Featured Research

New Forest National Park (UK): Browsing, Fire, Harvesting and Ecosystem Dynamics

Adrian Newton, Elena Cantarello, Phil Martin, Paul Evans, Arjan Gosal, Natalia Tejedor-Garavito, Gillian Myers

The New Forest National Park is situated on the south coast of England (UK) (Longitude from 1°17’59” to 1°48’8” W, Latitude from 50°42’19” to 51°0’17” N; see Fig. 1). The Park was designated in 2005 and extends over 57,100 ha (Newton, 2010). Its importance for nature conservation is reflected in its many designations, ranging from national-scale legislation (e.g. Site of Special Scientific Interest - SSSI), through European designations (e.g. Natura 2000 network), to global-scale designations (e.g. Ramsar Convention) (Cantarello et al., 2010). Some 20 SSSIs, six Natura 2000 sites and two Ramsar Convention sites are included at least partly within the Park’s boundaries (Newton, 2010).

The major components of the vegetation are the extensive wet and dry heath with their rich mire communities and associated wet and dry grassland, the ancient pasture and enclosed woodlands, the network of rivers and streams, and permanent and temporary ponds. Nowhere else do these habitats occur in combination and on such a large scale. The existence of this habitats mosaic is of fundamental importance in creating niche separation for a wide range of plants, invertebrates, reptiles, birds and animals of national and international conservation importance (Cantarello et al., 2010). The unique character of the New Forest is strongly dependent on its history as a mediaeval Royal hunting reserve and the long-term survival of a traditional commoning system, with large populations of deer and free-roaming livestock (principally ponies and cattle) interacting with the processes of ecological succession and generating a high spatial heterogeneity at local scales (Newton et al., 2013) (Fig 2).

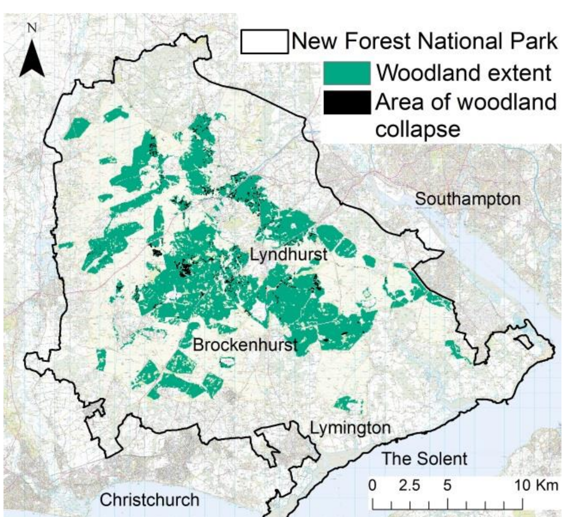
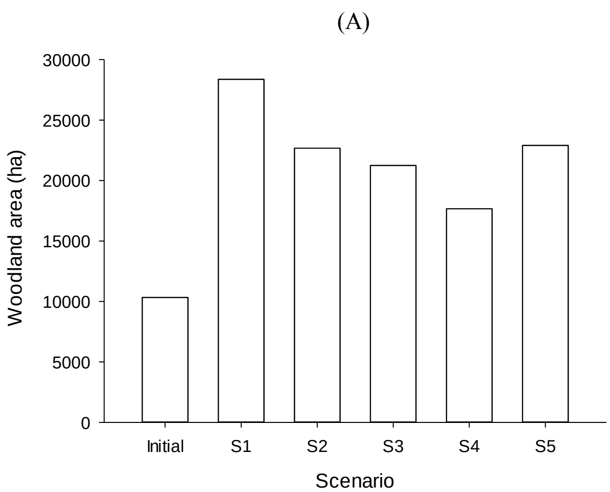


Fig. 1: Woodland extent within the New Forest National Park overlaid on an Ordnance Survey map (©Crown Copyright/database right 2015).

Fig. 2: Ponies and cattle roam freely over large part of the New Forest, and together with other herbivores, have influenced the landscape dynamics over a prolonged period of time.

Since 2005 our team has been employing LANDIS-II supported by the collection and analysis of empirical data, to examine the potential impact of different disturbances on the spatial dynamics and composition of the New Forest woodlands. The overall aim of the research is to inform conservation management plans, both in relation to browsing and to other forms of anthropogenic disturbance undertaken as part of management, including the cutting and burning of vegetation. Our results indicated that over the duration of the LANDIS-II simulations (300 years), woodland area increased in all scenarios, with or without browsing. While the increase in woodland area was most pronounced under a scenario of no herbivory, values increased by more than 70% even in the presence of heavy browsing pressure and rotational heathland burning. Model projections provided little evidence for the conversion of woodland areas to either grassland or heathland (Fig. 3A); changes in woodland structure and composition were consistent with traditional successional theory (Newton et al., 2013) (Figs. 3B-C).



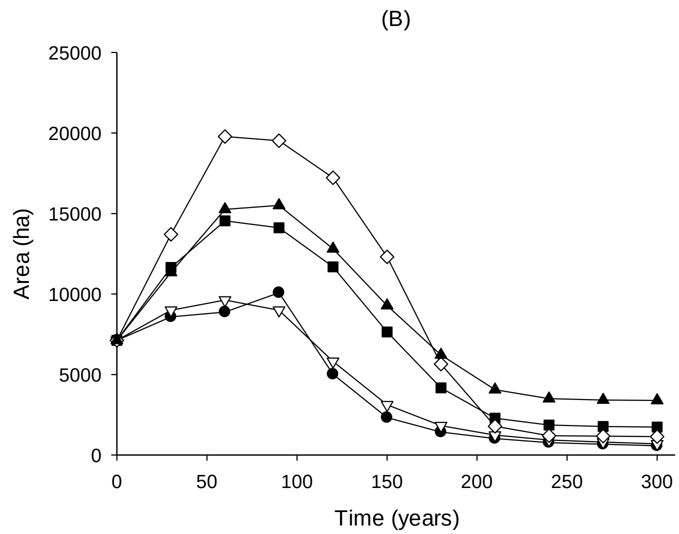
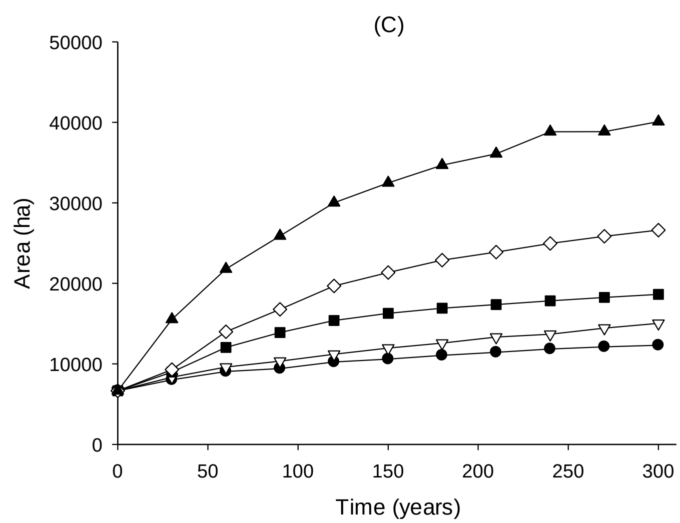


Fig. 3 (A): Projected woodland extent under different disturbance regimes. Values presented are the areas (ha) occupied by one or more of the five principal tree species (*Betula pendula*, *Fagus sylvatica*, *Ilex aquifolium*, *Pinus sylvestris* and *Quercus robur*), as individuals ≥ 10 years old. The values given under each scenario (S1-5) are those projected to occur after 300 years. S1, no disturbance (neither fire nor browsing); S2, browsing only; S3, fire only; S4, fire plus browsing; S5, browsing, fire and protection from herbivory by presence of spiny shrubs. In these scenarios, 'fire' refers to the use of burning as a heathland management tool, as currently practiced; and 'browsing' relates to current browsing intensities by deer and livestock. B-C): Projected extent of occurrence ('area') of selected tree species in the New Forest. B, *Betula pendula*; C, *Fagus sylvatica*. S1, empty diamond; S2, empty triangle; S3, filled square; S4, filled circle; S5, filled triangle. From Newton et al., (2013).



The New Forest has been remarkably resilient as a socio-ecological system, having withstood many internal and external shocks over the past 900 years, including the Black Death of 1346-53, a period of significant climate change (1550-1850), and a series of other major events primarily resulting from changes in how it was governed (Newton, 2011). However, some elements of this system are currently undergoing major changes in structure and composition as a result of the co-occurrence of multiple stressors, including climate change, atmospheric pollution and the spread of novel pests and diseases (Newton et al., 2015). *Fagus sylvatica* woodlands appear to be the most affected by these multiple stressors, and have started to show signs of collapse (Fig. 1).

Research is required to examine the potential impact of woodland collapse on the provision of ecosystem services at the landscape scale and to suggest management actions to strengthen woodlands resilience to emerging disturbances. Current pressures of forest ecosystems could lead to catastrophic declines in the provision of ecosystem services as a result of threshold effects (Newton and Cantarello, 2015). Key issues therefore include the identification of thresholds and feedbacks, which may lead to a transition from woodland to a vegetation type without trees; the identification of early signs of such transition; analysis of the interactions between different stressors affecting ecological systems; and the role of habitat connectivity in strengthening landscape resilience. Ongoing research in the New Forest under the NERC-BESS project is examining each of these aspects. Research activities comprise a combination of field surveys along gradients of forest dieback, resurvey of long-term plots and use of spatially explicit models of ecosystem dynamics (i.e. LANDIS-II with Century).

For more information on the LANDIS-II modelling contact Dr. Elena Cantarello ecantarello@bournemouth.ac.uk

References

Cantarello, E., Green, R. and Westerhoff, D. 2010. The condition of The New Forest habitats: an overview. *In:* Newton, A. C. (ed.) *Biodiversity in the New Forest.* Pisces Publishing: Newbury, Berkshire.

Newton, A. and Cantarello, E. 2015. Restoration of forest resilience: An achievable goal? *New Forests*, 1-24.

Newton, A. C. (ed.) 2010. *Biodiversity in the New Forest,* Pisces Publishing: Newbury, Berkshire.

Newton, A. C. 2011. Social-ecological Resilience and Biodiversity Conservation in a 900-year-old Protected Area. *Ecology and Society*, 16(4): [Online]. Available: http://dx.doi.org/10.5751/ES-04308-160413.

Newton, A. C., Cantarello, E., Douglas, S., Martin, P., Evans, P. and Gosal, A. 2015. Managing landscape resilience: the example of the New Forest. *In:* Rotherham, I. (ed.) *Wild Thing? Managing Landscape Change and Future Ecologies Conference 9-11 September 2015.* Sheffield, UK.

Newton, A. C., Cantarello, E., Tejedor, N. and Myers, G. 2013. Dynamics and Conservation Management of a Wooded Landscape under High Herbivore Pressure. *International Journal of Biodiversity*, [Online]. Available: http://dx.doi.org/10.1155/2013/273948.