The red-necked wallaby.

Safe habi

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Decision-support systems can help managers of conservation reserves to plan for the survival of selected species.

Decisions decisions

The Land Use Planning and Information System (LUPIS) developed at the Division of Wildlife and Ecology processes information according to case-specific 'decision rules'. The rules are formal statements drawn from experience and collective knowledge.

Typical rules suggest land-use and management options for sites according to their characteristics. LUPIS can be used to find solutions offering better trade-offs for almost any land management or planning task, provided the appropriate knowledge and supporting data exist.

LUPIS is a menu-driven PC-based program which runs under the MS-DOS operating system. Data can be entered using inbuilt editing facilities, or digitally imported.

Two main approaches are used to evaluate the decision rules: decision-trees, and rating and weighting.

Decision rules can be represented like the branches of a tree. Each branch represents a yes/no question leading to either more questions or a management option. Each choice eliminates options, filtering possibilities until only the preferred management option remains.

A comprehensive set of rules would allow one unambiguous choice for each site. Should a decision tree be unable to yield only one option, LUPIS turns to the rating and weighting approach to reach a single choice.

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Environmental management is often complex, incorporating so many factors and possibilities that making the best decisions can be difficult. One way to simplify the process is to use decision support-systems. These allow individuals to select options based on collective knowledge.

A spatial decision-support system has been developed by CSIRO's Division of Wildlife and Ecology to help land managers conserve native fauna at Nadgee Nature Reserve near Eden in the south-east of New South Wales. The system draws on the Land Use Planning and Information System (LUPIS) with its basic geographic information system functions developed in the late 1980s by John Ive and Dr Doug Cocks. By allowing a user to store and manipulate information about sites, LUPIS has assisted in the design of fire regimes to encourage vegetation types favoured by selected fauna.

The application of LUPIS at Nadgee, undertaken by the division's Ian Baird, Peter Catling and John Ive, is one of the first temperate-forest based decision support systems to focus on ecological and fauna management.

Fighting fire with fire

The effects of fire on forest ecosystems are complicated. Fire's primary ecological impact is on the vegetation and different kinds of fire affect vegetation differently. Fires vary in their frequency, season of occurrence, and intensity (hotness). These variables together are called the fire regime.

Many plant species have evolved under a history of intermittent fire and depend on particular fire regimes to survive. The fire regime to which species are best adapted can stimulate new growth, but the 'wrong' fire regime can degrade forest structure and alter species-composition.

Scientists can predict the effects of different fire regimes on the composition and structure of vegetation and forest fauna. But this is a complex task because of the many variables involved and the interactions between them.

The decision-support system developed for Nadgee takes some of the guesswork out of fire management, enabling managers to 'design' fires for achieving specific ecological outcomes. In this instance, the outcomes sought are forest habitats favouring selected species.

The Nadgee application provides a basis for managing six ground fauna species: the red-necked wallaby, eastern grey kangaroo, swamp wallaby, long-nosed potoroo, ground parrot, and the eastern bristle-bird. Red-necked wallabies and eastern grey kangaroos inhabit forest with grasses and an open understorey, while swamp wallabies and long-nosed potoroos live in forest with a dense understorey. The ground parrot's habitat is regenerating heathland and the eastern bristle-bird lives in mature coastal heath and taller swamps. Each habitat can be enhanced by different fire regimes.

Fire-response curves for each species were estimated. These predict changes in the number and distribution of fauna in relation to changes in vegetation structure induced by fire. The resulting fauna predictions (expressed as 26 decision rules) were superimposed on six fire-induced vegetation structures.

tats for potoroos and parrots

The decision rules are statements based on the conditions necessary to promote habitats for single species, or related species. They yield 'burn' or 'no burn' recommendations for each one square-kilometre grid. For example, decision rule eight is: 'As far as possible, to encourage the swamp wallaby, do not burn at low intensity grid squares with open forest when it is less than 10 years since the last high intensity burn.'

The other ecological rules are similar to this. They provide 'burn' or 'no burn' options — based on similar combinations of desired habitat type, starting vegetation type, and time since last high intensity burn — specific to each species.

In addition to the rules seeking ecological outcomes, other rules were framed to incorporate more traditional fire-management objectives. These are: prevention of fire entering or leaving the reserve; minimising the risk of unplanned; fires and reducing the fire hazard in areas with high visitor numbers.

The Nadgee application employs the LUPIS rating and weighting method to trade off the rules, since some of them contradict. Conflict between several objectives occurs because the selected fauna have different habitat requirements. Also, wildlife-management objectives can conflict with fire-prevention objectives. By trading off the decision rules by careful adjustment of weights, a best-compromise fire-regime plan recognising the needs of each species, can be produced.

Managers have the responsibility of choosing the fire regimes to be implemented, however LUPIS can show the fire regime required to favour a specific fauna species should that be desired. Ultimately the system could be used to provide a mosaic of habitat types within a reserve, ensuring that the habitat requirements of all fauna species are met.

Scope exists for expanding the application of the LUPIS decision-support system to a wider range of fire management problems, including the recognition of more species and other sites. In fact, the Nadgee system is in theory applicable to regional-scale forest systems throughout south-east Australia.

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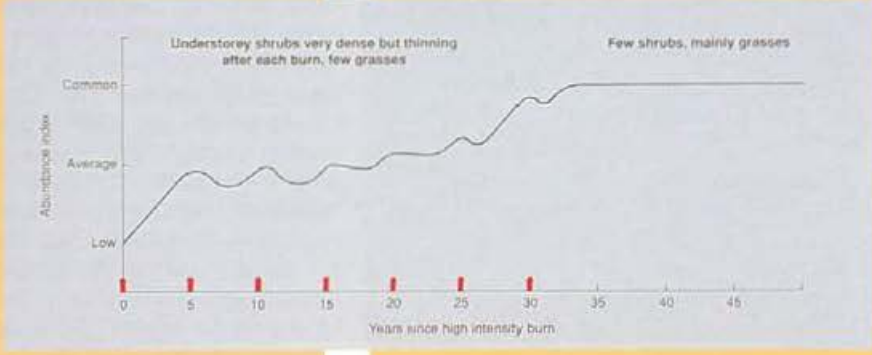
Rating and weighting is also used if the decision rules are unsuited to being expressed as a series of yes/no questions. Where there is ambiguity or conflict among the rules, they can be better expressed as preference guidelines.

A 'weighting' factor assigned by the user rates the importance a guideline has in the selection of the preferred management options or land use. To get started, LUPIS assigns each of the guidelines the same weighting. Users can then alter the weightings to assign a different importance to each guideline. Management options are listed in descending order of preference.

Rating and weighting can also determine the order in which to implement management actions. Prevailing environmental decisions can influence which management option is appropriate. For example, control burning may be appropriate on cool, calm days, but dangerous if conditions are hot and windy. Choices of this nature can be expressed in the same kinds of decision rules, also rated and weighted.

LUPIS can produce maps showing which sites have been recommended for which management options. Provided all important guidelines have been recognised, these maps, called plans, represent the best management strategies for the region under investigation.

Changing the relative importance of the guidelines, by weighting some more than others to reflect current objectives, or by updating the data set (such as wind speed or temperature), will cause the plan to change. Such changes, made systematically, provide a useful simulation and management tool.



Making management decisions

Above: Equal weight fire-management plan for April 1995 considering all six wildlife species.

Above right: Differentially weighted fire-management plan for April 1995 seeking to favour the red-necked wallaby and the eastern grey kangaroo.

Right: Postulated response of the red-necked wallaby and the eastern kangaroo after frequent (every five years) low intensity prescribed burns following a high intensity fire.