

Models are used in ecosystem management to aid in understanding and decision-making. Bayesian decision support tools can analyse complex problems and support decision-making in an adaptive management or risk assessment framework. In this paper a Bayesian network (BN) model was used to investigate processes that threaten peatland condition, and to test different management and climate change scenarios. This paper identified that reductions in precipitation and an increase in fire frequency, both likely under climate change, are the chief threats to these systems.

The Australian alpine and subalpine zones are very restricted in extent, covering less than 0.25 percent of the continent (Williams et al. 2003), and occur in the mountainous regions of the southeastern states (Tasmania, Victoria, New South Wales and the Australian Capital Territory). They are important from the point of view of biodiversity protection, summer and winter tourism and for the supply of high quality water. The Victorian Alps occur in the mountainous northeast of the state, the most extensive tract being the Bogong High Plains (~120 km²). The peatlands of the BHP take up less than 10 percent of the area of the BHP; they occur in drainage lines, depressions and seepages and are generally less than one ha in size.

Conceptual models, informed by the literature and expert elicitation, were used to formalize current knowledge regarding the function and condition of alpine-subalpine peatlands. Peatland systems are an important component of high mountain catchments, they receive high amounts of water in the spring thaw and during high intensity summer storms and they transmit most of this water over a period of several hours, removing particulate matter and protecting the underlying soil from erosion. Though small in size these peatlands form part of the local carbon budget, they also form the habitat for a number of threatened and endangered species. The Australian Alps have a naturally low level of bare ground. The introduction of cattle and frequent fire in the period following European settlement increased the amount of bare ground in all vegetation types, and it is likely that it reduced the extent and occurrence of peatlands.

A formal hazard assessment process identified climate change, reduced water supply, modified fire regime, weed invasion, water diversion, grazing and trampling by vertebrates and recreational pressures as the main hazards that threaten peatlands of the BHP. The most wide-ranging hazards were associated with climate change, which is a source of direct and indirect impacts. An influence diagram was used to convey how the threats and other factors that influence peatland condition interact, and this formed the structure of BN for peatland condition.

The BN was used to assign probabilities to the relationships identified in the influence diagram, to reflect our understanding of causal pathways and processes that act to influence peatland condition, while taking into account the uncertainties involved. A sensitivity analysis was used to rank the hazards in order of importance. The BN was used to predict the consequence of different management and climate change scenarios. As peatlands are complex systems with many interacting factors that contribute to condition and persistence, managers would benefit from a tool that could predict the consequence of different management actions and climate change scenarios. The BN model outputs indicated that climate change impacts on water supply and fire frequency, and weed invasion are the most serious threats to peatland condition. Possible management interventions include rehabilitation (revegetation and the construction of weirs) which will help to make the peatland systems more resilient to the impacts of climate change.

The outputs of the model indicated that climate change impacts on water supply and fire frequency are the most serious threats to peatlands, followed by weed invasion. The BN also highlighted that there is significant uncertainty around the likely success of management interventions in improving peatland condition. Incorporating uncertainty has made the model more realistic, this will help to produce a more reasonable idea of the chances of achieving desired outcomes. It also highlights a number of knowledge gaps, the most important of these relating to the uncertainty around the outcomes of management interventions. This BN may be used to guide future data collection, expert elicitation and monitoring programs, including the design of

management experiments, but also to test model predictions and assumptions, and quantify uncertainties.