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Hellenic Foundation for Research & Innovation

Description of the funded research project

2nd Call for H.F.R.I. Research Projects to Support Post-Doctoral Researchers

Title of the research project: **Ecological success beyond the genome: Linking adaptive potential with habitat connectivity**

Reader-friendly title: **UPadapt**

Principal Investigator:
Konstantinos Sagonas

Scientific Area:
Life Sciences

Institution and Country:
National and Kapodistrian University of Athens (NKUA), Greece

Host Institution:
NKUA, Department of Biology

Budget:
180,000€

Duration:
36 months

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Research Project Synopsis

Understanding the (evolutionary) mechanisms involved in species adaptation in their local environment has become a major quest in evolutionary biology and conservation. Populations ability to respond to environmental changes may differ dramatically, likely, due to different adaptive potential, a capacity that crucially depends on the expression of ecologically relevant phenotypes. Current traditional models rely on the assumption that phenotypic alterations primarily reflect genetic changes, resulting from species-specific genomic properties. Today, however, there is growing evidence for **heritable non-genetic mechanisms underlying plasticity, such as epigenetic responses to environmental change**. Yet, the extent to which genetic and epigenetic variation jointly interact to influence species or populations potential to adapt to a changing environment and whether different populations of a species evolve different or comparable levels of epigenetic capacity, are two issues that remain largely unknown.

To fill these knowledge gaps, the project is designed around three complementary work packages. The primarily **aim** of the project is to **understand how genetic diversity, epigenetic variation and population demography affect the adaptation of populations to local selective environments**. To address our questions we will use as a study system the Skyros wall lizard *Podarcis gaigeae*, for which ample ecological and genomic data exist.

We anticipate that epigenetic factors play a major role in a species adaptation, and provide organisms with an unprecedented opportunity to broaden their ecological boundaries.

Project originality

One of the basic tenets of evolutionary theory is that populations adaptive potential relies primarily on their genomic diversity. However, now that it is clear that the adaptive potential is also formed by epigenetics, this parameter must be included to reveal how both genetic and epigenetic factors contribute to the evolutionary rescue of populations, especially small ones. We have now entered a new era, where genomic advances and new tools make it possible to **establish the extent, nature and significance of epigenetics in species adaptive potential**, that would have been impossible only a few years ago. Yet, while landscape genomics has gained momentum, there is very little research aimed at jointly quantifying the genetic and epigenetic component of evolutionary potential.

Importantly, our study goes beyond populations demography to determine populations adaptive potential and relates their genetic structure (i.e., landscape connectivity). **At a broader geographic scale, the evolutionary potential of a local population is a function of natural selection relative to gene flow.** Although natural selection promotes evolutionary responses either through *de novo* mutations or through the reuse of standing genetic variation, gene flow affects the geographic distribution of genes coding for ecologically relevant traits. Therefore, without investigating this relative contribution, as will be attempted herein, studies may misestimate evolutionary potential – and as an extend adaptive potential – as the sole response to natural selection of a single population.

Altogether, the current project breaks new grounds for understanding and predicting populations capacity to rapidly adapt to their local environment.

Expected results & Research Project Impact

Each species has a specific niche, role and function in the ecosystem. The more diverse an ecosystem is, the more stable it is, the more productive it tends to be, and the better able it is to withstand environmental stress. As human activities continue to alter the environment to which the world's biodiversity has adapted, more knowledge is needed to better understand the mechanisms facilitating populations and species adaptive potential. While this research represents a case study of a single species, **its successful completion will contribute towards this research field by**: **I)** augmenting the body of knowledge on species survival capacity and the process of adaptive potential, **II)** enabling risk predictions to be made and improving supportive breeding programs of endangered species, **III)** building our understanding of the role of epigenetics on populations adaptive potential and **IV)** raising public awareness of biodiversity conservation.

The importance of this funding

Funding from the Hellenic Foundation for Research and Innovation is of fundamental importance for pursuing my research interest and establish my research agenda, while it provides all means to set up my own research team. I am further confident that this grant will allow me to answer important research questions, that upon completion will pave the way for future advancements in the research fields of evolution and conservation. Overall, I recognize the importance of this initiative as will allow to increase recognition and visibility of Greek Universities.

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