FCT Fundação para a Ciência e a Tecnologia

# Montesinho International Research Awards

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# Introduction

Territorial cohesion is a national priority. The knowledge that stems from scientific research and technological development plays a central role in stimulating the sustainable economic development of disadvantaged regions, promoting their natural resources such as forests, agricultural and agroforestry systems and landscapes, as well as cultural heritage and sociocultural dynamics. In mainland Portugal, disadvantaged regions are mostly located in the interior, namely along the country's border. The Lands of Trás-os-Montes are an example of this type of disadvantaged regions for which an adequate valuation is sought, centered on specific characteristics and endogenous resources, in symbiosis with social and cultural dynamics that it is important to know in a structured process of scientific research and application of the results obtained. Such is the case of the Natural Park of Montesinho.

The Natural Park of Montesinho represents a mountain area that constitutes the last relief in the northeast of Portugal that still belongs to the northwest of the Peninsula and borders the Iberian Plateau. With a very large environmental richness, it is part of the Natura 2000 Network and the United Nations Meseta Iberian Biosphere Reserve. Given its location in an area of interface between distinct natural domains, in this case the Peninsular Northwest and the Mediterranean Iberian Plateau, it has enormous biodiversity and provides privileged areas for monitoring and furthering the study of climate change, as well as developing mitigation measures and actions in useful time.

It was with these objectives that the Council of Ministers determined (through RCM No. 15/2020, of March 27) the development of an International Research Programme on Montesinho, having as priority the promotion of R&D activities of an interdisciplinary and multidisciplinary nature to be carried out in the Natural Park of Montesinho, thus contributing to a new international R&D agenda on the Natural Park of Montesinho including:

1. Earth knowledge and observation, including the use of satellite information and its integration into advanced information processing and artificial intelligence systems;
2. Climate and climate change;
3. Sustainable agricultural systems, including agriculture, forests and agroforestry systems, and the valorization of their products from a bioeconomy perspective;
4. Sociocultural dynamics;
5. Biodiversity and biological resources, natural and cultural heritage, and sustainable regional development.

In compliance with the provisions of the Council of Ministers Resolution, in July 2020 FCT launched the Montesinho International Research Awards, a call for scientific research and technological development projects to promote R&D activities of an interdisciplinary and multidisciplinary scope to be carried out in the Natural Park of Montesinho region, on the topics listed above. The aim was to strengthen the integration of knowledge and synergy between scientific areas, promoting its projection for the future and developing new knowledge in various thematic areas, from a scientific and cultural multidisciplinary perspective. After an external international evaluation of the applications, the FCT selected six projects, with a duration of 36 to 48 months, which represent a total investment of 1.4 million euros.

The funded projects are presented here.

**Helena Pereira**
**President of Fundação para a Ciência e a Tecnologia**

# R&D Projects for the Natural Park of Montesinho

MTS/BRB/0056/2020

## INTEGRATED APPROACHES FOR SOCIO-ECONOMIC BOOSTING THE SUSTAINABLE PRODUCTION AND CONSUMPTION OF MONTESINHO MUSHROOMS

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| **FUNDING** | € 245 890,59 |

Montesinho Natural Park (MNP) represents a mountain area with a unique mycological heritage. Among the approximately two hundred edible mushrooms found in this protected area, most of them have been consumed since ancient times for their exquisite taste and nutritional value. Nevertheless, the availability of these mountain products is limited by their seasonality and weather conditions, an issue intensified by climate change. On the other hand, unsustainable mushroom collection practices and illegal trade of high-value species have also been common practices with negative impacts in the ecosystem and regional and national economy. All these issues, together with the incapacity of local collectors to guarantee the authenticity/safety of the collected mushrooms, have led many restaurants to avoid their inclusion in their menus, safeguarding their business and consumer's health. To overcome these issues, a PROBLEM-BASED RESEARCH STRATEGY is proposed, through the production of appreciated edible mushrooms in controlled ex-situ environment, which is extremely challenging and has only been achieved for a very reduced number of species, along with mycotourism and mycological education actions. Furthermore, the recycling of forest/land cleaning material to produce mushroom growing substrates will be applied as a sustainable approach to mimic the original growing biomass and, at the same time, prevent devastating fires that can decimate the ecosystem biodiversity. To conserve this unique patrimony, the creation of a germplasm bank of MNP mushrooms is also proposed. An extensive nutritional/chemical/biological characterization will be performed to ensure the high quality of the produced species and the preservation of their original characteristics. The development of a quality and safety seal, "Safe2Taste", that guarantees the traceability of the entire production chain, will increase consumers' confidence on the products. For that purpose, a chain of adhering restaurants will introduce the produced mushrooms in their menu and exhibit the seal as guarantee of their origin, quality, and safety. As additional dissemination channel, this seal will be linked to a digital platform that can be easily accessed by consumers. The monitoring and modelling of the mycological resources will lead to the valorisation and conservation of MNP heritage. Education actions will promote efficient territory management for sustainable development.

MTS/BRB/0086/2020

## SUSTAINABILITY-LED APPROACHES FOR THE REHABILITATION AND REVITALIZATION OF THE CULTURAL BUILT HERITAGE OF MONTESINHO NATURAL PARK

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| **FUNDING** | € 248 926,82 |

The INHAVIT project proposes to evaluate and characterize: the rural built environment of the Montesinho Natural Park (MNP), at the building and village level; and socio-economic and environmental factors that may be contributing to the vulnerability of villages and vernacular buildings in MNP. A deep knowledge of both aspects is expected to help to obtain a better understanding of the reasons leading to the progressive abandonment of the villages. Ultimately, the research project will propose risk mitigation, retrofitting and conservation strategies for the built heritage, acknowledging that the valorization and preservation of the vernacular architecture is a key element of cultural identity and can become a privileged factor for local development. The first research hypothesis of the project is that improving vernacular settlements, aiming to create better living conditions, increase accessibility to infrastructures, or decrease vulnerability to natural hazards, among others, may attract and host strong local communities, becoming an effective measure to prevent depopulation of rural settlements. The outcomes of the project are expected to create awareness and help stakeholders and local communities to make decisions on how to intervene in the vernacular built-up environment to transform it into sustainable, resource-efficient settlements. Nevertheless, any intervention proposed must respect the cultural value of the vernacular heritage, as recommended in international guidelines. In the long term, the recommendations are expected to contribute to safeguarding the vernacular heritage by ensuring its continuous occupation. People tend to undervalue traditional buildings and relocate to modern housing, which is often seen as able to offer better living conditions and greater thermal comfort. An enhanced vernacular built environment, able to host stronger communities, can counterbalance the common aging situation and/or satisfy the housing demand from migrants and refugees, which can also bolster local development. The research project involves extensive on-site studies of representative rural settlements and buildings in the MNP. The outcomes of the project can have an important impact on society, shedding some light on how to address the common phenomenon of depopulation and mischaracterization of the vernacular heritage, which is intense in MNP, but also common in other Mediterranean countries.

MTS/BRB/0091/2020

## MONTOBEO - MONTESINHO BIODIVERSITY OBSERVATORY: AN EARTH OBSERVATION TOOL FOR BIODIVERSITY CONSERVATION

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| FUNDING | € 242 569,05 |

This proposal aims to implement an early-warning system, the Montesinho Observatory (MontObEO), using time series of satellite remote sensing (SRS) data and ecological niche models (ENMs) to identify changes on habitat quality and therefore estimate species' extinction risk over time and space. MontObEO will implement for the first time an ENM approach using only SRS time series, to estimate the species-specific extinction risk based on analyses of habitat quality trends. Until now, species extinction estimations have been based on ground data, normally using population data. ENMs have traditionally used static data from climate averages from long periods (e.g. 1950-2000). However, species respond to past and present environmental conditions. Modelling over time species' distributions with only recent SRS data (2000-2020) will help to identify habitat changes (trends), and then, to provide a map with the spatial distribution of habitat quality changes. Changes in habitat quality will be linked to extinction risks. This proposal will provide a new objective method, using current environmental data from ENMs fitted with SRS time series, to estimate and assess species' extinction risk and vulnerability based on the spatial-temporal tracking and forecasting of habitat loss and modification. Our proposal will be able to estimate the extinction risk locally, at the pixel level of the satellite image, for each species individually. We will use SRS data freely available through the Internet, and with a high temporal resolution (e.g. MODIS, Sentinel, and Landsat, with daily, five and 16 days of periodicity, respectively). Our proposed methodology will be applied to the species included in five taxa groups: flora, amphibians, reptiles, birds, and mammals, in Montesinho Natural Park (NP). The trends in habitat suitability over time (positive, negative, or null) for each species will represent those places where habitat quality increases, decreases, or remain constant over time. The places with strong decreases of habitat quality over time will be under higher pressures. MontObEO will provide new data about the conservation status of its flora and fauna, especially its rare habitats, at the species level, but also by taxonomical group and conservation level. Joining all species models, we will identify those areas in Montesinho NP under higher pressure, that should be priority areas to apply monitoring systems and conservation measures.

MTS/CAC/0028/2020

## LOCAL ADAPTATIVE RESPONSES OF PASTORALISM TO CLIMATE CHANGE IN THE NATURAL PARK OF MONTESINHO (PORTUGAL)

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| **FUNDING** | € 125 008,75 |

Pastoralism is particularly exposed to the changes in climate and landscape which threatens its viability and the survival of pastoralist communities. Thus, pastoralist communities are already adapting their husbandry practices to ensure survival and continuity of their activity. The Montesinho Natural Park (PNM) is encompassed within a historical region of pastoralism, notably of small ruminants. The PNM area counts 47 active flocks of local indigenous breeds of small ruminants, representing a total of 4,290 females officially registered in the genealogy books of the respective breed associations. Goat and sheep pastoralism provides animal proteins for locals' diet contributes both to the environmental management of the landscape and to settle population in areas suffering from pronounced emigration, and represents a cultural identity of the region of the PNM. While recent climatic predictions sustain that PNM's temperature will progressively rise 4 degrees until the end of this century according to portaldoclima.pt, replacing the humid temperate and supramediterranean by sub-humid mesomediterranean bioclimates, the scientific literature lacks references on the current adaptation of small ruminant pastoralists to climate change in the PNM, the proposal aims at addressing this gap. Local adaptative responses result not only from the attested evolution of climate but rely on the individual and collective perceptions on these evolutions by local dwellers which would demand a multidisciplinary effort, combining both natural and social sciences' perspectives and methods, to study them. In that sense and aiming at strengthening co-operation and synergies between natural science and environmental anthropology, this proposal is supported by a research team combining forestry, zootechny and anthropology backgrounds. The main goal is to study the biophysical and socio-cultural local adaptative responses of pastoralism to the effects of climate change in the PNM. Ultimately, this proposal seeks to enhance the knowledge base for improved scientific, institutional and practitioners' responses to climate change in Mediterranean mountain areas, by producing operational knowledge and tools to be mainstreamed into practical response plans. The PNM concentrates a rich and diverse landscape and effects of climate change tend especially to be visible in remote mountain areas, challenging local dwellers who make their living from land and nature.

MTS/SAS/0077/2020

## NEW REASONS TO CARE HONEY FROM THE NATURAL PARK OF MONTESINHO: A BIOINDICATOR OF ENVIRONMENTAL QUALITY & ITS THERAPEUTIC POTENTIAL

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| **FUNDING** | € 249 826,65 |

Honey+ seeks to add value to a traditional food product by exploring new potentialities far beyond its nutritional value. The project aims to generate new knowledge on the potential of honey produced in the Natural Park of Montesinho (NPM) to serve as a bioindicator for environmental quality and to investigate its pharmacological properties. A multidisciplinary team composed of experts with strong skills in analytical chemistry, molecular biology, food science and technology, pharmacology and microbiology will intensely collaborate to accomplish the main goal of the project: the valorization of the honey from the NPM and, consequently, enhance the regional economy. To achieve this main goal, the following general objectives were established: to evaluate if honey can be useful as a bioindicator to assess environmental pollution: (1) the monitoring of different classes of pollutants in air, soil, water resources, plants and NPM honey will be performed and (2) to explore the therapeutic and pharmacological potential of the honey produced in the NPM using in-vivo assays. To achieve these objectives, the following specific objectives were defined: to develop analytical methodologies to detect and quantify the different classes of pollutants in environmental compartments and honey based on gas- and liquid chromatography; to develop MIP sensors for hydroxymethylfurfural (HMF) and pollutant analysis due to the need for inexpensive and easy-to-use analytical devices for the fast evaluation of the honey's adulteration and the determination of pollutants levels after very simple sample preparation; to develop innovative tools based on molecular biology and genosensors for honey authentication to guarantee high quality and valued products; to characterize the physicochemical parameters of NPM honey samples collected at different locations in the Park; to assess in-vitro and in-vivo biological activities: biological effects will be evaluated using in-vitro assays, namely, inhibitory activity against enzymes related to dyslipidemia, hypertension, diabetes, cholesterol-lowering ability and inflammation, as well as antimicrobial activity. By integrating the knowledge generated during this interdisciplinary project the possibility to valorize honey as a bioindicator of environmental quality will be assessed, as well as the contribution to valorize the Protected Denomination of Origin (PDO) honey produced in the NPM in terms of their chemical and biological properties.

MTS/SAS/0099/2020

## BOOSTING THE SUSTAINABILITY OF THE MONTESINHO NATURAL PARK OAK FOREST THROUGH INNOVATION: VALORIZATION OF ACORN AND HONEYDEW

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| FUNDING | € 249 976,88 |

In the Montesinho Natural Park (MNP), one of the most abundant and relevant types of habitat are oak forests. These ecosystems are recognized by the Habitats Directive, therefore attesting to their importance for biodiversity and the need for their conservation. Among oaks, the Pyrenean oak (Quercus pyrenaica) is the most representative tree species in the MNP. Due to their extension, continuity, and conservation status, they are considered one of the most significant Pyrenean oak (PO) forests in Europe. Among its various agroecological and socioeconomic functions, PO forests are of particular importance for silvopastoral systems sustainability and are the natural ecosystem of origin of several wild non-wood forest products such as mushrooms, medicinal herbs or acorns, with a high potential for contributing to local economies. Current knowledge concerning the PO species and forest management is mainly focused in the tree wood growth, on traditional silviculture management plans for wood and biomass production. There is a clear lack of research regarding the PO acorns and its derived products. This knowledge gap has several consequences: suboptimization of management plans targeting acorn production; lack of production estimates; underuse of acorn for the development of transformed or derived products. The project will contribute to the fulfilling of these knowledge gaps using forest inventory, modelling and chemical profiling analysis methodologies. Although bees are not confined to forests, they are strongly associated with trees and forest areas, especially in periods where other floral sources are not available. MNP honey is already recognized as a PDO honey, showing the close link between this premium quality product and the floral richness of the region. Although traditional beekeeper's management recognize the possibility of honeydew production in the area during late summer, in particular from PO trees, the uncertainty of the conditions that favour its production is a handicap to obtain high quality honeydew honey and good harvests. Besides, the lack of specific honeydew products, represents a clear opportunity for regional products development and differentiation. Sustainable forest management and the development of innovative and differentiated regional products are key points for the MNP and surrounding regions. The ACORNDEW project aims at contributing to boost the sustainability of the MNP oak forest through innovation.

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