

	EUROPEAN COMMISSION RESEARCH AND INNOVATION DG	Periodic Report
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Project No: 265483

Project Acronym: REPHRAME

Project Full Name: Development of improved methods for detection, control and eradication of pine wood nematode in support of EU Plant Health policy

Periodic Report

Period covered: from 01/09/2012 to 28/02/2014

Start date of project: 01/03/2011

Project coordinator name:

Dr. Hugh Evans

Version: 1

Date of preparation: 22/05/2014

Date of submission (SESAM): 22/05/2014

Project coordinator organisation name:

FORESTRY COMMISSION RESEARCH AGENCY

Periodic Report

PROJECT PERIODIC REPORT

Grant Agreement number:	265483
Project acronym:	REPHRAME
Project title:	Development of improved methods for detection, control and eradication of pine wood nematode in support of EU Plant Health policy
Funding Scheme:	FP7-CP-FP
Date of latest version of Annex I against which the assessment will be made:	25/02/2014
Period number:	2nd
Period covered - start date:	01/09/2012
Period covered - end date:	28/02/2014
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Declaration by the scientific representative of the project coordinator (1)

I, Dr. Hugh Evans FORESTRY COMMISSION RESEARCH AGENCY , as scientific representative of the coordinator of the project REPHRAME and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

The project has achieved most of its objectives and technical goals for the period with relatively minor deviations.

The attached periodic report represents an accurate description of the work carried out in this project for this reporting period.

The public website is not up to date.

To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 6) and if applicable with the certificate on financial statement.

All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name	Dr. Hugh Evans FORESTRY COMMISSION RESEARCH AGENCY
Date	22/05/2014

This declaration was visaed electronically byHugh EVANS(ECAS user name nevanshu) on 22/05/2014

1. Publishable summary

Summary description of project context and objectives

Europe's pine forests are a valuable economic, social and environmental resource under threat from the introduction of the pine wood nematode (PWN), *Bursaphelenchus xylophilus*. Significantly, PWN is not a pest in its native North America, which is linked to both tolerance in native conifers and to unsuitable environmental conditions for wilt over much of its range there. Since the arrival of PWN in Portugal, the native maritime pine, *Pinus pinaster*, has proved to be extremely susceptible, with PWN being spread by the local longhorn beetle *Monochamus galloprovincialis*. Previous studies have shown that PWN could spread throughout the Iberian Peninsula and beyond, making it a major threat to European forests.

Effective containment and local eradication of PWN demands a detailed understanding of the behaviour and dynamics of the nematode and its vector insects in infested trees, especially because delayed onset of symptoms (latency) reduces survey accuracy and can compromise containment strategies. Research in REPHRAME concentrates on:

- vector dispersal capacity;
- improved ways to monitor and reduce populations using synthetic chemical lures;
- the potential for PWN transfer between trees in the absence of the *Monochamus* spp. vectors,
- the potential for the introduction of conifers resistant to PWN.
- extending the capability of existing models to identify the risk posed by PWN to the rest of Europe under current and future climates.
- synthesising the results of the project will be into an on-line toolkit for end users.
- extensive dissemination activities to ensure the uptake and application of results across the EU and world-wide.

Description of work performed and main results

WP2 Behaviour of PWN

- Elucidation of factors for entry of PWN into vector and departure into host tree
- Dynamics of PWN in *P. sylvestris* and effects on plant tissues elucidated. Histopathology of PWN in *P. pinaster*, *P. pinea* and *P. halepensis* visualised
- PWN inoculated 7-8 year old *P. sylvestris* trees died within 12 weeks
- Roles of bacteria associated with plant, nematode and insect identified
- Nematode DNA detection using ITS-PCR with LAMP

WP3 Phenology and dispersal of PWN vectors

- *M. galloprovincialis* traps and lures capture *M. sartor*, *M. sutor*, *M. saltuarius*
- At room temperature, *M. sartor* developed in approximately 6 months cf. 11 months outdoors
- Artificial diets to rear *Monochamus* spp; up to 80% development of adults in 95 days
- Tethered adult *M. sutor* flew equivalent to 2 km in 30 min, with longest of 5.6 km
- *M. galloprovincialis* adult fat content 15-18% of dry weight, dropping to 11%. Wing muscle 16% of thorax dry weight
- Mark recapture of *M. galloprovincialis* with flights up to 2000m
- *Monochamus* microsatellite markers indicated moderate allelic richness over all loci
- *M. galloprovincialis* from the French and Spanish sides of the Pyrenees genetically distinct
- Allelic richness of *M. galloprovincialis* high in central Spain and Eastern Europe suggesting potential glacial refugia

WP4 Methods for monitoring and control of *Monochamus* spp and PWN

- #-pinene moderately increases attraction to GALLOPROTECT 2D G 2D
- (+) Limonene reduces catches of *M. galloprovincialis* in baited traps
- Teflon®-coated multifunnel and crossvane traps suitable for *M. galloprovincialis*
- 1 year of mass trapping can remove up to 70% of *M. galloprovincialis*
- GALLOPROTECT 2D (SEDQ) effective in Germany
- Field trials in Spain, Austria and Sweden trapped *M. sutor* and *M. sartor*

WP5 Risk of non-vector spread of PWN through various pathways to healthy forests

- PWN decreased over one year in *P. sylvestris* wood chips at 15°C and 25°C
- PWN infested *P. sylvestris* wood chips with *P. sylvestris* saplings show possibility of non-vector

spread of PWN to trees by wood chips

- Non-vector spread of PWN from infested to uninfested *P. sylvestris* saplings through the soil or by root contact could not be demonstrated

WP6 Host tree resistance to PWN and its vectors

- Pathogenicity of PWN similar in 8 German *Pinus sylvestris* provenances
- cDNA transcripts differentially expressed were much higher in *P. pinaster* than in *P. yunnanensis*
- Hybridization between *P. pinaster* and *P. halepensis* gave some fertile seeds to be tested for resistance to PWN
- Pines on Madeira had thinner bark than on continental Portugal allowing *M. galloprovincialis* to lay eggs in lower trunk

WP7 Prediction of pine wilt expression, taking account of latency

- Improved ETPN model for wilt validated using historic disease occurrence from Japan
- Sensitivity analysis showed tree resistance and day of PWN infestation key factors; could explain latency of wilt
- Data on symptomatic trees recorded in Portugal used for bio-climate model in Portugal
- Spread model of infested *Monochamus* vectors, PWN and pine wilt disease developed. Dispersal model based on flight capability of *M. galloprovincialis* to simulate areas where PWN can be transmitted

WP8 EU and international cooperation and collaboration

- The ISEFOR consortium workshop in Finland included a risk model for *B. xylophilus*
- +ve interaction with EU, EPPO, IFQRC and IPPC, including International Standard of Phytosanitary Measures (ISPM)
- Global network used to develop the venue for International Conference on Pine Wilt Disease which was carried out in cooperation with REPHRAME (WP10)

WP9 Synthesis and development of PWN Tool Kit

- Online PTK will include updated life cycle drawing to provide a concise summary of *B. xylophilus* and its relationship with *Monochamus*; simulated vector emergence and duration of life cycle for different zones of Europe

WP10 Stakeholder Engagement & Dissemination

- > 40 publications; others under preparation
- SOG includes 22 scientists, plant health regulators, practitioners and timber trade representatives from 12 countries
- 15th to 18th October 2013; “International Conference on Pine Wilt Disease 2013” organized by B5; joint REPHRAME, IUFRO Unit 7.02.10 “Pine Wilt Disease”, Julius Kühn-Institute and German Scientific Society for Plant Protection and Plant Health
- 87 participants from 23 countries (Europe, Russia, Asia, North America and Australia); 41 talks and 22 Posters. Proceedings in the series “Berichte aus dem Julius Kühn-Institut”
<http://pub.jki.bund.de/index.php/BerichteJKI/issue/view/858>

Expected final results and potential impacts

REPHRAME addresses the requirements of the Call KBBE.2010.1.4-09 (Analysis of the potential of the pine wood nematode (*Bursaphelenchus xylophilus*) to spread, survive and cause pine wilt in European coniferous forests in support of EU plant health policy) and the research is undertaken by means of a structured approach addressed through 9 Work Packages.

Even though the programme start date was 1 March 2011 progress on some of the set deliverables was significantly affected by problems in setting up the Grant Agreement. This delay caused a significant amount of work to be initiated late in 2011 or even in 2012. Consequently, and supported by the external reviewer of the project, a request was made to extend end date by 9 months. This has just been approved and will enable some of the delayed work to be carried out by the end date of 30 November 2014.

Beneficiaries in all regions have been undertaking specific research relating to PWN in their region based on their expertise, as well as collaborative working on specific Work Packages.

Work Packages 2-7 have made excellent progress, despite the delays that have affected WP5 in particular, to address the critical issues identified in the call text. There is a constantly improving understanding of the interactions between PWN and its host trees, taking account of vector and non-vector transmission routes and integrating with environmental and tree/PWN genetic drivers that

could lead to wilt expression. This knowledge is being enhanced by international collaboration to extend data gathering and ensure maximum synergy through sharing of existing and new data (WP8).

WP9 is benefitting from this increased knowledge and we are now in a position to determine the full complexity of the PWN-vector-environment-human influence interaction that drives pine wilt disease as a phytosanitary problem.

WP10 has increased activity, especially the interaction with the Stakeholder Observer Group and the very successful international conference held in Braunschweig in October 2013. Evidence of the progress of the project is provided both by that conference and also the increasing number of publications, conference presentations, seminars and other outputs being produced by the Consortium. Plans are now being made for back to back workshops for Portuguese and Spanish (and other) beneficiaries during the summer of 2014. A final workshop in Brussels is also being developed in conjunction with the project science officer.

REPHRAME will have extensive positive impacts in socio-economic terms by providing substantial improvements to risk assessment and management of the PWN threat to European and global conifer forests and woodlands. As already demonstrated, this will be based on robust science-based methodologies underpinning improved management strategies. This will decrease uncertainty about specific factors that are critical to survey and management of PWN and its vectors.

Project public website address:

www.rephrame.eu

2. Core of the report

Project objectives, Work progress and achievements, and project management during the period

The Project Summary Pdf document contains the core of the report.

3. Deliverables and milestones tables

Deliverables (excluding the periodic and final reports)										
Del. no.	Deliverable name	Version	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex I (proj month)	Actual / Forecast delivery date	Status	Comments
1	Minutes of meetings of Management Committee and consortium	1.0	1	FORESTRY COMMISSION RESEARCH AGENCY	Report	PU	45	26/06/2012	Submitted	
2	Consortium Agreement signed	1.0	1	FORESTRY COMMISSION RESEARCH AGENCY	Report	PP	2	22/06/2012	Submitted	
3	Task and milestone reports	0.0	1	FORESTRY COMMISSION RESEARCH AGENCY	Report	PU	45	30/11/2014	Not submitted	
1	Factors governing association of PWN with vector beetles	0.0	2	UNIVERSIDADE DE EVORA	Report	PU	33	30/11/2013	Not submitted	
2	Factors affecting departure of PWN from vector beetles	1.0	2	UNIVERSIDADE DE EVORA	Report	PU	33	30/11/2013	Submitted	
3	Pathogenicity of PWN in host tree species	0.0	2	UNIVERSIDADE DE EVORA	Report	PU	45	30/11/2014	Not submitted	
4	Methods to detect PWN in trees	0.0	2	UNIVERSIDADE DE EVORA	Report	PU	45	30/11/2014	Not submitted	
1	Vector flight capacity related to physiology	1.0	3	INSTITUTO NACIONAL DE RECURSOS BIOLOGICOS I.P . INRB	Report	PU	33	30/11/2013	Submitted	
2	Vector dispersal related to forest condition	1.0	3	INSTITUTO NACIONAL DE RECURSOS BIOLOGICOS I.P . INRB	Report	PU	33	30/11/2013	Submitted	

3	Vector dispersal related to population genetics	0.0	3	INSTITUTO NACIONAL DE RECURSOS BIOLOGICOS I.P . INRB	Report	PU	45	30/11/2014	Not submitted	
4	Climate influences on vector dispersal	1.0	3	INSTITUTO NACIONAL DE RECURSOS BIOLOGICOS I.P . INRB	Report	PU	33	30/11/2013	Submitted	
1	Lure for <i>M. galloprovincialis</i>	1.0	4	UNIVERSIDAD DE VALLADOLID	Report	PU	33	30/11/2013	Submitted	
2	Development of traps for monitoring & control	1.0	4	UNIVERSIDAD DE VALLADOLID	Report	PU	12	26/06/2012	Submitted	
3	Effectiveness of mass trapping for vector control	0.0	4	UNIVERSIDAD DE VALLADOLID	Report	PU	45	30/11/2014	Not submitted	
4	Development of lures for other <i>Monochamus</i> spp.	0.0	4	UNIVERSIDAD DE VALLADOLID	Report	PU	45	30/11/2014	Not submitted	
1	Distribution of PWN in wood and wood chips	1.0	5	JULIUS KUHN-INSTITUT BUNDESFORSCHUNGSINSTITUT FUR KULTURPFLANZEN	Report	PU	33	30/11/2013	Submitted	
2	Transmission of PWN to trees with wood chips/bark	0.0	5	JULIUS KUHN-INSTITUT BUNDESFORSCHUNGSINSTITUT FUR KULTURPFLANZEN	Report	PU	45	30/11/2014	Not submitted	
3	Direct tree to tree transmission of PWN	1.0	5	JULIUS KUHN-INSTITUT BUNDESFORSCHUNGSINSTITUT FUR KULTURPFLANZEN	Report	PU	36	28/02/2014	Submitted	

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4	Wood to wood transmission of PWN in wood pack aging	0.0	5	JULIUS KUHN-INSTITUT BUNDESFORSCHUNGSINSTITUT FÜR KULTURPFLANZEN	Report	PU	45	30/11/2014	Not submitted	
5	Microsatellite markers for PWN identification	2.0	5	JULIUS KUHN-INSTITUT BUNDESFORSCHUNGSINSTITUT FÜR KULTURPFLANZEN	Report	PU	12	25/06/2013	Submitted	
6	PWN genetic diversity as indicators of invasion history	0.0	5	JULIUS KUHN-INSTITUT BUNDESFORSCHUNGSINSTITUT FÜR KULTURPFLANZEN	Report	PU	45	30/11/2014	Not submitted	
1	Susceptibility of <i>Pinus sylvestris</i> provenances to PWN	0.0	6	INSTITUTO NACIONAL DE RECURSOS BIOLÓGICOS I.P. INRB	Report	PU	45	30/11/2014	Not submitted	
2	Construction of cDNA libraries from sensitive and resistant genotypes of <i>Pinus</i>	1.0	6	INSTITUTO NACIONAL DE RECURSOS BIOLÓGICOS I.P. INRB	Report	PU	12	08/11/2012	Submitted	
3	Identification of PWN resistance genes in pines	0.0	6	INSTITUTO NACIONAL DE RECURSOS BIOLÓGICOS I.P. INRB	Report	PU	45	30/11/2014	Not submitted	
4	Resistance of pines to feeding by <i>Monochamus</i>	1.0	6	INSTITUTO NACIONAL DE RECURSOS BIOLÓGICOS I.P. INRB	Report	PU	33	30/11/2013	Submitted	

5	Host preferences for <i>Monochamus oviposition</i>	0.0	6	INSTITUTO NACIONAL DE RECURSOS BIOLOGICOS I.P . INRB	Report	PU	45	30/11/2014	Not submitted	
6	Hybrid progenies with different tolerance/ resistance to the PWN	1.0	6	INSTITUTO NACIONAL DE RECURSOS BIOLOGICOS I.P . INRB	Report	PU	18	31/08/2012	Not submitted	
7	Tree species mosaics to reduce PWN impact	0.0	6	INSTITUTO NACIONAL DE RECURSOS BIOLOGICOS I.P . INRB	Report	PU	45	30/11/2014	Not submitted	
1	Refinement of core model	0.0	7	INSTITUTO NACIONAL DE LA RECHERCHE AGRONOMIQUE	Report	PU	44	31/10/2014	Not submitted	
2	Field verification of process model	0.0	7	INSTITUTO NACIONAL DE LA RECHERCHE AGRONOMIQUE	Report	PU	45	30/11/2014	Not submitted	
3	Latency sub-model	0.0	7	INSTITUTO NACIONAL DE LA RECHERCHE AGRONOMIQUE	Report	PU	44	31/10/2014	Not submitted	
4	Analysis of PWN history in Portugal	0.0	7	INSTITUTO NACIONAL DE LA RECHERCHE AGRONOMIQUE	Report	PU	42	31/08/2014	Not submitted	
5	PWN spread model	0.0	7	INSTITUTO NACIONAL DE LA RECHERCHE AGRONOMIQUE	Report	PU	44	31/10/2014	Not submitted	
1	Knowledge from previous EU projects	2.0	8	UNIVERSIDADE DE EVORA	Report	PU	12	25/06/2013	Submitted	

2	Interaction with EU/International projects	0.0	8	UNIVERSIDADE DE EVORA	Report	PU	45	30/11/2014	Not submitted
1	PTK interface	2.0	9	FORESTRY COMMISSION RESEARCH AGENCY	Report	PU	12	29/02/2012	Submitted
2	Beta testing of PTK modules	0.0	9	FORESTRY COMMISSION RESEARCH AGENCY	Report	PU	39	31/05/2014	Not submitted
3	Launch of PTK	0.0	9	FORESTRY COMMISSION RESEARCH AGENCY	Report	PU	44	31/10/2014	Not submitted
1	REPHRAME website launch & maintenance	1.0	10	FORESTRY COMMISSION RESEARCH AGENCY	Other	PU	2	26/06/2012	Submitted
2	Project leaflet	1.0	10	FORESTRY COMMISSION RESEARCH AGENCY	Other	PU	4	18/10/2012	Submitted
3	SOG minutes	2.0	10	FORESTRY COMMISSION RESEARCH AGENCY	Report	PU	12	29/02/2012	Submitted
4	Workshop 1 Spain	0.0	10	FORESTRY COMMISSION RESEARCH AGENCY	Other	PU	38	30/04/2014	Not submitted
5	Workshop 2 Portugal	0.0	10	FORESTRY COMMISSION RESEARCH AGENCY	Other	PU	45	30/11/2014	Not submitted
6	International Conference on PWN	1.0	10	FORESTRY COMMISSION RESEARCH AGENCY	Report	PU	32	31/10/2013	Submitted
7	Plan for use & dissemination of foreground	0.0	10	FORESTRY COMMISSION RESEARCH	Report	PU	45	30/11/2014	Not submitted

				AGENCY						
8	Awareness & wider societal implications	0.0	10	FORESTRY COMMISSION RESEARCH AGENCY	Report	PU	45	30/11/2014	Not submitted	

Milestones

Milestone no.	Milestone name	Work package no	Lead beneficiary	Delivery date from Annex I	Achieved Yes/No	Actual / Forecast achievement date	Comments

4. Explanation of the use of the resources

The **explanation on the use of resources** was removed from the scientific periodic reports in SESAM. These details now have to be entered in the cost statement forms in FORCE instead.

Attachments	REPHRAME responses to recommendations by Dr Pertot.pdf, REPHRAME Second Periodic Report.pdf
Grant Agreement number:	265483
Project acronym:	REPHRAME
Project title:	Development of improved methods for detection, control and eradication of pine wood nematode in support of EU Plant Health policy
Funding Scheme:	FP7-CP-FP
Project starting date:	01/03/2011
Project end date:	30/11/2014
Name of the scientific representative of the project's coordinator and organisation:	Dr. Hugh Evans FORESTRY COMMISSION RESEARCH AGENCY
Period covered - start date:	01/09/2012
Period covered - end date:	28/02/2014
Name	
Date	22/05/2014

This declaration was visaed electronically by Hugh EVANS (ECAS user name nevanshu) on 22/05/2014