



Project of Strategic Interest NEXTDATA

Scientific Report
for the reference period 01-01-2014 / 31-12-2014

WP 1.7 Mountain ecosystems and biodiversity

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Authors:

1.7.1.

Mountain butterflies and mammals as eco system indicators of climate change effects:
upgrading the NextData bank

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1.7.2.

Monitoring of biodiversity in the NW Italian Alps
R. Viterbi, PNGP, **C. Cerrato**, CNR – ISAC, Torino

1.7.3.

Harmonisation and standards for existing and newly collected Data and MetaData on LTER
sites in Italian Mountain ecosystems. Data-LTER-Mountain

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G. Rossetti, University of Parma, **M. Freppaz**, University of Torino
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1.7.4.

Carbon and water fluxes in mountain forest and grassland ecosystems from leaf to ecosystem
level: effects of climate variability and management

C. Calfapietra, CNR – IBAF, Roma

1.7.5.

Effects of climate change in alpine plants

G. Rossi, University of Pavia

1.7.6.

Ecology of red squirrel in conifer forests

S. Bertolino, University of Torino

1. Scheduled activities, expected results and Milestones

The activities described in this report refer to the following researches:

1.7.1.

Identification, collection and analysis of data on terrestrial biodiversity in mountain environment, with particular reference to the Alps and to the Apennines.

1.7.2.

Conduction of new monitoring campaigns, as scheduled in the modulation of the Executive Plan. Validation and preparation of databases (data and metadata about biodiversity, land cover, meteo-climatic variables).

1.7.3.

Task 1. Data tools and standards

- Revising and checking the methods, architecture and tools created to collect, manage and query metadata of ecological datasets, following the metadata profile identified by the LTER community.
- Evaluating/listing available metadata of the datasets of LTER sites participating to the Special Project.
- Starting to obtain a catalogue of the available datasets.

Milestones:

a: architecture for bio-ecological dataset in NextData - month 6.

b: archives developed (two of four stages: empty tools for LTER partners - month 10, archives with LTER datasets already available – month 12).

Task 2. Data and metadata from mountain ecosystems: test cases from LTER Italy sites in mountain ecosystems

- Final selection and brief description of the sites.
- List of main type of biological and ecological variables (metadata and data) collected at the selected sites and available for the data “model” of Task 1.
- Provision of data from exemplary site to start the test of the data archiving.
- Discussion on the case study for scientific analysis.

Milestones:

a: selection of the sites - month 3.

b: provision of data- and metadata-sets of basic variables – month 12.

Task 3. Collection of new data sets from LTER Italy sites in mountain ecosystems

The collection of new data-sets is planned mainly in year 2 of the Special Project (focusing on growing season), although data collection was possible for some sites also in year 1.

Milestones

Collection of new data sets started - month: 6, 12.

1.7.4.

- A network of long-term eddy covariance sites in mountain forest and grassland ecosystems fully operational, gathering and providing continuous series of harmonized CO₂ and H₂O flux data. (Collelongo, Torgnon grassland, Torgnon forest, Brocon).
- Creation of proper subset of data from Alpine and Apennine sites to be archived within the NextData database. (Collelongo, Torgnon grassland, Torgnon forest, Brocon).
- Study of the inter- and intra-annual variability of ecosystem- and plot-level fluxes in relation to the main climatic drivers like temperature, precipitation, snow cover, length of the growing season. (Collelongo, Torgnon grassland, Brocon). This include investigation of the relationships between daily- seasonal-and interannual flux variability and potential climatic drivers. Processes behind certain ecosystem response to changing climate will be

evaluated through data analysis and with ecophysiological approaches like stable isotopes and fluorescence measurements. (Collelongo).

- Experimental evidences of the effects of management on the ecosystem C cycling (CO₂ uptake and emission) in grassland ecosystems using small-plot scale cuvette studies and radiocarbon measurements on soil to evaluate the differences in contribution of soil carbon decomposition (heterotrophic respiration) to total soil CO₂ efflux. (Brocon, Torgnon grassland).
- Optical measurements for estimation of ecosystem productivity using Light Use Efficiency (LUE) model. (Collelongo, Torgnon grassland).
- Definition of measurement and data-processing protocols for optical monitoring of phenology and ecosystem productivity.

Milestones for grassland sites:

- a: purchasing of the new equipment February-March 2014;
- b: re-activation of the flux measurements at Brocon site May-June 2014;
- c: fences installation at Brocon site June 2014;
- d: first year field measurement campaign completed October 2014.

Milestones for forest site:

- a: purchasing of the new equipment February-March 2014;
- b: start of the point flux, isotopic and optical measurements May-June 2014;
- c: First year field measurement campaign completed October 2014.

1.7.5.

Studies of the simulated effects of climate change on seed germination and seedlings recruitment and survival of alpine plant species, in the Alps and in the Northern Apennines (Italy). These investigations include both laboratory and field experiments.

This report includes all those studies started in 2014 and those already in place started in previous years as Pilot Studies (e.g. WP 2.6).

1.7.6.

Continuation of the monitoring activities in specific sites and data analysis.

2. Deliverables expected for the reference period

D1.7.2.1: Report on databases and data analysis for butterflies and mammals as biodiversity indicators.

D1.7.2.2: Report on the results of the 2014 studies on animal biodiversity in mountain environments.

D1.7.2.3:

Report with the results of the Project's activities and preparation of ecological data for the General Portal.

Task 1. Data tools and standards

First proposal of system architecture for bio-ecological dataset in NextData; summary of the current metadata and dataset of partners stored within LTER Europe facilities.

Implementation of system's components, according to the architecture of 1., in connection to NextData tools.

Task 2. Data and metadata from mountain ecosystems: test cases from LTER Italy sites in mountain ecosystems

- Description of the sites.
- Site metadata available in the Data-LTER-Mountain data system.
- Data- and metadata-sets of basic variables.

D1.7.2.5: Short report on the effects of climate change on alpine plants in the Alps and in the Northern Apennines; papers published on peer-review journals.

D1.7.2.6: Report on the ecology of red squirrel in conifer forests in the Gran Paradiso National Park.

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

3.1 Research activities

The following activities have been carried out during 2014:

1.7.1.

- Impact of climate change on predator-prey system (mammals-reptiles).
- Preparation of a data set on the distribution of small mammals obtained by analysis of barn owl pellets in Italy.
- Preparation of a data set on the distribution of Himalayan diurnal Lepidoptera with particular reference to Bhutan.
- Preparation of a data set on the distribution of some selected mountain diurnal Lepidoptera species (*Erebia tyndarus*, *E.nivalis*, *E.calcaria*, *E.cassioides*, *E.callias*, *E.hispania*, *E.rondoui*, *E.ottomana*, *E.iranica*, *E.graucasica*, *Parnassius apollo*, *P.phoebus*, *P.bremeri*, *P.smintheus*, *P.behrii*).
- A georeferenced CK-map dataset (the dataset on the distribution of the Italian fauna, Ministry of the Environment) of diurnal Lepidoptera species.

1.7.2.

- Preparation of biological databases for their insertion in the General Portal, related to past (2006-2007-2008) and current (2012-2013-2014) monitoring campaigns. Biological data are referred to 7 animal taxa (*Coleoptera Carabidae*, *Coleoptera Staphylinidae*, *Hymenoptera Formicidae*, *Araneae*, *Lepidoptera Rhopalocera*, *Orthoptera*, *Aves*), but include also data on vegetation and land cover (floristic analysis, photo-interpretation). Concerning the following 3 taxa, *Coleoptera Staphylinidae*, *Hymenoptera Formicidae* and *Araneae*, databases haven't yet been finished (75% of total; specimens collected in 2013 have been not yet fully determined).
- For each dataset, corresponding metadata have been prepared, following the GEO/GEOSS and LTER-DEIMS standards.
- Preparation of micro-climatic databases (temperature data collected in field, through the positioning of datalogger iButton DS1922) for their insertion in the General Portal, after the appropriate quality check.
- Conduction of the monitoring campaign during April-October 2014, as scheduled in the Project (*Aves*, *Lepidoptera Rhopalocera*, vegetation, micro-climate).
- Determination of the entomological and floristic samples, collected during 2014 (and the one still remaining from 2013). Concerning *Coleoptera Staphylinidae*, *Hymenoptera Formicidae* and *Araneae*, specimens' determination collected during 2013 has almost finished.
- Laboratory measurements of the specimens, belonging to the target carabid species, to study biomass along altitudinal gradients.
- Preparation and comparison of meteo-climatic and land-cover layers for the 3 protected areas in which monitoring activities have been carried out (Gran Paradiso National Park, Orsiera Rocciavrè Natural Park, Veglia Devero Natural Park).

- Leadership and coordination of the monitoring activities, carried out by the other National Parks of the Italian Alps (Stelvio National Park, Val Grande National Park, Dolomiti Bellunesi National Park), which adopted the protocol promoted by PNGP since 2013.

1.7.3.

Task 1. Data tools and standards

- Census of metadata and datasets of LTER sites in NextData already present in the IT facility of LTER Europe (DEIMS).
- Design of the architecture of the IT system that will store, manage and give access to the data and metadata collected from participants in the ecological sector of NextData.
- Verification, armonization and updating of metadata lacustrine LTER sites in NextData (parent site and simple site) of persons and datasets in IT facility of LTER Europe (DEIMS)
- Proposal of system architecture for bio-ecological dataset in NextData.
- Summary of the current metadata and dataset of partners stored within LTER Europe facilities.
- Creation of systems for the management and dissemination of their data and metadata in connection with the specific systems NextData (virtual machine with OGC services related to lacustrine sites at CNR Pallanza ISE).

Task 2. Data and metadata from mountain ecosystems: test cases from LTER Italy sites in mountain ecosystems

- Final selection of sites, list with type of available datasets – all selected sites;
- check and update of metadata and data, with a focus on lacustrine sites;
- preliminary planning of case studies for scientific analysis.

Task 3. Collection of new data sets from LTER Italy sites in mountain ecosystems

- Installation of new sensors for absorbed light at site IT03_001_T Collelongo. Activities in cooperation with Special Project 1.7.4.
- Collection of bio-ecological data at selected forest, meadows and high elevation sites.

1.7.4.

Collelongo (beech forest): Continuous monitoring of ecosystem CO₂ and H₂O fluxes. Gas exchange and isotope measurements on small plot scale. Optical measurements with the newly acquired MSRSYS16R System (Cropscan, USA). Analysis of the capability of beech leaves to dissipate the excess energy and its variation with changing light regime along the vertical canopy profile.

Torgnon (larch forest): Continuous monitoring of ecosystem CO₂ and H₂O fluxes. Bi-weekly measurements of plants phenological development.

Torgnon (grassland): Continuous monitoring of ecosystem CO₂ and H₂O fluxes. Bi-weekly measurements of physiological parameters of vegetation (LAI, biomass estimation). Continuous measurements of soil respiration in relation to the site microtopography and vegetation distribution. Optical measurements with MSRSYS16R System (Cropscan, USA). Soil sampling for radiocarbon and C/N analysis.

Brocon (grassland): Seasonal sampling of aboveground and belowground biomass in grazed and ungrazed plots. Seasonal measurements of soil respiration and its partitioning into autotrophic and heterotrophic respiration. Soil sampling for radiocarbon and C/N analysis. Brocon was heavily damaged by thunderstorms and snow in winter therefore the eddy covariance measurements will be fully operational from the beginning of the growing season of 2015.

1.7.5.

- In situ studies on the effects of climate change on seedling recruitment and survival on glacier foreland species from the Italian Alps (Alta Valtellina SIC Val Viola Bormina - Cima Piazzzi, Sondrio);

- effects of temperature manipulations and water availability on target alpine/arctic species;
- laboratory studies on the effects of extreme events (heat waves) on seed germination of mountain and alpine species from Northern Apennines;
- laboratory studies on the effects of ozone on seed germination of alpine plants;
- studies on trans-generational maternal and environmental influences on seed longevity in plants coming from different altitude.

1.7.6.

Continuation of the monitoring activities on red squirrel and seeds in a specific site in the Gran Paradiso National Park. Data analysis.

3.2 Applications; technological and computational aspects

1.7.1.

Identification of species and areas important for the conservation of mountain Lepidoptera and Mammals.

1.7.2.

None during this period.

1.7.3.

Task 1. Data tools and standards

- Data and metadata system architecture developed and tested;
- development of a “starter kit” to facilitate the distribution of observational data (in cooperation with the RitMare Project).

Task 3. Collection of new data sets from LTER Italy sites in mountain ecosystems

Set-up of new sensors at site IT03_001_T Collelongo, including sampling design and datalogger programming.

1.7.4.

Project partner ARPA Valle d'Aosta in collaboration with Max Planck Institute of Jena and Harvard University (USA) developed in R a tool “phenopix” dedicated to automated processing of digital images for vegetation phenological development (r-forge.r-project.org/projects/phenopix/). Data processing includes definition of one or more regions of interest (ROI) in the image from which the index of greenness should be extracted and filtered (were implemented 5 methods of sequential filtering). The seasonal trajectories of those indices are modelled in the following (5 different methods of fitting/smoothing) and from the modelled trajectories the extraction of the principal phenological thresholds is performed (4 different methods). Finally, a pixel-based analysis is implemented to evaluate the spatial variability of phenology within a specified ROI. All implemented methods are described and used in the most recent scientific publications on the topic.

Radiocarbon analysis and heterotrophic respiration estimation (DIBAF partner): DIBAF is currently measuring the C and N concentration of the soil samples collected at the two grassland sites. Once ready it will be possible to determine the soil heterotrophic component of the soil carbon efflux. This will be done according to the methodology proposed by Gaudinski et al., 2000 (Biogeochemistry 51:33–69), which determine the heterotrophic contribution as the ratio between the soil organic carbon (SOC) stock of a specific depth and the turnover time of the SOC in the same depth.

IBAF, in parallel, applied an alternative technique to estimate the contribution of heterotrophic respiration to soil respiration flux in grazed and ungrazed plots of Brocon. The technique is based on the assumed linear relationship between root biomass and amount of CO₂ respired by roots and rhizosphere microorganisms. The CO₂ originating from SOM

decomposition (heterotrophic respiration) corresponds to the y-intercept of the regression line between root biomass and total CO₂ efflux from soil.

$R_s = \alpha \times B_{Gb} + k_h$; $R_h = k_h$ and $R_a = R_s - R_h$

where R_s -total soil respiration; B_{Gb} – belowground biomass, k_h – y-intercept, which is assumed to be a measure of heterotrophic respiration.

Functional response of beech trees to local variations of climate was evaluated by means of stable isotopes and point gas exchange measurements by IBAF. Sampling was performed in June 2014 and the obtained data will be grouped together with the data of the previous years. Leaves were sampled with three replicates at three heights. Assimilation activity and chlorophyll fluorescence were monitored on the leaf level with a portable LiCor 6400 system. Leaf respiration was measured with the same instrument after keeping the leaves for 30 min in darkness. Recently assimilated soluble sugars as well as bulk leaf organic matter were analyzed in the laboratory for their $\delta^{13}C$ signature and for sugars quantity and composition. Quantitative analyses of photosynthetic pigments and antioxidant status were also performed. Trunk, root and soil respirations together with their $\delta^{13}C$ signatures were measured with closed static chambers by the Keeling plot approach. Phloem was sampled with a bark core aiming to analyze the C isotopic signature and composition of assimilates translocate downward with the phloem flow.

1.7.5.

Development of action plans and concrete intervention for alpine plants considered at risk of extinction. Intervention of reintroduction and reinforcement of plant populations at future risk (assisted migration).

1.7.6.

None during this period.

3.3 Training

1.7.1.

Two fellowships (one year) on biodiversity monitoring and data analysis.
Tutoring of 1 PhD student (University of Roma Tre, Rome).

1.7.2.

Technical meeting between the Italian Alpine National Parks to share the monitoring protocol for the season 2014. Milano, February 2014.

CERRRATO C.: Monitoraggio della biodiversità animale in ambiente alpino (oral presentation).

Technical meeting between the Italian Alpine Parks. Val Grande, Cicogna, 16 September 2014.

ROCCHIA E., VITERBI R., CERRATO C., PROVENZALE A., BASSANO B.: Measurement of biodiversity in NW Italian Alps (oral presentation). Scientific Committee of PNGP and Vanoise National Park, Valsavarenche, Degioz, 23th June 2014.

A one year grant to Emanuel Rocchia (by PNGP) for the monitoring of biodiversity in mountain ecosystems and a one year post-doc fellowship to Cristiana Cerrato (by ISAC-CNR) for the data analysis and the coordination of monitoring activities.

1.7.3.

Activities at site IT03_001_T are part of a PhD thesis.

Students are involved in research activities at the site coordinated by University of Parma, University of Molise and University of Torino.

1.7.4.

Activation of three Master Degree theses in Environment Biology and one three-year thesis in Natural Science (University of Torino).

IBAF: Optical measurements in Collelongo are part of PhD theses in Forest Ecology (University of Tuscia).

1.7.5.

Tutoring of 2 PhD students (University of Pavia and University of Parma).

1 Master Student and 2 Bachelor Students at Pavia University.

3.4 Dissemination

1.7.2.

VITERBI R.: Monitoraggio della Biodiversità in Ambiente Alpino” (oral presentation). Workshop *Stato di attuazione della Direttiva 2012 del Ministero Ambiente agli Enti Parco Nazionali. Esperienze a confronto. Proposte di avvio della Direttiva 2013*, Roma, 20 March 2014.

ROCCHIA E.: Monitoraggio della biodiversità in ambiente alpino (oral presentation) Workshop *Biodiversità – tre anni di ricerche in Valle d’Aosta*, Aosta, 20 May 2014.

VITERBI R.: Monitoraggio della biodiversità nelle Alpi Occidentali (oral presentation). Educational meeting. LIPU seat, Torino, 25 November 2014.

1.7.3.

The Special Project was presented by the Coordinator at the annual Assembly of the *ILTER – Italy network* (Turin 14-15 May 2014).

1.7.4.

ARPA Valle d’Aosta: May 2014. Field training in Advanced Chemical Methods for students of the Chemistry faculty of the University of Torino.

1.7.5.

ABELI T.: Invited lecture: *Extreme weather events: the dark side of global climate change*, Millennium Seed Bank, Royal Botanic Garden, Wakehursts Place, UK. 29 October 2014.

3.5 Participation in conferences, workshops, meetings

ABELI T, MONDONI A, ORSENIGO S, ROSSI G, GUASCONI DB, CRISTOFANELLI P, BONASONI P (poster): Heat-wave mediated high concentration of O₃ only temporally affect seed germination of alpine plants. *New Phytologist Next Generation Scientists Congress*, Norwich (UK), 29-30 July 2014.

CERRATO C., VITERBI R., PROVENZALE A. State and expected changes of animal biodiversity in the northwestern Italian Alps (poster). *International Biogeography Society – 7th Biennial Conference of the International Biogeography Society*, Bayreuth, Germania, 8-12 January 2015.

MONDONI A., ORSENIGO S., PROBERT R.J., BONOMI C., ABELI T., ROSSI G. Effects of climate change on seed germination and recruitment success of alpine plants (oral communication). *109° Congresso della Società Botanica Italiana. International Plant Science Conference (IPSC). From Nature to Technological Exploitations*, Florence, 2-5 September 2014..

SBORDONI V., BOZANO G.C., WANGDI K., MARTA S. & CESARONI D. A georeferenced checklist of the butterflies of Bhutan. *5 International Symposium of Biodiversity and Natural Heritage of the Himalaya*, Naturkundemuseum Erfurt, Germany, 11-13 April 2014.

VITERBI R., CERRATO C., ROCCHIA E., PROVENZALE A., BASSANO B., BOGLIANI G. Measurements of biodiversity in the Italian Alps (oral communication). In: *Monitoring biodiversity transformation to document climate change impacts in alpine protected areas – International Workshop of the ALPARC network*, Ceresole Reale (TO), 10-11 September 2014.

VITERBI R., ROCCHIA E., MOVALLI C., PEDROTTI L., CERRATO C., PROVENZALE A. Monitoring of biodiversity in the Italian Alps: a multi-taxa approach. In: International Biogeography Society (poster). *7th Biennial Conference of the International Biogeography Society*, Bayreuth, Germania, 8-12 January 2015 .

1.7.3.

Several researchers involved in the Project participated at the *annual Assembly of the LTER – Italy network*, held in Turin 14-15 May 2014.

The group of CNR-IREA participated to the *9th International Conference on Software Paradigm Trends - ICSOFT*, Vienna, Austria, 29-31 August 2014.

4. Results obtained during the reference period

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

1.7.1.

Among the results obtained has been found an effect of climate change on the predator-prey system (Mammals-Reptiles). The study has been carried out on four mountain species: in the Alps, *Vipera berus*, *Chionomys nivalis* and *Sorex alpinus* were investigated and in the Apennines, *Vipera ursinii* and *Chionomys nivalis* were studied According to our model, all four species will be exposed to a serious decline in the coming decades.

The data set of Bhutan butterflies allowed to obtain preliminary results. It was possible to highlight the dissimilarity between pairs of collecting sites with different latitude. This pattern is partly due to the geomorphology of the region. Moreover, the relative abundances of species that fall into four biogeographical classes (Himalayan, Oriental, Palearctic, widespread) vary with altitude.

The potential distribution of the selected mountain species of genera *Erebia* and *Parnassius* were determined for different historical periods (current, Holocene Climatic Optimum, Last Glacial Maximum). For *Erebia* species, the results show that the predominant factor in determining the current distribution area was the persistence within the areas of stability. For *Parnassius* species the current distribution area is the result of the simultaneous action of the persistence in the stability and dispersal ability and colonization of species.

1.7.2.

- Databases, formed by data obtained during the monitoring campaigns (fauna, vegetation, micro-climate data and metadata).
- Measurements of biomass of the carabid target species: 5 species, 11 morphological parameters, 2376 specimens.
- Conduction of monitoring campaigns: butterflies (17 transects*5 repetition), birds (50 point counts*2 repetition), micro-climatic parameters (datalogger iButton, 34 positioned and left in field from April to October).
- Climatic layers (temperature maps, with a spatial resolution of 250x250 m, over the territory of the 3 protected areas).
- Land cover layers (data available from public sources, compared and validated with the punctual field data).

1.7.3.

Task 1 Data tools and standards

- Architecture of the data and metadata system created and tested.
- Check and update of the metadata of lake sites.
- Update of the datasets from two lacustrine sites.
- Test of a “starter kit” to facilitate data distribution and connection to NextData portal.

- definition of a workflow.

Task 2. Data and metadata from mountain ecosystems: test cases from LTER Italy sites in mountain ecosystems

- Brief description of finally selected sites, with list of main bio-ecological data type to be tested for data archiving/distribution.

Task 3. Collection of new data sets from LTER Italy sites in mountain ecosystems

- Starting of collection of new data;

- absorbed PAR, litter collection at one forest site;

- other bio-ecological data in cooperation with 1.7.4.

1.7.4.

IBAF:

Collelongo (beech forest):

Continuous automatic monitoring of ecosystem CO₂ and H₂O flux.

Continuous automatic monitoring of the radiometric properties of the surface (NDVI, CROPSCAN).

Field isoflux measurements coupled to isotope analyses of the plant material. Evidences of changes in C allocation strategies of beech caused by excessive drought and heat. Monitoring of plant physiological response to variations in the local climate.

Assessment of different structure and metabolic functionality of beech leaves along the canopy vertical profile. Evaluation of morpho-physiological and molecular mechanisms involved in the adaptation of canopy layers to variable light regimes.

Brocon (grassland):

Data on the effect of grazing and its avoidance on plant physiology, soil respiration and its components: autotrophic and heterotrophic respiration.

ARPA partner:

There were created the following protocols:

a) Protocol for gathering and storage of NDVI data.

b) Protocol for gathering, storage and elaboration of digital images for phenology (in synergy with the protocol definition activity for digital images ICOS Phenocamera Protocol).

Measurements:

Torgnon (grassland):

Continuous automatic monitoring of ecosystem CO₂ and H₂O fluxes and soil respiration.

Continuous automatic monitoring of the radiometric properties of the surface (NDVI, CROPSCAN).

Continuous automatic monitoring of the phenology with digital images.

Biweekly measurements of vegetation physiology (biomass, LAI).

Torgnon (larch forest):

Continuous automatic monitoring of ecosystem CO₂ and H₂O fluxes.

Biweekly measurements of plants phenological development.

DIBAF partner:

Assessment of the heterotrophic efflux from soil on annual basis at Torgnon and Brocon grassland sites using radiocarbon measurements in the soil.

1.7.5.

The data on scoring of seed germination in laboratory are available. Temperature and water potential recorded in the field experiments (and in the previous years) are available. In particular Temperature data recorded with data loggers (Tinytag) from January 2010 (Alps, Val Dossdè) and from July 2013 (Northern Apennines, M. Prado) are available. Soil Water Potential recorded with data logger (MicroLog SP3) from July 2012 (Alps, Val Dossdè) and from July 2014 (Northern Apennines, M. Prado) are also available.

4.2 Publications

ABELI T., MONDONI A., ROSSI G., ORSENIGO S., (2014): Effects of summer heat waves on Europe's wild flora and vegetation. *Agrochimica*, 58, 128-132.

ABELI T., ORSENIGO S., GUZZON F., FAÈ M., BALESTRAZZI A., CARLSSON-GRANÉR U., MÜLLER J.V., MONDONI A., (2015 in press): Geographical pattern in the response of the arctic-alpine *Silene suecica* (Caryophyllaceae) to the interaction between water availability and photoperiod. *Ecological research*.

AMORI G., D'AMEN M., LUISELLI L. (submitted): Modeling climate change effects on a snake-rodent predator-prey system. *PlosOne*.

AMORI G., CASTIGLIANI V., LOCASCIULLI O., LUISELLI L., (in press). Long-term density fluctuations and microhabitat use of sympatric *Apodemus flavicollis* and *Myodes glareolus* in central Italy. *Community Ecology*.

FUGAZZA, C., MENEGON, S., PEPE, M., OGGIONI A. & CARRARA P., (2014): The {RITMARE} Starter Kit - Bottom-up Capacity Building for Geospatial Data Providers. PROCEEDINGS OF THE 9th International Conference on Software Paradigm Trends - ICSOFT, Vienna, Austria, 29-31 August, 2014. DOI: 10.5220/0004999801690176.

JULITTA et AL., (2014): Using digital camera images to analyse snowmelt and phenology of a subalpine grassland. *Agricultural and Forest Meteorology*.

MARTA, S., LACASELLA, F., GRATTON, P., CESARONI, D. & SBORDONI V. (submitted): Niche modelling through climate changes: disentangling the effects of local persistence and postglacial dispersal on alpine species distribution. *Global Ecology and Biogeography*.

MILANA G., LAI M., MAIORANO L., LUISELLI L., AMORI G.. (submitted) Geographic patterns of predator niche breadth and prey species richness. *Acta Oecologica*.

MONDONI A., ORSENIGO S., DONÀ M., BALESTRAZZI A., PROBERT R., HAY F.R., PETRAGLIA A., ABELI T., (2014): Environmentally induced transgenerational changes in seed longevity: maternal and genetic influence. *Annals of Botany* 113, 1257-1263.

ORSENIGO S., MONDONI A., ROSSI G., ABELI T., (2014): Some like it hot and some like it cold, but not too much: plant responses to climate extremes. *Plant Ecology*, 215(7): 677-688.

PAPALE et AL., (2014.): Carbon, water and energy fluxes of terrestrial ecosystems in Italy. The Greenhouse Gas Balance of Italy, Edition: *Environmental Science and Engineering*, Chapter: 1, Publisher: Springer.

ROSSINI et AL., (2014): Remote estimation of grassland gross primary production during extreme meteorological seasons. *International Journal of Applied Earth Observation and Geoinformation*.

SBORDONI, V., MARTA, S. & CESARONI D., (2014 in press): Alpine Butterflies: a Challenge to Understand the Effects of Climate Change on Biodiversity and Ecosystems. Atti della Conferenza Internazionale - *High Summit 2013*, Lecco, ottobre 2013. *I Quaderni della Ricerca Scientifica del CNR*.

SBORDONI V., BOZANO G.C., WANGDI K., MARTA S. & CESARONI D., (2014): A georeferenced checklist of the butterflies of Bhutan. *5 International Symposium of "Biodiversity and Natural Heritage of the Himalaya"*, Naturkundemuseum Erfurt, Germany, 11-13 April 2014., abstract.

VITERBI R., CERRATO C., BIONDA R., PROVENZALE A.: Effects of temperature rise on multi-taxa distributions in mountain ecosystems, in preparation for *Ecosystem*.

1.7.6.

Monitoring data, results of the data analysis. See Deliverable 1.7.2.6.

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

1.7.1.

Data set on the distribution of small mammals obtained by analysis of barn owl pellets in Italy.

Data set on the distribution of Himalayan diurnal Lepidoptera with particular reference to Bhutan.

1.7.2.

Biological and micro-climatic databases (collected during NextData and the previous monitoring campaigns) have been processed and made available.

Temperature and land cover data, over the 3 protected areas involved in monitoring activities, have been validated and made available for further analysis (spatial resolution 250 m).

1.7.3

- DEIMS is currently the main tool for metadata managing in LTER Europe. The status of metadata of Data-LTER-Mountain sites has been checked.
- Two simple sites (Lake Scuro and Lake Santo Parmense) have stored datasets and dataset metadata.
- Two other simple sites (Lake Pajone Superiore and Inferiore) have started to upload data.
- Dataset storage format is currently plain "spreadsheet". Work in progress for the use of more suitable tools.

1.7.4.

All the available data are currently stored in the local dedicated servers (external to the Project). Continuous flux data are shared with the Fluxnet network according to the accepted protocols.

All data of the first year measurement campaigns will be submitted to the NextData database after a proper quality check and post processing within the next year of the Project, according to the NextData requirements.

1.7.5.

Microclimatic data (temperature and water potential) are available for the area of the glacial morain of Dosdè Glacier.

4.4 Completed Deliverables

D1.7.2.1, D1.7.2.2, D1.7.2.5, D1.7.2.6: Report with the results of the second year of the study and papers published on peer review journals.

D1.7.3:

Task 1. Data tools and standards

System architecture for bio-ecological dataset in NextData; summary of the current metadata and dataset of partners stored within LTER Europe facilities and preliminary implementation of system's components, in connection to NextData tools.

The Deliverable is a report that describes the technological application of the system.

Task 2. Data and metadata from mountain ecosystems: test cases from LTER Italy sites in mountain ecosystems

- Description of the sites – as available in the LTER Italy format.
- Site metadata available in the Data-LTER-Mountain data system – included in the Deliverable provided by Task 1.
- Data and metadata sets of basic variables – in year 1 the focus was on lacustrine sites.

D1.7.4. Deliverables for grassland sites:

- a complete fully operating eddy covariance stations Brocon and Torgnon (completed for the Torgnon site).

- Experimental set-up for long-term study of the effects of grazing on C and N cycling in alpine grasslands.
- Protocols for measurements and data-processing of image-based productivity and NDVI.
- Scientific reports.

Deliverables forest site:

- Measurements and data-processing of image-based productivity and NDVI.
- Indications of the resilience of beech to changing climate by means of isotopic indicators and leaf gas exchange and fluorescence measurements.
- Scientific reports.

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

1.7.1., 1.7.2., 1.7.5.

Field monitoring activities, data storage and data analysis have been carried out as indicated by the Executive Plan.

1.7.3.

Focus of first year was on lacustrine sites. The selection for terrestrial sites has been delayed to 2015, and the work on terrestrial sites will be the focus of the second year of the Special Project.

1.7.4.

Continuous measurements of CO₂, H₂O and CH₄ in Brocon site were not activated in the first year of the Special Project. The station was heavily damaged by thunderstorm in autumn and by 4 m of the snow cover in winter. The data acquisition system was completely replaced. The anemometer was damaged and it was sent for repair. The largest part of the meteorological sensors were also replaced and the whole tower structure, bend under the snow weight, had to be adjusted.

1.7.6.

This activity, not included in the original executive plan, is an important addition to WP1.7.

6. Expected activities for the following reference period

1.7.1. Surveys and data collection as well as analysis and modeling on mammals and butterflies will be implemented and developed. The following activities are planned:

- improvement of the CKMap data set of Mammals with data from historical museum collections (e.g. Genoa Festa's Collection, Milan).
- Analysis of the vertical distribution of mammals in Europe.
- Analysis and models of the geographic distribution of the family Cricetidae (Rodentia) of the world in relation to climate change and to mountain environments.
- Improvement of the CKMap data set of Lepidoptera with data from museum and private collections.
- Analysis of temporal, altitudinal and phonological variations in Italian mountain Lepidoptera.
- Analysis of the spatial distribution and comparison between potential and real distributions of diurnal Lepidoptera in Italy.

1.7.2.

- End of specimen determination of the few missing groups (Coleoptera Staphylinidae, Hymenoptera Formicidae, Araneae).

- Completion of databases (data and metadata) for the insertion in the General Portal.
- Analysis of biomass variation along altitudinal gradient and identification of the most influential biotic and abiotic parameters.
- Identification of climate change indicator (target species), through the application of environmental changes scenarios (using as a starting point the data collected during these monitoring campaigns and the environmental layers developed and validated).
- Analysis of the time series currently available: butterflies and birds (9 years of continuous measurements in selected areas).

1.7.3.

Task 1 Data tools and standards

- Data services.
- DEIMS and CSW catalogue with already available metadata; web services with already available LTER dataset; mirroring to DTA server.
- Archives of LTER data.
- Geoviewing online tool.

Task 2. Data and metadata from mountain ecosystems: test cases from LTER Italy sites in mountain ecosystems

- Data and metadata on basic, ecological and biological variables from involved sites.
- Development of the common case study.

Task 3. Collection of new data sets from LTER Italy sites in mountain ecosystems

Collection of new datasets.

1.7.4.

In the second year of the Special Project all the monitoring activities will continue regularly. The data gathered during the first year of the Special Project will be elaborated and transmitted to the NextData database. Protocols could be modified if necessary. Flux measurements in Brocon site will be activated from the beginning of the growing season. The assessment of the heterotrophic respiration by radiocarbon measurements will be extended also to the forest site of Collelongo.

1.7.5.

For the work on alpine plants the following activities are planned:

- Complete the in situ studies on the effects of temperature warming on seedling recruitment and survival (experimental upward migration) of high-mountain and sub-alpine species in periglacial areas in the Rethian Alps, Italy, in Val Dossè (Sondrio Province).
- Complete the studies on local adaptations of seed dormancy and longevity of arctic/alpine species from different latitude.
- Continue the 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).
- Develop the theoretical models and Pilot Studies of reinforcement or migration of populations of alpine plants considered vulnerable to climate change in the Northern Apennines (assisted migration).
- 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).
- Processing the data collected in 2014 with the experiments and publishing papers in peer-review journals.

1.7.6.

Continuation of the monitoring activities and data analysis.