Development of a methodology for the assessment of sweet chestnut orchards dynamics in Northeastern Portugal with remote sensing and geostatistics

J. Castro[1], J.C. Azevedo[1] and L. Martins[2]

[1]Instituto Politécnico de Bragança & CIMO – Centro de Investigação de Montanha, 5301-855 Bragança, Portugal

[2]Universidade de Trás-os-Montes e Alto Douro, 5000-911 Vila Real, Portugal

The sweet chestnut productive area in Portugal has augmented in the last decades due to EU and Portuguese government funding schemes and favorable international market for the chestnut fruit. Farmers have been encouraged to replace traditional crops by chestnut plantations. A rising demand for sweet chestnut (*Castanea sativa*) in Portugal and elsewhere in the world has led to more intensive management practices in order to increase nut production. This intensification has contributed to the decline of sweet chestnut orchards as a result of the widespread of ink disease (*Phytophthora cinnamomi*) and chestnut blight (*Cryphonectria parasitica*) which have caused important losses in chestnut production as well as limited the establishment of new planted areas.

The balance between mortality and the establishment of new plantations is difficult to quantify based on field observations only because often new plantations are placed where chestnut mortality occurred. However, changes in chestnut orchards are registered in remotely sensed data collected over time that can be used to reconstruct regional and local history of this and other land use classes.

Time Series Analysis (TSA) and Geostatistical analyses can be combined with analogical conventional aerial photographs (CAP) and modern digital orthophotographs using photogrammetric techniques and Geographical Information Systems (GIS). In this work we developed a methodology integrating the tools above to estimate chestnut decline for the last twenty years (1986-2006) in the Trás-os-Montes region (Northeastern Portugal). We used aerial photography from 1986, 1995, and 2006 to map chestnut occupation and to quantify tree damage according to a categorical scale at the tree level within fixed sample plots. Decline surfaces were created by Kriging interpolation in a GIS based on the spherical model which provided the lowest Mean Absolute Errors by an iterative process in the variography analysis.

The results showed an expansion of total chestnut orchards in the study area from 1742 ha (14.3% of the area) in 1986 to 2562 ha (21.1%) in 2006 although chestnut mortality affected 1061 ha during the same period. More importantly, the results of the methodology developed here, showed the distribution and configuration of turnover areas and their spatial relationship with the degree of chestnut decline which can support the decision making process relative to sweet chestnut plantations establishment and management.

Keywords: Aerial photography; *Castanea sativa* mortality; kriging interpolation.