

Applicant: [REDACTED]  
Organisation: [REDACTED]  
Funding Sought: £5,000.00  
Funding Awarded: £5,000.00

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## SR18/1376

### Single and interactive effects of multiple stressors on post-fire regeneration

Last summer, wildfires ravaged across large forest expanses in Greece, Sweden, California and many other places, sparking concerns about the future of the world's forests. However, whereas fire can indeed change forest ecosystems in dramatic ways, it constitutes only one part of the story. Ultimately, the impact of fire on ecosystems is modulated by interactions with other disturbances. This includes natural disturbances like herbivory on regenerating seedlings, which can be particularly high. But it also includes human-caused disturbances like salvage logging –felling burnt trees–, which is an increasingly common human response to wildfire. Salvage logging can also modify the effect of herbivory, as it changes the structure of the habitat and therefore the movement possibilities and habitat for different animals. Further, climate change is modifying the conditions under which regeneration occurs, so that studies under current climatic conditions will not be applicable in the future. Again, the effects of climate change can be modified by salvage logging, as the latter removes trunks that ameliorate hot climate by providing shade and retaining water. However, whereas individual disturbances and stressors have been the focus of much research and important advances in ecological science to date, we know much less about how the effects of one disturbance may vary under the occurrence of another. This constitutes a key gap to understand and manage forests in today's world. I aim to apply state-of-the-art ecological theory and methods to assess how some major interacting forces may be affecting the capacity of ecosystems to regenerate after fire. To address this complex question, I will conduct a field experiment in a unique laboratory: the Doñana Natural Park in southern Spain, where a large wildfire occurred in summer 2017. I will study the regeneration capacity of four key plant species under different combinations of disturbance. I will sow seeds in plots located in burnt stands subject to salvage logging or no logging. In these plots, I will further analyse the effects of herbivory and increased temperature. I aim to assess how regenerating plants respond to these combinations of disturbances in terms of emergence, survival, growth, and the capacity to do photosynthesis. The proposed grant would cover the expenses related to fieldwork, the installation of herbivore fences, the acquisition of temperature loggers and other small field materials, the analysis of soils, and the temporary hiring of a field assistant to help set up the project. In short, this project will advance ecological science by bringing together the single and interactive effects of wildfire, human ecosystem management, herbivory and climate change on forest regeneration under a robust study design. It will deliver scientific results of the highest standard and provide feedback to managers and policy-makers who aim to enhance the recovery of ecosystems after wildfire. It will stimulate public debate through outreach publications. And it shall help identify strategies to manage the world's forests, increasingly affected by wildfire and other disturbances, to ensure the perpetuity of the services and functions they perform.

## PRIMARY APPLICANT DETAILS

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Title [REDACTED]  
Name [REDACTED]  
Surname [REDACTED]  
Tel (Work) [REDACTED]  
Email (Work) [REDACTED]  
Address [REDACTED]

## CONTACT DETAILS

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Role	Referee 2
Name	[REDACTED]
Surname	[REDACTED]
Email (Work)	[REDACTED]

## CONTACT DETAILS

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Role	Referee 1
Name	[REDACTED]
Surname	[REDACTED]
Email (Work)	[REDACTED]

# Section 1 - Eligibility

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Please answer the questions below to determine if you are eligible for this scheme

Does the project form part of a degree/thesis/fellowship?

No

Is this project a component of a larger already funded study?

(We accept there may be some additional funding from other streams, however the BES contribution should constitute for the majority of the project funding)

No

Please note we do not accept resubmissions of the same project. Applications will be rejected without being sent out for review if they are re-submissions of a proposal rejected in a previous round, or if they represent only a minor revision of such a proposal (for example, with a modified experimental design). As a guide, in order to be significantly different, at least 80% of objectives & activities should be different to the original proposal.

Using the above statement, is this project a resubmission?

No

# Section 2 - Contact Details

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## PRIMARY APPLICANT DETAILS

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Title  
Name  
Surname  
Tel (Work)  
Email (Work)  
Address

## CONTACT DETAILS

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Role	Referee 2
Name	
Surname	
Email (Work)	

## CONTACT DETAILS

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Role	Referee 1
Name	
Surname	
Email (Work)	

## GMS ORGANISATION

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Type	Organisation
Name	[REDACTED]
Phone (Mobile)	[REDACTED]
Email	[REDACTED]
Website	[REDACTED]
Address	[REDACTED]

If you do not have a current organisation (i.e. you are an independent researcher/retired), please provide your preferred contact address above and select the checkbox to the right.

Unchecked

### BES Membership Number

[REDACTED]

## Section 3 - CV

### Education History

Please note if you do not know the exact day, select the 1st day of the month e.g. March 2005: 01/03/2005

Start Date	End Date	Qualification	Organisation	Additional Info
[REDACTED]	[REDACTED]	PhD in Ecology	[REDACTED]	Cum laude
[REDACTED]	[REDACTED]	MRes in Ecology, Evolution and Conservation	[REDACTED]	Distinction
[REDACTED]	[REDACTED]	Bachelor in Environmental Sciences	[REDACTED]	Best-grades award
[REDACTED]	[REDACTED]	Master in Applied Statistics	[REDACTED]	Ungraded, distance learning

### Employment History

Please note if you do not know the exact day, select the 1st day of the month e.g. March 2005: 01/03/2005

Start Date	End Date	Position	Organisation	Additional Info
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[Redacted]	[Redacted]	PhD grant holder	[Redacted] No Response
[Redacted]	[Redacted]	Postdoctoral researcher	University [Redacted] No Response
[Redacted]	[Redacted]	Postdoctoral researcher	University [Redacted] No Response

**Research Grants/Fellowships Awarded**

Date	Details	Amount Awarded (£)	Additional Info
2016-2018	Project: [Redacted] [Redacted] [Redacted] [Redacted]	£180,000.00	Funded by [Redacted] [Redacted]
2016	Project: [Redacted] [Redacted] [Redacted] [Redacted] [Redacted]	£1,753.00	[Redacted] [Redacted] [Redacted]
2015-2019	Project: [Redacted] [Redacted] [Redacted] [Redacted] [Redacted]	£180,375.00	Funded by [Redacted] [Redacted]
2015	Project: [Redacted] [Redacted] [Redacted] [Redacted]	£1,087.00	Funded by [Redacted] [Redacted]
2014	Project: [Redacted] [Redacted] [Redacted] [Redacted]	£1,021.00	Funded by [Redacted] [Redacted]
2014-2018	Project: [Redacted] [Redacted] [Redacted] [Redacted] [Redacted] [Redacted]	£142,932.00	Funded by [Redacted] [Redacted] [Redacted]

2016-2018	Postdoctoral fellowship ████████████████ ████████████████	£43,860.00	████████████████ ████████████████ ████████
2015-2016	Postdoctoral grant, ██████ ████████████████	£13,047.00	████████████████ ████████████████
2017	Postdoctoral mobility grant ████████████████	£7,689.00	████████████████ ████████████████ ████████
2011-2015	Ph.D. grant ██████ ████████████████	£48,737.00	████████████████ ████████████████ ████████
2015	Pre-doctoral mobility grant ████████████████	£4,158.00	████████████████ ████████████████ ████████
2013	Pre-doctoral mobility grant ████████████████	£2,193.00	████████████████ ████████████████
2010-2011	Grant for postgraduate education ██████ ████████████████	£22,967.00	████████████████ ████████████████ ████████
2009-2010	Grant for novel researchers ████████████████	£2,368.00	████████████████ ████████████████ ████████
2008-2009	Grant for novel researchers ████████████████	<i>No Response</i>	████████████████ ████████████████
2018	Postdoctoral mobility grant ████████████████	£2,105.00	████████████████ ████████████████

**Conference Participation**

Please list a maximum of 3 most recent and relevant conferences

Conference Name	Details
II International Conference on Forests, April 2017, Bavarian Forest National Park, Germany	Talk: ██████████████████ ██ ████████████████
XIV MEDECOS conference, Feb 2017, Seville, Spain	Talk: ██████████████████ ████████████████████
European Ecosystem Services Conference, Sep 2016, Antwerp, Belgium	Talk: ██████████████████ ██ ████████████████

**Other Awards/Achievements/Skills**

██  
██

*No Response*

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*No Response*

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## **Summary of Publication Record**

[Redacted]

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### Professional Membership

British Ecological Society since 2017  
Ecological Society of America since 2016  
Spanish Society for Forest Science since 2016  
Spanish Association of Terrestrial Ecology since 2009

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### Additional Information

[Redacted]

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## Section 4 - Project Details and Keywords

**NB: The Total Project Cost and Amount Requested will be added automatically from the figures you provide on the budget page. Once you have completed your budget, you will be required to come back into this page, ensure the figures are correct, and save the page.**

### Summary Project Details

**Total project cost: £**  
5,000.00

**Amount requested from BES: £**  
5,000.00

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**Please read our [Bulletin article](#) for guidelines on writing an effective lay summary.**

#### Project title:

Single and interactive effects of multiple stressors on post-fire regeneration

#### Project lay summary:

Last summer, wildfires ravaged across large forest expanses in Greece, Sweden, California and many other places, sparking concerns about the future of the world's forests. However, whereas fire can indeed change forest ecosystems in dramatic ways, it constitutes only

one part of the story. Ultimately, the impact of fire on ecosystems is modulated by interactions with other disturbances. This includes natural disturbances like herbivory on regenerating seedlings, which can be particularly high. But it also includes human-caused disturbances like salvage logging –felling burnt trees–, which is an increasingly common human response to wildfire. Salvage logging can also modify the effect of herbivory, as it changes the structure of the habitat and therefore the movement possibilities and habitat for different animals. Further, climate change is modifying the conditions under which regeneration occurs, so that studies under current climatic conditions will not be applicable in the future. Again, the effects of climate change can be modified by salvage logging, as the latter removes trunks that ameliorate hot climate by providing shade and retaining water. However, whereas individual disturbances and stressors have been the focus of much research and important advances in ecological science to date, we know much less about how the effects of one disturbance may vary under the occurrence of another. This constitutes a key gap to understand and manage forests in today's world.

I aim to apply state-of-the-art ecological theory and methods to assess how some major interacting forces may be affecting the capacity of ecosystems to regenerate after fire. To address this complex question, I will conduct a field experiment in a unique laboratory: the Doñana Natural Park in southern Spain, where a large wildfire occurred in summer 2017. I will study the regeneration capacity of four key plant species under different combinations of disturbance. I will sow seeds in plots located in burnt stands subject to salvage logging or no logging. In these plots, I will further analyse the effects of herbivory and increased temperature. I aim to assess how regenerating plants respond to these combinations of disturbances in terms of emergence, survival, growth, and the capacity to do photosynthesis. The proposed grant would cover the expenses related to fieldwork, the installation of herbivore fences, the acquisition of temperature loggers and other small field materials, the analysis of soils, and the temporary hiring of a field assistant to help set up the project.

In short, this project will advance ecological science by bringing together the single and interactive effects of wildfire, human ecosystem management, herbivory and climate change on forest regeneration under a robust study design. It will deliver scientific results of the highest standard and provide feedback to managers and policy-makers who aim to enhance the recovery of ecosystems after wildfire. It will stimulate public debate through outreach publications. And it shall help identify strategies to manage the world's forests, increasingly affected by wildfire and other disturbances, to ensure the perpetuity of the services and functions they perform.

**Project start date:**

10/05/2019

**Project end date:**

09/05/2020

**Project country:**

Spain

**We have chosen a selection of key words which cover the breadth of the ecological research we fund to link the ecological content of an application to the most appropriate member of the BES Review College.**

**Your selections will determine which reviewers are asked to review your application. Please select carefully.**

**Please choose three from the following:**

- Forest Ecology
- Global change ecology
- Plant Ecology

## Section 5 - Grant Specific Questions

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**Please provide a project description**

**This should include:**

- a) background and rationale**
- b) the question or hypothesis to be tested**
- c) an outline of the methods to be use**
- d) expected outputs**
- e) expected timescales**

**Please capitalise all headings**

BACKGROUND

Fire shapes ecosystem dynamics and evolutionary trajectories in many parts of the world. However, wildfires are increasing in severity and extent [1], leading to concerns about ecosystem resilience. Other disturbances and stressors are associated to wildfire occurrence, and recent research has shown that interactions between multiple stressors can affect

resilience more than wildfire alone [2]. Wildfire creates open space that is rapidly colonised by small plants that, in turn, attract herbivores. Wildfire also frequently triggers an anthropogenic disturbance, namely salvage logging [3], which can, in turn, affect plant-animal interactions that intervene in regeneration [4]. Further, post-fire regeneration is increasingly occurring under hotter climate, which may interact with the extraction of microclimate-mitigating deadwood through salvage logging [5]. The occurrence of disturbance/stressor interactions implies that studying the effects of disturbances in isolation may be of little relevance. However, few studies have addressed their interactive effects. Understanding how post-fire regeneration is modified by such interactions thus represents a key gap to understand and manage the world's fire-prone forests.

#### HYPOTHESES

1. Post-fire salvage logging increases browsing pressure on young seedlings
2. Post-fire seedling survival and growth are reduced under hotter temperature
3. The reduction in plant performance due to increased temperature can be mitigated through avoiding the removal of dead wood

#### METHODS

I will conduct a plant-regeneration trial under field conditions in the Doñana Natural Park, where a wildfire burned ca. 8500 ha of shrublands and forest in summer 2017. I will establish 16 blocks of ca. 4x4 m, half in salvage-logged areas and half in unsalvaged areas. Blocks will be located as to maximise the similarity in pre-fire characteristics and fire severity between salvaged and unsalvaged blocks. To address Hypothesis 1, each block will encompass a fenced (herbivore-exclosure) and two unfenced plots of 1x1 m (one at each side of the fence). For Hypotheses 2 and 3, the fences will be extended to encompass a second 1x1 m plot, which will receive an open-top chamber aimed at increasing air temperature by ~2°C. In each of the resulting 64 plots, I will sow five locally-collected seeds of each of four species: *Pinus pinea*, *Quercus suber*, *Juniperus oxycedrus*, and *Pistacia lentiscus*. Seeds will be sown inside "seed shelters" [5] to prevent granivory. I will monitor the emergence and early growth of seedlings in spring; early growth, survival and photosynthesis (on a reasonable subset of the plants, with a LI-6800) in summer; and survival, growth, and biomass in autumn. Herbivory will be quantified in every field visit.

I will also collect data on the following covariates inside the plots: canopy cover, ground cover (vegetation, bare soil, deadwood), soil macronutrient content, and temperature, along the period of the study.

I will analyse the data with mixed-effects models, accounting for the spatial structure of the experiment.

#### OUTPUTS

- Scientific output: one publication in a high-impact ecological journal,
- Academic outreach: oral communication at BES annual meeting; news through ResearchGate
- General outreach: publication in non-academic journal; news through Twitter and Pau Costa Foundation website
- Educational output: master's thesis (in collaboration), which I would offer upon granting

#### TIMESCALES

The project will last 1 year, beginning in early 2019.

- Winter-2019: Acquisition of materials (incl. seed), preparation of open-top chambers, selection and establishment of study plots and fences, measurement of covariates, collection of soil samples. Seed sowing.
- Spring-2019: Early plant monitoring. Soil analyses.
- Summer-2019: Plant monitoring, including photosynthesis.
- Autumn-2019: Monitoring of plant performance and obtention of data from loggers. Collection of plants and biomass measurements in laboratory.
- Winter-2020: Data analysis. Write-up.

#### REFERENCES

1. <https://doi.org/10.1111/j.1526-100X.2009.00619.x>
2. <https://doi.org/10.1890/ES15-00058.1>
3. <https://doi.org/10.1111/geb.12772>
5. <https://doi.org/10.1016/j.ecoleng.2015.06.033>
6. <https://doi.org/10.1111/j.1526-100X.2009.00619.x>

#### **What are the risks to the health and safety of those involved in the project and how are these risks to be minimised?**

The greatest risks are related to fieldwork, including travel under poor road conditions, injury by falling trees, wildfire and biting by ticks. Risk avoidance encompasses driving at daytime, fieldwork under appropriate weather conditions (not too

windy or too dry); knowing nearby places where medical assistance is available; carrying a first aid kit including tick repellent and tick remover; always letting someone know about one's location if traveling alone.

**Please identify any ethical considerations that may arise from the project.**

Addressing wildfire effects only from an ecological perspective risks disregarding people's dependence on forest resources –particularly when these have been affected by wildfire. During the analysis, interpretation and writing-up of results, I will take care to balance ecological results with socioeconomic factors to avoid proposing dogmatic or narrow-sighted management recommendations.

**Please provide details of agreed collaborations and project partners that will facilitate the proposed project:**

[Redacted]

**Please provide details of the suitability of the institution where the work will be carried out and the availability of equipment and facilities required for the work:**

This project will be performed in the Doñana Natural Park, which is world-known as a protected area and as an ecological research laboratory. The wildfire that occurred in 2017 represents a unique opportunity to assess the hypotheses of this project in a unique setting and is cornerstone to the proposed project.

During the work, I will be based at the [Redacted] (Spain), an ideal institution to undertake this study due to its strong research vocation, the flexibility that I am given to produce my own research, the availability of laboratories for soil analyses, and the possibility to use the LI-COR 6800 apparatus.

**Please provide details of necessary permits/licences obtained, if applicable:**

I will require to obtain permission by the Doñana Natural Park administration to conduct this project. As the project itself will not constitute any significant disturbance to the ecosystems being studied, there shall not be any inconvenience. I have discussed this proposal with the person in charge of the licenses in the Natural Park and received a positive preliminary reply. Still, I can only apply for/obtain the official permission once the funding is granted.

**Please indicate how you will ensure the reach and impact of the project for both academic and non-academic audiences:**

Academic impact will be achieved through one publication in a high-impact journal, one oral communication at an international scientific meeting, and a seminar at my home university. Relevant progress and results will be posted in a "project" in ResearchGate. Communication with policy makers and forest owners/managers will be achieved through a non-academic publication in the environmental magazine "Quercus". I will also publish ongoing results and news in the website of the Pau Costa Foundation, specialised in fire ecology and management (<http://www.paucostafoundation.org/>).

**How do you intend to make your research data publically available?**

All data will be published permanently and for free at the institutional repository of my university.

**Please provide details of any published papers you are involved in relevant to this project:**

[Redacted]

[Redacted text block]

Outreach

[Redacted text block]

Have you previously applied for a grant from the BES?

Yes

If you would like to upload a document in support of your application please attach using the control below. Please

make sure you reference these in your text.

**NB: A maximum of 1 file can be uploaded. Please only upload files essential to the application. Files with additional text to supplement word limits will not be considered and may make your application ineligible.**



10/09/2018

11:20:03

pdf 232.23 KB

## Section 6 - Budget

Please note all budgets must be provided in Great British Pounds (GBP)

### Equipment/Consumables

Item	Quantity	Description	Total Cost
Wire fence and installation	16	Herbivore exclosures of 2.5 x 1.5 m (8 m); £4.5/m	£576.00
Temperature loggers	32	iButton DS1921G-F5# ThermoChron, 4K. Each £25	£800.00
Open-top chambers	16	1 x 1 m. Materials to build one cost ca. £39	£624.00
Consumables	1	Materials for fieldwork: tagging tape, stationery materials, etc.	£80.00
<b>Overall Equipment Cost:</b>			<b>£ 2,080.00</b>

### Personal Travel/Accommodation/Subsistence

Description	Total Cost
Car travel to field (fieldwork, personal): 6 trips x 446 miles (Granada-Mazagón-Granada) x £0.25	£666.00
Accommodation (fieldwork, personal): 6 trips x 2 nights (average) x £20	£240.00
Subsistence costs (fieldwork, personal): 6 trips x 3 days (average) x £20	£360.00
<b>Overall Personal Travel Cost:</b>	<b>£ 1,266.00</b>

### Field Travel/Accommodation/Subsistence

Description	Total Cost
Accommodation (fieldwork, assistant): 2 trips x 3 nights x £20	£120.00
Subsistence costs (fieldwork, assistant): 2 trips x 4 days x £20	£160.00
<i>No Response</i>	<i>No Response</i>
<b>Overall Field Travel Cost:</b>	<b>£ 280.00</b>

## Employment

(note only casual, short term assistance will be considered)

Position	Description of role	Rate & Duration of employment	Total Cost
Technical assistant	Assistant for preparation of materials and installation of plots	2 weeks full time, incl. social security fees (cost is fixed by institution)	£900.00
<i>No Response</i>	<i>No Response</i>	<i>No Response</i>	<i>No Response</i>
<i>No Response</i>	<i>No Response</i>	<i>No Response</i>	<i>No Response</i>
<b>Overall Employment Costs:</b>			<b>£ 900.00</b>

## Other

(note requests to cover conference attendance or publication costs will not be considered)

Item	Description	Total Cost
Soil analysis	General soil parameters (EC, pH, granulometry, macronutrients). 16 samples x £24 per sample	£384.00
Trailer hire	For taking materials to field and collecting them. 3 days, £30/day	£90.00
<i>No Response</i>	<i>No Response</i>	<i>No Response</i>
<b>Overall Other Costs:</b>		<b>£ 474.00</b>

### Total project cost:

£  
5,000.00

### Amount Requested from BES

£5,000.00

If the total cost of the project is greater than the amount sought from the BES, please state how the balance will be met:

*No Response*

## Section 8 - Declaration

### Applicant Declaration

I confirm that all the information submitted herein is wholly accurate at the time of submission.

I confirm that I have the permission of any person or persons I have included contact details for, to share their details