Managing for ecosystem change in the GBMWHA

An Australian Research Council Linkage project 2007-2010

Project overview

We have entered Earth's sixth mass extinction event, this time human-driven. Protected areas are a major preventative option. This research identifies the conservation importance and spatial impacts of drivers of change (frequent fires, climate change and invasive species) on biodiversity in the Greater Blue Mountains World Heritage Area. (1) A historical perspective on the establishment of the reserve will be contrasted with the current status of biodiversity within the GBMWHA, and the effectiveness of the current reserve boundary to reflect the extent and persistence of biodiversity in the region will be explored. (2) Drivers of change (or threats) will then be quantified to describe the spatial distribution of impacts. (3) This information will be used to model threat distributions and their impacts on bioindicators, to determine the efficacy of competing management strategies. (4) The knowledge gained will be used to inform an ongoing monitoring strategy for the GBMWHA within an adaptive management framework.

Project partner organisations

Blue Mountains World Heritage Institute; University of NSW; National Parks & Wildlife Service, DECC; Blue Mountains City Council; Policy & Science Division, DECC; Vertebrate Pest Research Unit, NSW Department of Primary Industry; Hawkesbury Nepean Catchment Management Authority; University of Western Sydney; University of Wollongong.

Chief researchers

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Project detail

(1) Past and current ecosystem condition

The past and current spatial extent and condition of ecosystems within the GBMWHA will be quantified: the configuration and composition of biodiversity within the GBMWHA over time; the relationship between reserve size, management actions and biodiversity; how management actions and values have changed with the increase in protected reserve area; the increasing effectiveness of different conservation tenures at conserving biodiversity and providing resilience; past and present biodiversity hotspots or core areas; and the on-going monitoring necessary to identify spatial patterns of biodiversity.

Biodiversity information in the GBMWHA is currently held in a variety of sources; the most recent and extensive survey of flora (aerial surveys for habitat mapping) and fauna (birds, herpatofauna, amphibians, and arboreal mammals) has been collected by NPWS. Advances in the availability of spatial data enable the physical, biological, and socio-economic characteristics of ecosystems to be analysed. The project will source all spatial data available for the GBMWHA and closely surrounding areas, and construct a Geographic Information Systems (GIS) using data layers provided by DECC, National Parks and Wildlife Service (NPWS) and the Blue Mountain City Council (BMCC). The GIS database will also include biodiversity data as well as data representing the implementation of management actions and ecosystem processes such as fire regimes. The GIS database will be developed by UNSW and made accessible to the partner organisations and other stakeholders to provide ease of data transfer and linkages. Environmental parameters (habitat, primary productivity, habitat loss, fragmentation) will be quantified and biodiversity hotpots identified.

(2) Responses to drivers of change (threats)

2.1 Impact of drivers. Two PhD projects have been developed with the partner organisations to address two of the most pressing areas of concern in the WHA. One project (undertaken by PhD student Fiona Thomson) is on "***Dispersal ability of plant species as a measure of the response to climate change***". Quantification of those ecological processes or habitat requirements critical to species persistence and their ability to move to new habitats is generally lacking, particularly given climate change scenarios. However, ecological information on functional plant types in GBMWHA is very well developed in relation to fire response, with NPWS having developed a fire response database for this. To assess the impact on flora of climate change, we need to be able to quantify the potential rate of movement of functional dispersal types, the mode of dispersal, and the ability of other species to disperse that are essential in the maintenance of the life cycle of plants (pollinators, dispersal agents). A second project (undertaken by PhD student Jack Pascoe) is titled "***A study of sympatric assemblages of native and exotic species within herbivore and carnivore populations endemic to the GBMWHA***". Little is known about the dispersion, abundance and impacts of invasive vertebrate species, and the relationship between feral and native animal abundance in the GBMWHA. Development of management plans for biodiversity preservation, especially for areas recently reclaimed from pastoral land use, requires accurate modelling of the population dynamics for herbivores and carnivores coexisting in selected habitats. A range of methods will be used to determine species abundance, diet selection, movement patterns, disease status and genetic introgression between compatible species for a range of invasive animals. The data will be added to the GIS database to enable modelling of habitat suitability for invasive species, and will also provide estimates of activity patterns and home range.

2.2 Mapping the spatial extent of drivers. Using the GIS database constructed, the past and current extent of threat impact within the GBMWHA will be mapped. A key outcome will be the identification of bioindicators of threats that are currently not well developed. This information will inform decisions about priorities for monitoring to determine whether the range or abundance of particular species is expanding. Using the information gained in (1), the spatial distribution of key species in response to climate change will be modelled. Spatial patterns of fire regimes will be provided by NPWS. Suitable surrogate species will be selected from a range of fire-response classes identified as being at risk. The distribution of these species will be modelled and superimposed on fire regime data. This analysis will enable the suitability of fire regimes for these indicators to be assessed and further inform fire management for the subset of species likely to decline under the fire regime considered appropriate for the majority of species found in a particular vegetation community. Distribution maps for 11 invasive plant species have currently been developed by NPWS, but the maps are not comprehensive and have not been completed for all invasive species. We will extend these maps by modelling habitat suitability of these invasive species. These models will indicate which species have the potential to increase their range or abundance. Habitat suitability maps of invasive fauna will be developed.

(3) Modelling ecosystem condition and drivers

Through modelling we will be able to quantify: the response of surrogate species to altered conditions; the efficacy of management decisions in reducing the impacts of altered conditions; and the sensitivity of ecosystem condition to individual drivers and future scenarios of change.

(4) Development of an adaptive management framework

The information collected in this research needs to be interpreted into management guidelines for the GBMWHA. NPWS is currently responsible for the development of a monitoring strategy for biodiversity under World Heritage guidelines, and has to report on monitoring to UNESCO on a regular basis. The project will help to develop a spatially-explicit adaptive management framework for monitoring biodiversity within the GBMWHA. A strategic monitoring framework for effective decision-making will be established with the partner organisations to facilitate the on-going management of the GBMWHA.