



2011
Activities
Report

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CITAB

Compiled by
CITAB Executive
Committee

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- ❖ SAC, Sustainable Agro-food Chains
- ❖ EI, EcoinTEGRITY
- ❖ BE, Biosystems Engineering

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0 – Executive Summary

As a result of the recommendations of the Stakeholder committee (SC) following their visit in late January, the Unit's made changes to the each Research Groups multidisciplinary projects and their component tasks under the supervision of scientific Group coordinators. The end result of this is a smaller number of more streamlined project tasks that involve a larger number of researchers. Following the SC guidelines, special attention has been paid to interacting with industrial partners and stakeholders and increasing the number of sustainable research and development partnerships

In order to meet the objective to increase the number of scholarships, a highly successful programme to finance short-term research scholarships in strategic projects was launched in 2011 .

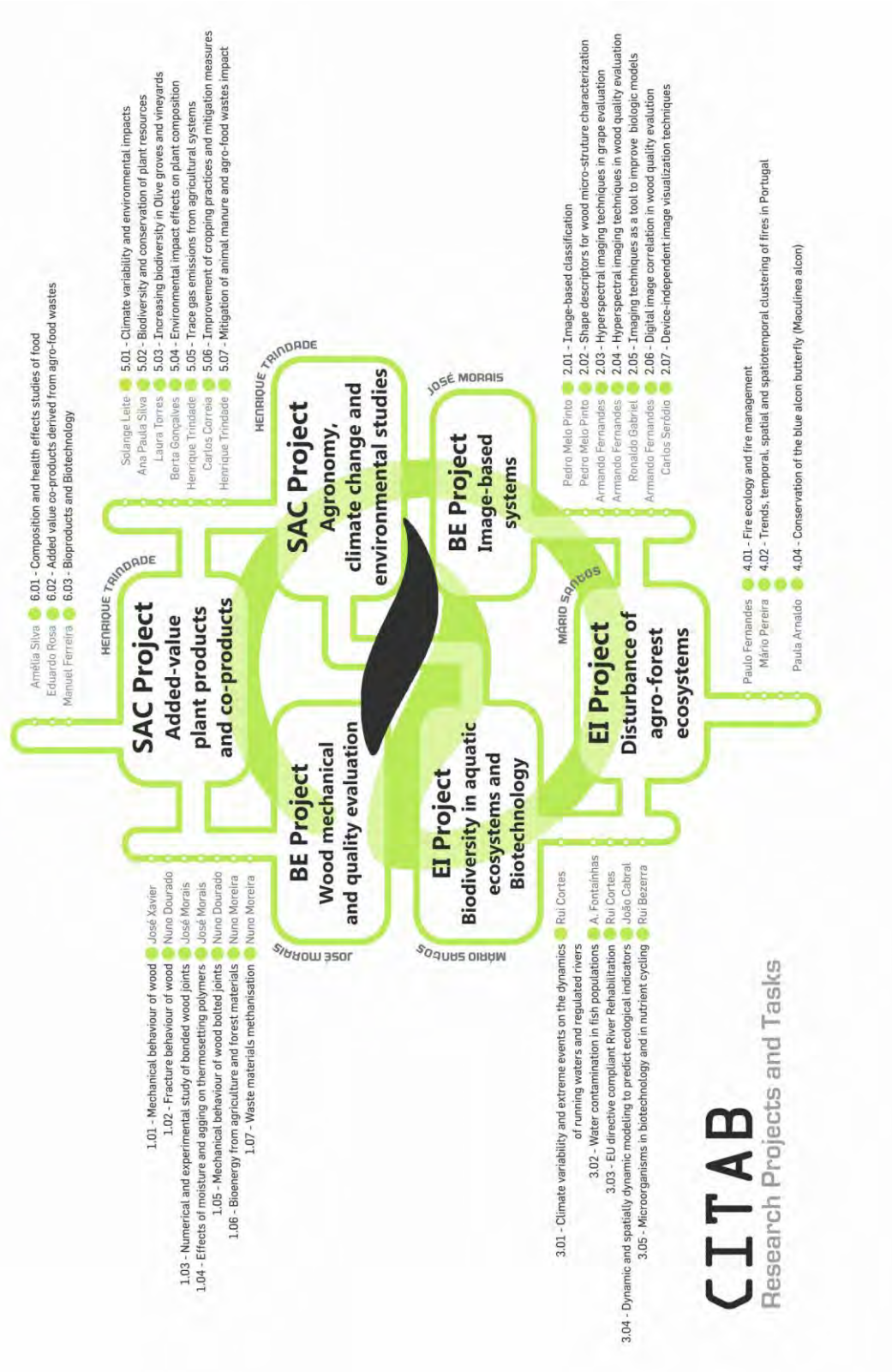
With future short to mid term challenges in mind, the Directorate is actively contacting different research units and institutions across northern Portugal, in order to set up a research network that coincides with CITAB's areas of expertise.

CITAB continues to regularly publish its English language Newsletter, which is distributed to more than 210 scientific organizations around the world. The publication of the first edition, which was welcome by many of its recipients, clearly achieved part of the Centre's strategic goals to increase internationalization.

As clearly stated in CITAB's early days, we continue to expect members and collaborators to obtain the minimum requirements that allow them to become fully integrated members. The number of integrated members has increased by approximately 10%, in line with last year's trend.

The scientific activities of our members are given in the main scientific achievements section but also in the so called "metric results". They largely meet the requirement set out in the Activity Plan for 2011.

CITAB made contributions to increase sustainability and provide innovative solutions, outlined in the main achievements section. We continue to face challenges for the future.



1 – Objectives and Achievements

1.1 – Unit description

Following reorganization of the UNIT working groups (WG), based on the the recommendations made by the External Advising Committee (EAC) in 2010 and the Stakeholders Committee, in January 2011, the Scientific Council approved and implemented redefined project and task in each WG. CITAB's core activities remain focused on agro-food, forestry and the environment, with an increasing input from engineering and engineering technologies to enhance development of agro-food and forestry production chains in Portugal.

CITAB's activities rely on the contribution of integrated members and collaborators (members with and without PhD), selected according to international benchmarking criteria. Since most of the CITAB members are primarily lecturers, the Unit supports post-graduate courses offered by the host institution and others centres of learning.

CITAB is managed using a bottom-up approach. The Directorate (1 Director and 2 Vice-Directors) is supported by the Executive Committee (ExCo; 6 members- 2 from each Working Group) forming a two way link between CITAB members and the Directorate concerning policy orientation defined by the Directorate. The ExCo is also responsible for compiling information and collaborating in actions that promote the visibility of the Unit. Both the Directorate and the ExCo meet approximately once a month. Research group members also hold regular meetings to evaluate group progress according to the Plan of Activities for the current year. The Scientific Council meets a minimum of 4 times a year, as stipulated by regulations. Given the considerable size of the Unit, a secretary has been contracted to deal with all administrative duties and provide support to the Directorate and the ExCo.

1.2 – General objectives

CITAB's general objectives follow those set for the previous year. Our aim is to raise the quality of the Unit and achieve a classification of "Excellent" by the international evaluators designated by FCT. We aim to identify and promote activities that distinguish CITAB from other Units at national level, by applying international benchmarking criteria to all ongoing scientific and co-scientific activities and promoting a clear, more transparent approach.

Planning of CITAB has focused on improving quality by incorporating new members of high scientific quality, promoting internationalization of the Research Groups, developing innovative research, promoting contact with industry and other R&D units and improving the image and visibility of CITAB. Each of the Research Groups contributes actively to meeting these goals.

1.2.1 – Scientific objectives

Research topics concentrate on developing more sustainable production chains of agro-food and forestry systems, aiming to make producers more competitive. As a result, our research objectives concentrate on every step and constraint within the chain, such as improving knowledge, studying plant stress adaptation to climate change - in particular the effect of extreme events - and how to overcome them by addressing water shortage, water quality and improving water management strategies (for instance in grape growing in the Port wine region). The quality and health benefits of vines and other major crops have been studied within the framework of sustainable production and organic farming.

Employing a novel approach, all three research projects benefit somehow from the closely allied contribution of technological engineering to better understand environmental change at different scales of the ecosystem and the individual (life organism) using signal and image processing, biosensing and remote sensing. A more specific contribution from the world of engineering has been the study and characterization of forestry resources used both in industry and as biofuel and the exploitation of biomaterials. We have focused on agro-food and forestry transformation units, envisaging added value of the co-products resulting from these industries. Sustainability and competitiveness of production chains focuses on agro-food and forestry transformation units, envisaging added value of co-products resulting from these industries.

We take special care to address the whole chain of interactions in natural or agro-forested ecosystems, from prediction techniques, ecological modelling of human impacts and climate change, to the monitoring of effects on biotic assemblages (flora and fauna), abiotic factors and the implementation of mitigation measures, providing innovative tools for restoring disturbed ecosystems (this is the case of

areas devastated by wildfires or streams impacted by fluvial erosion). We also study agro-forest management strategies to increase sustainability against environmental impacts, from climate change, natural hazards and anthropogenic impacts. The priorities rely on defining techniques to protect systems against biotic agents, to control fire and contribute to ecosystem recovery by identifying and quantifying disturbance in terrestrial and aquatic ecosystems. This is done by testing for sensitive metrics and biomarkers able to quantify the complex interaction of stressors, allowing the development of appropriate management and rehabilitation strategies

1.2.2 – Co-scientific objectives

CITAB's key objectives include increasing funding and JCR scientific production. We foresee an increase in the number of scholarships, supported by an active policy of the Board through funding of scholarships, and national and international links (increasing the number of anchor institutions), thereby improving the mobility of researchers and build projects within the Seventh Framework Programme (FP7). We also aim to bring our research activities to the attention of the private sector. CITAB's policy includes also a direct collaboration with secondary schools by receiving students to work in our labs for a short period, engaging them in scientific activity and divulging our scientific results.

1.3 – Main achievements during 2011

Main achievements of CITAB's research are pointed out:

A) Sustainable Agro-food Chains Group:

- Studies on climatic conditions at different spatial scales, particularly on drought events and consequences for different cultures: i) vineyard responses to climate stress and use of new procedures, like kaolin-based particle film to prevent leaf sunburn damage on grapevines, including procedures to improve *V. vinifera* cv. Alvarinho defence mechanisms against drought ii) new adapted chestnut and hazelnut Portuguese varieties, namely to pathogenic diseases under climate changes; iii) cover cropping techniques to improve the profitability and the sustainability of rainfed olive orchards
- Reduction of greenhouse gas emissions from animal slurries by treatment with nitrification inhibitors prior to soil application.
- Development of a new model for biochemical and biotechnological applications (nutrient transport, toxicological assessments, etc) following purification of intact, functional protoplast and vacuole populations from grape cells;

- Biofunctional textiles have been developed using resveratrol and other plant extracts;
- Research on antioxidant defences in human fibroblasts promoted by Curcumin and application of ursolic acid and luteolin-7-glucoside improve lipid profiles and to induce liver glycogen synthase kinase-3 in rats.

B) Eointegrity Group

- Development of new integrative tools for ecological assessment of aquatic ecosystems: i) environmental bioindicators based on benthic and fish communities; ii) validation of biomarkers for contamination assessment of fish and new applications on macroinvertebrate species to detect the effects of xenobiotic compounds; iii) use of functional indicators to quantify disturbance impacts iv) improvement on hydromorphological characterization of running waters.
- Modelling spatial ecological patterns using Spatially Explicit Stochastic Dynamic models for application in ecosystem management and conservation.
- Biotechnological development of biodiesel waste treatment using detoxification by fungal fermentation and their subsequent use as animal feedstuffs.
- Development of tools that allow forest managers to predict post-fire tree mortality for pine and broadleaved species. Advances in fire ecology offer a quantitative basis to create and maintain more fire-resistant and fire-resilient forests. Temporal clustering structures in fire sequences have been identified and characterized.
- Defoliation effects of insect plagues have been assessed and outbreaks have been modelled under future climate scenarios.

C) Biosystems Engineering Group

- A plate bending test was proposed for determining the bending stiffness components of MDF panels, which combines full-field slope measurements provided by the deflectometry technique with the virtual fields' method.
- Use of digital image correlation techniques in wood technology: i) at the meso-scale for measuring the Young's modulus and Poisson's ratio associated to earlywood and latewood; ii) for direct identification method of cohesive laws for adhesively-bonded wood joints.
- Application of hyperspectral imaging to wood quality evaluation (use of models to convert hyperspectral imaging information into wood density).
- The End Loaded Split test and the End Notched Flexure test were validated for mode II fracture testing of cortical bone.

- Important reasearch in the domain of bioenergy, namely: i) the thermochemical characterization of the biomass from different types of wood and forest wastes (shrubs and brushwood) for energy purposes; ii) establishment of a framework for bioenergy policies at the national and european level, leading to the definition of the standards concerning the injection of biomethane in the natural gas network.
- Improvement of image-based classification methodologies through image segmentation techniques using FSs, IVFSs, A-IFSs and other soft computing techniques, and its application for meat quality assesement and dynamic tracking movement analysis.
- Development of a robust methodology for feature tracking in image sequences using soft computing techniques with the incorporation of a feature behavioural characterization methodology.
- Development of a methodology to determine local (over)loading of the plantar surface; development of a software model for measuring plantar pressure in all limbs, used to detect plantar pressure abnormalities (e.g associated with hip dysplasia).
- Development of a WSN propagation model for indoor and outdoor environments (vegetations). The next step is to apply this system to image transmission.

2 – Activities in 2011

This section of the report describes how general activities of the Unit are aimed at integrating research from various groups, thereby promoting multidisciplinary and/or trans-disciplinary activities. The second part describes work carried out by the Unit that divulges our activities and research to the general public, schools or other forms of engaging the public in the Unit's work.

2.1 – Integrative/multidisciplinary activities

CITAB's research activities are organized into 6 multidisciplinary projects that optimise the expertise of 3 Research Groups. This allows us develop integrated, multidisciplinary research and maximise participation of integrated members and collaborators, essential criteria for effective scientific development. A set of tasks has been defined for each project that involves several members with different areas of expertise.

Within the *Agronomy, climate change & environmental studies* project there is clear interaction between colleagues working on climate modelling and prediction and ecophysiology, plant stress and mitigation measures in major crops (i.e. vines,

olive trees, cherries, chestnuts). This collaboration improves understanding on how climate change affects plant behaviour and final product quality. This project also interacts with colleagues from the BE group on areas like electronic control of experimental setups, data acquisition and field data transmission.

The BE Research Group's *Image-based systems* project also interacts with these studies, monitoring systems using computer vision, image processing and visual inspection. The "*Image-based systems*" and the "*Wood mechanical and quality evaluation*" projects show a steadily growing number of integrative activities through the use of image-based techniques (eg image correlation, image processing and morphology and, more recently, the use of hyperspectral imagery). Both these projects have national and international research partnerships. In the area of biomechanics analysis, the multidisciplinary analysis of itineraries and routes in natural spaces, has been done as a collaboration between the BE and the IE groups.

Biodiversity studies are clearly linked to the previous projects since novel varieties and landraces have been characterized, allowing CITAB to assess potential use as crops, in biological control and in major cropping system sustainability not only for vines and olive groves but also for medicinal and aromatic plants (several wild species have been studied and are maintained in our Botanical Garden). In alignment with this is the *Biodiversity in aquatic ecosystems and biotechnology*, which, apart from giving an added-value to biodiversity studies, also develops research in aquatic systems, a major contemporary topic in Portugal.

The *Added-value plant products & co-products* project interacts with the previous project, with the aim of reducing the environmental impact of cropping systems, studying the potential use of by-products as green-manures and for extraction of compounds for functional foods.

In the *Disturbance of forest and agro-forested ecosystems* project, wildland fire studies focus on the interface between fire science first principles (fire behaviour) and fire ecology. This cause-effect approach enables the development of either empiric or process-based closed predictive models. The ecology of forest disturbances and silviculture interact with atmospheric sciences, allowing a more holistic approach that takes temporal dynamics into account.

2.2 – Outreach activities

Outreach activities are an important part of CITAB's agenda. CITAB has organised a range of initiatives and activities specifically developed to meet different levels of knowledge or the needs of specific organizations:

- a) To steer research activities and generate new ideas: BE group workshops: "*Data and Uncertainty*" and "*Evolution of Access Networks and Mobile Data*". SAC organized several workshops and courses with the presence of national renowned speakers: "*From the olive tree to olive oil – New challenges*";

“Carbon Market: a way to the sustainability of the agro-food sector”; National workshop of organic olive growing: *“Olive orchards: Benefits of the Ecosystem”*; 2nd WS BioPlant & 2nd Annual BioPlant Workshop; Traditional Chinese Medicine (TCM) Symposium & 2nd GP-TCM Annual General Meeting; Oxidative Stress and Antioxidants course; Advanced Course on Molecular Nutrition: dietary phytochemicals and age-related disease prevention; Course on Optical techniques for the in vivo study of photosynthesis.

- b) To attract secondary school students to science, via initiatives such as *“Hands on Research”* and the *“The National Programme for Living Science (Ciência Viva)”*. CITAB opens its laboratories to students so that they can follow and actually carry out practical work: *“SOS of grapevines under stress”* and *“Evaluation of cell proliferation in cultured animal cells”*. Also the *“V Jornadas de Biologia”* and *“XII Jornadas de Biologia Aplicada”* to disseminate research activities to BSc and MSc students. Lectures are given in secondary schools, private companies and producers associations (*ArcGis Desktop I, Iniciação aos SIG, Aves migradoras e outras espécies emblemáticas do Norte de Portugal*).
- c) Give courses and promote activities that disseminate findings and to provide training to relevant private companies and interested parties. The *“iSci Interface Ciência”* is an example that offered training for 8 teams of students in private companies (Corticeira Amorim, Bioinvitro and CENTI). The BE group organised a workshop on *“Natural Gas Utilization”* in collaboration with Sonorgás, targeted to academic and industrial sectors. Members of the EI group gave short-courses in fire control and fire prevention (*Curso Fogo controlado para a FORESTIS; As Redes Primárias de Faixas de Gestão de Combustível como Prevenção Infraestrutural de DFCI*) and participated in short-films (Depoimento para o filme da Autoridade Florestal Nacional *“Novos Rumos para a Prevenção Florestal”*).

For the general public: The *“Science at Lunchtime”* monthly cycle of conferences where invited scientists talk on themes related to their research. Other organised courses were given on River Habitat Survey (accredited by the National Water Institute (INAG) and the UK Environment Agency), River Restoration and Ecohydrology and Landscape connectivity The Importance of nuts in Portugal and consumer nutrition and health information was broadcast by the national TV programme *“Biosfera”* (RTP2).

3 – Funding

	2009	2010	2011	Subtotal
FCT Base	200.062,50 €	200.062,50 €	65.945,10 €	466.070,10 €
FCT Projects	2.338.892,00 €	1.108.512,37 €	703.901,91 €	4.151.306,28 €
Other (National)	2.487.031,26€	2.152.074,58 €	958.036,58 €	5.597.142,42 €
Other (International)	1.797.055,00 €	266.568,50 €	83.388,33 €	2.147.011,83 €
Industry (National)	0,00 €	58.400,00€	381.443,84 €	439.843,84 €
Industry (International)	0,00 €	0,00 €	0,00 €	0,00 €
Total	6.823.040,76 €	3.785.617,95 €	2.192.715,76 €	12.801.374,47 €

4 – General indicators

4.1 – Composition and training

	2007	2008	2009	2010	2011	Total
Contracted Researchers (Ciência Programme)	0	1	4	1	0	6
Researchers (FTE)	41	42	55	66	75	-
Masters degrees (Master thesis completed)	7	26	52	15	36	136
PhDs (PhD thesis completed)	10	4	11	11	8	44

4.2 – Researchers hired

N/D

4.3 – Technical personnel hired

N/D

4.4 – Additional comments

The researcher Dr. Richard Neil Bennett, contracted in 2010 under Ciência Programme, suffered a major stroke in February 2011. Unfortunately Dr. Bennett is totally incapacitated and unable to carry out work in the Centre; as a result his contract with the FCT has been terminated

Since early 2011. the Centre has implemented na active policy of contracting researchers (with Masters degrees) via project funding and the Centre's pluriannual finances. This resulted in the hiring of 12 new research fellows over the year.

4.5 – Summary of budget execution

	2011
Board Budget Funds	22.509,38€
Board Budget Spending	
Repair of scientific equipment	7.970,40 €
<i>Contribution of researchers in the repair</i>	- 4.600,45 €
Administrative and computer equipment	2.872,89 €
Research Scholarships	6.598,66 €
Dissemination and promotion	
<i>Web site</i>	2.208,60 €
<i>Newsletter</i>	1.197,34 €
<i>CITAB's scientific conferences</i>	862,25 €
<i>Participation in Scientific events</i>	494,71 €
Secretariat	3.146,00 €
Consultants	893,50 €
Other expenses	222,00€
Total	21.865,80 €
Board Balance	643,58€

4.6 – Strategic project adjustments

Following the recommendations of the Stakeholder Committee (SC) made during their visit in late January, the Unit made changes to each Research Group's multidisciplinary projects and the component tasks under the supervision of scientific Group coordinators. The end result of this exercise is a smaller number of more streamlined project tasks that involve a larger number of the Centre's researchers.

Reorganization was carried out in a standardised way in order to guarantee a similar and coherent structure between groups. Research activities were divided hierarchically into two projects for each of the three Research Groups. Six projects were defined: Bio-Based Materials and Energy and Image-Based Systems for BE, Agronomy, Climate Changes and Environmental Studies and Plant Products and Co-products for SAC and Disturbance of Agro-Forest Ecosystems and Biodiversity, Environmental Assessment and Biotechnology for EI group; each project was then divided into several tasks.

The projects comprise a total of 25 tasks, each with a specific coordinator and a core of specialised integrated members. The aim of this initiative was to increase dynamism, responsibility and efficiency inside different research areas in order to better attain specific objectives within the global objectives of the project and group. The reallocation of researchers among the different tasks also aimed to boost interactions among the members and avoid "outliers", namely individual research lines that detract from group cohesion. Following also SC guidelines, special attention has been paid to interacting with industrial partners and stakeholders and increasing the number of sustainable research and development partnerships. This initiative promotes involvement of different tasks in applied research that clearly engages with the specific partner's interests.

5 – Research Groups

Reference	Group Title
RG-Norte-4033-134	<u>Sustainable Agro-food Chains</u>
RG-Norte-4033-135	<u>Ecointegrity</u>
RG-Norte-4033-136	<u>Biosystems Engineering</u>

5.1 – Sustainable Agro-food Chains

5.1.1 – Group description

Principal Researcher	Henrique Trindade
Research area	Agricultural Sciences
Home Institution	Universidade de Trás-os-Montes e Alto Douro

5.1.2 – Funding

	2009	2010	2011
FCT Projects	1.324.517,00 €	327.933,70 €	361.903,30 €
Other (National)	673.039,00 €	158.946,00 €	525.443,50 €
Other (International)	824.505,00 €	91.543,90 €	80.388,33 €
Industry (National)	0,00 €	43.400 €	227.293,40 €
Industry (International)	0,00 €	0,00 €	0,00 €
Total	2.822.061,00 €	621.823,60 €	1.195.028,53 €

5.1.3 – Objectives

Objectives have been set for each of the ongoing projects:

Project #05 – Agronomy, climate change & environmental studies (ACES)

The main objective of ACES is the development of suitable adaptation and mitigation measures in the agricultural sector in relation to environmental and climate changes, based on plant studies and numerical atmospheric modelling. ACES will also evaluate and reduce environmental impacts resulting from cultural production and other human activities related to farmland. Major scientific activities comprise:

- Task #5.01 – Studies on climate variability mechanisms;
- Task #5.02 – Atmospheric modeling and simulation of environmental impacts;
- Task #5.03 – Recovery and evaluation of local endangered germplasm; selection, characterization and conservation of plant resources to maintain biodiversity as a potential resource for sustainable development;
- Task #5.04 – Conserve and enhancement of biological control of insect pests in olive groves and vineyards by increasing their functional biodiversity;
- Task #5.05 – Effects of environmental impacts on plant composition - phytochemicals and other compounds;
- Task #5.06 – Study of trace gas emissions from agricultural systems under climate change scenarios;
- Task #5.07 – Design and improvement of cropping practices and mitigation measures;
- Task #5.08 – Mitigation of animal manure and agro-food wastes impacts - cycles of nutrients; residues processing and reuse.

Project #06 – Added-value plant products & co-products (APPC)

This project will provide pragmatic, effective and sustainable solutions for "greening the food chain" and optimizing human and animal health. Emphasis is given to Mediterranean crops, medicinal and aromatic plants (MAP), and other economically-important plants. The APPC project will provide strategies for using agro-food/forestry wastes and applying plant cell cultures to produce added-value products and co-products e.g. biopesticides, functional food ingredients and animal feeds. Major scientific activities include:

- Task #6.01 – Studies on composition and health effects of Portuguese and International foods;
- Task #6.02 – Development of added value co-products from Portuguese agro-food wastes: Phytochemical biopesticides and “green manures”; Functional food compounds from agro-food wastes – animal and human foods; Pragmatic and effective processing of agro-food wastes.
- Task #6.03 – Bioproducts & Biotechnology: Study of essential oils and phenolic compounds from medicinal and aromatic plants: phytochemistry, bioactivities and biotechnology; Identification and role of bioactive metabolites in plants; study of their biosynthesis and production and how to genetically manipulate plants to produce pharmaceutically useful compounds; Study and characterization of in vitro plant cultures (of economically-important species) at the developmental, physiological and biochemical levels.

5.1.4 – Main achievements

Within the “Agronomy, climate change & environmental studies” and “Added-value plant products & co-products” the following main achievements have been:

- a) Exploration of dynamic mechanisms underlying the occurrence of droughts in Portugal. An innovative perspective of these mechanisms has been developed. Another study has produced regional climate change projections for precipitation in Portugal until the end of this century using a state-of-the art regional climate model.
- b) Grapevine yield in Douro Wine Region has been modelled using a set of atmospheric variables. Projections based on future climatic conditions simulated by a regional climate model have been developed; Viticultural zoning is critical for assessing suitability grapevine growing and wine production in a given region. Viticultural zoning has also been carried out for Europe and climate change assessments until 2100 have been made using regional model data.
- c) Chestnut clonal selection program for cvs. Judia has been established from the best Trás-os-Montes genotypes. Hazelnut germplasm studies have completed the collation of descriptive data of cultivars in collections. All these studies allow better selection of 2 hazelnut Portuguese varieties, potentially important sources of genes tolerant of new environment conditions, pests and diseases resistance and/or nutritional characteristics.
- d) Trace gas studies concluded that: NH₃ emissions from dairy cattle buildings in Portugal were very important and that current Portuguese inventory underestimates emissions from this source; slurry processing by mechanical

separation and treatment with nitrification inhibitors affect emissions of NO & N₂O.

- e) Advances were made regarding summer stresses mitigation strategies on Mediterranean crops.
- f) Assessment of summer stresses mitigation strategies on Mediterranean species; assessment the physiological responses of cherry trees to different canopy light levels; a close relation between ¹³C and chestnut quality was found; studies on the action of *Bacillus velezensis* in the protection of chestnut against ink disease.
- g) Extraction of highly pure, intact and functional protoplast and vacuole populations from grape cells. The molecular characterization of some tonoplast Cu²⁺ transporters in grapevine was achieved; the study of the defence mechanisms of *V. vinifera* cv. Alvarinho against esca proceed: diseased, healthy and asymptomatic leaves were clearly distinguished using multivariate statistical techniques.
- h) Development of biofunctional textiles using resveratrol and other plant extracts.
- i) Curcumin was found to induce antioxidant defences in human fibroblasts. Ursolic acid and luteolin-7-glucoside improves lipid profiles and induces liver glycogen synthase kinase-3 in rats.

5.1.5 – Group productivity

International Projects

Early detection and management of abiotic stresses in olive. Scientific and Technological cooperation project. FCT-Tunisia Ref. 6818. CITAB coordinator: Eunice Bacelar. CITAB/UTAD budget: €2300. Starting date: January 2010, duration: 24 months.

Environmental Sciences teaching planning using the virtual campus. Universidad de Salamanca, REF: ID9/153. CITAB coordinator: Luís Jesus Rivas Soriano. Total budget CITAB/UTAD: 0 Euro. Starting date: 2010, duration: 12 months.

A Web-based System for real-time Monitoring and Decision Making for Integrated Vineyard Management. FP7-SME-2010-1. CITAB coordinator: Manuel Teles Oliveira. CITAB/UTAD budget: €105.000. Starting date: January 2010, duration: 24 months.

Good Practice in Traditional Chinese medicine research in the Post-genomic Era. Seventh Framework Programme/223154. CITAB coordinator: Alberto Dias. CITAB/UM budget: 80.215 Euros. Starting date: May 2009, duration: 36 months.

National Projects

AQUAVITIS - Understanding water transport in *Vitis vinifera*: biochemical characterization of aquaporins upon their heterologous expression in yeast. FCT, PTDC/AGR-AAM/099154/2008. CITAB coordinator: Hernâni Varanda Gerós. Total budget CITAB/UM: €14.400. Starting date: 2010, duration: 36 months.

Cillus Plus as a preventive agent of chestnut ink disease. CITAB coordinator: José Gomes Laranjo. Total budget CITAB/UTAD: €3.900. Starting date: February 2010, duration: 12 months.

Cover cropping: a decisive strategy for the sustainable management of rainfed olive orchards. FCT, PTDC/AGR-AAM/098326/2008. CITAB coordinator: Carlos Manuel Correia. Total budget CITAB/UTAD: €93.897. Starting date: March 2010, duration: 36 months.

Developing an adaptive management system for predicting and mitigating damage caused the pine wilt nematode *Bursaphelenchus xylophilus* (Nematoda: Aphelenchoididae) in Portugal. FCT: PTDC/AGR-CFL/098869/2008. CITAB coordinator: Richard Neil Bennett. Total budget CITAB/UTAD: €18.274. Starting date: January 2010, duration: 36 months.

Development of practical low-cost methods for processing sub-products of cereals. Vale I&DT No 11730 (Promotor: Moagem Ceres A. de Figueiredo & Irmão S.A.) CITAB coordinator: Richard Bennett. Total budget CITAB/UTAD: 33.400 Euros. Starting date: April 2010, duration: 12 months.

Direct and indirect impacts of climate change on soil erosion and land degradation in Mediterranean watersheds (ERLAND). FCT, PTDC/AAC-AMB/100520/2008. CITAB coordinator: João Carlos Andrade dos Santos. Total budget CITAB/UTAD: €0. Starting date: 2010, duration: 36 months.

Effect of phytochemicals on organic matter transformation and on key processes of carbon and nitrogen cycles in soil. FCT: PTDC/AGR-AAM/102006/2008. CITAB coordinator: Henrique Trindade. Total budget CITAB/UTAD: €125.680. Starting date: January 2010, duration: 36 months.

Feasibility study of Fertisol chestnut plantations. CITAB coordinator: José Gomes Laranjo. Total budget CITAB/UTAD: €2900. Starting date: April 2010, duration: 12 months.

Functional foods for neuroprotection: a role for *Hypericum perforatum* (Hyperic-Food) PTDC/Agr-Ali/105169/2008. CITAB coordinator: Alberto Carlos Pires Dias. Total budget CITAB/UM: €0. Starting 2010, duration: 36 months.

GrapeBerryFactory - Sugars, acids, phenolics and water on grape berry development and ripening. PTDC/AGR-ALI/100363/2008. CITAB coordinator: Hernâni Varanda Gerós. Total budget CITAB/UM: €155.000. Starting 2010, duration: 36 months.

Lightning activity in Portugal: variability patterns and socioeconomic impacts, RAIDEN. FCT, PTDC/CTE-ATM/101931/2008. CITAB coordinator: Maria Solange Mendonça Leite. Total budget CITAB/UTAD: €47.532. Starting date: 2010, duration: 36 months.

NanoSKIN: Chemotherapeutic agent-loaded nanoparticles for innovative therapy of severe skin diseases – muco-/cutaneous Leishmaniasis and squamous cell carcinoma as examples. CITAB coordinator: Amélia Dias da Silva. Total budget CITAB/UTAD: €0. Starting date: July 2010, duration: 24 months.

NaturAge - Anti-aging properties of natural compounds. PTDC/QUI-BIQ/101392/2008. CITAB coordinator: Cristóvão F. Lima. Total budget CITAB/UM: €145.884. Starting date: May 2010, duration: 36 month.

New bio-products and technologies for valuating *Hypericum* species (HypericumBiotech.) FCT (PTDC/AGR-AAM/70418/2006). CITAB coordinator: Manuel Fernandes Ferreira. Total Budget: €170.000. Starting date: May 2008, duration: 36 month.

“NutriDouro” Healthy crystalised fruits and jams with a traditional flavour. QREN-Comprovação: 13111 (Promotor: Douromel-Fábrica de Confeitaria, Lda). CITAB coordinator: Richard Bennett. Total budget €564.501. UTAD budget: €476.838. Starting date: July 2010, duration: 36 months.

PromoAgro - Promotion of Agro-food Competitiveness. PRJ-11-013. CITAB coordinator: Eduardo Rosa. Total budget CITAB/UTAD: €522.609. Starting date: October 2010, duration: 36 month.

Reconstruction of the past climate in Portugal from borehole temperatures, BOREHCLIM. FCT, PTDC/CLI/66304/2006. CITAB coordinator: Maria Solange Mendonça Leite. Total budget CITAB/UTAD: €0. Starting date: 2008, duration: 36 months.

Trace gas emissions from Portuguese irrigated rice fields in contrasting soils, by the influence of crop management, climate and increase concentration of CO₂ in the atmosphere. FCT, PTDC/CLI/66304/2006. CITAB coordinator: Henrique Trindade. Total budget CITAB/UTAD: €45.360. Starting date: March 2010, duration: 36 months.

Understanding Resistance to Pathogenic Fungi in *Castanea* sp.. ResCast. CITAB coordinator: José Gomes Laranjo. Total budget CITAB/UTAD: €8.400. Starting date: February 2010, duration: 36 months.

WUSSIAAME - Water use, survival strategies and impact of agrochemicals on water resources in agricultural Mediterranean ecosystems. PTDC/AAC-AMB/100635/2008. CITAB coordinator: Aureliano Malheiro. Total budget CITAB/UTAD: €51.574. Starting date: February 2010, duration: 36 months.

ClimVineSafe - Short-term climate change mitigation strategies for Mediterranean vineyards. PTDC/AGR-ALI/110877/2009. CITAB coordinator: José Moutinho-Pereira. CITAB/UTAD budget: €111.456.00. Starting date: April 2011, duration: 36 months.

Strategic Project - UI 4033 - 2011-2012. PEst-C/AGR/UI4033/2011. CITAB coordinator: Eduardo Rosa. CITAB/UTAD budget: €439.634. Starting date: January 2011, duration 24 months.

OlivaTMAD - Thematic Networks of Information and Dissemination of Olive Cultivation Line of Trás-os-Montes and Alto Douro. Project PRODER. CITAB coordinator: Eduardo Rosa. Total budget CITAB/UTAD: €241.791. Starting date: January 2011, duration: 54 months.

Infowine - Thematic Networks of Information and Dissemination. Action 4.2.2/PRODER. CITAB coordinator: Eduardo Rosa. Total budget CITAB/UTAD: €61.139,50. Starting date: January 2011, duration: 36 months.

Myrtillus with innovation, PRJ-11-029, QREN. CITAB coordinator: Ana Paula Silva. CITAB/UTAD budget: €158.393. Starting date: December 2010, duration: 36 months.

EcoDeep - Eco-efficiency and Eco-management in the Agro-Food sector. Project QREN. COMPETE - SIAC - AAC 01/SIAC/2011. CITAB coordinator: Henrique Trindade. Total budget CITAB/UTAD: €114.625. Starting date: September 2011, duration: 24 months.

In-Nitro: conceptualizing the effects of increased nitrogen availability in a Mediterranean ecosystem. PTDC/BIA-ECS/122214/2010. CITAB coordinator: Henrique Trindade. Total budget CITAB/UTAD: €15.411. Starting date: January 2011, duration: 36 months.

CLIFE - Alterações climáticas nos episódios extremos de precipitação na Península Ibérica e seus mecanismos forçadores. FCT, PTDC/AAC-CLI/111733/2009. CITAB coordinator: João Santos. CITAB/UTAD budget: €37.409. 2011-2014.

Molecular mechanisms of Agrobacterium recognition and defense activation in recalcitrant plant species. – How do recalcitrant plants avoid T-DNA transfer? PTDC/AGR-GPL/119211/2010. CITAB coordinator: Franklin Gregory. Total budget CITAB/UM: €153.000. Starting date: December 2011, duration: 36 months.

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Malheiro A.C., Santos J.A., 2011. Macrozonagem vitivinícola da Península Ibérica face a cenário de alteração climática. In Jorge Böhm (Ed.), Atlas das Castas da Península Ibérica: História, Terroir, Ampelografia (pp. 155–159). Portugal: Dinalivro.

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Masters and Ph.D.theses completed

MSc: Breia, R.M.G.. Study of the photosynthesis and of the metabolism of sugars and organic acids during the development and ripening of the grape berry. Supervisors: Hernâni Gerós, Ana Cunha.

MSc: De-Jesus, D.L.F.. Beta-cell reserve in insulin resistant pregnant mice. Mestrado em Biologia Clínica Laboratorial, Universidade de Trás-os-Montes e Alto Douro. Supervisors: Amélia M. Lopes Dias da Silva, Rohit Kulkarni (Joslin Diabetes Center, Harvard Medical School, Boston, USA).

MSc: Esteves, C.A.C.. Minimização dos efeitos do défice hídrico em *Quercus suber* L. com a aplicação de ácido salicílico. Mestrado em Engenharia Florestal, Universidade de Trás-os-Montes e Alto Douro. Supervisors: Carlos Manuel Correia, José Moutinho Pereira.

Msc: Jesus, J.M.O.. Gestão integrada de efluentes de piscicultura intensiva através de Leitões de Macrófitas: Remoção de nutrientes e valorização da biomassa vegetal. Mestrado em Ciências e Tecnologia do Ambiente, Faculdade de Ciências da Universidade do Porto. Supervisors: Maria Teresa Borges (FCUP), Isabel Aguiar Pinto Mina.

MSc: Khamsalath (Erasmus-Mundus Graduate student 2011) thesis entitled “Micropropagation and improvement of rosmarinic acid content in *Ocimum sanctum* cultures via plant growth regulator manipulation and genetic transformation” (Dept Biology, University of Minho). Co-Supervisor Franklin Gregory.

MSc: Macedo, P.J.. Técnicas Culturais para Minimizar o Stress Estival na Viticultura Duriense: Efeito do Caulino e da Calda Bordalesa. Mestrado em Engenharia Agronómica, Universidade de Trás-os-Montes e Alto Douro. Supervisors: José Moutinho Pereira, Carlos Manuel Correia.

Msc: Névoa, S.M.A.. Caracterização Técnica das Estações de Tratamento de Água para Consumo Humano em Portugal. Mestrado em Gestão Ambiental, Departamento de Engenharia Biológica, Escola de Engenharia da Universidade do Minho. Supervisors: Olívia Pereira (DEB-UM), Isabel Aguiar Pinto Mina.

MSc: Ribeiro, M.J.R.. Creation and characterization of mitochondrial DNA-depleted human Huntington’s disease and control derived lymphoblasts. Mestrado em Biotecnologia para as Ciências da Saúde, Universidade de Trás-os-Montes e Alto Douro. Supervisors: Amélia M. Lopes Dias da Silva, Ana Cristina Rego (FMUC, CNCBC-UC).

Msc: Rocha, P.S.F.. Acompanhamento analítico e avaliação do desempenho operacional da ETAR de Febros (Vila Nova de Gaia). Mestrado em Ciências e Tecnologia do Ambiente, Faculdade de Ciências da Universidade do Porto. Supervisors: Maria Teresa Borges (FCUP), Isabel Aguiar Pinto Mina.

MSc: Rodrigues, A.. “Functional characterization of purified vacuoles and evaluation of their role in yeast apoptosis induced by acetic acid”. Supervisors: Manuela Côrte-Real (CBMA, Universidade do Minho), Hernâni Gerós.

MSc: Silva, E.I.M.. Avaliação da actividade anti-bacteriana de extractos de dois arbustos Mediterrânicos, *Arbutus unedo* L. e *Rhus coriaria* L e estudo das suas características fisiológicas. Mestrado em Análises laboratoriais, Universidade de Trás-os-Montes e Alto Douro. Supervisors: Eunice Areal Bacelar, Ana Cristina Sampaio.

Msc: Simões, M.C.. Aplicação Multimédia para o apoio à Caracterização Ampelográfica de Castas. Mestrado em Comunicação e Multimédia, Universidade de Trás-os-Montes e Alto Douro. Supervisors: João Paulo Moura, Ana Alexandra Oliveira.

Patents/prototypes

N/A

Organization of conferences

“Opening of the School Year of BioPlant”, 2 Mar . Alberto Dias as member of Local Org. Commit.

Curso Avançado “Oxidative Stress and Antioxidants”, 24 Oct - 4 Nov, UMinho. Alberto Dias as member of Local Org. Commit.

2nd Annual BioPlant Workshop, 18 April, UMinho. Alberto Dias as member of Local Org. Commit.

2nd WS BioPlant (UMinho), 28 Feb-4 Mar, Alberto Dias as member of Local Org. Commit.

2nd GP-TCM Annual General Meeting (AGM), Braga, Portugal, 22-24 July. Alberto Dias as member of Local Org. Commit.

“Traditional Chinese Medicine Symposium”, (UM, Braga, Portugal, 21st July). Alberto Dias as member of Local Org. Commit.

“Molecular Nutrition: dietary phytochemicals and age-related disease prevention”, Advanced Course, Post-Graduate Training Programme 2011, Braga (Portugal), May 23 - June. Cristóvão Lima as member of Local Org. Commit.

Jornadas “Da Oliveira ao Azeite – Novos Desafios”, UTAD, Vila Real, 12 Oct. Henrique Trindade and others as members of Org. Commit.

“II Jornadas de Bioquímica “Horizontes da Bioquímica”. U Minho. Hernâni Gerós as member of Org. Commit.

Organization of the third meeting of the RAIDEN project. UTAD, Vila Real. João Santos as Member of the Scientific Commit.

“International Conference on Ecohydrology and Climate Change (EcoHCC2011)”, Inst. Polit. Tomar, Tomar. João Santos as Member of the Scientific Commit.

“7th Symposium on Meteorology and Geophysics, the 12th Luso-Spanish Meeting on Meteorology and the XIV Latin American and Iberian Congress on Meteorology”,

Associação Portuguesa de Meteorologia e Geofísica (APMG), Setúbal. João Santos as Member of the Scientific Commit.

“I Simpósio Nacional Castanheiro”, Trancoso, 11 - 12 Nov. José Gomes Laranjo as member of Org. Commit.

“V Jornadas de Biologia”. UTAD, Vila Real, 26 - 28 Oct. José Gomes Laranjo, Ana Sampaio, Amélia Silva and others as members of Org. Commit.

“II Chestnut European Meeting- Production and Marketing”, IPB, Bragança, 16 - 17 Jun. José Gomes Laranjo and others as members of Org. Commit.

“II European Interprofessional Meeting on Chestnut”. IPB, Bragança, 20-22 Jun. José Gomes Laranjo as member of Org. Commit.

“Optical techniques for the in vivo study of photosynthesis - Advanced Techniques of the BioPlant Doctoral Programme”. U Aveiro, 4-8 Jul. Ana Cunha as members of Org. Commit.

Curso Avançado “Uso da água e gestão da rega. Resultados obtidos em vinha no âmbito de projectos”. Dois Portos, 2-3 Jun. Aureliano Malheiro as member of Org. Commit.

“International Conference on Ecohydrology and Climate Change”, EcoHCC11, Cristina Maria Mendes Andrade as Chair of the Org. Commit.

II Jornadas Temáticas do CITAB “Mercado de Carbono – um caminho para a sustentabilidade do sistema agroalimentar”, UTAD, Vila Real, 15 Dec. Eduardo Rosa as Chair of the Org. Commit.

Industry contract research

N/A

Internationalization

Among others, SAC researchers have active and effective collaborations in several activities:

Project #05 – Agronomy, climate change & environmental studies (ACES)

Aristotle Univ. of Thessaloniki (Greece) (Prof. Filippos Aravanopoulos); FP7 consortium.

Biocentrum - Technical University of Denmark: join research (consultant) and publications; Active FCT Project (2010-2012).

Consejo Superior de Investigaciones Científicas (CSIC) Estación Experimental del Zaidín (Spain); Dr^a Mercedes Campos Aranda is co-adviser of a FCT funded PhD thesis.

CRA, Consiglio per la Ricerca e la Sperimentazione in Agricoltura, Italy, (Dr. Damiano Avanzato): Join social ecological actions, divulgation book.

CRAB, Consorzio di Ricerche Applicate alla Biotecnologia, Italy, (Dr. Daniela Spera): Samples Analyses, and join EC project.

ENEA, Ente per le Nuove Tecnologie, l'Energia e l'Ambiente, Italy, (Dr. L. Bacchetta): Active AGRI GEN RES (EC) project (2007-2010), join research and communications in International Congress.

Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (Spain) Subdirección General de Investigación y Tecnología; "Red ibérica de evaluación de eficacia y efectos secundarios de tratamientos para el control de plagas en el olivar (Proyecto/Acción nº AC2009-00045-00-00).

Institut de Recerca i Tecnologia Agroalimentàries (IRTA), Spain (Dr. Mercè Rovira): Join research and communications in International Congress, join EC project.

Lundbeck Pharmaceuticals: join research (consultant) and publications; Active FCT Project (2010-2012).

NAGREF - National Agricultural Research Foundation (Greece): (Prof Setefanos Diamandis), submitted FCT Project (2009); (Dr Pavolina Drogoudi and Dr. Metzidakis, Institute of Olive Trees and Subtropical Plants), Samples Analyses.

Plant Research International B.V. Wageningen, NL (Doctor Rene van der Vlugt): Join research and join publications.

Univ. Santiago Compostela: (Prof Santiago Pereira Lorenzo), FP7 consortium, book chapter and collaborations in INTERREG projects; (Prof. Cristina Cabaleiro), Join supervision of PhD student and join publications.

Univ. Torino (Italy); Prof Roberto Botta; FP7 consortium.

Univ. Zagreb (Prof. Mirna Curkovic-Perica): FP7 consortium.

Project #06 – Added-value plant products & co-products (APPC)

GRAB, Agropark (France) (Sophie Joy Ondet) Colaboration in Ph.D work programme, FCT Grant SFRH(BD/63468/2009).

HelmhotzZentrum Munchen – Institute of Stem Cell Research (ISF) (Germany): active FCT project PTDC/AGR-ALI/105169/2008.

King's College, London (UK): active project “Good Practice in Traditional Chinese Medicine Research in the Post-genomic Era (Acronyme: GP-TCM)” European Project (Cooperation).

KNUST, Ghana (Mr. Newton Amaglo): Ghanaian Plant Samples & Joint Papers.

Max Plank Institute (Cologne): Students Exchange (PhDs), Active Projects & Joint Papers.

SGGW, Poland (Prof. Ewa Rembiałkowska): Student Exchange (Erasmus), Active Projects & Joint Papers.

Swiss Federal Institute of Technology in Lausanne (Switzerland) & College of Engineering and Technology, University of Dar es Salaam (Tanzania) (Dr. Markus Schneider-Mmary): Sample Exchanges/Analyses & Joint Papers.

Univ. Bordeaux, France (Prof. Stéphane Quideau): Phytochemical Standards & Joint Papers.

Univ. Messina, Italy (Prof. Bruno Lo Curto): Sample Analyses & Joint Papers.

Univ. Novara, Italy (Prof. Marco Arlorio & Dr. Monica Locatelli): Sample Exchanges/Analyses & Joint Papers.

Univ. São Paulo (Prof. Beatriz Cordenunsi): Sample Analyses & Joint Papers.

Univ. Sri Jayewardenepura, Sri Lanka (Prof. KDDS Ranaweera): Joint Supervision of PhD Students, Provision of Sri Lankan Plant Samples, Joint Review Paper in 2010.

Univ. de Bordeaux – ISVV, France (Serge Delrot): Purification of protoplasts and intact vacuoles from grape berry tissues; transport experiments and molecular studies, proteomic and metabolomic analyses. Co-supervision of a PhD thesis and joint papers.

Univ. de Montpellier, Ecole Polytechnique (France) (Pascale Chalier) Collaboration in Ph.D work programme, FCT Grant SFRH(BD/63468/2009).

Univ. of Aarhus (Denmark) (Prof. Suresh Rattan): Scientific Advisement and Joint Papers.

Univ. of Leiden (Netherlands) (Robert Verpoorte): Metabolomics - Collaboration in the Ph.D work programme FCT Grants SFRH/BD/42513/2007.

Government/Organization contract research

N/A

5.1.6 – Future research

We have set out the following specific objectives:

Project #05 – Disturbance and management of forest, agro-forested and agricultural ecosystems

Task #5.01 - Climate variability and environmental impacts

Study of dynamic mechanisms underlying the occurrence of precipitation and temperature extremes in Portugal and in Europe (e.g. identification of dynamical precursors) and their associated hydrological impacts will be the most important goals of this task.

More detailed studies on viticultural zoning in Europe will be undertaken using state-of-the-art observational datasets. The inter-annual variability of several bioclimatic indices relevant to viticultural zoning will be assessed in greater detail (by applying multivariate statistical approaches) and related to the atmospheric large-scale circulation;

Task #5.02 – Biodiversity as a potential resource for sustainable development: Selection, characterization and conservation of plant resources

Chestnut fruit polispermic tendency will be analysed by controlled pollinations using different *C. sativa* pollinators. A germ bank will be prepared to preserve different genotypes from Côta variety; genotypic screening using molecular markers will be carried out. A project is in preparation for submission to the European commission – “Community programme on genetic resources in agriculture”, with partners from 6 countries to continue the studies on the Safenut project. Studies on chestnut metabolite composition will continue. Analyses on fibre, organic acids and phenolics compounds will be carried out on wild blueberries.

Task #5.03 – Environmental stresses. Improvement of cropping practices and mitigation measures

We will focus on the implementation of two FCT projects: “Short-term climate change mitigation strategies for Mediterranean vineyards” and “Cover cropping - the decisive strategy for the sustainable management of the rainfed olive orchards”; other activities will include studies on the chestnut interaction with abiotic and biotic factors to develop greater resistance to ink disease.

Task #5.04 – Nutrients cycles, processing and reuse of animal and agro-food residues

Gas emission measurements from stored animal slurries will be made following chemical and biological treatment methods. The kinetics of gas emissions will be

assessed under temperature scenarios corresponding to winter and summer conditions. We will investigate the effects of phytochemical compounds on the composting process and degradation pattern of compounds during the composting process.

Assessment of ammonia and greenhouse gas emissions from rice paddies in Mediterranean conditions under elevated atmospheric CO₂ and temperature will continue and associations between gas emissions and cropping practices, soil type, climatic parameters, and N cycle key-processes, like nitrification will be studied.

Project #06 – Plant products and co-products (3P's)

Task #6.01 – Food Composition and Health Effects

Continued analytical support for researchers in SAC/CITAB and other Researchers/Research Centers in UTAD – specifically further development of collaborations with CECAV. We aim to increase critical mass in the cell model area, a key research area for studying the health effects of dietary phytochemicals. This will be partly developed through an FCT funded post-Doctoral scholarship, a new project and scholarships proposals in 2011. In parallel with the co-products area (6.01) we will further development fundamental nutrient and compositional studies via international and national project proposals involving Anchor Institutes, Stakeholders (Ceres) and International Collaborators.

Task #6.02 – Added-Value Products from Agro-Food Wastes

Phytochemical biopesticides and “green manures”: we aim to identify effective natural products (phytochemicals and secondary metabolites from non-plant organisms) that can be used in the food chain to control economically important pathogens, food pests and also diseases of animals and humans e.g. pesticide resistant bacterial and fungal pathogens of crops and antibiotic resistant bacteria in animals and humans. This research involves researchers from ACES and 3Ps and also an important collaboration with the Microbiology group of CECAV.

Functional Food Compounds from Agro-Food Wastes: Agro-food wastes have great potential as sources of functional food ingredients including phytochemicals, dietary fibre and important nutrients and minerals. This sub-task involves collaboration between ACES and 3Ps and also the Animal Nutrition group in CECAV.

Task #6.03 – MAP Biotechnology & bioactivities

Study of results on solute (sugars/acids/phenolics) transport/metabolism in grapevine, under the effect of heat and drought. Evaluation of the utilization of biological control agents and biopesticides against esca e vineyards is underway and is expected to produce results in 2012. We will study the effect of plant polyphenols on intestinal SGLT1 glucose transporters, insulin secretion from beta-cells, mechanisms of colon anti-cancer effects. We will also study the use of plant extracts for obtaining functional foods with antioxidant and neuroprotective

activities. The nanoencapsulation of plant extracts and selected compounds with the aim of brain targeting will be studied.

Task #6.04 – Grape berry biochemistry & quality

Study of results on solute (sugars/acids/phenolics) transport/metabolism in grapevine, under the effect of heat and drought. Evaluation of the utilization of biological control agents and biopesticides against esca e vineyards is underway and is expected to produce results in 2012.



5.2 – EcoinTEGRITY

5.2.1 – Group description

Principal Researcher	Rui Manuel Vitor Cortes/Mário Gabriel Santiago dos Santos
Research area	Environment
Home Institution	Universidade de Trás-os-Montes e Alto Douro

5.2.2 – Funding

	2009	2010	2011
FCT Projects	166.288,00 €	638.918,00 €	198.741,97 €
Other (National)	1.042.492,26 €	1.659.081,45 €	354.076,08 €
Other (International)	503.550,00 €	80.000,00 €	0,00 €
Industry (National)	0,00 €	15.000,00 €	85.150,45 €
Industry (International)	0,00 €	0,00 €	0,00 €
Total	1.712.330,26 €	2.392.999,45 €	637.968,50 €

5.2.3 – Objectives

Research in this group focuses on ecosystem characterization (natural or changed by human activities) at different scales of observation. Results are used to select appropriate ecological indicators or ecosystem processes that allow modelling the different components, dynamics and to set guidelines for ecosystem management, namely the conservation of natural resources, biodiversity and the restoration of disturbed areas or target species. The EI Group research is grouped into two main projects:

Project #03 – Biodiversity, Environmental Assessment and Biotechnology

This project studies the effects of large-scale environmental change on the sustainability, resilience and diversity of disturbed natural ecosystems and agro-systems. The aim is: (i) to create appropriate tools for capturing and predicting the dynamics, structure and function of terrestrial and aquatic ecosystems affected by human disturbance over different spatial and temporal scales. (ii) To develop and promote appropriate management plans, based on the ecological assessment of different components of the natural community, in order to rehabilitate or restore degraded systems.

Task #3.01 – Studies on climate variability and extreme events on the dynamics of running waters and regulated rivers, including the interaction with human impacts

This task aims to continue to add to large-scale spatiotemporal data sets and assess combinations of biological indicators of catchment condition, landscape change and climate change on freshwater systems (natural and artificial).

Task #3.02 - Effect of water contamination in fish populations (reproduction, histopathological changes, oxidative stress, detoxification mechanisms)

The overall aim is the use of biomarkers as an “early warning system” linked to sub-organism level processes, allowing quick and predictable associations to be established between obtained results and particular stressor agents. This will provide valuable information on the effect of different sources of water contamination.

Task #3.03 – EU directive compliant River rehabilitation

This task is multidisciplinary, taking into account broad temporal and spatial dimensions and the use of bioindicators, physicochemical and hydromorphological elements to characterise and restore aquatic habitats and riparian ecotones. The following 5 actions are considered:

- a) Sampling programmes for assessing the use of bioindicators in the integrated bioassessment of environmentally degraded streams and rivers in Northern Portugal.
- b) Monitoring and compensatory/restoration/requalification measures for aquatic ecosystems and organisms affected by the construction of large dams.
- c) Contribute to the WFD oriented planning, development and execution of regional freshwater monitoring and management and planning of aquatic resources.

- d) Assess the use land-use and pressure parameters as predictors of ecological quality across different river typologies.
- e) Development and implementation of river restoration and requalification programmes.

Task #3.04 - Dynamic and spatially dynamic modelling to predict ecological indicators associated with different impacts, functional biodiversity and the planning of endangered species conservation

Stochastic Dynamic Methodology (StDM) is a sequential modelling process that predicts the ecological status of altered ecosystems. StDM can be complemented by agent-based modelling approaches (ABM), for predicting the response of ecological indicators to anthropogenically induced change.

- a) Initiate studies on the use of long term monitoring data and dynamic modelling for predicting regional ecological diversity.
- b) Initiate studies on the effect of climate change and anthropogenic factors on ecological processes in reservoirs.

Task #3.05 - Application of microorganisms in biotechnology and in nutrient cycling

This task studies how autochthonous bacteria, yeasts and fungi can be used in bioremediation, agro-food and forestry by product processes and as functional indicators of ecological quality. Agro-industry generates several sub-products, such as residual waters with high polluting potential from olive oil processing industries and wine production.

- a) Contribute to the sustainable management of olive orchards
- b) Study of the integrated use of industrial by-products of agro-food and forestry companies in the production of biodiesel and animal feed
- c) Assess the role of ecological function (fungal decomposition) in river bioassessment methods.
- d) Contribute to studies in the optimization of ecosystem services in the demarcated Douro region.

Task #3.06 - Increasing functional biodiversity in olive groves to enhance conservation biological control of insect pests

The aim of this task is to evaluate the possibilities of practical improvements to protect against natural enemies in olive agro-ecosystems via conservation biological control methods. The focus of these habitat manipulations involves the

evaluation of native plant species for provision of essential food sources, to natural enemies, thus enhancing their survival, fecundity, longevity and behavior and thereby increasing their effectiveness.

Task #3.07 - Maximizing ecosystem services provided by Douro Wine Region vineyards

A significant area of non-crop habitats occurs in the Douro Wine Region vineyards, whose importance for the conservation of a wide range of biota is known. The goal is to help promoting an habitat management strategy that can broaden the range of ecosystem services provided to society, so that in addition to producing the famous port wine, they are able to deliver a range of 'stacked' services (e.g. biocontrol of pests, diseases and weeds, maintenance of soil fertility, provision of clean air and water, regulation of climate, add of aesthetic values to the area and provision of food for locally rare endemic birds, reptiles and insects).

Project #04 – Disturbance of forest and agro-forested ecosystems

This project focuses on ecological abiotic (mainly fire) and biotic disturbance that act on forests, woodlands and agro-forestry systems. The aim is to characterize spatial and temporal patterns, regimes of disturbance and develop management-oriented guidelines towards mitigation and adaptation to disturbance.

Task #4.01 - Fire ecology and management

This task seeks to better understand the physical characteristics of fire and its effects and ecological role. It comprises two sub-tasks:

- a) Behaviour and ecology of fire in Mediterranean forest types, with an emphasis on the post-fire response and regeneration of overstorey vegetation.
- b) Fire-adapted silviculture and fire management systems, including the use of prescribed burning in the mitigation of fire hazard and the analysis of current fire management practices and policies.

Task #4.02 - Fire regime analysis

This task is dedicated to the analysis of the Portuguese fire regime, using the Forest Service atlas of fire perimeters and GIS tools. It has two sub-tasks:

- a) Analysis of trends, temporal and spatial variability and correlation with fire factors related with forest fire events (e.g., weather, climate, human activities). Geostatistical methods are used to detect spatiotemporal clustering of point-database for past fire events and to foresee the continuity of current and the development of new clusters in the future.

- b) Analysis of the role of vegetation in the Portuguese fire regime, describing and quantifying how fuel age and landscape pyrodiversity control the fire regime. Analyses are focused on fire frequency, burnt surface and fire size, and integrate the influence of weather conditions and human pressure.

Task #4.03 - Conservation of the blue alcon butterfly (*Maculinea alcon*)

This task targets the ecology of the blue alcon butterfly *Maculinea alcon*, the only representative of its genus and a rare resident butterfly in Portugal. Studies are carried out on the availability of host plant and host-ant species and the quality of potential habitats.

5.2.4 – Main achievements

Project #03 – Biodiversity, Environmental Assessment and Biotechnology

- a) Regional bioindicators of environmental stress in aquatic ecosystems were defined, with emphasis on benthic macroinvertebrate assemblages, for all North Portugal. The relationship between soil use and aquatic habitats (and their biota) was established, especially the role of landscape metrics. Integrated tools for river hydromorphological rehabilitation actions have been defined. Restoration projects have been drawn up and implemented in several catchments. Important contributions have been made on the ecology of protected species of Bivalvia.
- b) Validation of biomarkers for contamination assessment in fish species, such as the effects of heavy metals and endocrine disruptors using biochemical, histological, physiological and molecular biomarkers. Rupture of DNA chains has been recently used for the same purpose. The complementary role of these techniques in detecting emergent pollutants in the aquatic environment has been an important achievement over 2011.
- c) A novel spatially explicit modelling framework was developed and tested (and will be published in 2012). The model predicts ecological indicator responses to realistic scenarios of environmental changes. This has been achieved by integrating Multi-Model Inference statistical analysis, Stochastic-Dynamic Modelling and Geographic Information Systems within a common framework that relates ecological trends to changes in surrounding habitats and environmental conditions at local and regional levels.
- d) In regards to the biological control of insect pests in olive groves through biodiversity the role of *Foeniculum vulgare* flowering plants in the longevity increment of the predator *Chrysoperla carnea* was shown; the effect of *Hyadaphis foeniculi*, an aphid hosted by *Foeniculum vulgare* and/or of its honeydews in stimulating oviposition by *C. carnea* was shown; The effect of *Saissetia oleae* honeydew on the increment of *C. carnea* longevity, progeny production and progeny sex ratio was demonstrated.

Project #04 – Disturbance of forest and agro-forested ecosystems

- a) A model for regional fire incidence in Portugal as a function of past fire incidence and weather has been developed. Fire frequency in Portugal (1975-2008) was modelled from fuel age, and accounting for the effect of varying fire weather severity.
- b) Correction and analysis of the temporal characteristics (including trends) and other properties (e.g., completeness) of the fires in Portugal resulted in the release to the community of the Continental Portuguese Rural Fire Database.
- c) The effects of climate on population dynamics of the pine processionary moth (*Thaumetopoea pityocampa*) were determined, by modelling insect outbreaks under different scenarios for future climate conditions.
- d) Advances were made regarding the ecology of the life cycle of the threatened blue alcon butterfly (*Phengaris alcon*).

5.2.5 – Group productivity

International Projects

Advances in Homogenization Methods of Climate Series: an Integrated Approach (HOME). ESF, COST ACTION 306/06. Project coordinator CITAB: Mário Jorge M. Gonzalez Pereira. Total budget CITAB/UTAD: 0 Euro.

Forest fires under climate, social and economical changes in Europe, the Mediterranean and other fire-affected areas of the world (FUME). FP7, ENV-243888-2009. Project coordinator CITAB: Mário Jorge M. Gonzalez Pereira. Total budget CITAB/UTAD: 0 Euro. Starting date: 2010, duration: 36 months.

Projecto MARCADUERO: “MARCA DUERO DURADERO: Sostenibilidad, Calidad y Promoción”. INTERREG IVA, POCTEP). Project coordinator CITAB: António Crespí.

Post-fire Forest Management in Southern Europe. ESF, COST Action FP0701. Project coordinator CITAB: Paulo M. Fernandes. Total budget CITAB/UTAD: 0 Euro. Starting date: 2008, duration: 60 months.

National Projects

“Conhecer é Proteger”. ON.2/QREN. Project coordinator CITAB: António Fontaínhas Fernandes. Total budget CITAB/UTAD: 65.383,56 Euro. Starting date: 2010, duration: 24 months.

An Integrative Study on the Toxipathic Lesions in Portuguese Estuarine Fishes – Assessing Injury Impact and Toxicogenomic Implications in Experimental Modes. FCT, PTDC/MAR/70436/2006. Project coordinator CITAB: António Augusto Fontainhas Fernandes. Total budget CITAB/UTAD: 19.820,00 Euro.

AQUARIPOINT – National monitoring programme of freshwater fish resources and ecological monitoring of river systems. National Forest Authority. Project coordinator CITAB: João M. Oliveira. Total budget CITAB/UTAD: 36.000,00 Euro. Starting date: 2010.

Biomonitorization in rivers: an integrated approach. FCT, PTDC/BIA-ECS/114859/2009. Project coordinator CITAB: Rui M. V. Cortes. Total budget CITAB/UTAD: 189 521,00 Euro. . Starting date: 2010, duration: 36 months

Boticas Park: Nature and Biodiversity. Boticas Municipal Council. Project coordinator CITAB: António Fontainhas-Fernandes. Total budget CITAB/UTAD: 176.280,00 Euro.

Compensatory measures MC 10 – Programme for the protection and assessment of reptiles, amphibians and invertebrates in the Sabor valley as part of the Sabor Hydroelectric scheme. PROFICO Ambiente. Project coordinator CITAB: Rui M. V. Cortes. Total budget CITAB/UTAD: 25.000,00 Euro.

Compensatory measures MC 9 – Programme for the protection and assessment of riparian avifauna in the NW Transmontano region; part of the Sabor Hydroelectric scheme PROFICO Ambiente. Project coordinator CITAB: João A. Cabral. Total budget CITAB/UTAD: 85.257,33 Euro.

CONBI: Biodiversidade e Conservação de Bivalves - informação ecogeográfica, genética e fisiológica. Project coordinator CITAB: Simone Varandas.

Cover cropping: the decisive strategy for the sustainable management of the rainfed olive orchards. FCT, PTDC/AGR-AAM/098326/2008. Project coordinator CITAB: José Albino Alves Dias. Total budget CITAB/UTAD: 93.847,00 Euro.

Desenvolvimento de inóculos micorrízicos e aproveitamento micológico em áreas marginais. QREN/Agência de Inovação, microproject 1589. Project coordinator CITAB: Guilhermina Marques. Total budget CITAB/UTAD: 418.764,91 Euro. Duration: 36 months

Effect of phytochemicals on organic matter transformation and on key processes of carbon and nitrogen cycles in soil. FCT, PTDC/AGR-AAM/102006/2008. Project coordinator CITAB: Guilhermina Marques. Total budget CITAB/UTAD: 125.660,00 Euro. Starting date: 2010, duration: 36 months.

Evolution of North Atlantic Climate; the role of Blocking and Storm-tracks in the Past, Present and Future climate of Southern Europe (ENAC). FCT, PTDC/AAC-CLI/103567/2008. Project coordinator CITAB: Mário Jorge M. Gonzalez Pereira. Total budget CITAB/UTAD: 0 Euro. Starting date: 2010

Factors affecting the post-fire natural regeneration variability in *Pinus pinaster* and *Eucalyptus globulus* in Portugal: implications for biodiversity and post-fire management. FCT, PTDC/AGR-CFL/099420/2008. Project coordinator CITAB: Paulo Alexandre Martins Fernandes. Total budget CITAB/UTAD: 38.338,00 Euro. Starting date: 2010, duration: 36 months.

FIRE-ENGINE - Flexible design of forest fire management systems. FCT, MIT/FSE/0064/2009. Project coordinator CITAB: Paulo Alexandre Martins Fernandes. Starting date: 2011, duration: 36 months.

FIREGLOBULUS - Utilização de fogo controlado em eucaliptal. QREN - SI I&DT - Co-Promoção - 2011/021555. Project coordinator CITAB: Paulo Alexandre Martins Fernandes. Starting date: 2011, duration: 36 months.

Fire - Land - Atmosphere Inter-Relationships: understanding the processes to predict wildfire regimes in Portugal (FLAIR). FCT, PDC/AAC-AMB/104702/2008. Project coordinator CITAB: Mário Jorge M. Gonzalez Pereira. Total budget CITAB/UTAD: 21.240,00 Euro. Starting date: 2010, duration: 36 months.

ForeStake - the role of local agents in the success of forestry politics in areas affected by fire in Portugal. FCT, PTDC/AGR-CFL/099970/2008. Project coordinator CITAB: Paulo M. Fernandes. Starting date: 2010, duration: 36 months.

Increasing functional biodiversity in olive groves to enhance conservation biological control of insect pests. FCT, PTDC/AGR-AAM/100979/2008. Project coordinator CITAB: Laura M. Torres. Total budget CITAB/UTAD: 107.800,00 Euro. Starting date: 2010, duration: 36 months.

Inventory and monitoring plan for target species in Sernancelhe: Freshwater Pearl Mussel (*Margaritifera margaritifera*), Lusitanian Salamander (*Chioglossa lusitanica*), The Pyrenean Desman (*Galemys pyrenaicus*), the Iberian Wolf (*Canis lupus signatus*). Project coordinator CITAB: João A. Cabral. Total budget CITAB/UTAD: 73.791,90 Euro. Starting date: 2010, duration: 48 months.

Maximização dos Serviços do Ecossistema na Vinha da Região Demarcada do Douro. PRODER. Project coordinator CITAB: Laura M. Torres.

Monitoring of avifauna in the future area of the electricity lines at PE Alto da Coutada. ECOSFERA. Project coordinator CITAB: João A. Cabral. Total budget CITAB/UTAD: 7.765,33 Euro.

Monitoring of avifauna in the Montesinho Natural Park. Airtricity. Project coordinator CITAB: João A. Cabral. Total budget CITAB/UTAD: 12.961,33 Euro.

Monitoring of Avifauna in the Negrelo and Guilhado Wind Parks. ECOSFERA. Project coordinator CITAB: João A. Cabral. Total budget CITAB/UTAD: 7.386,67 Euro.

Monitoring of bird activity and mortality by towers for measuring eolic potential Montesinho Serra. Airtricity. Project coordinator CITAB: João A. Cabral. Total budget CITAB/UTAD: 11.301,33 Euro.

Monitoring of ecosystems in the Penedo Ruivo, Seixinhos and Mafômedes wind parks. EnergieKontor. Project coordinator CITAB: João A. Cabral. Total budget CITAB/UTAD: 23.040,00 Euro.

Monitoring of impacts on avifauna and habitat and vegetation distribution in the Mafômedes wind park, including monitoring of the effect of excluding birds from the associated electricity power cable. EnergieKontor. Project coordinator CITAB: João A. Cabral. Total budget CITAB/UTAD: 11.494,40 Euro.

Monitoring of Quiroptera in the Negrelo e Guilhado wind parks. ECOSFERA. Project coordinator CITAB: João A. Cabral. Total budget CITAB/UTAD: 4.312,00 Euro.

Monitoring River Cávado (impact of Salamonde II) LABELEC Project coordinator CITAB: Rui M. V. Cortes. Starting date: 2011, duration: 3 months. 9.000 Euro.

Ovary apoptosis in zebrafish (*Danio rerio*): pathways characterization, role in sexual differentiation and as endocrine disruptors. FCT, PTDC/CVT/102453/2008. Project coordinator CITAB: Ana Coimbra. Starting date: 2010, duration: 36 months.

Pinheiro silvestre em Portugal: o "extremo sudoeste" ou apenas "o fim"? PTDC/AGR-CFL/110988/2009. Project coordinator CITAB: Domingos Lopes. Total budget CITAB/UTAD: 198.041 Euro.

Project PISCES: Development of a behavioural barrier for fish. AID/Original Consulting Project coordinator CITAB: Rui M. V. Cortes. Total budget CITAB/UTAD: 182.068 Euro. Starting date: 2010, duration: 36 months.

Rehabilitation of riparian áreas of R. Odelouca Águas do Algarve Project coordinator CITAB: Rui M. V. Cortes. Starting date: 2010, duration: 18 months. 15.000 Euro.

Requalification of the banks of the Lima Estuary in the areas of Cardielos and Portuzelo. Viana do Castelo Municipal Council. Project coordinator CITAB: Rui M. V. Cortes. Total budget CITAB/UTAD: 40.000,00 Euro. Starting date: 2010, duration: 18 months.

Requalification of the R Castanheira (R. Tinto). Metro do Porto Project coordinator CITAB: Rui M. V. Cortes. Total budget CITAB/UTAD: 20.000 Euro. Starting date: 2010, duration: 10 months.

SeivaCorgo. ON2/QREN, Vila Real Municipal Council. Project coordinator CITAB: António Augusto Fontainhas Fernandes. Total budget CITAB/UTAD: 184,021.64 Euro.

Technical and scientific support to INAG on the complaint lodged in Brussels concerning the “Plano Nacional de Barragens de Elevado Potencial Hidroelétrico”. Project coordinator CITAB: Rui M. V. Cortes. Starting date: 2010, duration: 18 months.

The regulatory role of “aziniais” in the propagation of forest fire: defining planning measures and landscape scale management strategies. FFP/IFAP. Project coordinator CITAB: Paulo M. Fernandes. Starting date: 2008, duration: 48 months.

Urban green structure: study of the relation between public space morphology and flora and fauna diversity in the city of Porto. FCT, PTDC/AUR-URB/104044/2008. Project coordinator CITAB: Frederico Meireles.

Publications in peer review Journals

Anacleto, J., Pereira, M.G., & Ferreira, J. M., 2011. Dissipative work in thermodynamics. *European Journal of Physics*, 32: 37–47.

Arnaldo, P. S., Oliveira, I., Santos J. A., & Leite, S., 2011. Climate change and forest plagues: the case of the pine processionary moth in Northeastern Portugal. *Forest Systems*, 20 (3): 508–515.

Arnaldo, P.S., Irma Wynhoff, Patrícia Soares, Maria da Conceição Rodrigues, José Aranha, Sándor Csoz, et al., 2011. Maculinea alcon exploits Myrmica alba in Portugal: unusual host ant species of a myrmecophilous butterfly in a peripheral region. *Journal of Insect Conservation*, 15: 465–467.

Barros, C. R. M., Ferreira, L.M.M., Nunes, F.M., Bezerra, R.M.F., Dias, A.A., Guedes, C.V., Cone, J.W., Marques, G.S.M. and Rodrigues, M.A.A., 2011. The potential of white-rot fungi to degrade phorbol esters of *Jatropha curcas* L. seed cake. *Eng. Life Sci.*, 11 (1): 107–110.

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Boavida I., Santos J.M., Cortes R., Pinheiro A., Ferreira M.T., 2011. Assessment of instream structures for habitat improvement for two critically endangered fish species. *Aquat Ecol* 45, 113–124.

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Carvalho, L., Cortes, R., Bordalo A.A., 2011. Evaluation of the ecological status of an impaired watershed by using a multi-index approach. *Env. Monit. Ass.*, 174: 493–508.

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Fernandes, P. M., Rego, F.C., Rigolot, E., 2011. The FIRE PARADOX project: towards science-based fire management in Europe. *For. Ecol. Manag.*, 261: 2177–2178.

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Garcia-Santos, S., Vargas-Chacoff, L., Ruiz-Jarabo, I., Varela, J.L., Mancera, J.M., Fontainhas-Fernandes, A., Wilson, J.M., 2011. Metabolic and osmoregulatory changes and cell proliferation in gilthead sea bream (*Sparus aurata*) exposed to cadmium. *Ecotoxicology and Environmental Safety*, 74: 270-278.

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Other publications International

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Azevedo, J. C., Castro, J.P., Pinheiro, H., Moreira, C., Magalhães, S., Loureiro, C., Fernandes, P.M. (2011). Dinâmica e serviços da paisagem no Nordeste de Portugal. In R.L. Gonçalves C.J. Einloft J. F. Neto (Ed.), *Desenvolvimento Rural, Sustentabilidade e Ordenamento Territorial* (pp. 158–174). Visconde do Rio Branco, MG, Brasil: Suprema.

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Botequim, B., Fernandes, P.M., Borges, J.G. (2011). *Fire behaviour modelling in a maritime pine Portuguese forest to support management decisions at the stand and landscape levels*. Avignon, France.

Carvalho, L., G. C., Orgaz, M., Pereira, P., Caramelo, L., and Yamazaki, Y. (2011). *Modelling forest fire weather risk in Continental Portugal* (Vol. 13).

Catry, F. X., Fernandes, P.M., Pausas, J.G., Rego, F.C., Moreira, F. (2011). *Modelling post-fire mortality of Mediterranean pines*. Avignon, France.

Fernandes, L. F., Pereira, M.G., Carvalho, S., Caramelo, L., Alençõ A. (2011). *Water resources management under extreme events using Mike Basin*.

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Freitas, L., M. P., Caramelo, L., Stepanek, P., Mendes, M., Amorim, L., Nunes, L. (2011). *Portuguese temperature datasets: homogeneity and exploratory analysis* (Vol. 13).

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Nave A, P. M., Cotes B, Fernandez ML, Barroso H, Campos, M, Torres L. (2011). *Suitability of four naturally occurring sugars for adult *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae).*

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Silva-Santos P., L. R. J., Múrias T., Medeiros J., Cardoso P., Dolbeth M., Pardal M. A. & Cabral J. A. (2011). The Use of Stochastic Models as a Management Tool in a Shallow Temperate Estuary of South Europe (Mondego, Portugal). In *Seagrass: Ecology, Uses and Threats* (pp. 131–149).

Sousa, P., R. T., Pereira, M., Gouveia, C., Caramelo, L. (2011). *Regionalising Iberia fire regimes and links with large-scale meteorological variability* (Vol. 13).

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Completed Master and Ph.D. theses

PhD

PhD: CARROLA, J. 2011. Light microscopic studies of toxicopathic changes in fishes from the Tinhela and Vizela rivers, and from the Mondego, Douro and Ave estuaries. Doutoramento em Ciências do Ambiente, UTAD. Supervisors: Eduardo Rocha (ICBAS, Universidade do Porto) and António Fontaínhas-Fernandes.

PhD: GONÇALVES, M.F.M. 2011. Control of the olive fly, *Bactrocera oleae* (Rossi), in the context of a sustainable production of olives. Doutoramento em Ciências Agrárias, UTAD. Supervisors: Laura Monteiro Torres and José Alberto Pereira (ESAB/IPB).

PhD: RAPOSEIRO, P. 2011. The lotic benthic macroinvertebrates of the Azores: an ecological and taxonomic perspective and an evaluation of their application as ecological indicators under the Water Framework Directive. Universidade dos Açores. Supervisors: Ana Cristina Costa (FRESCO, Universidade dos Açores) and Samantha Jane Hughes.

MSc

MSc: Afonso, J.E.M. 2011. Implantação de planos de fogo controlado na gestão dos recursos alimentares para cavalos da raça garrana em Valença. Mestrado em Tecnologia e Sustentabilidade dos Sistemas Florestais, Instituto Politécnico de Castelo Branco. Supervisors: Luísa Nunes (IPCB) and Paulo M. Fernandes.

MSc: Cardoso, C.S.P. 2011. Isolamento, caracterização química e avaliação da actividade anti-tumoral de polissacarídeos de cogumelos silvestres comestíveis. Mestrado em Biotecnologia e Qualidade Alimentar, UTAD. Supervisors: Guilhermina Miguel da Silva Marques and Fernando Nunes.

MSc: Peixoto, M.J.D. 2011. Life-cycle exposure of *Danio rerio* to the human pharmaceutical Clofibrilic acid. Tese de Mestrado em Biologia Clínica Laboratorial, UTAD. Supervisors: Ana Maria Coimbra and Miguel Santos (CIIMAR - Universidade do Porto).

MSc: Pereira, S.I.R. 2011. Efeitos da genisteína no desenvolvimento embrionário e na diferenciação sexual de peixe-zebra (*Danio rerio*). Tese de Mestrado em Biologia Clínica Laboratorial, Universidade de Trás-os-Montes e Alto Douro. Supervisors: Ana Maria Coimbra and Sandra Mariza Monteiro.

MSc: Pinto, C.C. 2011. Selecção e caracterização molecular de inóculos mistos de bactérias potenciais agentes de controlo biológico de *Phytophthora cinnamomi* Rands. Mestrado em Genética Molecular Comparativa e Tecnológica, UTAD. Supervisor: Guilhermina Miguel da Silva Marques.

MSc: Ramos, P.I.A. 2011. Estudo das populações de bivalves (Unionidae) de rios do Norte de Portugal: a qualidade ambiental e a conservação de espécies ameaçadas. Mestrado em Tecnologia Ambiental, Instituto Politécnico de Bragança, Escola Superior Agrária. Supervisors: Amílcar Teixeira (IPB) and Simone Varandas.

MSc: Silva, E.I.M. 2011. Comparação de dois arbustos mediterrânicos, *Arbutus unedo* L. e *Rhus coriaria* L.: avaliação da actividade anti-microbiana de extractos e caracterização fisiológica. Mestrado em Análises Laboratoriais, UTAD. Supervisors: Eunice Bacelar and Ana Sampaio.

MSc: Sousa, D.B.B. 2011. Intervenção e reabilitação das Ilhas Barreira e as pequenas ilhas da Ria Formosa. Memória e Transformação de Centros Urbanos. Mestrado em Arquitetura da Paisagem, UTAD. Supervisors: Edna Cabecinha and Alexandre Cancela d' Abreu (UÉVORA).

Patents/propotypes

N/A

Organization of conferences

"IV Jornadas de Ecologia Aplicada: Gestão Ambiental e Ordenamento do Território", UTAD, Vila Real, April 1, 2011. Co-organized by Edna Cabecinha, João Alexandre Cabral and Mário Santos.

"Jornadas de Empreendedorismo: Inovar em Floresta - Jovens casos de sucesso no Empreendedorismo em Portugal". UTAD, Vila Real, November 4, 2011. Co-organized by Domingos Lopes and Simone varandas.

"Roteiro Ecológico do Conselho do Marco de Canaveses" in the frame of "2011 International Year of Forests", Marco de Canaveses, March 26, 2011. Co-organized by António Crespí and João Alexandre Cabral.

12th European Heathland Workshop: Southern European Heathlands – diverse landscapes under global change. Spain - Portugal, June 12-18, 2011. Co-organized by Paulo M. Fernandes and Hermínio Botelho

2nd National Meeting on Organic Olive Growing. Figueira de Castelo Rodrigo, September 9-10, 2011. Co-organized by Laura Monteiro Torres, Anabela Nave, Maria da Conceição Rodrigues, and Maria de Fátima Gonçalves.

5^{as} Jornadas de Biologia – Alterações Climáticas. UTAD, Vila Real, October 26-28, 2011. Co-organized by Ana Cristina Sampaio, Ana Coimbra and Rui Bezerra.

Exhibition "Morcegos e os seus segredos", Centro de Informação e Interpretação do PNAlvão (Vila Real), inaugurated on the 26th of October, 2011. Co-organized by João Alexandre Cabral and Mário Santos.

III Congresso de Fauna Selvagem. Waves-Portugal, February 18-19, UTAD, Vila Real. Organized by Aurora Monzón.

Training course “Análises de conectividade de paisagem com recurso ao software CONEFOR SENSINODE: fundamentos e exemplos de aplicação”. UTAD, Vila Real, May 11, 2011. Organized by Aurora Monzón.

Workshop “Gestão e Sistemas de Produção em veados (*Cervus elaphus*). Waves-Portugal, February 16, UTAD, Vila Real. Organized by Aurora Monzón.

Industry contract research

Fire danger rating in *Eucalyptus globulus* industrial plantations. AFOCELCA. Paulo M. Fernandes.

Development of “Guia da Natureza do Douro” for Turismo do Douro through a cooperation protocol with Longomai, Consultoria e Serviços, Lda. Aurora Monzón.

Internationalization

18th International Symposium on Chironomidae. Trondheim, Norway, July 3-7. Rui Manuel Vitor Cortes, Samantha Jane Hughes

19th European Biomass Conference and Exhibition. Berlin, Germany, June 6-10. Helder Viana

6th International Meeting on Plant Litter Processing in Freshwaters. Cracóvia, Polónia, July 26-30. Ana Cristina Sampaio and Rui Manuel Vitor Cortes.

7th Symposium for European Freshwater Sciences SEFS7. Girona, Spain, June 27 to July 1. Rui Manuel Vitor Cortes, Samantha Jane Hughes and Simone da Graça Pinto Varandas.

Active cooperation, including collaborative publication, has involved wildland fire researchers from: CEAM (Spain); University of Kastamonu and Hacettepe University (Turkey); Wageningen University (Netherlands); CSIRO Sustainable Ecosystems (Australia); Centre for Environmental Risk Management of Bushfires, University of Wollongong (Australia); Ben Gurion University of the Negev (Israel); CESAM (University of Aveiro), US Forest Service Pacific Northwest Research Station and University of Washington (USA); University of Leon, Spain; Wageningen University (Netherlands); Università di Napoli Federico II (Italy); and others in the frame of COST action FP0701.

Erasmus Mundus Master Degree in Ecohydrology, module River Ecosystem Restoration. University of the Algarve. July 25-27 and December 12-16. Rui Manuel Vitor Cortes, Samantha Jane Hughes, Simone da Graça Pinto Varandas.

MEDPINE 4 - Conservation, Ecology, Restoration and Management of Mediterranean Pines and their Ecosystems: Challenges under global change. Avignon, France, June 6-10. Paulo Alexandre Martins Fernandes.

River Restoration Centre: 12th Annual Network Conference. University of Nottingham - Jubilee Campus, United Kingdom. April 14. Samantha Jane Hughes.

Rivers as Linked Systems, 2nd Conference of the International Society for River Science (ISRS). Berlin, Germany. August 8-12. Rui Manuel Vitor Cortes, Samantha Jane Hughes and Simone da Graça Pinto Varandas.

Supervisory Board member of the Pau Costa Foundation for Fire Ecology and Management. The supervisory board is responsible for setting the strategic lines of programs where the foundation should act and also to ensure the economic viability of the projects budgets. Since January 2011. Paulo Alexandre Martins Fernandes

Sustainable Forest Management in Europe. Austrian Forestry Training Center. Forestry European Association. June 14-17. Invited speaker (“Nature Forestry Applied to Mediterranean Forests”) at the Workshop Nature Forestry. João Paulo Fidalgo Carvalho.

Water & Industry, IWA Specialist Conference - Chemical Industries. Valladolid, Espanha, May 2-4. Ana Cristina Sampaio and Carla Maria Alves Quintelas do Amaral Marinho.

Watershed Management Workshop and technical meetings at the Federal University of Minas Gerais (UFMG). Belo Horizonte, Brazil, August 8-13. Cooperative field work with UFMG members was carried out from the 15th to the 18th of August. Samantha Jane Hughes.

Workshop Adapting Water Management to Climate Change: Putting our Science into Practise, Peter Wolf Early Career Hydrologists Event. Loughborough University, United Kingdom, April 12 - 13. Samantha Jane Hughes.

XII Congreso Hispano Luso de Fisiología Vegetal at the University Jaume I. Castelló de la Plana, Spain, June 21-24. Ana Cristina Sampaio.

XIVth IWRA World Water Congress. Porto Galinhas, Pernambuco, Brazil, September 25-29. Ana Cristina Sampaio.

XVII Encontro Luso-Galego de Química. Pontevedra, Spain, November 9-11. Ana Cristina Sampaio, José Albino Alves Dias

Other publications National

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Nave A, G. F., Nunes F, Campos M, Torres L. (2011). *Poderá o desempenho de Chelonus elaeophilus beneficiar do acesso a fontes de açúcar?*

Nave A, G. F., Rodrigues MC, Campos M, Torres, L. (2011). *Qual o papel do funcho-bravo, Foeniculum vulgare Miller na protecção biológica de conservação contra pragas do olival?*

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Torres, L., Carlos, C., Marques, G., Crespí, A. (2011). A Protecção biológica de conservação contra pragas da vinha. O caso da traça-da-uva na Região Demarcada do Douro. *Revista da Associação Portuguesa de Horticultura*, 30–34.

Government/Organization contract research

Definition of Reference Terms for the “Evaluation of Ecological Sustainability of Fluvial Habitats in Protected and Classified Areas of the Minho and Lima Hydrographic Regions (RH1)”- V01/2010. Collaborative Protocol between the

Fundação Rei D. Dinis and ARH-Norte. Coordinated by Cortes R.M.V.. Budget: 80.965,94 Euro

Hydromorphological Characterization of Lotic Water Bodies “Evaluation of Ecological Sustainability of Fluvial Habitats in Protected and Classified Areas of the Minho and Lima Hydrographic Regions (RH1)”- V01/2010. Collaborative Protocol between the Original-Consulting and ARH-Norte. Coordinated by Joaquim Barreira. Budget: 17.651,75 Euro.

Studies on the Fish and Invertebrate Fauna of the Minho and Lima Hydrographic Regions Evaluation of Ecological Sustainability of Fluvial Habitats in Protected and Classified Areas of the Minho and Lima Hydrographic Regions (RH1)”- V01/2010. Collaborative Protocol between Instituto Politécnico de Bragança, UTAD and ARH-Norte. Coordinated at UTAD by Cortes R.M.V. CITAB budget: 80.999,82 Euro

Implementation of a Monitoring Programme for determining the Ecological Potential of Reservoirs in Northern Portugal. Collaborative protocol between UTAD e a ARH-Norte. Coordinated by Cortes R.M.V. Budget: 88.500,00 Euro.

5.2.6 – Future research

Some of the tasks that underway during 2011 will continue into 2012 but with slightly modified designations in order to better accommodate and integrate research while other new tasks will start.

Project #03 – Biodiversity, Environmental Assessment and Biotechnology

Task #3.01 – Studies on the effect of climate change and extreme events on natural and modified systems and EU directive compliant River rehabilitation

- a) A project proposal on PTDC/AAC-AMB/118021/2010 “*Predicting ecological conditions in large reservoirs from climate and landscape changes*” will be revised and resubmitted for funding during 2012. A submitted manuscript on this project (Area – the journal of the Royal Geographic Society – Impact Factor 1.548) and will be published in 2012.
- b) Studies on the hydrological cycle at regional scale will continue to contribute to the understanding, simulation and modelling of the hydrological cycle processes across catchment areas in northern Portugal. Specific objectives for 2012:
 - To proceed with the climatological, geological and hydrological characterization of river basins located in the Northern region of Portugal;
 - To calibrate the MIKE BASIN model that runs on a Geographic Information System (GIS) to perform hydrologic modelling at basin-scale.

- To use MIKE BASIN and other modelling tools to simulate the river basin catchment behaviour under a series of specific conditions associated with hydrological extreme;
 - Publication of results (national and international conferences), SCI journals; Masters thesis.
- c) Various members of the EcoinTEGRITY group will discuss the possibility of drafting a proposal for modelling climate change, hydrological change and extreme event effects on fluvial macroinvertebrate communities in order to better predict changes and trends ecological quality.

and

- d) Contribute to WFD oriented planning, development and execution of regional freshwater monitoring and management and planning of aquatic resources. This will include a close cooperation with Spain in international catchments to intercalibrate procedures and improve public participation. An INTERREG SUDOE (Spain – Portugal) proposal will be submitted to analyse divergences in assessment international waterbodies, analyse and produce a programme of catchment plan measures, promote efficient exchange and assimilation of data and improve public participation in WFD matters.
- e) Assess the role of land-use and pressure parameters as predictors of ecological quality across different river typologies and waterbodies with no previous ecological or physicochemical data.
- f) Develop and implement river restoration and requalification programmes for aquatic ecosystems and organisms affected by the river regulation or habitat disturbance;
- g) Carry out post restoration action monitoring and assessment programmes.

Task #3.02 - Effect of water contamination in fish populations (reproduction, histopathological changes, oxidative stress, detoxification mechanisms)

This task will continue to assess the use of biomarkers as an “early warning system” linked to sub-organism level processes, providing valuable information on the effect of different sources of water contamination. Some results will come from studies underway as part of the FCT funded project PTDC/AAC-AMB/118021/2010 “*River biomonitoring: an integrative approach*”.

- a) Evaluate and validate multiple biochemical markers of exposure in lotic and estuarine fish populations.
- b) Continue field studies initiated in 2011 related to biomarker sensitivity and further validation in 2012. Results will contribute to the development of

integrated bioassessment methods in heavily polluted streams and rivers (this task is related with the previous task).

Task #3.03 - Dynamic and spatially dynamic modelling to predict ecological indicators associated with different impacts, functional biodiversity and the planning of endangered species conservation

This task will comprise studies to assess scales, indicators and tools to evaluate monitor and forecast land use change effects on biodiversity. The modelling frameworks, scenarios and projections will contribute to the development of management models to monitor ecological integrity. Studies will cover

- a) Spatial distribution and abundance of local passerine guilds and changes in habitat conditions in rural landscapes;
- b) Effect of wind farm installations on the ecological integrity of mountain areas using scenarios and projections from a dynamic model to forecast spatial distribution in ecological diversity;
- c) Forecasting land use change on the distribution and abundance of selected animal species (*Tetrax tetrax* and *Pyrrhocorax pyrrhocorax*) using complementary modelling frameworks to forecast species dynamics in changing landscapes.

The Laboratory of Applied Ecology (LEA), part of the Eco-Integrity group, will continue to improve collaboration with other national and international institutions via participation in R&D and PhD projects, such as PTDC/AUR-URB/104044/2008, "*Urban green structure: Relationships between the morphology of the public green spaces and plant and animal diversity*", the PTDC/AGR-AAM/100979/2008, "*Increasing functional biodiversity in olive groves to enhance conservation biological control of insect pests*" and SFRH/BD/77872/2011, "*Modelling the landscape genetic structure and dispersal patterns of endangered Red-billed Chough (*Pyrrhocorax pyrrhocorax*) populations in Portugal: new insights for conservation and management*".

Task #3.04 - Application of microorganisms in biotechnology and in nutrient cycling

This task studies autochthonous bacteria, yeasts and fungi in bioremediation, agro-food and forestry by product processes and as functional indicators of ecological quality. Agro-industry generates several sub-products, such as residual waters with high polluting potential from olive oil processing industries and wine production.

- a) Contribute to the sustainable management of olive orchards

- b) Study of the integrated use of industrial by-products of agro-food and forestry companies in the production of biodiesel and animal feed
- c) Assess the role of ecological function (fungal decomposition) in river bioassessment methods.
- d) Contribute to studies in the optimization of ecosystem services in the demarcated Douro region.

Project #04 – Disturbance and management of forest, agro-forested and agricultural ecosystems

Task #4.01 – Fire ecology and management

In 2012 this task intends to:

- a) Complete ongoing modelling work on the post-fire mortality of conifer and broadleaved Mediterranean trees;
- b) Contribute to a national-level study on the factors that affect post-fire regeneration variability of *Pinus pinaster* and *Eucalyptus globulus*;
- c) Initiate the study of fire behaviour in *Eucalyptus globulus* plantations to assess the effectiveness of fuel treatments and derive guidelines for prescribed burning;
- d) Model (from a combination of empirical data and fire behaviour modeling) how fuel treatments and fire suppression contribute and interact to determine fire control.
- e) Examine the impact of alternative fire management strategies on fire policy effectiveness.

Task #4.02 - Fire regime analysis and assessment of the influence of weather and climate in agro forested ecosystems

In 2012 this task intends to:

- a) Update the Continental Portuguese Rural Fire Database for the 1980-2011 period;
- b) Assess the potential impact of regional climate change on wildfires in Portugal using an appropriate Burnt Area Model with simulated data for future scenarios by a regional circulation model;
- c) Extend the methodology to fires in Europe using burnt area data from the European Forest Fire Information System, meteorological data from the

European Climate Assessment and simulated values of temperature, precipitation wind and relative humidity from the COSMO-CLM model.

- d) Proceed with the temporal, spatial and spatio-temporal clustering of fires in Portugal using different cluster analysis algorithms and assessing the influence of factors such as climate and vegetation type;
- e) Assess the role of landscape and fire recurrence metrics on fire size distribution in Portugal through the use of several distribution functions;
- f) Model how landscape pyrodiversity and fire weather contribute to area burned and fire size in Portugal.
- g) This task will also assess the role of weather and climate on the chestnut agroecosystem. The European chestnut is cultivated for its nuts and wood. Several studies highlight specific chestnut productivity needs concerning soil and climate characteristics. Recently Pereira et al (2011) identified a set of meteorological variables/parameters with high impact on chestnut systems.

Specific objectives for 2012 will include continued assessment of meteorological impacts on chestnut productivity in Portugal; assessment of future climate change on chestnut productivity, diseases in Portugal as well as on European chestnut orchards, presentation of finding in national and international conferences and submitted to JCR journals

Task #4.03 - Conservation of endangered insect species: the blue alcon butterfly (*Maculinea alcon*) – Paula Arnaldo

The main objective for 2012 is to study several conservation-related ecological issues of this insect life cycle. *P. alcon* flight period and oviposition preferences will be determined. Determination and identification of its host ants species will be made and new *Phengaris* populations will be studied.

Task #4.04 - Increasing functional biodiversity in olive groves to enhance conservation biological control of insect pests and maximizing ecosystem services provided by Demarcated Douro Region vineyards – Laura Lorres

This new task will carry out the following in 2012:

- a) Determine the sugar composition of the nectars and pollens of the flowering plant species that have been pre-selected to enhance conservation biological control of olive grove insect pests;
- b) Determination of the sugar composition of the honeydews of *Saissetia oleae* and *Hyadaphis foeniculi*;

- c) Evaluation of the attractiveness of several plant species on *C. carnea* using a 4-way olfactometer and analysis of plant volatiles;
- d) Results obtained will be evaluated under the advice of Dr. Carsten Müller, Cardiff University, UK.
- e) Develop spatial analysis methodology that will support activities within an ecological infrastructure network.
- f) Apply mating disruption techniques to control *Lobesia botrana* to maintain and/or promote study farm biodiversity;
- g) Characterization of ecological infrastructures and biodiversity at study sites and assessment of their role in the increase of natural enemies.
- h) Publication of an informative brochure for farmers presenting the project's results.

Pending and expected funding

Funding can be divided into three sources: a) international research projects; b) national research projects, and c) contributions from stakeholders.

Several research projects will be funded from 2012 onwards, while others will be resubmitted as calls for funding open or other sources of funding become available over the coming year. Within both EI projects there are several “ongoing” projects that will continue into 2012 or beyond.

Projects on the following topics have been submitted in 2011 and are awaiting evaluation, will be re-submitted in the near future, or were approved for funding:

- histological and molecular fish markers;
- copper-induced cellular death in fishes;
- sustainable practices of slurry management;
- natural dyes for the textile industry;
- ex-situ conservation of olive clones;
- olive mill wastewater management;
- characterization of intense rainfall events and their consequences;
- forecasting the ecological conditions in large dams under climate change;
- patterns of speciation and distribution in freshwater macroinvertebrates;
- bivalves biodiversity and conservation;

- ethnographic characterization of natural resources;
- maximizing ecosystem services in the Douro region vineyards;
- economy of mountain biodiversity.



5.3 – Biosystems Engineering

5.3.1 – Group description

Principal Investigator	Pedro José de Melo Teixeira Pinto / José Joaquim Lopes Morais
Research area	Engineering
Home Institution	Universidade de Trás-os-Montes e Alto Douro

5.3.2 – Funding

	2009	2010	2011
FCT Projects	166.288,00 €	140.660,67 €	143.256,64 €
Other (National)	1.042.492,26 €	334.047,13 €	78.517,00 €
Other (International)	503.550,00 €	95.024,60 €	3.000,00 €
Industry (National)	0,00 €	0,00 €	68.999,99 €
Industry (International)	0,00 €	0,00 €	0,00 €
Total	1.712.330,26 €	569.732,40 €	293.773,63 €

5.3.3 – Objectives

The general objective is the development of engineering technologies applied to agri-forestry systems, the environment and life towards providing sustainable development and better quality of life. During 2011, the BE group focused the research activities into two ongoing projects, whose objectives and main tasks are presented next.

Project #1 – Wood mechanical and quality evaluation

This project aims to develop a materials science approach to wood mechanics, from the micro to macro levels. This is fundamental for promoting wood as a thoroughly characterized engineering material. The project also aims to improve

bioenergetic conversion technology of agricultural and forest materials and wastes. The major scientific activities comprise:

Task #1.01 - Mechanical behaviour of wood.

Task #1.02 - Fracture behaviour of wood.

Task #1.03 - Numerical and experimental study of bonded wood joints.

Task #1.04 - Study of effects of moisture and physical aging on the mechanical behaviour of thermosetting polymers.

Task #1.05 - Mechanical behaviour of wood bolted joints.

Task #1.06 - Bioenergy from agriculture and forest materials.

Task #1.07 - Waste materials methanisation.

Project #2 – Image-based systems

This project aims to design and develop computer vision and image based systems and solutions in the areas of agri-forestry, environment and biology, using both traditional imagery combined with hyperspectral systems (which have been used by us for inspection and quality assessment in fruits and wood so far). The major scientific activities comprise:

Task #2.01 - Improved methodologies for image based classification using computational intelligence techniques.

Task #2.02 - Development of image based methods for characterising bio-material micro-structure and finding a shape descriptor (through image based parameterization) of wood micro-structure.

Task #2.03 - Application of local hyperspectral imaging techniques for non invasive grape analysis and evaluation: assessment of grape maturity using pH, sugar content and anthocyanin content.

Task #2.04 - Local hyperspectral imaging techniques and wood quality evaluation.

Task #2.05 - Development of computer assisted imaging techniques, based on kinematic and kinetic data capture on biological models.

Task #2.06 - Application of digital image correlation (DIC) techniques to wood quality evaluation, using computational intelligence.

Task #2.07 - Development of device-independent image visualization techniques and data transmission issues.

5.3.4 – Main achievements

Project #1 – Wood mechanical and quality evaluation

- a) A plate bending test was proposed for determining the bending stiffness components of MDF panels. This novel approach combines full-field slope measurements provided by the deflectometry technique with the virtual fields method.
- b) The digital image correlation method was applied to wood at the meso scale for measuring heterogeneous strain fields associated to earlywood and latewood layers. The Young's modulus and Poisson's ratio associated to each layer were identified.
- c) Conclusion of experimental data reduction in order to model the effects of water content, below the fiber saturation point, on the elastic and viscoelastic behaviour of Pinus pinaster wood
- d) The Arcan test method was tailored for characterising shear properties of cortical bone tissue from full-field measurements provided by digital image correlation.
- e) The scale effect on the mode I strain energy release rate of pine wood were modelled, involving the SEN-TPB and DCB specimens.
- f) The End Loaded Split Test and the End Notched Flexure test were adapted and validated for mode II fracture testing of cortical bone.
- g) A direct identification method of cohesive laws for adhesively-bonded wood joints, under pure modes I and II, was developed and validated. This method is based on the loading–displacement curve and on the crack opening displacement, measured through the digital image correlation technique.
- h) An experimental methodology was developed for the analysis of the combined effects of water and physical aging on the mechanical properties of polymers.
- i) A method for measuring quantities associated to the fracture process (crack opening displacement and crack length), based on digital image correlation was implemented
- j) Cohesive zone modelling of wood structures involving dowell pins has been performed through two-dimensional simulations. Experiments have been performed in wood structures involving the application of dowell pins.
- k) A framework for bioenergy policies and the level of national and european actions has been achieved.
- l) A quality specification for the injection of biomethane in the natural gas network was proposed.

Project #2 – Image-based systems

- a) Improved image-based classification methodologies through image segmentation techniques using FSs, IVFSs, A-IFSs and other soft computing techniques.
- b) Application of the classification methodologies developed in 1. for meat quality characterization and assessment.
- c) Application of classification methodologies developed in 1. in the development of a dynamic tracking based movement analysis methodology.
- d) Development of a robust methodology for feature tracking in image sequences using soft computing techniques with the incorporation of a feature behavioural characterization methodology.
- e) A cooperation with the University of La Rioja was established in the scope of the work in hyperspectral imaging applied to non-destructive chemical analysis of grapes. The joint experiments conducted provided us the data necessary to enhance our machine learning algorithms that convert hyperspectral information into chemical compounds concentration.
- f) Application of hyperspectral imaging to wood quality evaluation, with the development of models to convert hyperspectral imaging information into wood density at a spatial resolution of approximately 80 μm .
- g) Development of a reliable methodology for measuring deviant foot biomechanics concerning local (over)loading of the plantar surface. This methodology is a useful tool to promote sustainable management of the natural and human environments as a resource for physical and mental health.
- h) Development of a reliable software model for measuring plantar pressure in all limbs used to detect slight plantar pressure abnormalities eventually associated with hip dysplasia that could not be detected using a normal subjective observation.
- i) Development of a WSN propagation model for indoor and outdoor environments (vegetations). The next step is to apply this system to image transmission.

5.3.5 – Group productivity

International Projects

Production of MDF panels of mixed fibre SP Saccharum (sugar cane) associated with fibres of *Eucalyptus grandis*: anatomical characterization and physical-mechanical properties. CAPES/GRICES 206/08 (UTAD/USP). Project coordinator: José Luís Penetra Cerveira Louzada. Total budget CITAB/UTAD: 9,000 Euro. Duration: 36 months. State: Termined in 2011.

Nuevas Ciudades Fluviales del Siglo XXI (FLUVIAL). Programa de Cooperação Transfronteiriça Espanha/Portugal (POCTEP). Project coordinator: Ronaldo Eugenio Calcada Dias Gabriel. Total budget CITAB/UTAD: 400,000 Euro. State: In progress.

Nuevo Modelo de Representación y Agregación de la Información Utilizando las Extensiones de los Conjuntos Difusos: Aplicaciones. Plan Nacional de I+D+i, Ministerio de Educación y Ciencia. Spain. Project coordinator: Pedro José de Melo Teixeira Pinto. Total budget CITAB/UTAD: variable. State: In progress.

Vision para Vehículos Aéreos No-tripulados. Plan Nacional de I+D+i, Ministerio de Educación y Ciencia. Spain. Project coordinator: Pedro José de Melo Teixeira Pinto. Total budget CITAB/UTAD: variable. State: Termined in 2011.

National Projects

ADAPT – Adaptive Learning Management System. FCT, PTDC/CPE-CED/115175/2009. CITAB project coordinator: Eduardo José Solteiro Pires. Total budget CITAB/UTAD: 2,100 Euro. Starting date: 2011, duration: 36 months.

Applying Computational Fluid Dynamics to sports (aquatic environment). FCT, PTDC/DES/098532/2008. Project coordinator: Abel Ilah Rouboa. Total budget CITAB/UTAD: 99,940 Euro. Starting date: 2010, duration: 36 months.

BioGN. AICEP, QREN SI Inovação. Project coordinator: Nuno Paulo Correia e Afonso Moreira. Total budget CITAB/UTAD: 160,000 Euro. Starting date: 2010, duration: 36 months.

DouroBiogas. IAPMEI, QREN QREN, SI I&DT. Project coordinator: Nuno Paulo Correia e Afonso Moreira. Total budget CITAB/UTAD: 360,000 Euro. Starting date: 2008, duration: 36 months.

Fundamental and simulation study of SYNGAS Combustion on Static Chamber. FCT, PTDC/AAC-AMB/103119/2008. Project coordinator: Abel Ilah Rouboa. Total budget CITAB/UTAD: 134,000 Euro. Starting date: 2010, duration: 36 months.

Strategic information for the pine row. Project coordinator: Maria Emilia Calvão Moreira da Silva. Total budget CITAB/UTAD: 117,223 Euro. Starting date: 2010, duration: 36 months

Numerical and experimental study of cohesive laws in bonded wood joints. FCT, PTDC/EME-PME/114443/2009. Project coordinator: José Joaquim Lopes Morais. Total budget CITAB/UTAD: 38,761 Euro. Starting date: 2011, duration: 36 months.

Oakwoods: Properties of wood from Portuguese oaks for high value solid and assembled wood products. POCI/AGR-AMM/69077. Project coordinator: José Luís Penetra Cerveira Louzada. Total budget CITAB/UTAD: 18,600 Euro. Duration: 36 months.

Optimização dos perfis das embarcações desportivas (NELO-Kayaks). QREN/4608/17-2008. Project coordinator: Abel Ilah Rouboa. Total budget CITAB/UTAD: 32,500 Euro. Starting date: 2010, duration: 24 months

Plano de Gestão Integrada do Sítio PTCOM0025 Montemuro. Project coordinator: Jorge Azevedo (UTAD). Total budget CITAB/UTAD: 65,000 Euro. State: In progress.

Phenotypic plasticity of maritime pine to climate change. FCT, PTDC/AGR-CFL/099614/2008. Project coordinator: José Luís Penetra Cerveira Louzada. Total budget CITAB/UTAD: 14,400 Euro. Starting date: 2010, duration: 36 months.

Physiologic supply system for in vivo evaluation of bone implants behavior. FCT. PTDC/EME-PME. Project coordinator: Raul Manuel Pereira Morais dos Santos. Total budget CITAB/UTAD: 48,734 Euro. Starting date: 2009, duration: 36 months.

PortalDouro. QREN/ON.2. Project coordinator: Raul Manuel Pereira Morais dos Santos. Total budget CITAB/UTAD: 124,534 Euro. Starting date: 2009, duration: 18 months.

Scots pine in Portugal: the “Southwest end” or just “the end”? FCT, PTDC/AGR-CFL/110988/2009. Project coordinator: José Luís Penetra Cerveira Louzada. Total budget CITAB/UTAD: 181,781 Euro. Starting date: 2011, duration: 36 months.

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Internationalization

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N/A.

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5.3.6 – Future research

Objectives

An adjustment of projects and tasks is planned to start on 2012, reflecting the evolution of research activities of BE group and looking for a more focused and integrated work.

Project #1 - Bio-based materials and energy

In the context of bio-based materials and energy project we have set out the following specific tasks and objectives:

Task #1.01 - Mechanical behaviour of bio-based materials and structures

This task aims the mechanical characterisation of bio-based materials based on full-field measurements provided by a suitable optical method. To start with, novel mechanical tests are proposed for evaluating orthotropic stiffness of wood at both macro and meso scales. Moreover, wood quality is discussed in term of spatial variation of mechanical properties within and among trees of pine maritime. A single heterogeneous plate bending test is also proposed for characterising wood and wood-based products based on the deflectometry technique. Issues that can be addressed are gradient properties within the wooden plate and visco-elastic behaviour of wood products such as MDF. A complete mechanical characterisation of cortical bone tissues is also aimed by coupling digital image correlation with several test methods. Finally, a homemade digital image correlation toolbox will be developed integrated with the available equipment in the mechanical testing laboratory.

Task #1.02 - Fracture behaviour of bio-based materials and structures

The main goals of this task are the (a) development of appropriate methods to provide reliable measurements of fracture properties in bio-based materials, under pure mode I, II and III loading, as well as the combination of failure modes: I+II+III, both submitted to quasi-static loading; (b) the identification of appropriate failure criteria to allow designers to perform reliable analyses when bio-based materials are used at different size scales; and (c) fatigue characterization under mode I loading.

Task #1.03 – Bioenergy from waste, agriculture and forest materials

It will be developed work towards the definition of conversion technologies which will offer the maximum yield ratio of forest and agriculture material. Specific objectives are (1) to specify available agricultural materials; (2) to specify available forestry materials; (3) to identify the best conversion technologies based upon forestry and agricultural material characteristics. Moreover, it will be studied

the entire methanisation process (digestion, gasification, cleaning and purification systems) and establish the principles for the development of a biomethane market in Portugal, since there is no market for biomethane in Portugal or any legislation regulating its introduction into the same network as natural gas or its price.

Task #1.04 – Biomass gasification and combustion studies

The biomass gasification is gaining renewed attention, as a way to use a renewable feedstock to produce a valuable synthesis gas. It can then be used to generate electricity in a gas turbine or internal combustion engine, used as a feedstock to produce methanol, dimethyl ether, or, used in a Fischer-Tropsch system to produce diesel and other liquid fuels. The present task is motivated by the lack of numerical/experimental data on combustion in static chamber operated on alternate fuels. In particular, we are interested in Dilute Oxygen combustion of syngas fuels containing H₂, CH₄ and CO as the reactive species. For example, hydrogen-syngas and Methane-syngas produced from pines biomass residues, an abundant specie in Portugal, contains 15–40% H₂, 10-20% of CH₄ and 20–45% CO, depending upon the gasification process. In addition, within this task a sub-task include a deeper analysis about the performance and understanding of a fuel cell activation procedure.

Project #2 - Image-based systems

Within the Image-based systems project research is focused on engineering applications in relation to Agro-Forestry, Environmental and Biological contexts:

Task #2.01 - Image-based classification using computational intelligence techniques

This task will incorporate and develop the use of computational intelligence in computer vision and existing image processing classification methodologies, for agricultural, forestry, environmental and biological systems, developing approaches that take advantage of the flexibility provided by soft computing to deal with the complex problems present in image based systems.

Task #2.02 - Hyperspectral imaging techniques for agro-forestry, environment and biology

Hyperspectral imaging will continue to be used for non-destructive analysis of grapes chemical content and in the determination of wood characteristics. Advanced machine learning algorithms will be used to extract from hyperspectral information the values of parameters to be measured.

Task #2.03 - Imaging techniques as a tool to improve biologic models

Through biomechanical and environmental analysis, using computer assisted imaging techniques, we intend to assess the quality of the movement in biological models. Different techniques will be used for kinematic and kinetic analysis.

The Estrela Mountain Dog is used as research model, due to the high incidence of the hip dysplasia in the breed. Retro-reflective infra-red markers are placed on the dogs' skin over their backquarters joints and data of plantar pressure will be collected with the RsScan footscan 2D system.

Task #2.04 - Device-independent image visualization techniques and data transmission

It will be studied the image adaptation that is necessary in order to get a reliable transmission of digital images over a transmission channel with low bandwidth (when compared with the amount of information to be sent). This adaptation must be done considering the final application

Pending and expected funding

“Fracture behaviour of cortical bone under mixed-mode I+II loading”. Fundação Para a Ciência e a Tecnologia, PTDC/EME-PME/119093/2010. Coordinator: Marcelo Moura (FEUP/INEGI). CITAB/UTAD coordinator: José Lopes Morais. Funding: 84 120,00 €. Funding for UTAD, 2012-2014: 24 000,00 €.

“Hyper - Application of hyperspectral imaging and neural networks to viticulture”. Fundação para a Ciência e a Tecnologia, PTDC/EEA-AUT/121056/2010. Coordinator: Pedro Melo Pinto (CITAB/UTAD). Funding for UTAD, 2012-2014: 74 910,00 €.

“Vision para Vehículos Aéreos No-tripulados”. Ministerio de Ciencia y Innovación de Espanha, Plan Nacional de I + D + i 2010-2012 (project DPI2010-20751-C02-01). Investigador - Pascual Campoy. CITAB/UTAD coordinator: Pedro Melo Pinto. Funding for 2010-2012: 140 000,00 €. Estimated funding for UTAD: 5000 €.

“Nuevo Modelo de Representación y Agregación de la Información Utilizando las Extensiones de los Conjuntos Difusos. Aplicaciones”. Ministerio de Ciencia y Innovación de Espanha, Plan Nacional de I + D + i 2010-2012 (project TIN2010-15055). Investigador principal - Humberto Bustince. CITAB/UTAD coordinator: Pedro Melo Pinto. Funding for 2010-2012: 30.492,00€. Estimated funding for UTAD: 5000 €.

“Biochemical, morphological and functional evaluation of breast cancer-induced muscle wasting: the role of exercise training”. Fundação para a Ciência e a Tecnologia, PTDC/DES/114122/2009. Coordinator: Rita Maria Pinho Ferreira (Aveiro University). CITAB/UTAD coordinator: Mário Manuel Dinis Ginja. Funding for UTAD, 2011-2013: 65.000,00€.

“Development of equipment for Pastéis de Chaves production”. Sistema de Incentivos à Investigação e Desenvolvimento Tecnológico, Vales de I&DT, reference 019019. CITAB/UTAD coordinator: José Lopes Morais. Funding for UTAD, 2012-2013: 33 400 €.



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