# European Research Council

**ERC Starting Grant – Stage 1**
**Research proposal**

# Biotic community attributes and ecosystem functioning: implications for predicting and mitigating global change impacts

# BIOCHANGE

Principal Investigator: Fernando T. Maestre
Hosting Institution: Universidad Rey Juan Carlos, Móstoles, Spain
Project duration in months: 60

Project summary (possibly copy/paste of abstract from the administrative part)

Increases in nutrient availability and temperature, and changes in precipitation patterns and biodiversity are important drivers of global environmental change facing terrestrial ecosystems. It is thus imperative to understand their impacts on the functioning of natural ecosystems to predict the consequences of global change, and to establish effective mitigation actions. Inspired by an increasing concern on the ecological and economical consequences of its decline, biodiversity has been the subject of many studies, which have led to major advances in describing its relationship to key ecosystem functional processes, such as productivity, nutrient cycling and carbon dioxide ($CO_2$) fixation and release. However, little is known on the relative importance of biodiversity against other community attributes, such as spatial pattern, as a driver of these processes. Furthermore, the effects of global change on the relationships between community attributes and ecosystem functional processes are virtually unknown. The overall objective of this project is to evaluate the relationships between the attributes of biotic communities (spatial pattern, species richness, species composition, species evenness, and cover) and key ecosystem functional processes (nutrient cycling, soil $CO_2$ flux and net $CO_2$ exchange, nitrogen fixation, litter decomposition, microbial functional diversity, and water infiltration and availability) in semiarid ecosystems under different global change scenarios. Its specific objectives are to: i) evaluate the relative importance of major biotic attributes as drivers of key ecosystem functional processes using different communities (vascular plants and biological soil crusts formed by lichens, mosses and cyanobacteria) and experimental approaches (experiments and observational studies), ii) assess how multiple global change drivers (temperature, nutrient availability and precipitation) affect these processes, iii) test if global change drivers modify observed relationships between biotic attributes and key ecosystem processes, iv) develop modelling approaches to forecast global change effects on these processes, and v) set up protocols for the establishment of restoration and mitigation actions based on the results obtained. This proposal will provide valuable insights on the relationships between community attributes and processes governing ecosystem functioning, an important database to test the generality of established paradigms based on results obtained with other model systems, and will also open the door to new research lines exploring the functional role of spatial pattern and its importance as a modulator of biotic community responses to global environmental change.

## A. Principal Investigator (PI) *(max. 3 pages)*

**i. CV**

Education, honors and awards

*Ph.D. in Biology*, awarded by the University of Alicante on 1st July 2002. Qualification: Extraordinary Award (Highest mark in Spain).
*Bs.C. in Biology*, awarded by the University of Alicante on 25th January 1999. Qualification: Extraordinary Award (Highest mark in Spain, best ranks of the 1994-1998 Biology promotion).
*Bs.C. Extraordinary Award*, awarded by the University of Alicante in January 1999.
*Award for Academic Excellence*, awarded by the Valencian Regional Government in May 1999.
*Ph.D. Extraordinary Award*, awarded by the University of Alicante in January 2005.

Professional experience

*"Ramón y Cajal" Research Fellow*, Department of Biology and Geology, University of Rey Juan Carlos (Spain), 01/10/2005-onwards
*Postdoctoral Fulbright Fellow*, Spanish Ministry of Education and Science, Department of Biology, Duke University (USA), 01/10/2003- 30/09/2005
*Associate in Research*, Department of Ecology, University of Alicante, 01/01/2003-30/09/2003
*Graduate Research Fellow*, Spanish Ministry of Education and Science Ministry, University of Alicante, 01/01/1999-31/12/2002
*Undergraduate Research Fellow*, Spanish Ministry of Education and Science, University of Alicante, 01/12/1998-30/05/1999

Publication Record

I have published 45 articles in international scientific journals included in the JCR database (8 more are currently under review), 9 articles in Spanish peer-reviewed scientific journals, 17 articles in popular Spanish journals, 15 book chapters and three whole books (in Spanish). Five publications relevant to this proposal are:
1) Reynolds, J.F., D.M. Stafford Smith, E.F. Lambin, B.L. Turner II, M. Mortimore, S.P.J. Batterbury, T.E. Downing, H. Dowlatabadi, R.J. Fernández, J.E. Herrick, E. Huber-Sannvald, R. Leemans, T. Lynam, **F. T. Maestre**, M. Ayarza & B. Walker. 2007. Global desertification: Building a science for dryland development. *Science* (in press).
2) **Maestre, F. T.** & J. F. Reynolds. 2007. Amount or pattern? Grassland responses to the heterogeneity and availability of two key resources. *Ecology* 88: 501-511.
3) **Maestre, F. T.** & J. F. Reynolds. 2006. Spatial heterogeneity in nutrient supply modulates plant nutrient and biomass responses to multiple global change drivers in model grassland communities. *Global Change Biology* 12: 2431-2441.
4) **Maestre, F. T.**, A. Escudero, I. Martínez, C. Guerrero & A. Rubio. 2005. Does spatial pattern matter to ecosystem functioning? Insights from biological soil crusts. *Functional Ecology* 19: 566-573.
5) **Maestre, F. T.** & J. Cortina. 2004. Do positive interactions increase with abiotic stress? A test from a semi-arid steppe. *Proceedings of the Royal Society of London B (Supplement)* 271: S331-S333.

Participation in Research projects

In addition to the projects listed in Table I, I have participated in the following research projects:

*Experimental basis for the ecological sustainability of highway hillslopes*; Funded by CINTRA and Fundación Biodiversidad (Spain) with 184,804 €; Duration: June 2006- June 2010; Principal investigator (PI): Dr. Fernando Valladares.
*Ecosystem processes in Mediterranean steppes: relationships between composition, structure and function*; Funded by the Comunidad de Madrid (Spain) with 30,500 €; Duration: December 2005-March 2007; PI: Dr. Fernando T. Maestre.
*Research Network on Ecological Restoration in Madrid*; Funded by the Comunidad de Madrid (Spain) with 743,000 €; Duration: January 2006- January 2010; PI: Dr. Adrián Escudero.
*Indicators of success in the restoration of Mediterranean ecosystems*; Funded by the Comisión Interministerial de Ciencia y Tecnología (Spain) with 60,000 €; Duration: December 2005-December 2008; PI: Dr. Susana Bautista.
*ARIDnet: A Research Network for Testing New Paradigms for Global Desertification*; Funded by the National Science Foundation (USA); Duration: October 2003 - October 2008; PI: Dr. James F. Reynolds.
*What drives ecosystem functioning? Evaluation of an hypothesis using biological soil crusts from semiarid environments of Madrid*; Funded by the Comunidad de Madrid (Spain) with 24,168 €; Duration: January 2005 - January 2006; PI: Dr. Adrián Escudero.
*Water and nitrogen fluxes in biological crusts of semiarid areas*; Funded by the Comisión Interministerial de Ciencia y Tecnología (Spain) with 91,400 €; Duration: December 2001-December 2004; PI: Dr. Jordi Cortina.
*Selection of provenances to improve restoration of plant cover and soil erosion control in semiarid areas*; Funded by Fundación CEAM (Spain) with 84,142 €; Duration: January 2001-January 2005; PI: Dr. Juan F. Bellot.
*Restoration of degraded ecosystems in Mediterranean regions*; Funded by the European Union (GD XII) with 130,480 €; Duration: January 1998 – February 2001; PI: Dr. Ramón Vallejo.
*Restoration of plant cover in semiarid areas and control of erosion in areas with high desertification risk*; Funded by Fundación (Spain) with 85,879 €; Duration: January 1996 - January 1999; PI: Dr. Juan F. Bellot.

International Experience

*Rothamsted Experimental Station*, Department of Statistics, UK (15/06 – 31/07/1999); Topic: Spatial analysis of ecological data
*University of Montana*, Division of Biological Sciences, USA (01/06 – 31/08/2000); Topic: Evaluation of ecosystem impacts of the invasion by *Acer platanoides*
*Duke University*, Department of Biology (20/09 – 20/12/2001); Topic: Assessing the effects of soil nutrient heterogeneity on the performance of *Prosopis glandulosa* seedlings
*Rothamsted Research*, Plant and Invertebrate Ecology Division, UK (22/08 – 12/09/2003); Topic: Spatial analysis of ecological data
*Duke University*, Department of Biology (01/10/2003 – 30/09/2005); Topic: Assessing the effects of global change and nutrient heterogeneity on model grassland communities

Editorial Responsibilities

Member of the Editorial Boards of the international scientific journals *Journal of Ecology* (since September 2006) and *Arid Land Research and Management* (since November 2005), and of the Spanish journal *Ecosistemas* (since September 2004).
Referee of more than 80 scientific paper for journals such as *Ecology*, *Ecological Applications*, *Ecology Letters*, *Oecologia*, *Proceedings of the Royal Society B*, *Journal of Ecology*, *Oikos*, *Ecography* and *Journal of Vegetation Science*.
Referee of scientific projects for the Grant Agency of the Czech Republic and FONDECYT (Chile).

**ii. Self Evaluation**

During my Ph.D. at the University of Alicante, I was trained as a community ecologist with a strong emphasis on quantitative statistical methods and on field-based, applied research (restoration of degraded ecosystems in semiarid areas using environmental heterogeneity and plant-plant interactions). The skills acquired during this stage were complemented with the research stays conducted at different internationally recognized research centers and, specially, during my two-year post-doc at Duke University. In my post-doc I developed an independent, original, research program on global change using controlled environments (to evaluate the joint effects of nutrient heterogeneity and global change drivers on plant community structure and functioning), and had the chance to interact with (and learn from) some of the most prominent global change scientists (James F. Reynolds, Robert Jackson and William Schlesinger, among others). Since my return to Spain, with a "Ramón y Cajal" Research Fellow, I have implemented an independent research program, using plants and biological soil crusts as model organisms, to evaluate the relative importance of the attributes of biotic communities on ecosystem functioning and to assess how this relationship changes along environmental gradients.

I am a dynamic person, have a strong capacity to work with teams and to motivate my colleagues. Despite I was awarded with my Ph.D. less than five years ago (in July 2002), my research activities have led to numerous publications in high quality peer-reviewed journals (including *Science*, *Ecology*, *Journal of Ecology* and *Global Change Biology*, among others). Many of these publications are multi-author works, reflecting the collaborative approach that I take to research and the large number of connections established with scientists from Spain and abroad. However, it must be noted that I have led most of the research I have been involved in (I am the leading author of 73% of all my publications). My research activities and collaborative approach to research have given me an increasingly high profile within the ecological community. As a consequence, I was appointed to the Editorial Board of the *Journal of Ecology*, one of the leading ecological journals, in September 2006, being the youngest member of the Board since then.

Since my return to Spain in 2005, I have led two research projects, and I am currently mentoring three graduate students in my Department. Overall, my career so far demonstrates my value as an independent research leader, and my potential to become a reference in the field of terrestrial ecology.

**iii. Funding ID**

Currently I have funding from the British Ecological Society, and I have another proposal actually under review, for work related to this application (see table I). An ERC grant would complement perfectly my current funding, as the work proposed to develop with this application is built on my current research. Furthermore, and more important, an ERC grant would allow me to substantially expand my research activities to cover key topics that cannot be afforded with my current level of funding, and to establish an independent laboratory and research group within my Department. Such a group would focus on the evaluation and mitigation of global change impacts in terrestrial ecosystems.

**Table I.** Current and foreseen proposals for work related to this ERC application.

| Title | Funding scheme/ organization responsible | Participation | Size of the grant (in €) | Duration |
|---|---|---|---|---|
| *Testing the effects of biodiversity and spatial pattern on ecosystem functioning: An experimental approach using biological soil crusts* | Early Career Project Grant / British Ecology Society | Principal investigator | 34,018 | 01/05/2006 - 30/08/2008 |
| *Plant-plant interactions and ecosystem functioning under global change* | Research program con conservation ecology/ BBVA Foundation | Principal investigator | 200,000 | Under evaluation |

## B. Research Project *(max. 4 pages)*

### i. State-of-the-art and objectives

The recently released 4th Assessment Report of the Intergovernmental Panel on Climate Change (http://www.ipcc.ch/) provides unequivocal evidence of the increase of temperature worldwide. Such augments, together with increases in nutrient availability and atmospheric $CO_2$ concentration ($[CO_2]$), changes in precipitation patterns and in biodiversity, constitute key drivers of the global environmental change currently facing terrestrial ecosystems (Zavaleta *et al.* 2003). Inspired by an increasing concern on the ecological and economical consequences of its decline, biodiversity has been the subject of many studies conducted primarily with terrestrial plant communities, model microbial systems, and aquatic communities (Hooper *et al.* 2005). Albeit this research has led to major advances in describing the relationship between biodiversity and key functional processes, our ability to make strong generalizations on the functional role of biodiversity, and to extrapolate the results obtained so far to other types of communities is still quite limited. Furthermore, little is known on the relative importance of biodiversity against other co-occurring key community attributes as a driver of ecosystem functioning (Maestre *et al.* 2005).

Among the community attributes that may be relevant for ecosystem functioning, spatial pattern merits special attention. The presence of non-random patterns in the spatial distribution of organisms and ecological processes is the norm, rather than the exception, in most ecosystems (Dale & Fortin 2005). Theoretical and modeling studies highlight the importance of these patterns for ecosystem functioning, stability and dynamics (Tilman & Kareiva 1997). However, very few studies have empirically evaluated how changes in the spatial patterns of a community, *per se* (i.e. independently of other co-occurring community attributes), are directly related to ecosystem functioning (Maestre *et al.* 2005), and none of them has been conducted using experimental approaches. I hypothesize that, by influencing intra- and inter-specific interactions, individual performance and individual-environment interactions, the spatial pattern of ecological communities controls key ecosystem functional processes such as nutrient cycling and water infiltration and availability.

Substantial research efforts are being currently devoted to predict how biodiversity will respond to some components of global environmental change, such as climate change (Araújo & New 2007), invasions by exotic species (Fridley *et al.* 2007), land use (Zhou *et al.* 2006) or changes in $[CO_2]$ and nutrient availability (Zavaleta *et al.* 2003). However, the impact of these global change drivers on the relationships between biotic community attributes (including biodiversity) and key functional processes is virtually unknown (Zhou *et al.* 2006). The very few studies evaluating joint changes in biodiversity and global change drivers on functional processes such as primary production have been conducted with herbaceous plants (Reich *et al.* 2004, Maestre & Reynolds 2006), and much remains unknown on the potential effects of global change on the ecosystem processes and services that are dependent on attributes of biotic communities. Expanding these studies to incorporate biotic attributes such as spatial pattern is essential to advance in our understanding of the effect of biotic community attributes on ecosystem functioning, to accurately predict the consequences of global environmental change on key processes for sustaining life on earth, and to establish effective mitigation actions.

The overall objective of this project is to evaluate the relationships between key attributes of biotic communities (spatial pattern, species richness, species composition, species evenness, and cover) and key ecosystem functional processes (nutrient cycling, soil $CO_2$ flux and net $CO_2$ exchange, nitrogen fixation, litter decomposition, microbial functional diversity, and water infiltration and availability) in semiarid ecosystems under different global change scenarios. It focuses on these ecosystems because they are a key terrestrial biome, are highly vulnerable to global change (Körner 2000), and their biotic communities have marked spatial patterns (Maestre 2006). Its specific objectives are to:

i) evaluate the relative importance of different biotic attributes as drivers of ecosystem functioning using different communities (vascular plants and biological soil crusts formed by lichens, mosses

and cyanobacteria [BSC]) and experimental approaches (field/common garden experiments and observational field studies).
ii) assess how multiple global change drivers (temperature, nutrient availability and precipitation) will affect key ecosystem functional processes.
iii) test whether global change drivers modify observed biotic attributes-ecosystem functioning relationships.
iv) develop modeling approaches to forecast global change effects on ecosystem functioning in semiarid regions.
v) set up protocols for the establishment of mitigation actions based on the results obtained.

This project is highly relevant for the study of global change, as it aims to study, for the first time, the joint impacts of multiple biotic community attributes and global change drivers on key ecosystem processes. The proposed use of different experimental approaches and organisms to test the same core ideas will add further value to the project by allowing wider generalizations of the results obtained. If successful, this project will have notable impacts on both basic and applied research regarding global change impacts and their mitigation. It will provide valuable insights on the effects of global change on the relationship between community attributes and ecosystem functioning, an important database to test the generality of established paradigms based on results obtained with other model systems and organisms, and baseline data to refine current modeling approaches, to develop forecast models to predict functional consequences of global change, and to design specific technologies to mitigate or reverse predicted impacts of global change. Furthermore, this project will open the door to new research lines exploring the functional role of spatial pattern and its importance as a modulator of ecosystem responses to global environmental change.

**ii. Methodology**

The methodology of the project is based on the establishment of new field (both observational and experimental) and common garden experiments, the monitoring of experiments already running, the development of modeling tools, and the synthesis of all the data gathered during the project. This combination of approaches is appropriate to achieve the objectives of the project. Below I present a brief summary of the main research that will be carried out during its duration:

**1)** Field experiments. The following experiments will be set up and maintained in representative ecosystems of semiarid areas of Spain (steppes dominated by *Stipa tenacissima* rich in BSC communities):

a) *Response of BSC to multiple global change drivers*. It will evaluate, using a factorial design, the effects of BSC (presence vs. absence), nutrient availability (control vs. nutrient addition as predicted by models), temperature (control vs. increased temperature as predicted by current climatic models), and rainfall (control vs. a reduction in rainfall as predicted by current climatic models) on key ecosystem functions (net $CO_2$ exchange, soil enzyme activities related to N, C and P cycles, soil water dynamics, litter decomposition, microbial functional diversity and N fixation). The attributes of BSC (cover, species richness, species diversity and spatial pattern) will be used in the design as covariates. The experiment will be replicated in two sites. It will set up during the first year of the proposal, and will be monitored for four years.

b) *Joint effects of BSC and plant attributes on ecosystem functioning along natural gradients*. This observational study will evaluate how the biotic attributes of BSC and vascular vegetation (cover, species richness, species diversity and spatial pattern) influence ecosystem functioning (same variables as experiment 1a) in *S. tenacissima* steppes along a large geographical gradient (from the Center to SE Spain) including natural variations in rainfall, temperature and overall nutrient status. A minimum of 30 sites (dimensions 30 × 30 m), located in the same substrate type and orientation, will be selected for the study. This study will, for the first time, evaluate the relative importance of BSC, vascular vegetation and abiotic factors as drivers of

ecosystem functioning and will complement the results of the experiment 1a. It will be carried during the first three years of the proposal.

c) *Biotic attributes and small-scale heterogeneity in ecosystem functioning*. The principal investigator started in November 2006 an experiment where monthly measurements of soil respiration and seasonal measurements of nutrient cycling are being taken in 78 sampling points located in different microsites of a *S. tenacissima* steppe located in Central Spain (below *S. tenacissima* canopies, below *Retama sphaerocarpa* canopies, bare ground soil without BSC and bare ground soil with different BSC cover, richness and composition). This experiment aims to: i) evaluate the relative importance of spatial pattern and other BSC attributes as drivers of ecosystem functioning, and ii) monitor small-scale patterns in key functional processes. It will be continued during the five years of the project, so a long-term dataset can be obtained for the modeling activities (see below).

d) *Restoration experiment*. This experiment aims to test whether the results obtained from the previous experiments can be applied for the establishment of effective restoration and mitigation actions. Experiments will be carried out using BSC, as management protocols are poorly developed for these organisms (Bowker 2007), and they play key functional roles. At four sites located along an abiotic stress gradient determined by rainfall we will establish experimental plots in eroded areas without BSC. Different BSC re-inoculation treatments will be established in order to maximize the recovery of ecosystem functioning (these will be set up according to the results of 1a, 1b and 1c). The experiment will be carried out during the last two years of the project.

**2)** Common garden experiments. Three large common garden experiments will be set up:

a) *Spatial pattern-ecosystem functioning experiment 1*. This microcosm experiment aims to test for the independent effects of species richness (four and eight species), species composition (random selections from a species pool), and spatial pattern (clumped vs. random) on ecosystem functioning (soil $CO_2$ efflux, soil enzyme activities related to N, C and P cycles, microbial functional diversity) using BSC. This experiment will be set up during the first year of the project, and will be monitoring during the following two years.

b) *Spatial pattern-ecosystem functioning experiment 2*. This microcosm experiment, related to the previous one, will independently test for the effects of species richness (two, four and eight species), species evenness (maximal evenness vs. communities with a geometric distribution of abundances among species) and spatial pattern (clumped vs. random) on ecosystem functioning (same variables as in experiment 2a) using BSC. The experiment will be set up during the first year of the project, and will be monitoring during the following two years.

c) *Spatial pattern-ecosystem functioning experiment 3*. This common garden experiment aims to test for the independent effects of spatial pattern (clumped vs. random), species richness (4, 8 and 16 species), temperature (control vs. increased temperature), and rainfall (natural rainfall vs. a reduction of rainfall) on the functioning of herbaceous assemblages (evaluated with productivity, net $CO_2$ exchange, soil enzyme activities related to N, C and P cycles, microbial functional diversity and litter decomposition). This experiment differentiates from current global change and biodiversity experiments in that it incorporates explicitly the spatial pattern of the community in the design. The experiment will be set up during the first year of the project, and will last for three years.

**3)** Modeling activities. The data gathered in the field and common garden experiments will be used to set up predictive models of ecosystem functioning based on attributes of biotic communities, including spatial pattern and surrogates of biodiversity. A range of modeling approaches, including predictive (Bowker *et al.* 2006) and ensemble forecasting modeling (Araújo & New 2007), and global change scenarios (Schröter *et al.* 2005) will be tested to predict how changes in the attributes of plants and BSC biotic attributes may impact the functioning of semiarid ecosystems under global change.

**4)** Synthesis and meta-analyses. Together with the modeling activities, the data gathered from all the field and common garden experiments will be combined with those of published studies to conduct different synthesis and meta-analyses of the relative importance of biotic attributes on ecosystem functioning, and on the effects of multiple, and co-occurring, global change drivers on the performance of organisms and on related ecosystem functional processes.

**iii. Resources**

The team that will conduct the research planned will be formed by eight members, the principal investigator and seven members recruited during the duration of the project. The profiles of the members to be recruited are the following:

**1)** *A post-doctoral research associate with background on community and ecosystems ecology*. He/she will be contracted during the first 2.5 years of the project, and will work in experiments 1a and 1b.

**2)** *A post-doctoral research associate with background on ecological modeling and forecasting*. He/she will be contracted during the last 2.5 years of the project, and will be responsible for testing and developing forecast modeling approaches based on the results gathered from the field and common garden experiments.

**3)** *A graduate student, with a Bs.C. in Biology, Environmental Sciences, Forest Engineering or related fields*. He/she will be contracted during the first 4 years of the project, and will conduct his Ph.D. research based on experiments 2a, 2b and 2c outlined above.

**4)** *A graduate student, with a Bs.C. in Biology, Environmental Sciences, Forest Engineering or related fields*. He/she will be contracted during the last 4 years of the project, and will conduct his Ph.D. research based on experiments 1a, 1c and 1d outlined above.

**5)** *Two field assistants*, who will help researchers with the set up, maintenance and data gathering of field and common garden experiments.

**6)** *A laboratory technician*, who will help researchers with the analysis in the laboratory of all the samples gathered during the field and common garden experiments, as well as with data management and curation.

The hosting institution has the basic infrastructure needed to carry out the research project. However, to fully achieve its objectives it is necessary to acquire some pieces of equipment (e.g. portable photosynthesis system, sensors for temperature and moisture monitoring, microplate reader and spectrophotometer for enzyme activity and soil functional analyses, weather stations, and potentiometer for measure soil water potential). Some pieces of equipment (e.g. LI-COR 8100 Automated soil $CO_2$ system, chlorophyll fluorometer), and all the laboratory facilities and instrumental available at the hosting institution will be used for the research planned in the project.

**References**

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## C. Research Environment *(max. 1 page)*

### i. Transition to independence

My position within my University, as a "Ramón y Cajal" research fellow, allows me to develop an independent research program, as I have no obligations for teaching. However, the level of funding commonly available for researchers in my position makes extremely difficult to recruit people, and thus to create an independent laboratory. As a consequence, I still need to participate in all the stages involved in research (including experimental setup and monitoring, and data curation and analysis), which constrains my productivity and my ability to become an independent researcher. An ERC grant would provide me with the resources needed to establish my own laboratory within my Department, and to substantially expand the research I am currently doing into new, exciting, and mostly under explored, research areas with important scientific, political and socio-economical implications. Such a grant would definitively consolidate my profile within the ecological and global change research community, and would provide the resources to become an independent research leader.

### ii. Hosting institution

The hosting institution (Universidad Rey Juan Carlos, URJC) strongly supports this proposal. Created 10 years ago, the URJC is the youngest public university located in the Madrid region. It is an expanding University with an ample number of degrees in Environmental, Engineering, Health and Social sciences, and with strong research groups on Chemical Engineering and Biological Sciences. My department (Biology & Geology) is mostly formed by young and talented teachers and researchers, with a strong background in areas such as terrestrial ecology, evolutionary biology, conservation ecology and biodiversity research (for more information and recent publications see http://www.escet.urjc.es/biodiversos/engl/main.htm). The URJC is maintaining very active policies to increase its research activity. It has established its own incentive programs to motivate its teachers and researchers to become involved as much as possible in research activities. It is also seeking to attract and retain top researchers in different fields.

### iii. Budget

The overall budget requested for the project, including indirect costs, is 1,167,307 €. This will be distributed among the five years of the project as follows: 288,317 € (year 1), 227,993 € (year 2), 235,010 € (year 3), 220,684 € (year 4), and 195,303 € (year 5).

### iv. Additional participants

No additional participants are included in this project.