



Project of Strategic Interest NEXTDATA

Scientific Report for the reference period 01/01/2013 – 31/12/201

WP 1.7 Mountain ecosystems and biodiversity

WP Coordinator (*ad interim for 2013*): Antonello Provenzale
CNR-ISAC, Torino

Authors:

Animal biodiversity in mountain regions:

R. Viterbi, PNGP

C. Cerrato, CNR-ISAC, Torino

Effects of climate change on alpine plants:

G. Rossi

University of Pavia

1. Scheduled activities, expected results and Milestones

The activities described in this report are related to the second year of the study devoted to the identification, collection and analysis of data on terrestrial biodiversity in the western Italian Alps in relation with climate (PI: Ramona Viterbi). Data were retrieved from previous campaigns and new campaigns were conducted during 2012 and 2013. The present report includes a preliminary description of the activities on the effects of climate change on alpine plants, which started in the course of 2013 (PI: Graziano Rossi). These two studies were originally included among the Pilot Studies of WP 2.6; starting from this year, these activities have become a part of the newly created WP 1.7 devoted to mountain ecosystems and biodiversity.

2. Deliverables expected for the reference period

Deliverable D1.7.1: Report with the results of the second year of the study on animal biodiversity in the western Italian Alps.

3. Activities which have been actually conducted during the reference period

3.1 Research activities

For what concerns the study of animal biodiversity in mountain regions (PI R. Viterbi), the following activities have been carried out:

- Involvement in the project of 3 new protected areas (Stelvio National Park, Val Grande National Park, Dolomiti Bellunesi National Park), sharing of working protocols and mission statement. Authorization from the Parks for accessing to the data of the monitoring campaigns 2013, in order to analyse biodiversity patterns and to develop model simulations. As soon as the determination of the collected specimens will be finished, such data will be available for the comparison with the data collected by the other parks.
- Preparation of biological datasets. Databases are ready for the insertion in the General Portal. For each type of biological data we chose the metadata, needed for their precise identification. As soon as the format of the GP will be available we will adapt our data to this standard.
- Simulation of temperature increase scenarios, using as a starting point data collected from the monitoring activities of 2007-2008. Such data have been analysed to assess the risk of modifications in alpine animal biodiversity in response to temperature rise, by modelling the effect of climate warming on species richness and community composition using the multi-taxa approach.
- Conduction of new field campaigns in Summer 2013 to monitor and measure terrestrial faunal biodiversity in the Gran Paradiso National Park, in the Veglia-Devero Natural Park and in the Orsiera Natural Park. Sampling activities have been carried out to provide presence and relative abundance data of species belonging to seven taxa: Lepidoptera Rhopalocera (butterflies), Orthoptera, birds, surface-active macroarthropods (Coleoptera Carabidae, Coleoptera Staphylinidae, Araneae, Formicidae).
- Collection of micro-climatic conditions, through the positioning of temperature data-logger (iButton DS1922).

- Preparation of data collected during the field season (April-October 2013) to update databases.
- Analysis and identification of the samples collected during field session (not finished yet).
- Application of the working protocol to the measurements of arthropod biomass, both in term of weight and of volume, along the altitudinal gradients for all the arthropods contained in the pitfall traps.
- Start of the measurements of carabids body size along altitudinal gradients for the data collected in 2012.
- Comparison through time of the biological and micro-climatic data, collected from 2007. Moreover, we are analysing our data to identify potential indicators of biodiversity changes, in order to simplify in the long term the monitoring activities (in course).

For what concerns the effects of climate change on alpine plants (PI G. Rossi), it was studied the effect of temperature and water availability on plant reproductive performance, seed germination, seed longevity and viability, seedling recruitment and survival. These investigations include both experiments in the wild and in laboratory. In the wild, different approaches were used, including facilities specifically designed for field manipulation of climate, (e.g. open top chambers, OTC), or movement of plant species (seeds) across altitudinal gradients. In each case, plant phenology, seedling emergence and survival (seedling recruitment) are regularly monitored, together with temperature and water potential, using *ad hoc* equipments (data loggers). In laboratory this group simulates environmental conditions aimed to define species growth optimum, stress tolerance, temperature required for seed germination and to break dormancy. These experiments are carried out using cooled incubators with temperature and light controls, growth chambers and green houses. Recently it was explored the effect of a warmer climate and extremes weather events (e.g. heat waves and extreme drought) on the reproduction performance and seed germination of several alpine plants, in the Alps and Apennines. Preliminary results indicate that the alteration of temperature and water supply driven by climate change, will anticipate the timing of emergence and reduce the level of seed germination in some alpine/arctic plants, highlighting significant concerns for the survival of these species. Furthermore, long-term monitoring of montane species in the N-Appennines showed a negative effect of warm (extreme) temperatures on the reproductive performance of many species, the most negatively affected being the snow bed species. Further studies are on the way in order to understand the extent to which climate warming will affect seedling recruitment in the wild, considering species from different habitats along an altitudinal gradient. The results of these researches will have implication for nature conservation, providing new tools to guide future actions for plant conservation. Indeed, these observations are fundamental to understand the impact of climate change on plant regeneration from seeds and other aspects linked to plant reproduction (e.g. flowering, fruiting), laying the basis to detect which species are more likely to disappear or, conversely, to become dominant.

3.2 Applications; technological and computational aspects

The problems related to the specific needs of biological data and metadata, compared with the standard needed for the atmospheric and climatic data, have been resolved.

3.3 Formation

Renewal of 2 scholarships (6 months) and 1 fellowship (one year) on biodiversity monitoring and data analysis.

Tutorship and coordination of a PhD student at University of Milano Bicocca (Doctoral School in Science – Course in Environmental Science, XXVIII Cycle). Main objective of the PhD Thesis is the analysis of the data collected inside the NextData Project.

Tutoring of 3 Master Students and 2 Bachelor Students at Turin University.

Operative meetings with the biologists and technicians of 3 National Parks, located in the Italian Alps, which decided to join the project and to share the objectives and the working protocols. The 3 Parks are: Stelvio National Park (CPNS), Val Grande National Park (PNVG) and Dolomiti Bellunesi National Park (PNDB). During Spring 2013 (March-April), we formed the personnel of these Parks, in order to obtain comparable data and we developed the appropriate databases for common data storage.

As for the previous periods, researchers and rangers of the Parks followed internal courses, concerning:

- methods for monitoring animal biodiversity in mountain ecosystems;
- lessons for the identification of the species belonging to the studied taxa.

3.4 Dissemination

Lectures at the Alpine Summer School about “Climate change and the mountain environment”, organised by CNR-ISAC, Valsavarenche, June 2013.

3.5 Participation in conferences, workshops, meetings

Presentation of the first year of activities by our PhD Student. “Biodiversity patterns along altitudinal gradients: a multi-taxa approach”, Seminar at Milano Bicocca University, 25 November, 2013.

Student Workshop of Gran Paradiso National Park. Presentation by 1 Master Student and 1 boursary student “Biodiversity patterns along altitudinal gradients” by a Master Student and “Body size variation along altitudinal gradient”, Val di Rhemes, 20 December, 2013.

4. Results obtained during the reference period

4.1 Specific results (Data libraries, Measurements, Numerical simulations, etc)

Storage of the data coming from the campaign 2012 in the database, which already host data from 2007-2008. The databases are list of species, with data on presence and relative abundance, for each taxon and each sampling plot. Currently, the following databases are finished:

- birds and butterflies (years 2007, 2008, 2012, 2013);
- carabids, staphylinids and spiders (years 2007, 2008, 2012);
- ants (2012);
- temperature (years 2007, 2008, 2012, 2013).

- Creation of a monitoring protocol and a common database for the 3 Parks that in 2013 joint the monitoring project, developed in 2006 by PNGP. Data for butterflies and temperature are already stored. The other data are not available because the determination of the specimen is not finished yet.
- Simulation of the biological datasets (years 2007-2008) using MaxEnt software with three temperature increase scenarios and three environmental constraints. The model results indicate only small changes in the overall biodiversity patterns, but highlight different responses depending on taxonomic group and degree of specialization. In particular, we observed that changes in species richness could be significant in the alpine belt and particularly strong for vulnerable species. Community composition significantly changed, but a gradual and clear separation between the three vegetation belts was retained also in the warming scenarios. These results suggest that even a moderate temperature increase could influence animal biodiversity in mountain ecosystems.
- Conduction of new field campaigns to measure terrestrial faunal biodiversity in three selected protected areas in the north-western Italian Alps. Monitoring has been carried out by the 3 ISAC-CNR researchers (3 one year grants), helped by Park wardens and technicians (6 from PNGP, 3 from PNOR, 2 from PNVD) and by students from University of Torino and Milano (for a total of 6 students). The field activities required the following sampling effort:
 - Lepidoptera Rhopalocera (butterflies), monitored using linear transects, one per month from May to September, for a total of 370 linear transects, distributed on 76 working days;
 - Orthoptera, monitored using linear transects, with 3 repetitions during mid July and mid September for a total of 220 linear transects, distributed on 40 working days;
 - birds, monitored by point counts, with 2 repetition per plots, for a total of 148 point counts, distributed on 52 working days during mid April and July;
 - surface-active macro-arthropods (Coleoptera Carabidae, Coleoptera Staphylinidae, Araneae, Formicidae), monitored using pitfall-traps. The number of traps set per station was 5, for a total of 350 traps. The number of temporal collections is 10 per station, for a total of 130 working days. Number of obtained traps for the analysis is 3700;
 - Microclimatic conditions with the positioning of 74 temperature data-logger (iButton DS1922), for 150 days with a total of 3600 temperature data collected for each logger.
 - Analysis and identification of the samples collected during field session. We have performed the 70 % of the analysis
 - Measurements of arthropod biomass, both in terms of weight and of volume. We have completed the 75 % of the analysis.
 - The first results of the comparisons between taxa in time (carabids, butterflies, birds, years 2007-2008-2012) are now available. The flow-chart for the identification of indicator species and for the analysis of the available time series (butterflies, birds, temperature, from 2006 to 2013) has been done and the data are ready for the subsequent analysis.

4.2 Publications

The following paper: Patterns of biodiversity in the north western Italian Alps: a multi-taxa approach, by R. VITERBI, C. CERRATO, B. BASSANO, R. BIONDA, A. VON HARDENBERG, A. PROVENZALE, G. BOGLIANI has been published in *Community Ecology* (2013) 14:18-30. DOI 10.1556/ComEc.14.2013.1.3.

The following paper: Effects of temperature rise on multi-taxa distributions in mountain ecosystems, by R. VITERBI, C. CERRATO, R. BIONDA, A. PROVENZALE has been submitted to *Oecologia*.

4.3 Availability of data and model outputs (format, type of library, etc)

The data from the campaigns of 2007-2008 are available. The data from the 2012 field campaign have been processed for birds, butterflies, carabids, staphylinids, spiders, ants and climatic-environmental conditions. The data from the 2013 field campaign have been processed for birds and climatic conditions.

4.4 Completed deliverables

Report of the second year of activities of the study on animal biodiversity in high-elevation region, now indicated as Deliverable 1.7.1.

5. Comment on differences between expected activities/results/Deliverables and those which have been actually performed.

The execution of field monitoring activities, data storage and data analysis have been carried out in line with the Executive Plan. The activities described here, previously included in the Pilot Studies, now constitute the newly created WP 1.7.

6. Expected activities for the following reference period

The following activities are planned for the next reporting period:

Animal biodiversity in high-elevation regions

- Improve the suitability of the databases and their effectiveness for the entry into the General Portal.
- Processing of the data of the 2013 campaign to include them in the data archive;
- Complete the comparisons (already started during the previous period) of collected data for some taxa (coming from field work in 2012) with data coming from previous monitoring (2007-2008), to detect variations in biodiversity patterns and to compare real data with the models coming from temperature increase scenarios.
- Perform the first analysis of the collected data, to look for indicator species, useful to simplify in the long term the monitoring activities.
- Beginning of the analysis of the available and stored time series, for the reference period 2007-2013 for birds, butterflies and temperature.
- End of the identification of the samples collected during field session 2013.
- End of the measurements of arthropod biomass, both in terms of weight and of volume.
- End of the measurement of carabids body size.

Effects of climate change on alpine plants

- *In situ* studies on the effects of climate change on seedling emergence and survival on glacier foreland species from the Italian Alps (Alta Valtellina SIC Val Viola Bormina Cima Piazzì).
- Effects of water availability and temperature manipulations on target alpine/arctic species.
- Long term monitoring of the effects of climate change on plant populations at the edge of their geographical distribution in North Apennines (M. Prado, M. Cusna, Italy).
- Laboratory studies on the effects of heat waves on seed germination on alpine/montane species from Monte Cimone (North Apennines, Italy).
- *In situ* studies on the effects of temperature warming on seedling emergence and survival of high-montane and sub-alpine species in periglacial areas (experimental upward migration) in the Rathian Alps, Italy, in Val Dossè, high Valtellina SCI Val Viola Bormina Cima Piazzì, Natura 2000 network.

In the course of the third year (2014), the new activities of the Special Projects approved following the call of October 2013 are starting.