**, where all

the country is considered infested or under potential infestation. The territory is divided in two zones: the buffer zones (BZ), a 20 km wide strip along Spanish border, and the rest of the country, that are covered by the same national plan but have different approaches.

Table 18. Territorial scales of pine wood nematode management plans.

Region	Development scale of the plan	Application scale of the plan
Nouvelle-Aquitaine	Commission Implementing Decision of 26 September 2012 (2012/535/UE) on emergency measures to prevent the spread within the Union of <i>Bursaphelenchus xylophilus</i> : developed and applied at EU scale National plan against pine wood nematode, under elaboration by the Service Santé des Végétaux (DGAL, Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt): developed and applied at national scale Regional plan against pine wood nematode adapted by Nouvelle-Aquitaine: developed and applied at regional scale	
Castilla y León	Commission Implementing Decision of 26 September 2012 (2012/535/UE) on emergency measures to prevent the spread within the Union of <i>Bursaphelenchus xylophilus</i> Spanish pine wood nematode national contingency plan. The Servicio de Defensa del Medio Natural de Castilla y León has elaborated based on the national plan a series of action protocols. As a whole they could be considered the regional plan in this autonomous community. They standardise and bring more detail different procedures to implement the control of this pest.	
Portugal	Plano Operacional de Sanidade Florestal is a national action plan aiming mostly BZ, and partially applied on the IA where pine wood nematode is already present.	The national action plan is applied at national, regional and local scales (called prevention plans).

Moreover, to protect large areas spared by pine wood nematode, **Portugal** has internally defined regional rules and procedures to avoid the dispersion of this pest into uninfected areas.

Regional plans from **Nouvelle-Aquitaine** and **Castilla y León** could be easily applied to other regions, as they are based on EU legislation. Both plans could be used to extract more detailed protocols, procedures and actions, and adapt them to other regions. The Nouvelle-Aquitaine plan is most appropriate to regions with extensive plantations of maritime pine, and with a local sawmilling industry able to transform pine timber from eradication and contingency zones. Galicia would fit such a description. It would be more difficult to apply to mountainous zones (because of timber transport), colder areas (as there are no visible symptoms under 20°C in summer) or with other sensitive pine species. With regional adaptations, the national and regional **Portuguese** plans could be adapted to other regions infested by the pine wood nematode.

The characterisation of the area to locate risk zones has been done in all three regions, although they are very different because of their relative distances from the potential source of pine wood nematode in Portugal:

- **Nouvelle-Aquitaine:** risk zones are the potential points of entry of the pest through contaminated timber. A 3km wide buffer around them has been marked: road and railway

border crossings between France and Spain, ports, airports, main roads used by freight from Portugal and Spain, rest areas along A63 motorway, main primary sawmills transforming wood from Spain. All of these risk zones together cover 600,000 ha in Nouvelle-Aquitaine.

- **Castilla y León:** risk zones are defined according to the distance from Portugal. High risk zones are less than 20 km from the border, medium risk zones between 20 and 100 km from the border, low risk are more than 100 km from the border. Demarcated areas exist in the region, defined by the Commission Implementing Decision of 26 September 2012 (2012/535/UE).
- **Portugal:** all the country is considered infested or under potential infestation. The territory is divided in two zones: the buffer zone (BZ), a 20 km wide strip along the Spanish border, and the rest of the country. Outside the BZ, a national map at municipal resolution locates municipalities where pine wood nematode is present. The clusters of these infested adjacent municipalities are called the intervention zones (IZ). The focus of the pine wood nematode risk management plan is to avoid the spread of the pest outside the IZ.

Legislation

Legal rules about pine wood nematode are very abundant, as it is a highly threatening pest in Europe. Regional legislation is detailed in each regional report. For **Nouvelle-Aquitaine**, **Castilla y León** and **Portugal** two UE laws apply: Commission Implementing Decision of 26 September 2012 (2012/535/UE) on emergency measures to prevent the spread within the Union of *Bursaphelenchus xylophilus* and Commission Implementing Decision (EU) 2015/226 of 11 February 2015 amending Implementing Decision 2012/535/EU as regards the definition of susceptible wood and measures to be taken in demarcated areas. Regional national and regional laws are derived from them.

According to the interviewed organisations, the legal rules applied to their regions cover the four phases of a risk management plan, except for the prevention stage in Nouvelle-Aquitaine and the rehabilitation stage in Castilla y León and Portugal. In **Nouvelle-Aquitaine**, the earliest upstream procedures appear in monitoring the arrival of the pine wood nematode, but no prevention rules exist (Table 19). In **Castilla y León** and **Portugal** rehabilitation is not planned but when extended clearcuts are executed as an eradication measure a rehabilitation project has to be planned each time. In Nouvelle-Aquitaine legal rules exist to impose tree planting from a list of authorised tree species, although these measures are not formally incorporated in the regional plan.

Table 19. Phases covered by the present pine wood nematode risk legislation (number of respondents).

Region	Prevention	Prediction	Crisis management	Rehabilitation	Total number of respondents
Nouvelle-Aquitaine	None	2	2	2	2
Castilla y León	1	1	1	None	1
Portugal	2	2	2	None	2

Organisations involved

Organisations involved in pine wood nematode risk management are mainly public (Table 20). In **Nouvelle-Aquitaine**, the EU refunds part of the surveillance costs.

Table 20. Organisations involved in pine wood nematode risk management.

Organisations involved in soil degradation management ^a	Status	Main sources of the budget
Mission Santé des Forêts de la DRAAF Nouvelle-Aquitaine	Public	State and EU
FREDON Aquitaine (Fédération Régionale de Défense contre les Organismes Nuisibles)	Private	State and EU
Caisse de Prévoyance et de Protection des Forêts	Private	Members' contributions
Consejería de Fomento y Medio Ambiente de Castilla y León	Public	Regional government
Associação Florestal de Portugal (FORESTIS)	Private	EU, state and forest owners associations
Instituto da Conservação da Natureza e das Florestas (ICNF)	Public	EU and state

Mission Santé des Forêts de la DRAAF Nouvelle-Aquitaine is responsible for information dissemination about nematode risk in **Nouvelle-Aquitaine** and advises which tree species should be authorized for replanting. FREDON Aquitaine is in charge of pheromone traps for vector insects and sawdust collection to detect pine wood nematode presence (Table 21).

Table 21. Roles of the organisations involved in pine wood nematode risk management.

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
Mission Santé des Forêts de la DRAAF Nouvelle-Aquitaine	Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Control of information
FREDON Aquitaine	-	Execution	-	-
Caisse de Prévoyance et de Protection des Forêts	-	Coordination	-	-
Consejería de Fomento y Medio	Design Coordination	Design Coordination	Design Coordination	-

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
Ambiente de Castilla y León	Execution Support Control of information	Execution Support Control of information	Execution Support Control of information	
Associação Florestal de Portugal (FORESTIS)	Coordination Execution Control of information	Coordination Execution Control of information	Coordination Execution Control of information	Coordination Execution Control of information
Instituto da Conservação da Natureza e das Florestas (ICNF)	Design Coordination Support Control of information	Design Coordination Support Control of information	Design Coordination Support Control of information	-

Existing systems

Tools and procedures

Tools and procedures have been highly detailed in the Portuguese interviews and are described in the **Portugal** regional report. Otherwise, because national and regional plans are derived from EU legislation, tools and procedures are very similar between regions.

Prevention against pests and diseases

Prevention tools and procedures concern efforts to avoid the spread of pine wood nematode. They include:

- Information dissemination to raise awareness among foresters, timber transporters and the general public.
- Knowledge transfer aimed at foresters and forest owners.
- Identification and preventive felling of symptomatic pine trees and control on where this timber is transported and how it is transformed.

Surveillance, monitoring and early warning of pests and diseases

- Joint actions between forest health authorities and custom agents to inspect transnational road timber transport
- Inspections and samplings in sawmills transforming the timber of sensitive species.
- Systematic sampling in forests composed of sensitive species, searching for symptomatic trees. Sampling efforts are adjusted according to risk zones.
- Wood sampling in declining trees in risk zones and pheromone trapping of the vector insect to monitor the presence of pine wood nematodes.

Eradication, control and contingency of pests and diseases

- If the European legislation is not modified this involves felling of all sensitive tree species in a 500 m radius around the detection point (the infested zone), plus a 20 km buffer within which all symptomatic trees are systematically felled (the buffer zone). Transport, treatment, and transformation of felled timber from these zones are controlled.

Rehabilitation of affected forest sector by pests and diseases

- Control on the tree species that can be planted in the infested zones after sensitive species have been removed. Otherwise, a rehabilitation plan is made for every particular location of infestation if it is considered necessary.

Procedures updating

In **Nouvelle-Aquitaine**, the prediction and crisis management phases in the national and regional plans will be updated every three years, as this is the expected updating frequency of the Commission Implementing Decision concerning pine wood nematodes.

In **Castilla y León**, updates in prevention, prediction and crisis management are done once a year, usually in January.

In **Portugal**, the national action plan is established for five years, but regional and local prevention plans derived from the national plan, are reviewed yearly or whenever necessary. The Grupo de Acompanhamento de Sanidade Florestal (GASF; formed by public and private organisation) meets once or twice a year to update contact lists.

Personnel coordination

In **Nouvelle-Aquitaine**, prediction and crisis management phases are coordinated by the chief of the Service Régional de l'Alimentation, who supervises the Mission Santé des Forêts. An annual meeting is held to coordinate the services involved. In the case of pine wood nematode detection, a steering committee will be set in place to coordinate the actions.

In **Castilla y León**, environmental public agents and Grupo TRAGSA (a public company) coordinate the tasks to be done in the forest. Regional government agents coordinate the inspections in tree nurseries, wood industries and road.

The designated area in Valverde del Fresno, Extremadura, needs coordination with the neighbouring autonomous community and with Portugal. The Spanish Ministry of Agriculture, Fisheries, Food and Environment assumes this coordination.

In **Portugal**, INCF coordinates the pine wood nematode risk management plans. Since 2015 there is also a national forest committee, with a section specialised in forest health, which advises on pine wood nematode management and is formed by the same organisations that are in GASF. Coordination has been supported since 2009 by a web database where all surveillance and monitoring efforts are described and located.

Past events recording

FORESTIS in **Portugal** records in a database all actions by its partners in relation to the pine wood nematode. Since 2014 there are no more coordinated actions and every partner is supposed to individually record its actions in the format of their choice. This prevents a national level of integration and the analysis of the results at a national scale.

Prevention against pests and diseases

There is no recording of past events concerning prevention in **Nouvelle-Aquitaine**.

In **Castilla y León**, preventive felling of symptomatic pine trees and control on timber transport and transformation are kept in an Excel spreadsheet. Paper deeds are scanned and digitally stored.

Surveillance, monitoring and early warning of pests and diseases

In **Nouvelle-Aquitaine** and in **Castilla y León**, surveillance and monitoring information is stored in a database managed by the regional forest service. In Castilla y León, this database includes digital maps with information about forest stands and single trees that have been inspected or monitored, as well as risk zones and hotspots.

Since 2009 in **Portugal**, all surveillance and monitoring efforts are recorded by the ICNF in a web database where they are described and located. This database is updated in real-time and can be consulted by any organisation concerned by the pine wood nematode.

Eradication, control and contingency of pests and diseases

Not necessary in **Nouvelle-Aquitaine** as pine wood nematode has not been detected yet.

In **Castilla y León** there is a database, which includes digital maps with information about forest stands and single trees that have been treated for eradication and control of pine wood nematode. It is managed by the regional forest service.

Since 2009 in **Portugal**, all eradication, control and contingency efforts are recorded by the ICNF in a web database where they are described and their position given. This database is updated in real-time and can be consulted by any organisation concerned by the pine wood nematode. It also contains a list of companies authorised to harvest, transport, treat and/or transform timber of tree species sensitive to pine wood nematode.

Rehabilitation of affected forest sector by pests and diseases

There is no recording of past events concerning rehabilitation in any of the three regions.

Strengths and weaknesses analysis

Evaluation of the pine wood nematode risk management plans

In **Nouvelle-Aquitaine**, prediction and crisis management phases on national and regional plans will be updated every three years, as this is the expected updating frequency of the Commission Implementing Decision concerning pine wood nematode.

In **Castilla y León**, updates in prevention, prediction and crisis management are done once a year, usually in January.

In **Portugal**, the national action plan is established for five years, but regional and local prevention plans, derived from the national plan, are reviewed yearly or when necessary. The Grupo de Acompanhamento de Sanidade Florestal (GASF; formed by public and private organisation) meets once or twice a year to evaluate the pine wood nematode risk management plans.

Strengths

Prevention against pests and diseases

Nouvelle-Aquitaine:

- Information dissemination to raise awareness among foresters, timber transporters and general public. Extensive know-how and available resources for DSF, with many contacts and channels to disseminate information through government, private partners and forest managers.

Portugal:

- Compulsory applications required for all tree felling, timber processing and transport of sensitive tree species.
- Application of protective phytosanitary measures for timber transport, including pine wood nematode treatment at destination, use of pesticides, and banning of timber transport.

Surveillance, monitoring and early warning of pests and diseases

In this phase, strengths are similar between regions:

- Efficient wood sampling in dying trees in risk zones, and adequate methodology for pheromone trapping of the insect vector in order to monitor the presence of pine wood nematode: standardized protocols, well established teams with appropriate experience, confidence in the skills and know-how of the laboratory personnel, and the presence of regional laboratories, public or private, certified for the diagnosis of pine wood nematodes. The whole works as an integrated system of sampling, testing, and results communication.
- The use of georeferenced databases to record surveillance and monitoring efforts.
- Inspection of timber transport inside **Portugal** and, in **Nouvelle-Aquitaine** and **Castilla y León**, inspection of timber lorries from Portugal by Spanish and French custom agents.
- Inspection of sawmills that process and treat timber of sensitive tree species.
- In **Castilla y León**, the use of helicopters to detect dying trees.
- In **Portugal**, the use of preventive injections of emamectine benzoate.

Eradication, control and contingency of pests and diseases

Due to the different states of the pine wood nematode among the regions and the differences of the forest sector in each region they each have different strengths.

Nouvelle-Aquitaine:

- Long regional experience in clearcutting, which is easily executed thank to the dense road network. Highly mechanised forest operations and flat orography.
- Timber from designated areas cannot leave the area without having been treated against the pine wood nematode or transformed by authorised companies. This is not a problem in Nouvelle-Aquitaine as there are many companies in the region and they have already been identified.

Castilla y León:

- Experience of the regional forest service officers due to the existence of two designated areas in the region.

Portugal:

Measures that help to contain pine wood nematode inside an infested area:

- Register of companies authorised to harvest, transport, treat and/or transform timber of tree species sensitive to pine wood nematode.
- Elimination of the woody debris from eradication areas.

Rehabilitation of affected forest sector by pests and diseases

Only **Nouvelle-Aquitaine** has expressed strengths about this phase, although they do not directly concern the risk management plan:

- The regional forest sector has a good resilience against large forest perturbations, acquired from past storms and forest fires events. There are in Nouvelle-Aquitaine the resources for salvage logging, stocking, transporting and locally transforming large amounts of damaged timber.

Weaknesses

General weaknesses of the pine wood nematode risk management plan include:

- There is a lack of prevention tools. These need to go further than just the legal requirement of felling symptomatic trees and sensitive tree species in the infested zone.
- Weak regional and international coordination. Even though the risk management plan includes it, this coordination is not carried out. Information exchange should be improved.

In Portugal:

- The risk management plan is only partially implemented. The only phase that is completely implemented in the whole country is the surveillance and monitoring one. The whole plan is completely implemented only in public forests managed by the ICNF in the intervention zones (IZ) close to the buffer zone (BZ), and in private forests under subsidised programs (PRODER and PDR2020).

Prevention against pests and diseases

Nouvelle-Aquitaine:

- Information about timber flow entering France from Spain and Portugal recorded by custom services are transmitted with a 6 to 9 months delay. Information about timber imports by the timber industry in Nouvelle-Aquitaine is not available.

Castilla y León:

- There is a lack of tools to improve early detection of symptomatic trees.

Portugal:

- Since 2014, the national plan is not implemented regularly in the whole territory. It is well implemented in the buffer zone along the Spanish border through identification and felling of symptomatic trees, but neglects the rest of the territory.
- The results of prevention operations are not publically available.

Surveillance, monitoring and early warning of pests and diseases

Nouvelle-Aquitaine:

- The presence of the of pine wood nematode can be underestimated because wood sampling on the tree are made at breast height, whereas nematode infests trees throughout the crown. During the delay due to laboratory diagnosis pine wood nematode can spread losing precious reaction time.
- Symptomatic trees are difficult to spot away from road margins.
- Timber transport and sawmills inspections are inefficient. It is difficult to coordinate with the custom services, there is lack of information about timber flows, there is a lack of cooperation from private companies, and there is even forged documentation.
- There is a lack of traps for vector insects and of information about the optimal distribution of these traps according to the territory to be monitored.

Castilla y León:

- Surveillance and monitoring generate a large amount of data. There is a lack of tools to improve data recording, processing and use.

Portugal:

- The exact location of infestation foci are not transmitted to forest owners associations so they can quickly and efficiently proceed, along with the private owners, to control the pine wood nematode.

Eradication, control and contingency of pests and diseases

Nouvelle-Aquitaine:

- Clearcutting all sensitive tree species in a 500 m radius around the infested spot does not seem effective. The area could be too small and even foster the spreading of the vector insects.
- Derogations to allow a reduction of from 500 m to 100 m of the radius of the infested zone are poorly defined.
- There is a lack of solutions to secure timber transport from the infested zone, especially during the warm season, which is the period of spread of the vector insect.

Rehabilitation of affected forest sector by pests and diseases

General weaknesses on rehabilitation phase are:

- The ecosystem rehabilitation phase is not included in any of the risk management plans of the three regions. Plans for rehabilitating the forest ecosystem affected by felling of all sensitive tree species in the infested zone must be done case by case because no planning exists.
- Crisis and post-crisis measures for the forest sector are not considered, including how the wood supply will be affected.
- The legal rule of stopping eradication measures after four years without pine wood nematode detection in the demarcated area seems arbitrary.

Potential for improvement

Improvements and updates

Improvements and updates proposed by interviewed organisations have been numerous. In this section are listed those that will not be considered within the PLURIFOR project:

Prevention against pests and diseases

- Reinforce and improve a communication plan for general public, foresters and timber importers.
- Improve contact with forest owners.
- Preventive sanitary felling of declining and dead trees. This would make the detection of pine wood nematode symptomatic trees easier and would reduce false positive cases. The ecological impacts of this removal have to be studied.
- Destroying wood debris after forest operations (thinning and final cuts) in order to reduce the substrate where the vector insect can develop. The ecological impacts of this removal have to be studied.
- Assemble all these pieces of information into a good practice guidelines.
- In **Portugal**, develop local plans (currently not done because of lack of public support). These local plans should be integrated at the national level. Any improvement in the plans should not be associated with the administrative limits of municipal borders.

Surveillance, monitoring and early warning of pests and diseases

- Wood sampling to detect pine wood nematode should be done in the crown and not at breast height.

- Study if pruning is useful. Pruning could be done when sampling tree crowns.
- Develop live and in-situ diagnostic technics using molecular analysis, to be used in the forest and at custom controls.
- Develop pathway model analysis to evaluate risk. This would use data such as wood origin and flow, port of entry, location where pine wood nematode is detected, etc.
- Determine the optimal size of woodchips that prevent vector insect larvae to develop into adults.
- Improve the models that predict the dispersion of the vector insect in realistic landscapes.
- Evaluate the efficiency of secure transport practices.
- Study how timber flow from salvage logging after storms or forest fires should be managed.
- Develop new biological control agents, and improve breeding and releasing methods of existing agents.
- Improve interregional and international coordination.

Eradication, control and contingency of pests and diseases

- Define an eradication strategy that concentrates on really infested trees and not on trees that just show symptoms of decline.
- Study the application of health felling tree by tree (like in Korea) and increasing the radius around the infested tree as the area of dying trees expand, as an alternative to felling all sensitive trees inside a radius around the infested tree.
- Better define the radius of the infested zone and the width of the buffer zone in accordance with landscape heterogeneity.
- Improve the knowledge about the presence of pine wood nematode in loblolly pines that do not develop any symptoms.
- Improve insect vector trap for mass capture, not just for monitoring.
- Specific funds should be dedicated to pine wood nematode eradication and contingency actions. One source could be the PDR 2020.
- In **Portugal** give priority of action to intervention zones instead of buffer zone. Within the intervention zones give priority to the most productive area (in northern and central Portugal).
- In **Portugal** evaluate the current eradication and contingency actions undertaken in isolated infested foci.

Rehabilitation of affected forest sector by pests and diseases

- Propose post-crisis reconstruction solution considering the possibility of the long term (or permanent) presence of pine wood nematode at the regional scale. Possibilities include species substitution or species diversification.
- Develop a regional socio-economic study to evaluate the viability of post-crisis reconstruction solutions for the forestry sector.

Collaboration with the PLURIFOR project

The following improvements have been retained for development in PLURIFOR. In each phase proposals are listed in decreasing order of priority, as set by the interviewed organisations:

Prevention against pests and diseases

- Adjust silvicultural regimes and forest management practices as a function of the forest typology affected by the pine wood nematode, including rehabilitation options.
- Develop a specific awareness plan directed at prevention and the adoption of good practice guidelines.
- Produce risk maps that ease decision making and help the establishment of intervention priorities.

Surveillance, monitoring and early warning of pests and diseases

Improve surveillance, monitoring and early detection methods for pine wood nematode, mainly by:

- Improving detection of isolated dying tree located inside forest stands (far from roads) with new remote sensing tools. These tools should also predict the mortality cause, distinguishing between attacks by bark beetles, fungal root rot, and pine wood nematode.
- Optimised the distribution of pheromone traps at regional scale to quickly detect vector insects carrying pine wood nematodes so the zone with contaminated trees (that would be felled) could be better delimited.
- Develop new pheromone traps and improve current pheromones, including pheromones that attract immature insects.
- Improve pine wood nematode detection methods in wood samples and in vector insects in order to minimise false negatives.

Optimise data recording and the use of data from surveillance and monitoring. These tools would have to be practical and user-friendly.

Eradication, control and contingency of pests and diseases

In **Portugal**:

- Implement quick and bureaucracy-free procedures for a fast execution of eradication actions.
- Develop new eradication methods.

In **Nouvelle-Aquitaine**:

- Implement an operational plan.

Rehabilitation of affected forest sector by pests and diseases

In **Portugal**:

- Develop genetically modified trees that tolerate or resist pine wood nematode.

CHESTNUT GALL WASP

General plan information

In Spain and in Portugal, the status of chestnut gall wasp has changed from quarantine pest to non-quarantine pest, thus limiting the capacity for the implementation of protection measures. In **Castilla y León**, there is no chestnut gall wasp risk management plan. In Spain, there is an experimental plan to release parasitoids of the chestnut gall wasp. It is fostered by the Spanish Ministry of Agriculture, Fisheries, Food and Environment, and it is implemented at local level in some regions in Spain, but not in **Castilla y León**. The *Biological control experimental plan* and the *Surveillance and monitoring technical instructions* are the main documents that are used to manage this pest. Currently, there is no connection between them.

In **Portugal**, there is a chestnut gall wasp national risk management plan (*Plano de ação nacional para controlo do inseto Dryocosmus kuriphilus Yasumatsu, vespa das galhas do castanheiro*). An environmental impact study was done to authorise the import and release of the parasitoid *Torymus sinensis*.

The answers summarised here refer to these documents.

Interviewed organisations

Interviewed organisations are mostly regional public administrations in charge of forest and agriculture, except for REFCAST (Table 22). However, it works closely with DRAP Norte.

Table 22. Interviewed organisations in charge of the chestnut gall wasp risk management.

Region	Person interviewed	Organisation	Address
Castilla y León	Ana Belén Martín Hernández	Centro de Sanidad Forestal de Calabazanos – Consejería de Fomento y Medio Ambiente de Castilla y León	Polígono Industrial de Villamuriel s/n, 34190 Villamuriel de Cerrato
Portugal	Maria Amália da Gama Lobo Xavier Diretora de Serviços	Direção Reginal de Agricultura e Pescas do Norte	Rua da República, 133, 5370-347 Mirandela
Portugal	Maria Cláudia Duarte de Araújo e Sá Diretora de Serviços de Sanidade Vegetal	Direção-Geral de Alimentação e Veterinária (DGAV)	Tapada da Ajuda, 1349-017 Lisboa

Portugal	José Gomes Laranjo Presidente	Associação Portuguesa da Castanha (REFCAST)	Universidade de Trás os Montes e Alto Douro, Quinta de Prados, 5000-102 Vila Real
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Territorial scale and risk zones

Both regions have national plans that are applied regionally or locally (Table 23).

Table 23. Territorial scales of chestnut gall wasp management plans.

Region	Development scale of the plan	Application scale of the plan
Castilla y León	National scale: <i>Biological control experimental plan</i>	Regional and local scales: <i>Surveillance and monitoring technical instructions</i>
Portugal	National scale: chestnut gall wasp national risk management plan	The national chestnut gall wasp national risk management plan is applied at local scale

In **Castilla y León**, the *Surveillance and monitoring technical instructions* currently used are focused on early detection of chestnut gall wasps in forests where the pest is not yet present. Currently, this insect is present in Castilla y León in the chestnut masses of the north of the province of Burgos (northeastern of Castilla y León). Consequently, these procedures could be also implemented in other regions where the pest is not present yet or has a restricted range.

In **Portugal**, the national chestnut gall wasp national risk management plan could also be easily applied elsewhere. The plan was developed when the pest was detected in the Norte region. Currently the national plan is also being successfully applied in Central Portugal region after the pest was detected there.

In **Castilla y León**, any location with chestnuts is considered a hotspot. Two zones are distinguished:

- natural forests with chestnut (24,000 ha),
- tree nurseries and garden centres.

In **Portugal**, the national chestnut gall wasp national risk management plan includes a map of identified risk zones where surveillance and monitoring must concentrate. The resolution is at municipal scale. It has six zones:

- chestnut plantations for wood production (infested areas),
- chestnut plantations for nut production and isolated trees (infested areas),
- buffer zones around infested areas,
- buffer zones around tree nurseries and garden centres,
- recently planted chestnut plantations (less than five years old),
- areas with a high density of host plant species.

The number of zones and the extent of the maps have evolved since the spread of the pest. The map was currently used to decide where to make the first biological control actions with the release of the parasitoid *Torymus sinensis* in 35 locations during May 2015, and the 130 made during 2016.

Legislation

The 2006/464/EC: Commission Decision of 27 June 2006 on provisional emergency measures to prevent the introduction into and the spread within the European Community of *Dryocosmus kuriphilus* Yasumatsu is currently derogated by the 2014/690/EU: Commission Implementing Decision of 30 September 2014. In **Spain** there is no national or regional law concerning the control of this pest.

In **Portugal**, affected by the same EU legislation, there was a law even when chestnut gall wasp was not present in the territory. The law only regulates the quality of reproductive material. It is compulsory to communicate the presence of the chestnut gall wasp, although there is no law to enforce this.

Table 24. Legislation on chestnut gall wasp.

Region	Prevention	Prediction	Crisis management	Rehabilitation
Castilla y León	No	No	No	No
Portugal	Yes	Yes	Yes	No
Comments	Only to control reproductive material quality	-	-	Not necessary because the pest causes just a decrease of chestnut and timber production

Organisations involved

All organisations involved in chestnut gall wasp management are publically funded (except REFCAST) and work at the regional level (except DGAV; Table 25).

Table 25. Organisations involved in chestnut gall wasp risk management.

Organisations involved in management plan creation and execution	Status	Main budget source
Centro de Sanidad Forestal, Consejería de Fomento y Medio Ambiente de Castilla y León	Public	Regional government
Direção Regional de Agricultura e Pescas do Norte (DRAP Norte)	Public	State, municipalities, and chestnut producers associations for the parasitoid aquisition

Direção Regional de Agricultura e Pescas do Centro (DRAP Centro)	Public	State, municipalities, and chestnut producers associations for the parasitoid acquisition
Direção-Geral de Alimentação e Veterinária (DGAV)	Public	State
Instituto da Conservação da Natureza e Florestas (ICNF)	Public	State
Associação Portuguesa da Castanha (REFCAST)	Private	Municipalities

When chestnut gall wasp first arrived in the Norte region of **Portugal**, DRAP Norte and REFCAST quickly collaborated to manage the pest. Thanks to the increasing expertise, DRAP Norte is transferring the execution of the management plan to REFCAST in the Norte region, and also the coordination of the prediction phase (starting in 2017; Table 26).

Table 26. Roles of the organisations involved in chestnut gall wasp risk management.

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
Centro de Sanidad Forestal, Consejería de Fomento y Medio Ambiente de Castilla y León	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	None
Associação Portuguesa da Castanha (REFCAST)	Execution ^a Coordination (2017)	Execution ^a	Execution ^a	None
Direção Regional de Agricultura e Pescas do Norte (DRAP Norte)	Design Coordination Support Control of information	Design Coordination Support Control of information	Design Coordination Support Control of information	None
Direção Regional de Agricultura e Pescas do Centro (DRAP Centro)	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	None
Direção-Geral de Alimentação e Veterinária (DGAV)	Design Coordination Control of information	Control of information	Control of information	None

Instituto da Conservação da Natureza e Florestas (ICNF)	Design Coordination Control of information	None	Authorization for the import and release of the parasitoid <i>T.</i> <i>sinensis</i>	None
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^a In behalf of DRAP Norte.

Existing systems

Tools and procedures

Prevention against pests and diseases

Castilla y León:

- Information dissemination through government website, leaflets in town halls, and visits to tree nurseries and garden centres.

Portugal:

- Information dissemination to forest owners to prevent them from applying chemical treatments (that are not effective and harm the parasitoid) or doing biological control (as parasitoid imports are very restrictive and must be done but official organisations).
- Warnings are sent to forest owners to start searching for galls and begin their destruction.
- Control in tree nurseries and garden centres.
- Banning of the use of infested reproductive material.
- Procedures to find and destroy galls in newly established chestnut plantation to locally eradicate the pest and prevent their dispersion.

Surveillance, monitoring and early warning of pests and diseases

Castilla y León:

- Annual surveillance on 178 sample points (2 x 2 km grid in the chestnut distribution area) and health plan inspections in tree nurseries and garden centres.

Portugal:

- The progression of the pest is monitored, annually updated, and disseminated by DRAP Norte, DRAP Centro, and ICNF, with support from chestnut producer associations that participate in the monitoring tasks.
- Surveillance and monitoring are used to locate priority areas where the release of the parasitoid should be carried out. This evaluation is done at the national level. They are focused on chestnut plantations, natural forests and reproductive material.
- Pictures sent by forest owners and chestnut producers help to identify and locate new foci.

Eradication, control and contingency of pests and diseases

Castilla y León:

- Destruction of affected trees found in tree nurseries and in garden centres.

Portugal:

- Procedures to find and destroy galls in newly established chestnut plantation to locally eradicate the pest and prevent their dispersion.
- Every new detection point is considered as a high priority intervention zone. The procedure is to manually destroy young galls but keep the oldest, especially when parasitoid release will follow, as this helps the establishment of the parasitoid by providing some host wasp larvae.
- Biological control: DRAP Norte and DRAP Centro provide technical support to assist on parasitoid releases by the technicians from the chestnut producers associations; DRAP Norte also provides training for them. These are the organisation, along with REFCAST, that execute the biological control.
- In the case of detection in older buds, the only recommendation is parasitoid release (but not the destruction of the galls).

Rehabilitation of affected forest sector by pests and diseases

No rehabilitation tasks are executed.

Procedures updating

In **Castilla y León**, prevention and prediction phases are updated as needed; there is no update protocol.

In **Portugal** prevention, prediction and control phases are updated by the periodical meeting of the working group that elaborated the national risk management plan in July 2014. The plan was updated in July 2015 with a special focus on updating the distribution area of the pest.

Personnel coordination

In Spain and Portugal the coordination of personnel is done by the public organisations responsible for managing the chestnut gall wasp risk. In the region of Norte, Portugal, personnel coordination will be transferred from DRAP Norte to REFCAST, as both organisations worked together since the arrival of the pest in Portugal.

Past events recording**Prevention against pests and diseases**

No prevention events are recorded in **Castilla y León**. In **Portugal**, there is a georeferenced database of prevention events.

Surveillance, monitoring and early warning of pests and diseases

In **Castilla y León**, surveillance and monitoring information on natural forests, tree nurseries and garden centres is collected in a georeferenced database. Paper deeds are scanned and digitally stored. A similar procedure is done in Portugal, and the information is published as an appendix to the national risk management plan.

Eradication, control and contingency of pests and diseases

DRAP Norte and DRAP Centro, in **Portugal**, keep updated a database with the description and location of new foci and the areas where parasitoid releases have been made. No eradication, control and contingency events are recorded in **Castilla y León**.

Rehabilitation of affected forest sector by pests and diseases

No rehabilitation events are recorded.

Strengths and weaknesses analysis

Evaluation of the chestnut gall wasp risk management plans

In **Castilla y León**, the evaluation of the whole plan is foreseen. The instructions for surveillance and monitoring are evaluated annually. Stakeholders' proposals are taken into account.

In **Portugal**, the national, regional and local risk management plans are evaluated annually.

Prevention against pests and diseases

There is no evaluation of the prevention phase.

Surveillance, monitoring and early warning of pests and diseases

In **Castilla y León** and in **Portugal**, continuous, rigorous and intensive surveillance and monitoring allow a real-time update of the state of the pest. The delimitation of the infested zone is made by the visual observation on the ground of the symptoms caused by the chestnut gall wasp.

Eradication, control and contingency of pests and diseases

In **Portugal**, during December 2016 and January 2017 REFCAST will coordinate the collect of galls in areas where the 130 releases of the parasitoid were made. With this, DRAP Norte will evaluate the parasitism index in order to evaluate the efficiency of the parasitoid releases.

Rehabilitation of affected forest sector by pests and diseases

There is no evaluation of the rehabilitation phase.

Strengths

Early detection and quick reaction since the arrival of the chestnut gall wasp in **Portugal** and **Castilla y León** is a strength. According to REFCAST, the plan works and should continue. In Portugal, all teams have a good experience, coordination and participation. They all follow the same forecasting methodology for predicting where to release parasitoids.

Prevention against pests and diseases

In **Portugal**, awareness and the training of technicians from municipalities and chestnut producers associations is very important. The early warning network during high risk periods is judged very efficient. Tree nurseries and garden centres are contacted and receive backing to control the pest.

Surveillance, monitoring and early warning of pests and diseases

In **Castilla y León**, tree nurseries are inspected and it is judged efficient.

In **Portugal**, the training of technicians from municipalities, chestnut producers associations and forest firefighters for the detection and destruction of galls is considered an efficient control method.

Eradication, control and contingency of pests and diseases

In **Portugal**, the municipalities have trained technicians to control the pest, and pay for the import of the parasitoid. There is a characterisation of the infested zones and of the dispersion of the pest. This allows the identification of risk zones and the early release of the parasitoid in order to create barriers to the dispersion of the chestnut gall wasp.

Rehabilitation of affected forest sector by pests and diseases

No rehabilitation strengths have been expressed.

Weaknesses

According to the Centro de Sanidad Forestal de Calabazanos in **Castilla y León**, there is a lack of legislation for the actions to be taken against this pest. No other weaknesses have been communicated from this region. The following weaknesses come from **Portugal**:

Prevention against pests and diseases

- Although the early warning network during high risk periods is judged very efficient, the communication of new infection points is not so efficient.
- There is a lack of information dissemination on TV and radio.
- A practical problem for prevention is the difficulty to detect the galls when the plants leave the tree nurseries. A plan was produced to track the plants provided by the tree nurseries from the nursery to the forest for a posterior certificate. However, once a year, when chestnut producers buy new plants to replace those that died there is a danger of introduction of the chestnut gall wasp.

Surveillance, monitoring and early warning of pests and diseases

- During surveillance and monitoring campaigns, inspection agents should have an internet connection and GPS devices that could update the database in real-time.

Eradication, control and contingency of pests and diseases

- It is necessary to improve the timing of the releases of the parasitoid to maximise the success of parasitism.
- The releases of the parasitoid depend on decisions of the municipalities where new foci of chestnut gall wasp are detected, and the budget to buy the parasitoid is very low. Some private chestnut producers fund parasitoid releases, and proceed without authorisation, in municipalities that do not have funds.
- The long term establishment of the parasitoid in the ecosystem is not yet achieved.
- Low funding for the management of chestnut gall wasp (this pest is not eligible for EU aid) and for research.

Rehabilitation of affected forest sector by pests and diseases

There is no rehabilitation plan because no major areas of chestnut production are affected.

Potential for improvement

Improvements and updates

In **Castilla y León**, the Centro de Sanidad Forestal de Calabazanos considers that the prevention and prediction phases of their chestnut gall wasp risk management plan need to be improved. The eradication, control and contingency phase do not need to be improved or updated.

Improvements and updates proposed by interviewed organisations have been numerous. In this section are listed those that will not be considered for collaboration with the PLURIFOR project. They are mostly from Portugal:

Prevention against pests and diseases

- Foster European and even international rules for plant trading from certified tree nurseries. This would ease national control measures.

Surveillance, monitoring and early warning of pests and diseases

- Increase the control on imports of new chestnut plans, as, in **Portugal**, past imports where the source of a second focus of infestation, with contaminated tree plants coming from France and Italy.

Eradication, control and contingency of pests and diseases

- Foster homogeneous European level rules and authorisation for the use of the parasitoid.
- Study how to avoid introducing other pests when *Torymus sinensis* is bought in China.
- Diversify releases locations and, in the future, releases of the parasitoid should only be done to reinforce locally established populations. Afterwards, when the parasitism index is high, release should be done through galls where the parasitoid is already present.
- Proceed to systematically photograph chestnuts stands before and after parasitoid releases to evaluate the evolution of the stand and the installation of the parasitoid.
- Encourage municipalities to adhere to the protocol for parasitoid release (BIOVESPA).
- Adapt the Rural development program 2020 (PDR2020) measures for eradication and control of chestnut gall wasp in chestnut plantations aimed at fruit production, as current measures focus on chestnut stands for timber production.

Rehabilitation of affected forest sector by pests and diseases

No improvements other than those that could be developed by PLURIFOR.

Collaboration with the PLURIFOR project

In **Castilla y León**, the main collaboration with PLURIFOR would be the creation of a risk management plan for chestnut gall wasp. The national Portuguese plan could be a source of information, and Castilla y León agents are willing to collaborate with them.

Fostering a homogeneous European strategy to manage chestnut gall wasp is another possible collaboration that has been expressed by many interviewed organisations.

Prevention against pests and diseases

No PLURIFOR collaboration detected for this phase.

Surveillance, monitoring and early warning of pests and diseases

- Implement new tools to improve recording, processing and use of data obtained from surveillance and monitoring campaigns (in natural forests as well as in tree nurseries).
- Develop new procedures to monitor chestnut gall wasp in tree nurseries.

Eradication, control and contingency of pests and diseases

- The main collaboration with PLURIFOR, expressed by most of the organisations, would be the development of a methodology to evaluate the parasitism success, in order to optimise the effects of the releases.
- Study the possibility of using other exotic parasitoids, or foster local existing parasitoids for biological control. All biological control aspects should be optimised.

Rehabilitation of affected forest sector by pests and diseases

- Develop a strategy to promote the recovery of badly affected chestnut forests.

EUCALYPTUS WEEVIL

General plan information

In Spain (**Euskadi**, **Cantabria** and **Asturias**) there is no risk management plan for the eucalyptus weevil. In **Cantabria**, there is a Control Plan and Integrated Management Guidelines for the control of eucalyptus weevil. These two documents are very recent and are not approved yet. They represent a strategy of control used as a daily tool for forest management. Forest managers would like them to become part of an integrated risk management plan for this pest. In **Asturias**, control actions, executed by the regional government, are authorised by the Spanish Vegetal health service. In **Portugal**, there are two main risk management plans: a national plan developed by ICNF including prediction and pest control applied regionally and locally, and plans developed by RAIZ and ALTRI Florestal for the corporate forests of these groups and those that are managed by these companies.

Interviewed organisations

There has been a diversity of respondents, including public government bodies, private companies, forest owners associations, industrial associations and research centres (Table 27).

Table 27. Interviewed organisations in charge of the eucalyptus weevil risk management.

Region	Person interviewed	Organisation	Address
Euskadi	Aitor Omar Aspiazu Jefe de Sección de Protección, Experimentación y Mejora	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación de Bizkaia	Avda. Lehendakari Agirre 9, 48014 Bilbao
Cantabria	Javier Espinosa Rubio de la Torre Jefe del Servicio de Montes	Servicio de Montes, Gobierno de Cantabria	
Cantabria	Carlos Tejedor Mardomingo	Asociación Forestal de Cantabria (ASFORCAN)	
Cantabria	María Jesus López Ortega	Asociación Cántabra de Empesarios de la Madera y del Comercio del Mueble (ACEMM)	
Asturias	Eloy Alvarez Ron Responsable Vivero Forestal	Empresa Pública Sociedad de Servicios del Principado de Asturias S.A. (SERPA)	
Asturias	Carlos Tejedor Mardomingo Director Técnico	Bosques 2.000 S.L. (Grupo Sniace)	

Region	Person interviewed	Organisation	Address
Asturias	Isabel Feito Díaz Investigadora	Servicio Regional de Investigación y Desarrollo Agroalimentario (SERIDA)	
Asturias	Ivan Castaño Fernández	Asociación de Propietarios Forestales de Asturias	
Asturias	Alejandro Oliveiros García	Ence - Energía y Celulosa S.A.	
Portugal		Instituto de Investigação da Floresta e Papel (RAIZ)	Eixo, Aveiro
Portugal		ALTRI Florestal SA	Olho Marinho, Furadouro
Portugal		Departamento de Desenvolvimento e Projetos – Associação Florestal de Portugal (FORESTIS)	Rua de Santa Catarina 753, 4000 - 454 Porto
Portugal		Instituto da Conservação da Natureza e das Florestas (ICNF)	Av. da República 16, 1000-141 Lisboa

Territorial scale and risk zones

In **Spanish** regions, if there is a regional plan it is used. However, when there is no plan or regional rules national instructions and rules (from the Ministry of Agriculture and Environment, MAGRAMA) are applied by the regional governments (autonomous communities). It depends on the regional governments for the coordination to be effective.

In **Portugal**, the national plan is developed by ICNF and is applied nationally and regionally. Responsibility for warnings and communications are also with ICNF at the national level and with Organizations, as Forest Associations like FORESTIS, at regional scale. The plans developed by RAIZ and ALTRI Florestal, for the corporate forests are applied nationally and regionally (Table 28).

Table 28. Territorial scales of eucalyptus weevil management plans.

Region	Development scale of the plan	Application scale of the plan
Euskadi	If a plan had existed, it would have been developed at regional scale	If a plan had existed, it would have been applied at regional scale
Cantabria	If a plan had existed, it would have been developed at regional scale	If a plan had existed, it would have been applied at regional scale

Region	Development scale of the plan	Application scale of the plan
Asturias	If a plan had existed, it would have been developed at regional scale	If a plan had existed, it would have been applied at regional scale
Portugal	National scale: eucalyptus weevil risk management plan developed by INCF, with prevention and pest control phases only	The national eucalyptus weevil risk management plan is applied at national and regional scales
Portugal	-	The plans developed by RAIZ and ALTRI Florestal are applied nationally and regionally for the corporate forests of these groups and those that are managed by this company The rehabilitation phase of the plan is only implemented in high altitude areas in central and northern Portugal

According to interviewed organisations in **Cantabria**, the Control Plan and an Integrated Management Guidelines (under approval) could be easily applied in northern Portugal and Northern Spain as both documents are very general, and climatic conditions are very similar.

In Spain (**Cantabria** and **Asturias**), there is no previous characterisation of the region to locate risk zones. There are only some provisional studies that suggest a higher sensitivity of *Eucalyptus globulus* to the eucalyptus weevil at altitudes of more than 300 or 350 m above the sea level. In Asturias there is no characterisation of risk zones as the pest is found in the entire region.

The situation is different in **Portugal**: in the national plan there is a ranking of municipalities according to their risk of attacks by the eucalyptus weevil. One of the objectives is so that forest owners can claim financial help from Rural development program 2020 (PDR2020). Within the municipalities forest technicians identify forest stands with higher risks, but this information is neither systematic nor aggregated. For the forests managed under the RAIZ and ALTRI Florestal groups, there is a risk map, annually updated. Weevil attack zones are mapped, but they are not accurately characterised.

Legislation

In the three **Spanish** regions there is no regional legislation concerning the eucalyptus weevil. There are national and regional legal rules about forest health, and pest and disease control. Consequently, national (through MAGRAMA and developed by the Spanish Vegetal health service) and European legislations apply.

In **Portugal**, there is no specific legislation about the eucalyptus weevil. European legislations apply.

Organisations involved

There are many private organisations involved in the management of the eucalyptus weevil (Table 29), as the extensive eucalyptus plantations have a financial importance for the pulp and paper industry in northern Spain and Portugal (some of these eucalyptus plantations are owned by pulp and paper companies in Portugal). In **Spain**, if there is a lack of regional legislation, each region implements the legal rules developed by the Spanish Vegetal health service, including pest monitoring and control.

Table 29. Organisations involved in eucalyptus weevil risk management.

Organisations involved	Status	Main budget source
Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación de Bizkaia	Public	Regional government
Servicio de Montes, Gobierno de Cantabria	Public	Regional government
Asociación Forestal de Cantabria (ASFORCAN)	Private	Forest owners' contributions
Asociación Cántabra de Empesarios de la Madera y del Comercio del Mueble (ACEMM)	Private	Members' contributions
Empresa Pública Sociedad de Servicios del Principado de Asturias S.A. (SERPA)	Public	Regional government
Bosques 2.000 S.L. (Grupo Sniace)	Private	Private funding
Servicio Regional de Investigación y Desarrollo Agroalimentario (SERIDA)	Public	Regional government
Ence - Energía y Celulosa S.A.	Private	Private funding
Instituto de Investigação da Floresta e Papel (RAIZ)	Private	Private funding
ALTRI Florestal	Private	Private funding
Departamento de Desenvolvimento e Projetos – Associação Florestal de Portugal (FORESTIS)	Private	Forest owners' contributions
Instituto da Conservação da Natureza e das Florestas (ICNF)	Public	EU and state

In **Portugal**, risk management plans for private companies (RAIZ and ALTRI for their forests and other private forests they manage) are well developed and implemented, and their plans cover the four phases of a risk management plan. ICNF is responsible for coordinating information at national, regional and local scales, and for coordinating pest control at national scale with the *Plano operacional de sanidade florestal: plano de controlo para o inseto gonipterus platensis gorgulho-do-eucalipto*. At regional scale, there are the *planos específicos de intervenção florestal*. At local scale, eucalyptus weevil can be managed through the certification processes. Rehabilitation is not considered. According to the ICNF, there are no prediction and rehabilitation phase, just some recommendations at national scale within good practices guidelines. A national risk management plan exists that includes pest monitoring and control phases (Table 30).

Table 30. Roles of the organisations involved in eucalyptus weevil risk management.

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
Servicio de Montes, Gobierno de Cantabria	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	-
ASFORCAN	Design Control of information	Design Control of information	Design Control of information	Design Control of information
ACCEMM	-	-	-	-
SERPA	-	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	-
Bosques 2.000 S.L.	-	Design	Design	-
SERIDA	-	Support	Support	-
Ence - Energía y Celulosa S.A.	-	Design	Design	-
RAIZ and ALTRI	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information
FORESTIS	-	Control of information	Control of information	-
ICNF	-	Design Coordination Execution Support Control of information	-	-

Existing systems

Tools and procedures

These are the general tools and procedures applied in most of the regions or by most of the organisations responsible for eucalyptus weevil risk management. Tools and procedures specific to a single region or organisation are identified.

Prevention against pests and diseases

- Use of eucalyptus species (e.g. *E. nitens*) less sensitive to eucalyptus weevil to replace *E. globulus*. This replacement is mainly done in areas with a presence of eucalyptus weevils and/or with frost risk (*E. nitens* does not grow well in areas with warm summers). Genetically improved breeds of *E. nitens* exist, yielding higher productivity than *E. globulus*.
- More resistant clones of *E. globulus*.
- Preventive silvicultural treatments to enhance tree health: fertilisation, vegetation control, coppice selection, etc.
- Information dissemination to forest managers and forest owners through leaflets, good practice guidelines, and seminars.

Surveillance, monitoring and early warning of pests and diseases

- Surveillance and monitoring network, including visual defoliation measurements, oothecae evaluation, and sampling of the eucalyptus weevil's parasitoid *Anaphes nitens*.
- Risk maps, annually updated, to plan control actions during the following year (RAIZ).
- At the beginning of spring, a more accurate and frequent (every two weeks) survey is done to evaluate how eucalyptus weevil evolves, property by property. The aim is to identify intervention need with chemical control (RAIZ).
- ALTRI has an early warning system to communicate new occurrences of eucalyptus weevil to the ICNF. A new management system to record, map and provide alerts on new foci is being implemented.

Eradication, control and contingency of pests and diseases

- Definition of the intervention areas (from surveillance and monitoring data), development of an action plan with control measures, post-treatment evaluation, and frequent monitoring of the pest within the stands.
- Chemical control: there are two homologated insecticides.
- Biological control.
- Silvicultural treatments, like soil scarification or harrowing to destroy pupae (although it is considered a low impact treatment).
- Fostering natural enemies of eucalyptus weevil.
- Parasitoids (*Anaphes nitens*) releases.
- Kairomone traps (ALTRI, under test).

Rehabilitation of affected forest sector by pests and diseases

- Use of eucalyptus species (as *E. nitens*) less sensitive to eucalyptus weevil to replace *E. globulus*. This replacement is mainly done in areas with an existing eucalyptus weevil

presence and/or with frost risk (*E. nitens* does not grow well in areas with warm summers). Genetically improved breeds of *E. nitens* exist, yielding higher productivity than *E. globulus*.

- In case of severe attacks in young stands, poles are harvested for biomass or chipped and incorporated into the soil. The stand is then replanted with the same species (but with a more thorough treatment), with a resistant species, or reconverted.

Procedures updating

This is how procedures are updated in most of the regions or by most of the organisations responsible for eucalyptus weevil risk management. Procedures updating issues specific to a single region or organisation are identified.

Prevention against pests and diseases

- Research and development programs, public and private.
- RAIZ and ALTRI plans (for their private forests) are updated annually.

Surveillance, monitoring and early warning of pests and diseases

- Annually updated according to the results of previous surveillance and monitoring campaigns.
- Research and development programs, public and private.
- RAIZ and ALTRI plans (for their private forests) are updated annually.
- ICNF plan is updated biannually.

Eradication, control and contingency of pests and diseases

- Annual monitoring of eucalyptus weevil control measures and silvicultural treatments to evaluate their efficiency.
- Research and development programs, public and private.
- RAIZ and ALTRI plans (for their private forests) are updated annually.

Rehabilitation of affected forest sector by pests and diseases

RAIZ and ALTRI plans (for their private forests) are updated annually.

Personnel coordination

In **Spain**, because regions (autonomous communities) lack a risk management plan for eucalyptus weevil, it has to be coordinated between the Spanish Vegetal health service (in the MAGRAMA), who dictates the rules and the instructions, and the regional administrative bodies responsible for forest management. Ultimately, coordination of personnel is done by the regional government.

In **Asturias**, according to the company Bosques 2.000 S.L., there is a lack of coordination between researchers, between the research sector and the private forest sector, and also between the latter and public administrative bodies.

Prevention against pests and diseases

In **Asturias**, the Spanish Vegetal health service coordinates and disseminates information about eucalyptus weevils. There is no continuous communication from the International Co-operative

Programme (ICP) forest monitoring network and consequently damage events are evaluated and communicated after a long delay.

Surveillance, monitoring and early warning of pests and diseases

In **Spain**, the Spanish Vegetal health service coordinates health inspections in tree nurseries and surveillance and monitoring in forest stands. This is done by regional forest agents. The results are transmitted to the Vegetal health service. There is no continuous communication from the International Co-operative Programme (ICP) forest monitoring network, consequently damage events are evaluated and communicated after a long delay.

In **Portugal**, timber producers, forest companies, and forest managers are responsible for plan implementation. Forest owners associations give support to their members for this implementation. ICNF issues warnings about eucalyptus weevil attacks to forest owners at national and regional scales. ALTRI and RAIZ have an early warning system to communicate new occurrences of eucalyptus weevils in its corporate forests to the ICNF. The ICNF has the ultimate responsibility for recommending the appropriate action to take when the presence of eucalyptus weevils is reported by forest technicians. The ICNF working group meets twice or three times a year to do any necessary update.

Eradication, control and contingency of pests and diseases

In **Spain**, the Spanish Vegetal health service coordinates pest control actions. They are executed by different entities, depending on the forest concerned. However, these actions are barely coordinated.

In **Portugal**, RAIZ has a network of stakeholders that are contacted when eucalyptus weevil control measures are carried out, especially when they use insecticides. ICNF has a role in information control between forest owners and companies that execute control treatments. The ICNF working group meets twice or three times a year to do any necessary update.

Rehabilitation of affected forest sector by pests and diseases

There is no coordination in rehabilitation.

Past events recording

Prevention against pests and diseases

In **Cantabria**, eucalyptus planted stands are mapped with a GIS. In **Asturias**, there a database with preventive actions, but it has no public access. In **Portugal**, ALTRI and RAIZ have a risk map with the past attacks of eucalyptus weevil for its corporate forests. This is the only preventive information recorded in Portugal.

Surveillance, monitoring and early warning of pests and diseases

In **Spain**, eucalyptus weevil attacks are registered in a georeferenced database managed by the Vegetal health service.

In **Portugal**, during spring, detailed information about eucalyptus health is gathered in the ALTRI and RAIZ corporate forests to evaluate the needs for pest control. This information is recorded in a

georeferenced database and transmitted to the immediate superior and to the Portuguese Vegetal health service. In private forests, according to FORESTIS, surveillance and monitoring surveys are neither homogeneous nor systematic, so it is very difficult to compare information gathered by different organisations and to build a coherent database.

Eradication, control and contingency of pests and diseases

In **Spain**, eucalyptus weevil control measures are registered in a georeferenced database managed by the Vegetal health service. RAIZ, in **Portugal**, has a similar database. However, there is not an aggregate database for private forests: each forest management organisation has its own, even for certified forest.

Rehabilitation of affected forest sector by pests and diseases

There are no records about rehabilitation actions, except for an internal database for the whole corporate forests of The Navigator Company.

Strengths and weaknesses analysis

Evaluation of the eucalyptus weevil risk management plans

In **Spain**, the most common situation is an annual evaluation of the forest health state related to eucalyptus weevils and an evaluation of the efficiency of the control measures. The analysis of these results could be used to annually evaluate the risk management plan or any similar management instrument.

In **Portugal**, in certified forests contingency plans for pests are reviewed every five years or more often if it is justified. The ICNF national risk management plan is evaluated every two years.

There is no evaluation of the rehabilitation phase, as it does not exist in the risk management plans.

Strengths

In **Cantabria**, ASFORCAN appreciated the Control Plan and the Integrated Management Guidelines for the control of eucalyptus weevil that have been recently developed (they are currently under authorisation). In **Asturias**, according to SERIDA, information transfer systems are a strength in the region.

According to RAIZ (**Portugal**), there are different organisations at the Iberian scale, public and private, that are focused on fighting eucalyptus weevils. This makes possible synergies for prevention, monitoring, pest control and research.

Prevention against pests and diseases

Cantabria: less sensitive species and silvicultural treatments that decrease the possibilities of eucalyptus weevils entering a new area.

Surveillance, monitoring and early warning of pests and diseases

In **Spain**, surveillance and monitoring network, including the ICP forest monitoring network.

Portugal: specialised knowledge about eucalyptus weevil for its prevention, monitoring and control.

Eradication, control and contingency of pests and diseases

The most appreciated strength in eucalyptus weevil control is the possibility of integrated control, combining insecticides with biological control. Forest manager know which control treatments are most suitable for each situation.

Portugal: specialised knowledge about eucalyptus weevil for its prevention, monitoring and control.

Rehabilitation of affected forest sector by pests and diseases

The most appreciated strength in rehabilitating forest stands severely affected by eucalyptus weevil is the plantation of resistant species such as *E. nitens*.

Weaknesses

A general weakness in **Spain** and in **Portugal** is the poor integration of all actions undertaken for prevention, prediction and pest control. There is a territorial discontinuity in the implementation of actions.

A common weakness in **Spain** is the lack of communication between organisations involved in managing eucalyptus weevils. There is poor communication with forest owners for training, the current situation of the pest, warnings, control measures, etc. There is a need for better connection between the research sector and final users to achieve more efficient technology transfer. In **Asturias**, according to Bosques 2.000 S.L., there is a lack of coordination between researchers, between the research sector and the private forest sector, and also between the latter and public administrative bodies. In **Cantabria**, the implementation of the new Control Plan and Integrated Management Guidelines could fail if there are not enough funds. Similarly, some good initiatives such as the evaluation of new eucalyptus clones lack institutional support.

Prevention against pests and diseases

No more specific prevention weaknesses.

Surveillance, monitoring and early warning of pests and diseases

In **Spain**, there is no continuous communication of monitoring information from the International Co-operative Programme (ICP) forest monitoring network (ICP network could support and complement regional monitoring networks). Consequently, damage events are evaluated and communicated after a long delay. In **Asturias**, the regional monitoring network is insufficiently funded for eucalyptus and the information it generates does not reach the forestry sector, or reaches it too late.

Eradication, control and contingency of pests and diseases

In **Asturias**, in some cases, the eucalyptus weevil's parasitoid releases have not had significant effects yet. Insecticides are the only efficient treatment for severely infested stands.

In **Portugal**, the development of more efficient control measures is slow, especially the biological control and the identification of eucalyptus breeds more resistant, or even tolerant, to the eucalyptus weevil.

Rehabilitation of affected forest sector by pests and diseases

Generally, there are not planned rehabilitation actions. Where they exist they are usually poorly funded.

Potential for improvement

Improvements and updates

Improvements and updates proposed by interviewed organisations have been numerous. In this section are listed those that will not be considered for collaboration within the PLURIFOR project:

Prevention against pests and diseases

- Enhance communication and coordination between organisations responsible for eucalyptus weevil risk management, both public and private.
- Enhance information transfer to forest owners concerning the state of the pest, preventive measures, and provide more training. This could imply transferring prevention knowledge and tools from corporate forests to forest owners associations.
- Apply Cantabria's pest and diseases risk management plan in Asturias (Asturian eucalyptus stakeholders are interested).
- Evaluate the long term sustainability of actions against the eucalyptus weevil.

Surveillance, monitoring and early warning of pests and diseases

- Enhance information transfer to forest owners concerning monitoring of the pest and provide more training for forest owners. Develop and implement an early warning system allowing forest owners to communicate new foci and to receive eucalyptus weevil presence warnings.
- Reduce the time delay between the moment when the measures in ICP forest monitoring network are taken and the moment when they are communicated to eucalyptus weevil risk managers.
- Extend the prevention plan used in corporate forests to the rest of the forests of the Iberian Peninsula, so that it becomes an international prevention plan.
- Increase the budget for surveillance and monitoring of eucalyptus weevil.

Eradication, control and contingency of pests and diseases

- Extend control of eucalyptus weevil in all areas of the Iberian Peninsula growing eucalyptus.
- Approve more pesticides for the chemical control of the eucalyptus weevil.
- Develop new tools for the application of insecticides (e.g. drones).
- Study the implementation of new biological control agents.
- At a national scale give priority for control of eucalyptus weevil in the most productive areas.
- Increase funding for control plans, especially in the most productive areas.

Rehabilitation of affected forest sector by pests and diseases

All rehabilitation proposals can be developed within the PLURIFOR project. They should be integrated into the rehabilitation phase (which also needs to be created) of an international eucalyptus weevil risk management plan.

Collaboration within the PLURIFOR project

The following improvements have been retained for development by PLURIFOR. In each phase proposals are listed in decreasing order of priority, as set by the interviewed organisations:

Prevention against pests and diseases

- Improve existing risk maps (forest companies such as ALTRI already have them for their properties) so they can be used as a model to forecast eucalyptus weevil activity: e.g., have the capacity to forecast the location and severity of eucalyptus weevil attacks for the coming year as early as January.
- Improve the production and release methods of already available parasitoids (e.g. *Anaphes inexpectatus* and *A. nitens*) for biological control, and study the use of new parasitoids. Some projects already exist; they could be enhanced or tested in real conditions.
- Gather existing preventive tools or preventive silvicultural regimes or develop new ones that make eucalyptus more resistant to eucalyptus weevils or the ecosystem less favourable to the pest, and disseminate them among practitioners.
- Develop awareness campaigns, information dissemination, and knowledge transfer to forest owners and practitioners. Bring support to forest managers in areas where there is no legislation.
- Develop a processes based model to model volume growth loss according to defoliation.

Surveillance, monitoring and early warning of pests and diseases

- Foster studies about the evaluation of eucalyptus weevil attacks. Develop methods to estimate the intensity of the attacks (mainly defoliation) that are accurate and easy to implement, and that could be incorporated into the decision making process. CETEMAS is already working on this type of evaluation, specifically with UAVs (drones).
- Develop an early warning plan. Define a communication network between different organisations involved in the risk management plan, and improve existing communications. Transfer monitoring information from corporate forests to private forest owner and public forests. Implement an early warning system where any forest owner could communicate any eucalyptus weevil outbreak.
- Develop and implement processes based models such as the one that is already working to estimate the evolution of the pest as a function of the temperature and degree-days. This could be useful for warning systems. Some data for these models could be obtained from corporate forests.
- Standardise the criteria used for the whole Iberian Peninsula for surveillance and monitoring. Compare the monitoring systems and produce a single system that could be used internationally. Train technicians to use this system.
- Enhance or implement a permanent network of monitoring traps to detect the first weevils and proceed to the control measures, and to evaluate the evolution of the pest and of its

parasitoid. This network should be implemented internationally. The information generated would be useful to feed the models. Some measures have already been taken but not frequently enough.

- Improve the knowledge of the evolution of the pest by analysing forest survey data to better quantify and qualify the affected area. Link there results to a model of volume growth loss.

Eradication, control and contingency of pests and diseases

- Improve biotechnical control through mass capture with pheromones or kairomone traps.
- Improve the production and release methods of the already available parasitoids (e.g. *Anaphes inexpectatus* and *A. nitens*) for biological control, and study the use of new parasitoids. Some projects already exist. They could be enhanced or tested in real conditions.
- Develop economical cost-benefit models to uniformly evaluate the economic cost of eucalyptus weevil attacks and the applied control measures.
- Produce national and international guidelines for eucalyptus weevil management in private forests.

Rehabilitation of affected forest sector by pests and diseases

Rehabilitation plans do not exist and they should be created. The following points could be developed by PLURIFOR and incorporated into the plan:

- Pursue genetic improvements of different eucalyptus species to create breeds resistant to eucalyptus weevil while featuring desirable productivity and technological characteristics. They could be used in rehabilitating affected zones.
- Rehabilitation plans do not exist. They should be created internationally. They would include instructions on how to manage severely attacked forests and how to rehabilitate the site to continue with timber production, if this is possible.
- Develop new forest management procedures to improve the potential of timber production after the salvage logging of an infested stand.

PITCH CANKER

General plan information

Cantabria has no risk management plan for pitch canker. **Portugal**, since 2010, has one that includes three phases: prevention, prediction, and disease control. Cantabria's answers concern only the potential for improving the management of this risk. The next sections feature only the answers about the Portuguese plan.

Interviewed organisations

Two public organisations have been interviewed (Table 31).

Table 31. Interviewed organisations in charge of the pitch canker risk management.

Region	Person interviewed	Organisation	Address
Cantabria	Milagros de Vallejo Sancho de Sopranis Sección de Producción y Mejora Forestal	Servicio de Montes, Dirección General de Biodiversidad, Montes y Conservación de la Naturaleza	Atilano Rodríguez 5, 39002 Santander,
Portugal		Instituto da Conservação da Natureza e das Florestas (ICNF)	Avenida da República, 16 a 16B, 1050-191 Lisboa

Territorial scale and risk zones

In **Cantabria** there is no risk management plan for pests and diseases. National and regional rules exist to regulate this disease.

The **Portuguese** pitch canker risk management plan has been developed at a national scale and is applied also at a national scale.

In both regions, the pitch canker risk is not mapped, but major risk areas or hotspots are known: garden centres, facilities that produce reproductive material (tree nurseries, seed orchards and seedling orchards), and pine tree stands. In **Cantabria**, some studies point that pitch canker is more prevalent near the coast and in pruned pine stands because of infections caused by wounds.

Legislation

In **Cantabria**, as there is no risk management plan for this disease, all decisions are taken based on the current legislation. Main laws are listed in the regional report.

In **Portugal**, a national law applies: Portaria n.º 294/2013, de 27 de setembro. D.R. n.º 187, Série I. It establishes extraordinary phytosanitary protection measures to prevent the introduction and

dissemination of the fungus *Gibberella circinata* (Nirenberg & O'Donnell; also known as *Fusarium circinatum* in its anamorph form) in Portugal.

Organisations involved

In **Cantabria**, the main organisation involved in managing pitch canker risk is the Government of Cantabria. The Asociación Forestal de Cantabria (ASFORCAN) and the Asociación Cántabra de Empresarios de la Madera y del Comercio del Mueble (ACEMM) also collaborate.

The national pitch canker risk management plan has been implemented in **Portugal** by the Instituto da Conservação da Natureza e das Florestas (ICNF) since 2010. The ICNF is a public organisation mainly financed by the European Union and the Portuguese state.

As the major actor in pitch canker risk management, the ICNF assumes all tasks in prevention, prediction and disease control (Table 32). No rehabilitation phase exists.

Table 32. Roles of the organisations involved in pitch canker risk management.

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
Government of Cantabria	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	-
Instituto da Conservação da Natureza e das Florestas (ICNF)	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	Design Coordination Execution Support Control of information	-

Existing systems

Tools and procedures

Prevention against pests and diseases

- Delivering of a phytosanitary passport for host plants and seeds in circulation.
- Early diagnostic in seeds and plants in tree nurseries.
- Awareness actions (through leaflets) and training to disseminate knowledge about propagation methods of the pitch canker fungus and about the symptoms.
- Planting less susceptible tree species.

Surveillance, monitoring and early warning of pests and diseases

In **Cantabria**, the monitoring network is the ICP Forests plots.

In **Portugal**, the ICNF has a five-step protocol for surveillance of infested plants: observation of host plants, sampling those with symptoms, laboratory analysis for pathogen identification, communication of the results, and recording of these results. This protocol is executed annually in major risk areas or hotspots: garden centres, facilities that produce reproductive material (tree nurseries, seed orchards and seedling orchards; before their commercialisation), and pine tree stands.

In garden centres and facilities that produce reproductive material each lot is sampled and analysed before being sold. All producers are listed in a national record and are inspected every three or five years. However, those that are located in the 20 km wide buffer strip along the Spanish border are inspected annually.

In forest stands and young plantations monitoring is done systematically in sample plots located on a 2 x 2 km national grid (already used for the national forest inventory and also for monitoring the pine wood nematode) in forest stands with the tree host species (*Pinus* and *Pseudotsuga* genera). Areas of special sensitivity take priority.

Other tools are:

- three certified quarantine laboratories for the identification of organisms,
- the database Sistema de informação FITO that records surveillance and monitoring actions and analysis results. A surveillance and monitoring report is issued every six months.
- 18 vegetal material inspectors and 28 year-round assistants.

Eradication, control and contingency of pests and diseases

In **Cantabria** and **Portugal**, when the pitch canker fungus is detected a demarcated area is established. It is composed of an infested zone and a buffer zone. The buffer zones is at least 1 km wide around the infested zone.

The main control measure is the destruction of symptomatic seeds, seedlings, plants and trees within the infested zone. For the rest of the host plant species without symptoms and within the demarcated area a two-year quarantine is applied. During this period their movement is forbidden and they are intensively monitored and sampled.

Rehabilitation of affected forest sector by pests and diseases

No rehabilitation tasks are executed.

Procedures updating

In **Portugal**, since 2016 the pitch canker risk management plan has a validity of five years. However, any update can be introduced when it is judged necessary. The plan was developed in collaboration with the Instituto Nacional de Investigação Agrária e Veterinária (INIAV) and the last update was done in collaboration with the INIAV and the Direção Geral de Alimentação e Veterinária (DGAV).

Personnel coordination

In **Cantabria**, personnel coordination is the responsibility of the Government of Cantabria, through the Sección de Sanidad Vegetal and the Sección de Producción y Mejora Forestal.

In **Portugal**, the Grupo de Acompanhamento de Sanidade Florestal (GASF; formed by public and private organisation) meets once or twice a year to update contact lists and introduce any needed modification to the plan.

Past events recording

In **Cantabria**, the main tools to record past events are GIS (for prevention and eradication) and the ICP Forests database (for monitoring). They are only accessible for public forests.

In **Portugal**, the ICNF is responsible for maintaining a database, called Sistema de informação FITO, where surveillance and monitoring actions and analysis results are recorded. A surveillance and monitoring report is issued every six months.

Strengths and weaknesses analysis

Evaluation of the pitch canker risk management plans

The periodicity of the evaluation of the pitch canker risk management plan is considered adequate by the ICNF (**Portugal**).

Strengths

In both regions, legislation is judged to be rigorous and exhaustive.

In **Portugal**, main strengths are the prevention in tree nurseries, and the destruction of infested plants and the establishment of the buffer zone.

Weaknesses

In **Cantabria**, there is a lack of communication with the private forest owner for information about the disease, alerts, training and measures to take.

In **Portugal**, main weaknesses are all related to improvements that could ease or accelerate the prevention and the prevision of this disease: better diagnostic systems in forest, disinfection methods for tree nurseries, early warning through spore traps, etc.

In both cases, there is a lack of strategies for rehabilitate the affected area.

Potential for improvement

Improvements and updates

Improvements and updates proposed by interviewed organisations from **Cantabria** and from **Portugal** have been numerous. In this section are listed those that will not be considered for collaboration with the PLURIFOR project:

Prevention against pests and diseases

- It has not been shown that the transport of vegetal material from demarcated areas is responsible for spreading pitch canker to new zones. Transport rules from demarcated areas are very difficult to respect and they need to be more flexible.

Surveillance, monitoring and early warning of pests and diseases

No improvements other than those that could be developed by PLURIFOR.

Eradication, control and contingency of pests and diseases

- In **Portugal**, forest owners are requested to pay for the laboratory analyses to detect the presence of pitch canker fungus, and there is no financial support for those that need to destroy infested material on their property at their own expense. Compensatory measures should be implemented for laboratory analyses and vegetal material destruction.

Rehabilitation of affected forest sector by pests and diseases

No improvements other than those that could be developed by PLURIFOR.

Collaboration with the PLURIFOR project

The following improvements from **Cantabria** and from **Portugal** have been retained for development by PLURIFOR. In each phase, proposals are listed in decreasing order of priority, as set by the interviewed organisations:

Prevention against pests and diseases

New tools:

- Methods for the disinfection of seeds, containers and vegetal production tools and facilities.
- Risk maps.
- Fast detection by aerial images (drones).

New procedures:

- It is necessary to have access to fast growing and productive softwood tree species free of pitch canker. Procedures must be established to guarantee that available reproductive material (including seeds) is free of disease.
- Define a communication network to share information between the different organisations involved in the pitch canker risk management plan and improve the coordination between them, including forest owners.
- Procedures to build a risk map.

Surveillance, monitoring and early warning of pests and diseases**New tools:**

- Methods for early detection in the field based on fungal spores traps.
- Faster methods for the diagnosis of infected vegetal material.

New procedures:

- Define a communication network to share information between the different organisations involved in the pitch canker risk management plan and improve the coordination between them.
- Implement an early warning system that integrates a set of components leading to the application of preventive and pest control measures in order to avoid the introduction, the dispersion, or the population increase of pests and diseases at the national scale. This system should apply to public and private organisations.

Eradication, control and contingency of pests and diseases

- To enhance the chances of eradication, legislation must ease the quick extraction of infested timber from the forests. The use of this timber to produce pellets would be appropriate, as the risk of infection is practically inexistent and would help financing forests operations.

Rehabilitation of affected forest sector by pests and diseases

- Develop a rehabilitation plan for effected forest areas according to their typology. Some suggestions are the introduction of new pine species, or pine species or breeds that are not sensitive to the pitch canker fungus.

EMERGING PESTS AND DISEASES

General plan information

Both **Euskadi** and **Portugal** have a risk management plan to deal with emerging pests and diseases. **Aquitaine** has none.

In **Portugal**, for pests and diseases not present in the country for which the European Commission requires risk management plans, these plans are at their final approval phase and will be implemented shortly. They cover mainly eradication, control and contingency measures.

In **Portugal**, forest companies that manage corporate forests, like RAIZ and ALTRI, have their own internal risk management plan to deal with emerging pests and diseases, covering mainly surveillance, monitoring and eradication, while ICNF does a similar task for the rest of the forests and other risk areas, through its Forest Health section. The former have to report new detections to the latter.

Interviewed organisations

In **Nouvelle-Aquitaine** and in **Euskadi**, interviewed organisations are mostly regional public administrations in charge of forest and agriculture, while in **Portugal** there is a diversity of public and private entities (Table 33).

Table 33. Interviewed organisations in charge of the emerging pests and diseases risk management.

Region	Person interviewed	Organisation	Address
Nouvelle-Aquitaine	Dominique Piou	Département de la santé des forêts (DSF) – Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt	251 rue de Vaugirard, 75732 Paris cedex 15
Euskadi	Carlos Uriagereka Jefe del Servicio de Montes	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación de Bizkaia	Avda. Lehendakari Agirre 9, 48014 Bilbao
Euskadi	Aitor Omar Aspiazu Jefe de Sección de Protección, Experimentación y Mejora	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación de Bizkaia	Avda. Lehendakari Agirre 9, 48014 Bilbao

Region	Person interviewed	Organisation	Address
Euskadi	Ismael Mondragón Laskurain Jefe del Servicio de Montes y Gestión de Hábitats	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación de Gipuzkoa	Plaza Gipuzkoa s/n, 20004 San Sebastián
Euskadi	Ibai Portu Zuloaga Jefe del Servicio Montes	Servicio de Montes, Departamento de Sostenibilidad y Medio Natural – Diputación Foral de Araba	Plaza de la Provincia 4, 1º izq., 01001 Vitoria-Gasteiz
Euskadi	Iñaki Etxebeste Larrañaga Independent consultant and researcher	Independent consultant and researcher	-
Portugal	Dina Ribeiro	Instituto da Conservação da Natureza e das Florestas (ICNF)	Av. da República 16, 1000-141 Lisboa
Portugal	Ricardo Marinho	Departamento de Desenvolvimento e Projetos – Associação Florestal de Portugal (FORESTIS)	Rua de Santa Catarina 753, 4000 - 454 Porto
Portugal	Ana Raquel Reis	ALTRI group	Olho Marinho, Furadouro
Portugal	Carlos Valente	Instituto de Investigação da Floresta e Papel (RAIZ)	Eixo, Aveiro

Territorial scale and risk zones

Risk management plans for emerging pests and diseases are developed at national scale following the norms of the European Union (EU) and the European and Mediterranean Plant Protection Organization (EPPO), especially about cautions and restrictions with species listed as potentially invasive or with an expansion risk in the European territory. These plans are applied at national, regional, and local scales.

In **Portugal**, the ICNF is the responsible organisation for developing the national risk management plan, and phytosanitary inspectors apply it nationally and regionally. In **Euskadi**, provincial governments develop, implement and fund the national plan at the regional scale to reduce the risk of introduction and dispersal of new pests and diseases. The information generated is transmitted to the national coordination entity.

In **Euskadi**, regionally financed projects survey and monitor emerging pests and diseases. In **Portugal**, RAIZ has a characterisation of the region to locate risk zones within its corporate forests.

Legislation

Legal rules about emerging pests and diseases cover the four phases of a risk management plan, except for **Portugal**, where there are no set of rules for rehabilitation (Table 34). Prevention and prediction rules mainly focus on phytosanitary controls and quarantine measures in plant trade. Pests and disease control rules and **Basque** rehabilitation rules exist to subsidise pest and disease eradication tasks and forest recovery measures for affected stands. National and regional legislation is detailed in each regional report. **Nouvelle-Aquitaine** uses the European Commission legislation to manage emerging pests and diseases.

Table 34. Phases covered by the present emerging pests and diseases risk legislation.

Phases of risk management	Regions with rules existing
Prevention	Euskadi, Portugal
Prediction	Euskadi, Portugal
Crisis management	Euskadi, Portugal
Rehabilitation	Euskadi

Organisations involved

In **Nouvelle-Aquitaine**, the DSF and, in **Portugal**, the ICNF are at the highest decisional level about emerging pests and diseases. FORESTIS is a national forest owners association, and ALTRI and RAIZ are the two major forest companies in the country (Table 35). Of these, only the ICNF play a role in the design and the execution of risk management plans against emerging pests and diseases (Table 36). In **Euskadi**, the Basque government plays a role in the coordination, support and control of information, while the execution of the plan is the responsibility of the provincial governments.

Table 35. Organisations involved in emerging pests and diseases risk management.

Organisations involved in management plan creation	Status	Main budget source
Département de la santé des forêts (DSF)	Public	State
Eusko Jauraritza (Basque government)	Public	Regional government
Instituto da Conservação da Natureza e das Florestas (ICNF)	Public	EU and state
Organisations involved in management plan execution	Status	Main budget source
Servicio de Montes, Diputaciones Forales de Bizkaia, Gipuzkoa and Araba	Public	Municipalities
Instituto da Conservação da Natureza e das Florestas (ICNF)	Public	EU and state
ALTRI group	Private	Private funding

Organisations involved in management plan creation	Status	Main budget source
Instituto de Investigação da Floresta e Papel (RAIZ)	Private	Private funding

Table 36. Roles of the organisations involved in emerging pests and diseases risk management.

Organisation	Prevention	Prediction	Crisis management	Rehabilitation
DSF	-	-	-	-
Basque government	Coordination Control of information	Support (research)	Control of information	Control of information
Diputaciones Forales	Execution Support (funding)	-	Execution Support (funding)	Execution Support (funding)
ICNF	Design Coordination Execution Control of information	Design Coordination Execution Control of information	Design Coordination Execution Control of information	Design Coordination Execution Control of information
FORESTIS	-	-	-	-
ALTRI	Support Control of information	Support Control of information	Support Control of information	Support Control of information
RAIZ	Support Control of information	Support Control of information	Support Control of information	Support Control of information

Existing systems

Tools and procedures

The main tool used in **Nouvelle-Aquitaine** (and in France) for the management of any pest and disease is the *Guide de gestion des forêts en crise sanitaire* (Gauquelin *et al.* 2010). It is an integrated scheme for decision making to manage any phytosanitary crisis. Monitoring plans exist to follow the European directive for pine wood nematode, pin, *Xylella fastidiosa*, *Fusarium circinatum* and *Anaplophora glabripennis*.

In **Portugal**, some contingency plans exist for quarantine pests and diseases such as *Hymenoscyphus fraxineus*, *Anoplophora chinensis*, *Anoplophora glabripennis*, *Phytophthora ramorum* and *Thaumastocoris peregrinus*. Currently, a new forest management system to oversee this risk, including a warning system and mapping of new foci is under implementation.

Prevention, surveillance, monitoring and early warning of pests and diseases

Legislation controls the production and import of vegetal material (including timber). Different procedures exist when prevention is done for imported material at border customs or in forest stands.

Customs at ports of entry:

- A network of national (in **Nouvelle-Aquitaine** and **Portugal**) and regional (in **Euskadi** and **Portugal**) forest and agricultural sector phytosanitary inspectors enforces the law through the inspection of imported vegetal material at ports of entry. Inspection is compulsory for a list of species. Vegetal material cannot be cleared without inspection. If infested material is detected the lot cannot enter the country without having passed a quarantine period. If judged necessary its destruction can be imposed.
- In **Euskadi**, the regional administration has no access to the phytosanitary registry at the Basque ports of entry (for vegetal material imported from outside the EU) because this inspection is done by the Spanish Custom surveillance service.
- More intensive inspections are done in garden centres and tree nurseries, in areas around ports of entry, and in seed orchards.
- When inspecting vegetal material, compulsory quarantine can be enforced for suspect or sensitive vegetal material. Importers pay for the inspection and for the quarantine.
- Issuance of a phytosanitary passport for host plants and seeds in circulation.
- Compulsory rules demand extreme caution when importing seeds, plants, biological control agents or wood. For example, importing chipped wood to reduce the chance of pest survival or to avoid importing timber from high risk areas.
- European directive defines the methodology and the sampling effort for emerging pests and diseases surveillance and monitoring.
- Support from international organisations, such as the International Plant Protection Convention (IPPC) or the European and Mediterranean Plant Protection Organisation (EPPO).

In forest stands:

- Regular surveys are conducted to detect the presence of already established pests and diseases, according to national and regional plans. In **Euskadi**, even if these surveys can detect emerging pests and diseases, this information is neither recorded at the regional level nor at the national level. In **Portugal**, any new pest or disease should be sent to the ICNF.
- For **Portuguese** corporate forests their phytosanitary state is permanently monitored: through scheduled surveys by forest technicians or by a specific survey when a phytosanitary problem has been detected by another means. When monitoring forest stands health if emerging pests and diseases are found the level of damage is also evaluated and georeferenced. This information is transferred to the hierarchical superior and to the Forest Health section of the ICNF (RAIZ, for forests of the ALTRI group and the Navigator Company).
- When inspecting vegetal material, compulsory quarantine can be enforced for sensitive vegetal material. It has to be respected by importers, producers, sellers and forest owners.

In both cases:

- Identification of suspect material is done by national laboratories (INIAV and DGAV in **Portugal**) that also have quarantine facilities.
- National and regional administrations play a crucial role by funding research programs about emerging pests and diseases.

Eradication, control and contingency of pests and diseases

- If the presence of an organism requiring quarantine is detected, the authorities can force the owners of the vegetal material to execute control measures such as phytosanitary treatments, felling of infested trees, or destruction of the vegetal material, as stipulated by compulsory contingency plans under European directive. These tasks are controlled by phytosanitary inspectors.
- In **Euskadi**, eradication actions in forest stands (private or public) are subsidised by the government, whereas in **Portugal**, the cost of these compulsory measures are assumed by the owner of the infested material.
- Chemical, biological or genetic control measures exist and are applied, according to the action plan developed for the situation.

Rehabilitation of affected forest sector by pests and diseases

- In **Nouvelle-Aquitaine**, the French forest code forces a forest area to remain forested, but there are no particular recommendations when dealing with stands affected by pests and diseases and their eradication measures.
- In **Euskadi**, rehabilitation actions in forest stands (private or public) affected by emerging pests and diseases are subsidised by the government.

No rehabilitation tasks or subsidies exist in **Portugal**.

Procedures updating

In **Euskadi**, there is no specific approach to update the risk management plan. In **Portugal**, the national emerging pests and diseases risk management plan is reviewed and updated every five years by the ICNF. The Grupo de Acompanhamento de Sanidade Florestal (GASF; formed by public and private organisation) meets annually to discuss plan updating and modifications to be introduced. RAIZ updates its phytosanitary plan (with which it detects emerging pests and diseases) annually.

In research, some invasive species have their own scientific forums (like the pine wood nematode). However, some emerging pests and diseases (such as exotic bark and wood beetles) are treated along with native pests. Research results are published in scientific journals or disseminated through congresses and meetings covering subjects other than just emerging pests and diseases.

Personnel coordination

In **Euskadi**, the Basque government coordinates the Mesa de sanidad forestal de la Comunidad Autónoma del País Vasco, a group involving forest institutions and stakeholders representation, in order to manage forest phytosanitary issues. In **Portugal**, regional phytosanitary inspectors are nationally coordinated by the ICNF and the DGAV. In RAIZ, technical teams are coordinated according

to the content of the Operation Plan of forest health. National contact lists are updated once or twice a year by the GASF.

Past events recording

In **Portugal**, RAIZ has an internal database where new detected pests and diseases are recorded, as well as applied control measures. This information (detection and control measures) is communicated to the DGAV and to the scientific community. The ICNF receives the surveillance and monitoring campaign reports from phytosanitary inspector, which are transferred yearly to the DGAV and the European Commission. However, these reports are not collected in a database. Similarly, in **Euskadi**, recorded information about emerging pests and diseases is recorded at the Mesa de sanidad forestal de la Comunidad Autónoma del País Vasco meeting minutes, but no database exists. Actions are not tracked to their conclusion.

PEFC certified forests must provide a report when pests and diseases are reported.

Strengths and weaknesses analysis

Evaluation of the emerging pests risk management plans

Interviewed organisations are not aware of any evaluation of the emerging pests and diseases risk management plans or any related instructions.

Strengths

A common strength is the existence of European legislation about emerging pests and diseases and the national and regional public entities that apply it. Strengths are different between Euskadi and Portugal. In **Euskadi**:

- Participation and interest of the private forest sector in forest health.
- In Euskadi, there is a good institutional coordination thanks to the Mesa de sanidad forestal de la Comunidad Autónoma del País Vasco, where public and private organisations participate.
- Annual funds to allow possible actions against emerging pests and diseases.
- Specific research, innovation and development projects on emerging pests and diseases permanently funded by the region.

Strengths in **Portugal** are:

- Legislation that regulates the vegetal materials that have to be inspected and preventive actions carried out including the destruction of suspect seeds or plants.
- The network of national and regional phytosanitary inspectors.
- RAIZ in Portugal has a permanent evaluation system in corporate forests that allows the detection of new pests and diseases. Resources can be quickly allocated to the evaluation of emerging problems.

Weaknesses

General weaknesses are:

- Even if phytosanitary inspectors report their activities, there is no method to record and handle this information, neither at national scale nor at regional, so that it could be used to detect patterns and foresee or improve future interventions.
- Difficulties in the participation, coordination, and articulation between stakeholders, including private companies, forest owners associations and citizens for prevention, early detection and eradication of emerging pests and diseases at the national level. The lack of transparency and information transfer between states at the international level.
- Lack of anticipation of emerging pests and disease when surveying and monitoring.

Weaknesses in **Nouvelle-Aquitaine** are:

- Problems can arise when there are big forested areas to be treated with eradication measures such as the clearcuts around infested plants.
- Clearcuts around an infestation focus as an eradication measure do not have a precise radius.
- Tree nurseries and garden centres are the weakest link (for their potential for large-scale introduction and spread), even though these are the locations where eradication of emerging pests and diseases is the easiest.

Weaknesses in **Euskadi** are:

- A lack of planning to monitor emerging pests and diseases.
- Lack of coordination with regions (autonomous communities) bordering Euskadi.

Weaknesses in **Portugal** are:

- Legal measures exist for the destruction of contaminated material but no legal rules exist for the eradication of new pests and diseases if they are detected in public or private forests.
- For RAIZ, there are difficulties to quickly implement biological control for new pests and diseases due to legal restrictions.

Potential for improvement

Improvements and updates

General improvements in all regions are:

- The creation of a standardised registry of public data to record prevention, surveillance, monitoring, eradication, control, and contingency actions concerning emerging pests and diseases.
- The creation of an interregional working group to evaluate emerging pests and disease data at national and international scales.
- Setting priorities for prevention and control of emerging pests and diseases as a function of their risk of introduction and spread.

In France (**Nouvelle-Aquitaine**), the *Guide de gestion des forêts en crise sanitaire* (Gauquelin *et al.* 2010) should be adapted to emerging pests and diseases, and an on-line version should be published.

Prevention against pests and diseases

- Analyse reports from phytosanitary inspections to detect patterns in emerging pests and diseases and foresee high risk situations and improve future interventions. Some variables to predict risk could be type of vegetal material, region of origin, time of the year, etc.
- Incorporate other early detection systems at ports of entry. Create fast and portable diagnostic tools for *in situ* identification.
- Identify molecular markers of emerging pests and diseases for batch identification of emerging pests and diseases from suspect vegetal material.

Surveillance, monitoring and early warning of pests and diseases

- Improve vegetal material inspections.
- Develop a plan for an early warning system.
- Involve citizens in a warning system, e.g. by developing a smartphone application to communicate new cases of emerging pests and diseases.
- The creation of sentinel plantations (arboreta of different species) in specific areas to identify the pathways of entry for different pests and diseases.
- Study population genetics to identify the origin of emerging pests and diseases.
- Use of drones for surveillance and monitoring of emerging pests and diseases in forest areas, especially at the earliest phase of establishment.
- Improve training of technicians to detect emerging pests and diseases in the field.

Eradication, control and contingency of pests and diseases

- Develop a system for quick eradication, control and containment of emerging pests and diseases as soon as they are detected.
- Improve risk management in tree nurseries and garden centres.
- Evaluate the optimum size of clearcut area (as an eradication measure) around infested forest trees using pathogen trait modelling.
- Develop proposals to reconcile the conflict between eradication measures and conservation of dead wood for biodiversity conservation.
- Reduce legal procedures to import living organisms for use as biological controls.

Rehabilitation of affected forest sector by pests and diseases

- There are no specific management plans for the rehabilitation of forest areas affected by emerging pests and diseases. They should be developed considering regional forest sector characteristics.

Collaboration with the PLURIFOR project

The following improvements have been retained to be developed within PLURIFOR. In each phase, proposals are listed in decreasing order of priority, as set by the interviewed organisations:

Prevention against pests and diseases

- Build a standardised registry of public data to record prevention, surveillance, monitoring, eradication, control and contingency actions concerning emerging pests and diseases to improve pathway knowledge. Organise this information to reveal patterns that could be used to optimise preventive strategies and to evaluate the efficiency of the system, so that emerging pests and diseases can be stopped at the port of entry. This tool could take the form of a pathway model.
- The creation of an interregional working group to evaluate emerging pests and diseases data at national and international scales and to provide support to administrative bodies in emergency situations. It would also provide information of what is being done in other regions and countries in order to coordinate measures and prepare preventive actions. (Euskadi does not seem to want a risk management plan for emerging pests and diseases because it is judged difficult to apply within the SUDOE area).
- Set priorities for prevention and control of emerging pests and diseases as a function of their risk of introduction and spread.
- Produce a review of pests that could establish in the SUDOE area, and imported goods that could act as a vector in order to improve inspections at the ports of entry.
- Identify biotic damage and economic impacts of a selected number of emerging pests and diseases.

Surveillance, monitoring and early warning of pests and diseases

- The creation of sentinel plantations (arboreta of different species) or the use of existing ones, in specific areas (such as around ports of entry or urban areas), to identify the pathways of entry and dispersal for different pests and diseases.
- Improve training of technicians to detect emerging pests and diseases in the field.
- Develop a warning system for the whole Iberian Peninsula for new detections with the participation of public organisations, private companies, forest owners associations and citizens. Involvement of citizens in the warning system could be done by developing a smartphone application to communicate new cases of emerging pests and diseases.
- Study population genetics to identify the origin of emerging pests and diseases. As this is already done for some pathogens, a review of study cases and tools that are useful could be done. Study cases could be conducted for selected species.

Eradication, control and contingency of pests and diseases

No collaboration with PLURIFOR has been expressed relating to the eradication, control and contingency phases.

Rehabilitation of affected forest sector by pests and diseases

No collaboration with PLURIFOR has been expressed relating to the rehabilitation phase.