FPS COST Action FP1202 "Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest trees to climate change in Europe (MaP-FGR)

Report of activities carried out during Short-term Scientific Mission (STSM) at ALTERRA (The Netherlands)

Title: "Analysis of variability for adaptive traits in Apennine silver fir MaP populations and wild cherry"

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From 5th to 11th October 2014 (travel days included), thanks to FPS COST Action FP1202 "*Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest trees to climate change in Europe (MaP-FGR)*", Roberta Proietti benefited to a Short Term Scientific Mission (STSM) at ALTERRA, Wageningen University and Research Centre (The Netherlands), at the Vegetation, Forest and Landscape Ecology Institute. Activities carried out during this period were followed by Dr. Koen Kramer.

The main STSM aims were to processing and analysing different phenological data (e.g.: bud flush and cambium phenology) collected in MaP populations of Apennines *Abies alba* Mill. and in *Prunus avium* L. Italian clones and to test correlation between phenological and climatic data sets (temperature and rain). The monitoring of adaptive traits, as phenology, is a way to describe and to characterize variation within population (*A. alba*) or at genotype level (*P. avium* clones). For studied species results will be useful to model growth patterns in different climate and to promote right conservation strategies in marginal areas and/or under global change effects.

Phenology is indeed influenced by climate and vice versa. Relationships between phenology and environmental factors, particularly temperature, are especially important. The seasonal changes in phenology (i.e. spring on-set and autumn senescence) can partially influence microclimate in different ways: could affect the physical and biogeochemical properties of the Earth's surface (with changes in temperature, humidity, precipitation, thermal properties of the soil, atmospheric CO2 concentration and alteration of nutrient cycles and water), agriculture (length of growing season, sensitivity to frost, pest epidemiology, timing and amount of use of plant protection, food quality, potential yield) and human health (duration of the pollen season) (Morissette *et al.*, 2009; Peñuelas and Filella, 2001; Richardson *et al.*, 2013; Schwartz, 1992). The trend toward global warming observed in recent years has been associated with earlier onset of vegetation activity in spring and with an extension in the length of the growing season (Linderholm, 2006). The 4th Assessment Report ("AR4") of the Intergovernmental Panel on Climate Change (IPCC) since the 1970s found spring onset has been advancing at a rate of between 2.3 and 5.2 days per decade (Parry *et al.,* 2007).

For this reason "*Phenology…….is perhaps the simplest process in which to track changes in the ecology of species in response to climate change*" (IPCC AR4: Climate Change 2007 – Impacts, Adaptation and Vulnerability, page 99). It is therefore important to develop effective methods for monitoring these traits, in order to assess phenotypic plasticity present both at species and population level and to know their ability to adapt to new environmental conditions.

The first step was to prepare and to manage good climate data files for the 4 different studied areas: La Verna (Chiusi della Verna – Arezzo) and Pigelleto (Piancastagnaio – Siena) silver fir sites, Ravenna and Forestello (San Giovanni Valdarno – Arezzo) wild cherry sites. Because bud break phenology was monitored

in 2010 and 2011 for *P. avium* and cambium phenology was monitored in 2011 and 2012 for both *P. avium* and *A. alba*, climate data for the period 2009 – 2012 were considered.
Data from the Tuscany and Emilia Romagna Regional Hydrological Service were collected and daily mean files for temperature and precipitation, starting from January 2009 until December 2012, were prepared. The second step was to calculate the chilling unit and temperature sums for considered period. Chilling, temperature sums and day length regulate the transition from dormancy to beginning of the growing season (Nielsen and Jørgensen, 2003). Temperature is the key factor for phenology (both for shoots and cambium) in spring and autumn, as observed both in natural and controlled conditions (Deslauriers *et al.*, 2008; Oribe *et al.,* 2001). Temperature influences the timing of the start of the growing season and its duration, the level of frost hardiness and consequently the reduction of foliage area and photosynthetic capacity following a severe frost event. But in the Mediterranean areas, characterized by wet and cold winters and dry and hot summers (both periods unfavorable for growth), phenology is driven also by water availability (Cherubini *et al.,* 2003; Carrer and Urbinati, 2006), that affects the development of leaf area and the general phenological timing (Kramer *et al.,* 2000; Vieira *et al.,* 2014a). Spring drought (May–June) however was the primary factor limiting conifer growth in the Mediterranean area (Lebourgeois *et al.,* 2012).
To define chilling unit and temperature sums Enthought Canopy software was used. Enthought Canopy is a comprehensive Python analysis environment.
The third step was to fill in the right way the bud break and cambium phenology data files in order to correlate meteorological and different type of phenological information. Indeed bud break were monitored in field trial using scoring method (with a seven score scale), while cambium activity was monitored in laboratory, through optical microscope analysis of sections obtained from microcores. With this last survey were available two different information: i) the phenological stage reached (i.e.: xylogenesis onset or end) at a definite day of the year (DoY); ii) type (cambium, enlarging/extending cells, early wood, late wood) and number of cells per type produced on the same DoY.
The final step was to create Access tables where, as in a database, information are organized in a logical structure that allows easy access to any data. Tables were used to obtained query files (always in Microsoft Access). Queries allow to make correlation between different stage of xylem formation or bud break stage reached at same DoY by different populations of A. alba or P. avium clones in different sites and chilling unit and/or temperature sum.
Due to the amount of data to organize and analyze for two different species considered, the time spent to obtain an initial knowledge of Enthought Canopy software, in the coming months it will be possible to continue a collaboration between Roberta Proietti and Dr Koen Kramer for a correct interpretation of results and to define phenological models for silver fir and wild cherry. The final results of this work would be the production of scientific articles, one for *P. avium* clones and another for *A. alba* population.

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Arezzo, 31.10.2014

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