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Description of the funded research project

1st Call for H.F.R.I. Research Projects to Support Faculty Members & Researchers and Procure High-Value Research Equipment

Title of the research project: **Self-restoration of pollination services in Mediterranean post-fire communities co-considering fire traits and grazing stress**

Principal Investigator: **Theodora Petanidou**

Reader-friendly title: **SERAPIS**

Scientific Area: **Environment**

Institution and Country: **Greece**

Host Institution: **University of the Aegean**

Collaborating Institution(s): **ETH – Swiss Federal Institute of Technology Zürich**

Project webpage (if applicable):

Pollinator sampling during the first post-fire year near Vessa village, Chios, June 2013

Theodora Petanidou,
Professor at the University of the Aegean
Principal Investigator

Budget: **170.000 €**

Duration: **36 months**

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Research Project Synopsis

Disturbances play a fundamental role in shaping the dynamics of biological communities as they cause changes, often to the worse, to biodiversity, which in turn affect important ecosystem services. **Pollination**, one of the most central ecosystem services, is subject to the impact of a wide range of disturbances, including **grazing** and **fire**, which in Mediterranean ecosystems coexist in space and time. As the effects of these two disturbances on pollinators have only been occasionally studied and never in combination, the present research intends to fill this gap thereby introducing four **major innovations**:

1. the combined impact of fire and grazing in space and time taking into account the landscape structure,
2. the use of time series of 13 communities based on the year-to-year succession for the first 8 post-fire years,
3. their pre-fire condition assessed with the same methods and protocols as in post-fire years and
4. for the first time, focusing on the ecosystem stability, co-considering, besides pollinator biodiversity, the characteristics of flowering plant–pollinator networks in the context of their ecological succession.

The research is carried out in southern Chios, combining the above spatiotemporal approach, i.e. analysis of the landscape structure in all phases of succession, both inside and outside the burnt areas. Tested methods of sampling and analysis are used, and results, potentially concerning management strategies, will be applied to develop advanced deterministic and/or stochastic metamodels.

The outcomes are expected to make a significant contribution to:

1. generating long overdue prediction models for the response of plant–pollinator systems to the combined impact of grazing and fire, which is especially timely during times of climate change and intense anthropogenic pressures and
2. developing effective management strategies to ensure the quality of pollination services and thereby safeguard food security.

Project originality

Grazing and fire constitute two of the most important disturbances affecting the structure and function of the Mediterranean ecosystems. However, research has shown that the effect of both these disturbances is not necessarily all negative. Proper management of these disturbances can lead to an optimal conservation of pollinator biodiversity, excellent pollination services, thereby safeguarding food security. To date, the effects of grazing and fire on pollinators have been investigated separately for each factor. The unsupervised and intensive grazing almost always follows a fire –a phenomenon often encountered in the Mediterranean, especially in the Aegean– thereby acting cumulatively to the degradation of the ecosystem services.

This research project's endeavor is to fill the gap concerning the combination of the effects of the above disturbances on pollinators, co-considering four important innovations:

1. The elucidation of the grazing and fire effects combined, which is expected to fundamentally change present knowledge and induce the application of the Intermediate Disturbance Hypothesis, all the more so, when these combined effects are studied taking into account the structure of the post-fire landscape.
2. The use of time series data of 13 study systems, each for 9 consecutive post-fire years. Worldwide, this will be the only study in which detailed mid-term data are available for plants and pollinators, viz. diversity, abundance and, most important, species identities.
3. The availability of matching data for some study systems one year before the fire. These data have been collected with exactly the same protocols, in exactly the same sites. The available time series of data refer to -1, 1, 2, 3, 8 and 9 post-fire years.
4. The exploration of the dynamics of plant–pollinator networks, which will be practiced for the first time worldwide in post-fire systems.

Expected results & Research Project Impact

This research project will contribute significantly to the theoretical scientific knowledge, as it is the first time that the combined effect of two different disturbances is studied in this context. Through a prototype study of the effect of fire and grazing on the plant–pollinator system, our research approach can highlight the mechanisms that contribute synergistically to the formation of the composition of existing biological systems. Pollination is one of the most important ecosystem services, responsible for both primary production and species' evolution. Therefore, elucidating aspects of how this important relationship responds to disturbance is critical to enrich the theoretical background of ecology.

The proposed research might help to enhance the precision of prediction models of plant–pollinator response to future disruptions due to climate change and man-made pressures. Consequently, our research can contribute to the development of targeted and effective management interventions to ensure the quality of pollinating services, to cope with the decline of flowering plant populations, as well as the decline of pollinator species observed worldwide in recent years.

Finally, our research will have a significant socio-economic impact on Greece, as well as on climatically similar environments, mainly in the Mediterranean and elsewhere in the world, threatened by these disturbances.

The importance of this funding

The research activity of the Laboratory is largely focused on pollination and pollinators leading the researchers to multiple and constantly further stemming research paths. This is because the results of the research, published in very high-impacting scientific journals in the field of ecology, raise new questions – challenges for further research that requires funding to cover expenses for fieldwork, equipment for sampling, management and conservation of biological material; support PhD students, field assistants and collaborators for insect identification, etc. All the above also apply to this project, for which H.F.R.I. financial support is indispensable.

Specifically, the funding enables:

1. responding to the scientific question of the effect of fire and grazing combined
2. the cooperation with the Swiss Federal Institute of Technology in Zurich (ETH)
3. the training and career development of postgraduate students and
4. the enrichment of the Melissotheque of the Aegean (the museum collection of pollinating insects from the Aegean) of the Laboratory with ca. 20,000 insects.

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