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The usefulness of a long-term perspective in assessing current forest conservation management in the Apuseni Natural Park, Romania

Angelica Feurdean [a,*], Katherine J. Willis [a,b]

[a] Long-term Ecology Laboratory, School of Geography, Centre for the Environment, University of Oxford, South Parks Road, OX1 3QY Oxford, UK
[b] Department of Biology, University of Bergen, Allegaten 41, N-5007 Bergen, Norway

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ABSTRACT

The forest ecosystem of the Apuseni National Park (ANP) in NW Romania is recognized for its high species and genetic diversity and is protected through various conservation measures. As ANP is the most populated natural park in Romania, the focus is on the need for communities to manage, sustain and prosper by using, exploring and sustaining the natural resources. But what activities are the most appropriate for the conservation of a highly diverse natural forest? This paper presents results from a long-term ecological study using fossil pollen, microscopic and macroscopic charcoal and AMS ^{14}C dating on a site in the ANP in order to examine how the interaction between climate change, human activities and other disturbances have shaped the present protected landscapes over the last 5700 years in this part of the reserve. Results from this study show that the landscape in this region has been continuously forested over the last 5700 years BP, but the forest composition and structure have been dynamic throughout much of the time. In particular, distinct changes in forest composition have occurred over the last 700 years of the record. *Fagus sylvatica* was the major taxon between 5200 and 200 years BP and its dominance is associated with the highest forest stability. The formation of the current *Picea abies* forests started 400 years ago and spruce became the dominant forest species during the last two centuries as a result of selective forest clearance, intensive grazing, and more recently, plantations. This led to a large reduction in forest diversity, decline of *F. sylvatica* and local extinction of several species including *Abies alba*, *Ulmus*, *Tilia*, and *Acer*. Our results show the high conservation values of *A. alba* and *F. sylvatica* in the ANP. Current management practices that allow the anthropogenic activities of timber production and fast tree regeneration, usually involving the plantation of *P. abies* in this part of the ANP are not in keeping with the NATURA 2000 objectives of ensuring the persistence of the most vulnerable species and habitats.

1. Introduction

One region in Europe where there are still exceptionally large tracts of 'undisturbed' natural temperate forests is Romania. Many of the forests in Romania are protected in 27 National and Natural Parks and many of these are covered by some conservation designation (http://www.mmediu.ro/dep_mediu/biodiversitate.htm). One of these is the Apuseni National Park (ANP) in north-western Romania.

The management of Europe's natural forests, however, tends to be focused on practices that see these forest systems as 'stable' and any change, be it from human activity or climate, as detrimental; the ultimate goal in most of these conservation practices is therefore to maintain the status quo or restore the forests to some former 'natural' benchmark. But what are these 'natural' benchmarks? Long-term ecological studies provide information on the past variability in ecosystem and can help recognize when ecosystem variability exceeds past norms and crosses critical thresholds. They can also inform on the antiquity of the existing forest communities and provide reference conditions beyond those offered by current and historical records (Knapp, 2003; Gillson and Willis, 2004; Willis and Birks, 2006; Willis et al., 2007; Jackson, 2007). With predictions suggesting that climatic variability will increase over the next 50–100 years and with human impact in many regions becoming more intense, it is essential that we have the capability to understand and manage the response of vegetation within the range of its natural variability (Hannah et al., 2002).

The ANP was founded in 1990 with the aim of protecting the forests of the Apuseni Mountains and their high species and genetic diversity. ANP hosts the largest track of forest developed on limestone in Europe and contains a distinctive flora typical of

* Corresponding author. Tel.: +44 1865 285178.
E-mail addresses: angelica.feurdean@ouce.ox.ac.uk, angelica.feurdean@gmail.com (A. Feurdean), kathy.willis@ouce.ox.ac.uk (K.J. Willis).

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karstic landscapes in the Northern Hemisphere. To date, over 1550 vascular species have been identified in the ANP and the park hosts a high number of faunal and floral endemics and rare species (http://www.parcapuseni.ro). This list includes many species/habitats protected in the European Habitats and Birds Directives, NATURA 2000 network. Their collective aim is to ensure the persistence of the most vulnerable species and habitats. The management plan of the park was elaborated in 2001 (Law no. 462/10.06.2001) and is carried out by the Administration of the Apuseni Natural Park, under the direction of the National Forestry Center, Oradea, Romania. In time, the management plan has benefited from PHARE CBC, and LIFE programs and consultancy from many EU specialists in the management of protected areas, which led to the elaboration of a new plan management in June 2006 (APNA, 2006).

ANP has been classified as a protected area (management category V according to IUCN, 1994; The World Conservation Union). Within this classification of protected areas, three management categories exist: zone category Ia with rigorous protection where no human interference except research is allowed; zone category II where research combined with minimal management activities are permitted, and category V where a diverse human activity (logging for wood and timber production, tourism, agriculture, grazing, etc.) is permitted. As ANP is the most populated natural park in Romania with over 10,000 inhabitants, and its management allows diverse human activities, the majority of the park is category V. The success of this reserve can therefore be achieved only through an effective management plan that focuses on the need for communities to manage, sustain and prosper by using, exploring and sustaining all natural resources.

Previous palaeoecological studies from the Apuseni Mountains have provided insights into the pre-anthropogenic vegetation and the disturbance regime by humans on these landscapes (Pop, 1960; Bodnariuc et al., 2002; Fărcaş et al., 2005), but so far none have specifically addressed questions associated with the forest's long-term management and conservation. In this study we use fossil pollen, microscopic and macroscopic charcoal to determine the long-term history of the temperate forests in the Apuseni Natural Park during the last 5700 years. Specific research questions include: Are the present-day woodlands in the ANP a consequence of past human activities or a result of natural long-term climate/vegetation dynamics? Are there particular tree species in decline or that have recently disappeared from region? Are there particular management practices that encourage the regeneration/establishment of certain species/groups? Is the preservation of a wide range of human activities in category V area appropriate for maintaining a biodiverse and dynamic ecosystem? Such questions are critical to the park's current and future management.

2. Study area

The Apuseni Natural Park (ANP) covers approximately 76,065 ha and lies between 46°26′ and 46°45′ lat N; 22°32′ and 23°5′ long E. It is located in the Apuseni Mountains, Western Carpathians, NW Romania (Fig. 1), a predominantly calcareous region. The vegetation in the park is dominated by spruce (*Picea abies*) with other deciduous trees such as beech (*Fagus sylvatica*), hornbeam (*Carpinus betulus*), sycamore (*Acer pseudoplatanus*), elm (*Ulmus montana*), white birch (*Betula verrucosa*), rowan (*Sorbus aucuparia*), and European ash (*Fraxinus excelsior*). Trees species in the park that are Red Data listed (APNA, 2006) include fir (*Abies alba*), larch (*Larix decidua*) and European yew (*Taxus baccata*). Due to a thermal inversion on the mountainous slopes of the park, beech often develops above coniferous woodlands or forms a direct contact with montane and sub-alpine meadows.

Climatically, the Apuseni National Park is classified as being in a cold continental-temperate zone (APNA, 2006). There are, however, distinct local differences within the park area due to altitudinal variation and the complex relief. In the study area located in the west-centre of the park, mean annual temperature is ca. 5 °C and annual precipitation ca. 1400 mm, with the highest rainfall in the summer and the lowest in winter.

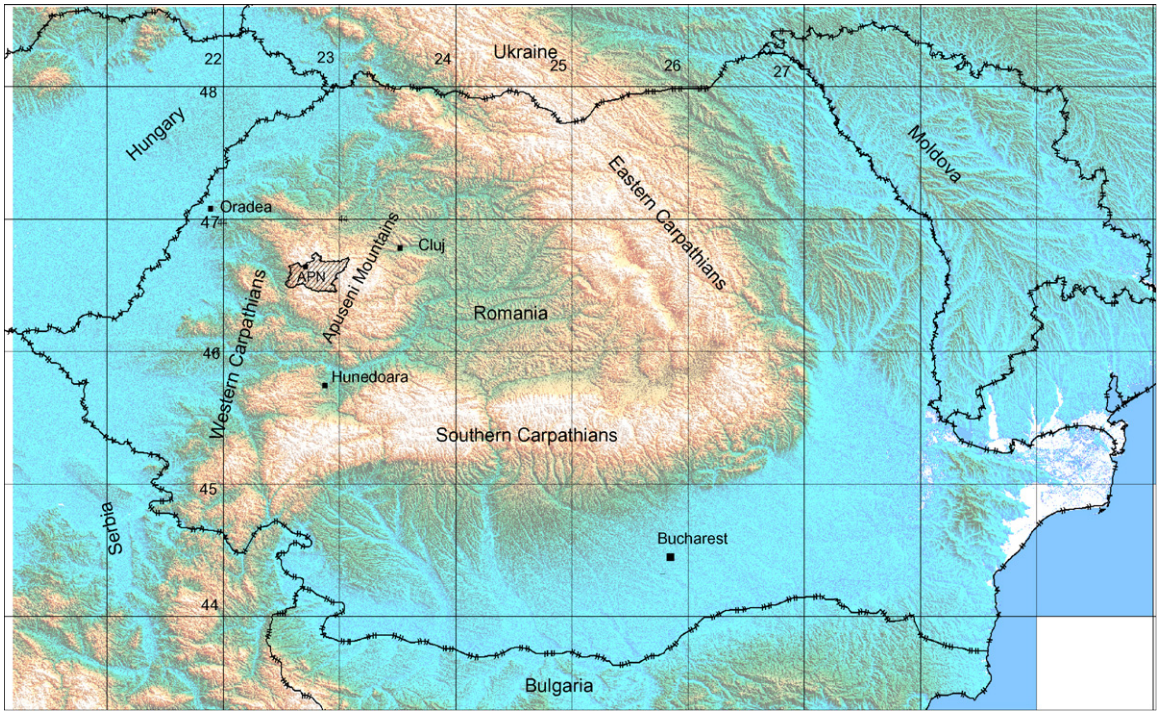

Fig. 1. Map showing the location of the Apuseni Natural Park (APN) in the Apuseni Mountains, Western Carpathians, Romania. The location of the study site, Molhaşul Mare within the APN is indicated by the black square.