

ReSMILEnet: Research on Ecological Dynamics of Small Islands

Project: Vegetation Resurvey to detect plant diversity changes due to climate change

Background

Biological communities on islands in the Mediterranean basin have been largely studied, especially for vascular plant species. A large amount of data has been collected in many islands to describe vegetation types or insular flora. Given the abundance of information and high-quality data, small islands (defined as islands with an area between 1ha and 1km²) are a perfect study system to develop resurvey studies dedicated to understanding ecological dynamics. This is due to their limited interest for agricultural, grazing or settlements, and thus alleged minor effects of ecological drivers other than climate.

With this study we aim to assess the effects of climate change on plant species diversity (e.g., richness, composition) of plant communities living on small islands. The hypothesis to be tested is that climate change has deviated the island equilibrium in the direction of lower species richness (as resulting from a stable immigration rate combined with a higher extinction rate). By using an open cooperative approach, we aim to establish a joint team to resurvey vegetation plots on a subset of small islands encompassing the entire basin area as study extent. The final goal is to produce an ambitious paper quantifying the plant diversity changes in small islands and identifying the climatic drivers of these changes, under a clear and well stated hypothesis testing. We aim to prepare a paper during winter 2024-25 to be submitted to a high rated journal, for which each contributor will be coauthor.

Resurveying vegetation

In recent decades, resurvey studies have received attention as they enable tracking vegetation changes during time. Kapfer et al. (2017) reviewed the opportunities and the issues connected to this type of studies. Here, we summarise the keystone findings of this paper which will be used as a guideline for our project.

The major challenge in resurveying vegetation is to precisely relocate plots. Kapfer et al. (2017) outlined three different plot categories (fig. 1), which have a direct effect on the type of analyses to be undertaken. The main distinction is made between **permanent** and **non-permanent** ones, respectively based on the presence or not of durable markers in the site.

The most common situation is to deal with non-permanent plots. Based on the precision of relocation (dependent on the detail of available information), these ones are further subdivided between **quasi-permanent** and **non-traceable** plots.

Quasi-permanent plots can be more or less precisely relocated, given the indication of environmental variables such as elevation, slope or aspect. Non-traceable ones, instead, lack this kind of info.

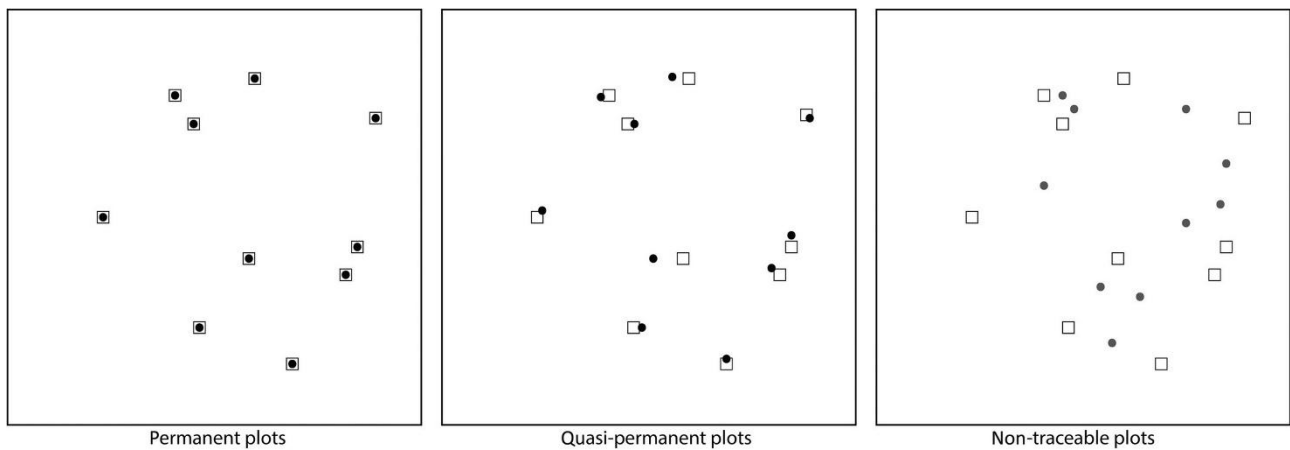


Figure 1 - Graphical concept of different plot categories in resurvey studies. Image taken from Kapfer et al. (2017)

As a consequence, passing from permanent plots to quasi-permanent and non-traceable ones, the increase in relocation error leads to a potential increase in pseudoturnover (i.e., the difference in species composition due to a mismatch in plot relocation rather than to a real temporal change). One way to reduce this error is to associate several new plots (e.g. three to five) to each old one, in a position close to the suspected original one.

Other potential biases are driven by a difference in the phenological stage of plants and in the identification competence of the botanists involved in the surveys. In the first case, the error is minimised by sampling in the same time period as in the first surveys, whereas the second one is reduced by involving well trained botanists and with plot replicates.

Our approach

As a first step for our project, we retrieved vegetation plot data from the European Vegetation Archive (<https://euroveg.org/requests/EVA-data-request-form-2022-11-15-Chiarucci-Santi-Testolin-Zanini.pdf>). We also digitised published records not already included in EVA and we then selected all the islands accomplishing the following criteria:

- Island area from 1 ha to 1 km²
- Vegetation data recorded at least 30 years ago
- Absence of permanent human presence on island.

Islands are unique study systems for investigating ecological dynamics. We focus on small islands because their limited extension facilitates accurate plot relocation. In addition, the limited species pool on small islands facilitates testing the deviation from the equilibrium. Moreover, the Mediterranean is a perfect study area, given the large amount of vegetation data collected during the last decades, offering an opportunity also to combine the project findings with other well investigated patterns and processes. Focusing on small islands also helps in limiting the issues connected to plot relocation, given the small size of the islands and the low habitat diversity.

In fig. 2 you can find the location of the set of islands which have been identified on the basis of the selection criteria adopted (size, absence of human pressures, presence of vegetation plots originally surveyed at least 30 years ago).

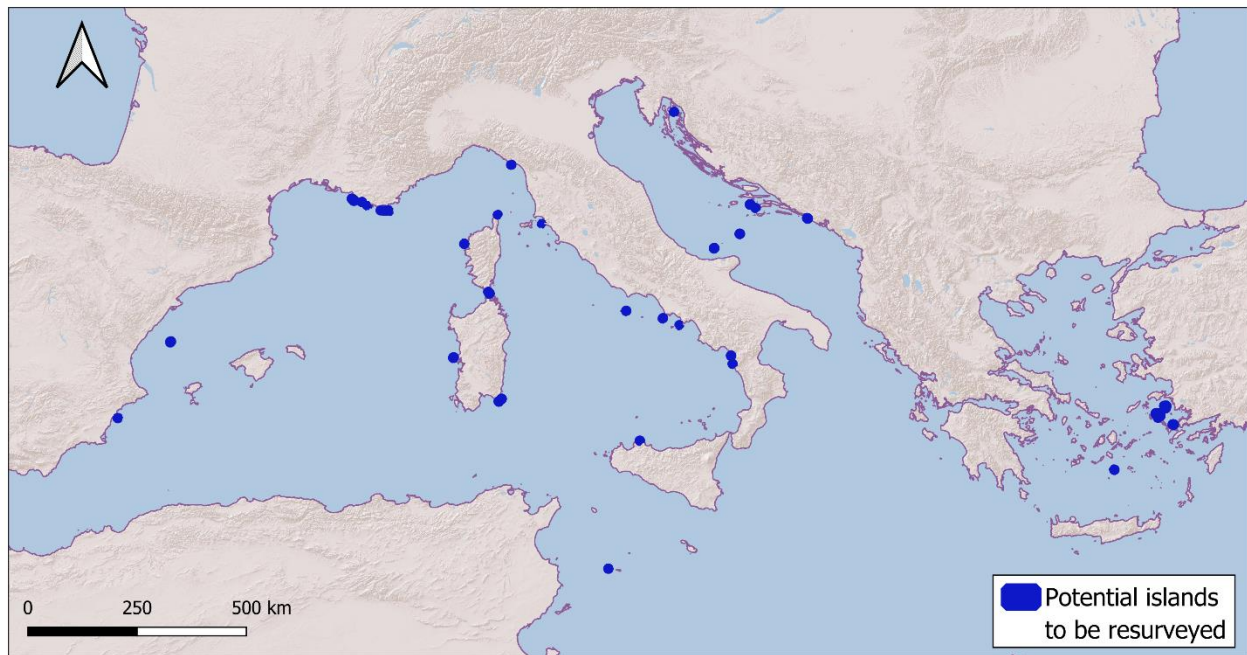


Figure 2 - Location of the small islands selected for resurvey.

Plot selection

In accordance with the protocol outlined by Kapfer et al. (2017) and previous resurvey studies, for each old plot we propose to select three new ones to be resurveyed.

First, go through the attached list of potential islands to be resurveyed. Select one or more islands that you or your research team would be able to revisit during Spring 2024. Then, proceed according to the following steps:

- Look for the original data source (paper or report). We are going to provide the citation of the paper, and the pdf with the original data when available.
- We will provide the best accurate geographic information on the plots but you can also improve plot relocation by reading through the document (using maps, photos and other information contained on the paper; if you are familiar with the area, then it would be easier to locate them). To locate plots, you can get some help from environmental indicators (altitude, slope, aspect...). Then, write down the coordinates of each point and estimate a measure of spatial accuracy. Finally, check if you can get extra info from field notes taken by original authors.
- For each point, select two points in addition to the best guess of the original one. These ones are the replicates and should be selected in the same habitat type as the first one, and at least 20 m apart from it.

Project steps

Task	Time period
Selection of islands and plot relocation on map	November – December 2023
Definition of resurvey plan details	January – February 2024
Field surveys	Spring 2024
Data digitisation	Summer 2024
Data analysis and paper writing	Autumn 2024 – Spring 2025

Reference

Kapfer, J., Hédli, R., Jurasinski, G., Kopecký, M., Schei, F. H., & Grytnes, J. A. (2017). Resurveying historical vegetation data—opportunities and challenges. *Applied Vegetation Science*, 20(2), 164-171.

This protocol was developed within the BIOME Lab (University of Bologna). For any question, you can contact Francesco Santi: francesco.santi12@unibo.it - <https://site.unibo.it/resmile/en>