**Readme for "Data and code for: Consistent population declines but idiosyncratic range shifts in Alpine orchids under global change"**

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**Contents**

This data repository consists of the following folders and files:

* Main folder
  + Word document containing information on each file and instructions for use (**"ReadMe.docx")**
  + R script to perform analyses (**"AnalyseData.R"**)
* `data` folder
  + Local survival based on resurveys (`**Resurvey.txt**`)
  + Temporal trends in population size (`**Abundance.txt**`)

**Metadata**

**Local survival based on resurveys (`Resurvey.txt`)**

This dataset was obtained revisiting in 2018 and 2019 463 sites of the historical dataset in all major habitat types, covering the whole elevational range of orchid distributions from the lowlands to high elevation natural areas. This dataset contains the following columns:

* **Species**: Species name of orchids
* **Site:** Site code
* **Survival:** 1 when confirming orchid presence in the second survey, 0 when the orchid species was absent in the second survey
* **Delta\_jd:** difference between survey dates in Julian days
* **Delta\_year:** difference between the year of the initial and second survey
* **Elevation:** elevation (m a.s.l.) of the site
* **Habitat\_alteration:** local disturbance (e.g. construction sites, touristic activities) or a habitat type change occurred in the second survey by comparing the description of the sites in the initial survey with the current conditions
* **log\_Abu:** natural logarithm of historical population size
* **Count\_hist:** how many times each species occurred during the initial survey
* **Count\_recent:** how many times each species occurred during the second survey
* **Habitat\_preference:** we attributed each orchid species to one of six, non-overlapping categories using the description of habitat preferences according to Perazza, G., & Lorenz, R. *Le Orchidee dell’Italia Nordorientale. Atlante Corologico e Guida al Riconoscimento*. Osiride, 2013. Categories: 1) specialists of forest (forest), 2) generalists, 3) specialists of grassland habitats with wide thermal niche (grassland), 4) warm-adapted specialists of semi-natural grassland (semi-natural), 5) cold-adapted specialists of subalpine habitats (subalpine), and 6) specialists of wetlands (wetland). See Methods for a more detailed description.
* **Thermophilic\_index:** Landolt’s indicator values for temperature
* **Light\_index:** Landolt’s indicator values for light
* **Soil\_moisture\_index:** Landolt’s indicator values for soil moisture
* **Thermal\_niche:** realized thermal niche breadth in the study area (see Methods).

**Temporal trends in population size (`Abundance.txt`)**

This dataset includes 49,303 records for 44 species that meet our criteria for inclusion in the study, i.e. at least 30 records in the first 14 years (1990-2003) and last 14 years (2004-2017) of the historical dataset. Data were collected by Giorgio Perazza (GP) and collaborators by systematically covering the whole area of Trento Province.

* **Species**: Species name of orchids
* **Abundance**: number of individuals per species
* **Elevation**: elevation (m a.s.l.) of the recorded species
* **Elevation.std**: elevation was standardized to mean 0 and SD = 1 within species to make the elevational distribution comparable among species
* **Year**: year of the sampling
* **Forest**: 0 if the species does not belong to the group with ecological preference for forests, 1 if the species belonged to it.
* **Grassland**: 0 if the species does not belong to the group with ecological preference for grasslands, 1 if the species belonged to it.
* **Generalist**: 0 if the species does not belong to the group of generalist orchids, 1 if the species belonged to it.
* **Semi\_natural\_grassland**: 0 if the species does not belong to the group with ecological preference for semi-natural grasslands, 1 if the species belonged to it.
* **Subalpine\_Alpine**: 0 if the species does not belong to the group with ecological preference for subalpine-alpine habitats, 1 if the species belonged to it.
* **Wetland**: 0 if the species does not belong to the group with ecological preference for wetlands, 1 if the species belonged to it.
* **Period**: 0 for the historical period (1990-2003), 1 for the current period (2004-2017).
* **ID:** unique ID per observation
* **Count\_historical**: how many times each species occurred in the historical period
* **Count\_recent:** how many times each species occurred in the current period
* **Count\_tot:** how many times each species occurred overall.

**System Requirements**

To run this code you will need a current installation of R and some R packages. Code was tested on R version 3.5.1 and the following packages: ‘nlme’, ‘lme4’, ‘car’, ‘DHARMa’, ‘lsmeans’, ‘multcompView’, ‘WRS2’, ‘plyr’.

Installation of all necessary packages may be performed by running the following line of code in R:  
`install.packages(c("nlme”, "lme4", "car", "DHARMa", "lsmeans", "multcompView", "WRS2", "plyr"), dependencies = TRUE)`

To run the R script on your local machine, you will first need to specify your local working directory by modifying the "main.dir" variable in the R script.