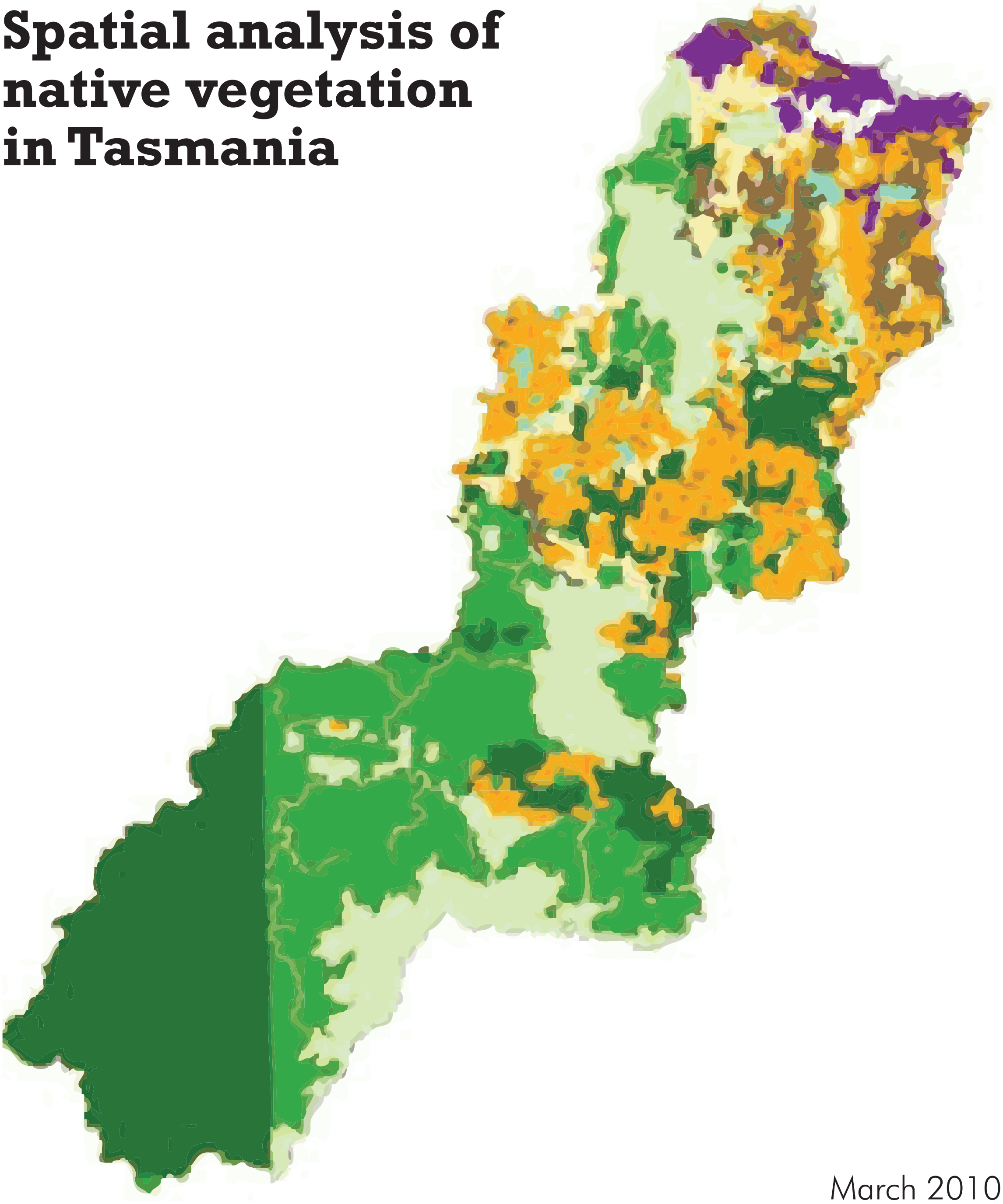
LANDSCAPE LOGIC
LINKING LAND AND WATER MANAGEMENT TO RESOURCE CONDITION TARGETS

Technical Report No. 17

Spatial analysis of native vegetation in Tasmania



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LANDSCAPE LOGIC is a research hub under the Commonwealth Environmental Research Facilities scheme, managed by the Department of Environment, Water Heritage and the Arts. It is a partnership between:

- **six regional organisations** – the North Central, North East & Goulburn–Broken Catchment Management Authorities in Victoria and the North, South and Cradle Coast Natural Resource Management organisations in Tasmania;
- **five research institutions** – University of Tasmania, Australian National University, RMIT University, Charles Sturt University and CSIRO; and
- **state land management agencies in Tasmania and Victoria** – the Tasmanian Department of Primary Industries & Water, Forestry Tasmania and the Victorian Department of Sustainability & Environment.

The purpose of Landscape Logic is to work in partnership with regional natural resource managers to develop decision-making approaches that improve the effectiveness of environmental management.

Landscape Logic aims to:

1. Develop better ways to organise existing knowledge and assumptions about links between land and water management and environmental outcomes.
2. Improve our understanding of the links between land management and environmental outcomes through historical studies of private and public investment into water quality and native vegetation condition.

Spatial analysis of native vegetation in Tasmania

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Summary

We undertook a spatial analysis of the native vegetation of Tasmania at a range of scales – state, bioregion and catchment. A conceptual model of landscape modification was used to describe the degree of modification of native vegetation, and spatial metrics were used to quantify the degree of fragmentation of the native vegetation, and to map vegetation patches using three size classes: < 10 ha, 10–50 ha, >50 ha.

Overall, the Tasmanian landscape at the state-wide scale can be described as medium variegated – i.e. there is 76% cover of native vegetation, by area. Some landscapes are intact, some are variegated, and some are fragmented. The state has 33,760 patches of native vegetation of which fewer than 3% exceed 50 ha in area. We evaluated how buffering small patches could increase patch size and decrease fragmentation at a landscape level using an example from the Leven catchment in north west Tasmania.

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Contents

Introduction

Tasmania supports a diverse range of vegetation including around 150 native vegetation communities (Harris and Kitchener 2005). These communities span the nine bioregions and 48 water catchments identified for the state. In this contribution we undertook a spatial analysis of the native vegetation to describe its current extent and the size and connectivity of patches of native vegetation at a state, bioregion and catchment level. The analyses were designed to provide a state-wide context to examine the condition of native vegetation using new remote-sensing technologies, spatial modelling techniques and field-based assessment protocols (e.g. Parkes et al. 2003, Michaels 2006, Williams 2007).

Methods

Modelling landscape modification

A conceptual model of landscape modification developed by McIntyre and Hobbs (1999) was used to describe the degree of modification of native vegetation in Tasmania. Spatial metrics were used to quantify the degree of fragmentation of the native vegetation, and to map vegetation patches. McIntyre and Hobbs (1999) described landscape modification using a framework of defined states based on the proportion of native vegetation in the landscape. The four states used by the authors were intended to represent a continuum of human modification of a (previously) undisturbed landscape. 'Intact' ecosystems are placed one end of the continuum, relictual landscapes at the opposite end, and 'variegated' and 'fragmented' habitats are located between the two extremes depending on the degree of landscape modification (McIntyre and Hobbs 1999; Figure 1).

Typically, habitats become more highly modified with increasing levels of native vegetation removal and particular states have distinctive patterns of land use and disturbance. As land-use intensity increases, more native vegetation is lost, the amount of intact habitat decreases, and habitat degradation increases as remnants of native vegetation are increasingly influenced by processes originating in modified areas. Habitat in the form of native vegetation still forms the majority of the land cover in intact and variegated landscapes whereas in fragmented and relictual landscapes the setting is increasingly of ''replaced habitat'' (McIntyre and Hobbs 1999).

The model of McIntyre and Hobbs (1999) proposed that the habitat states can reflect hypothesized thresholds related to the dispersal and population interactions of species. For example, the distinction in the model between variegated and fragmented landscapes is supported by theoretical landscape models that suggest that populations of organisms are not hindered when more than 60% of the initial area of habitat is retained in a landscape. The model of McIntyre and Hobbs (1999) uses this threshold as the transition point between variegated and fragmented landscapes. Below this threshold – in landscapes with between 10% and 60% retention of habitat – the perceived degree of habitat fragmentation is highly dependent on the mobility of the organism and the spatial arrangement of the remaining patches of habitat (see McIntyre and Hobbs 1999).

To examine the varying degrees of variegation and fragmentation and relationships to theorised threshold states, we subdivided the variegated and fragmented landscape states outlined in the

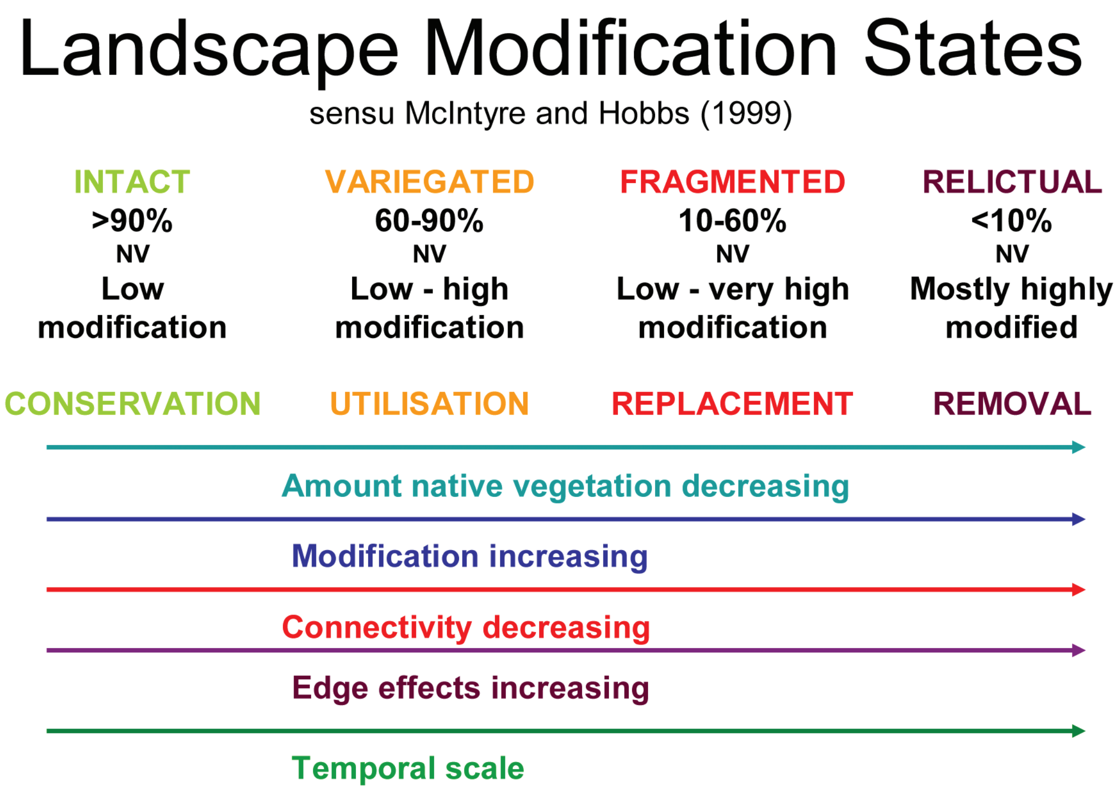


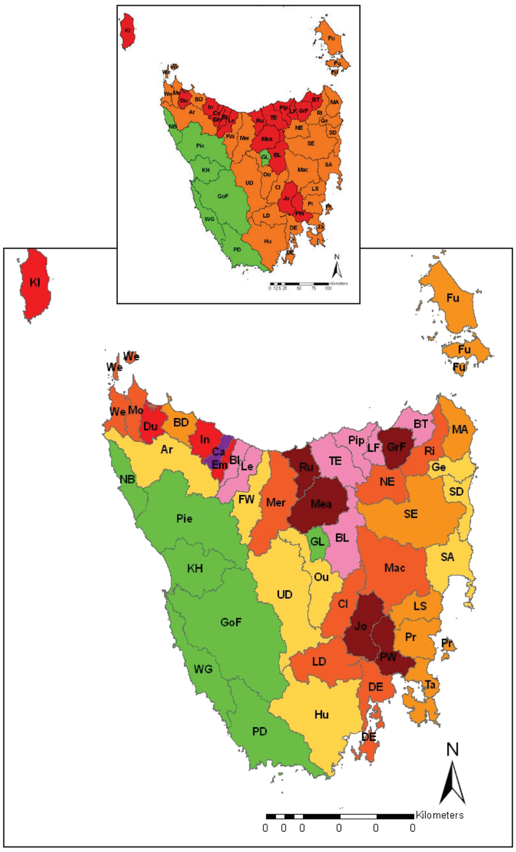
Figure 1. The McIntyre and Hobbs (1999) model of landscape modification states based on the proportion of native vegetation (NV) in the landscape.

model of McIntyre and Hobbs (1999) into sub-states (Figure 2). The variegated state was represented as three sub-states: low (80–90% cover of native vegetation, by area), medium (70–79%) and high (60–69% cover of native vegetation, by area). The fragmented state was represented as four sub-states: low (50–59% cover of native vegetation, by area), medium (40–49%) high (30–39%) and very high (10–29% cover of native vegetation, by area). Provisional TASVEG_05, the latest version of the TASVEG state-wide mapping program was used to determine the extent and distribution of native vegetation (Harris and Kitchener 2005).

Analysis of native vegetation patches

We quantified the fragmentation of native vegetation using spatial metrics (patch size, patch density). FRAGSTATS is a computer software program designed to compute a wide variety of landscape metrics for categorical map patterns (McGarigal and Holmes 2002). The FRAGSTATS program (McGarigal and Holmes 2002) was used to perform a 25 m grid analysis of native vegetation (based on Provisional TASVEG_05). Patches greater than 50 m apart are considered to be separate patches. Patches may contain multiple ecological vegetation communities.

We assigned patches into three patch size categories based on area. Small patches (<10 ha), medium patches (10 ha – <50 ha) and large patches (>50 ha). Patches greater than 50 hectares were considered to be core areas for the purposes of native vegetation condition assessments (Parkes et al. 2003, Michaels 2006).We evaluated how buffering of small patches (<10ha) could contribute to the dual goals of expanding existing native vegetation and decreasing landscape fragmentation, using the Leven catchment on the north coast of Tasmania as an example. We applied buffers of 25m, 50m and 100m to small patches and evaluated the number of patches and the patch size distribution in each of the three patch area categories relative to the initial FRAGSTATS analysis.



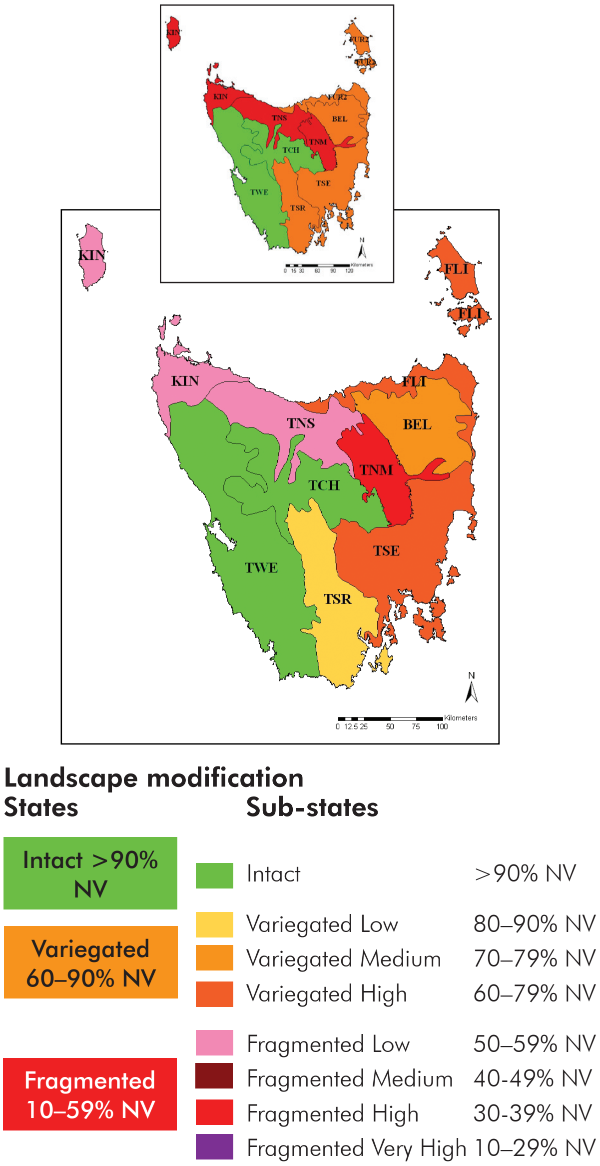


Figure 2. Landscape modification states (sensu McIntyre and Hobbs 1999) and sub-states for Tasmanian bioregions and catchments defined by the proportion of native vegetation (NV).

Results and discussion

Overall, the Tasmanian landscape at the state scale can be described as medium variegated (i.e. 76% cover of native vegetation, by area). Some Tasmanian landscapes are intact, some are variegated, and some are fragmented (Figure 2). Almost half (4) of Tasmania's bioregions are in a variegated state (65–87% cover of native vegetation, by area), two are intact (99% and 94% cover of native vegetation, by area), and one third (3) are fragmented (36–59% cover of native vegetation, by area). A similar pattern is evident at the catchment scale. Half (24) of the catchments are variegated (68–88% cover of native vegetation, by area), a third (17) are fragmented (29–59% cover of native vegetation, by area) and a sixth (7) of the catchments are in an intact state (with 94–100% cover of native vegetation, by area). No bioregions or catchments have been subject to large-scale land clearing that results in relictual vegetation.

The use of sub-states at bioregional and catchment scale showed that there is considerable variation in landscape modification and the level of remaining native vegetation across the state. This is seen most clearly at the catchment scale (Figure 2). Almost half the bioregions and one third of all catchments are close to the theorised 60% threshold (Figure 3) above which organisms perceive the landscape as 'operationally unfragmented' according to McIntyre and Hobbs (1999). Both of Tasmania's largest offshore islands, King Island and Flinders Island, are close to this threshold. King Island has experienced the greater loss and modification of native vegetation. Loss of native vegetation and landscape modification in Tasmania is greatest in catchments with high levels of agriculture, intensive land use and plantation forestry and in areas with low levels of conservation as a land use (Figure 4).

Tasmania has 33,760 patches of native vegetation of which fewer than 3% exceed 50ha in area. The number of patches increases with increasing landscape modification state. The landscape modification sub-state level showed that the number of patches decreases markedly around the threshold between high variegated and low fragmented states, and is evidence of attrition of native vegetation (Figure 5).

At the catchment scale, there was a decrease in the proportion of area in large patches and a

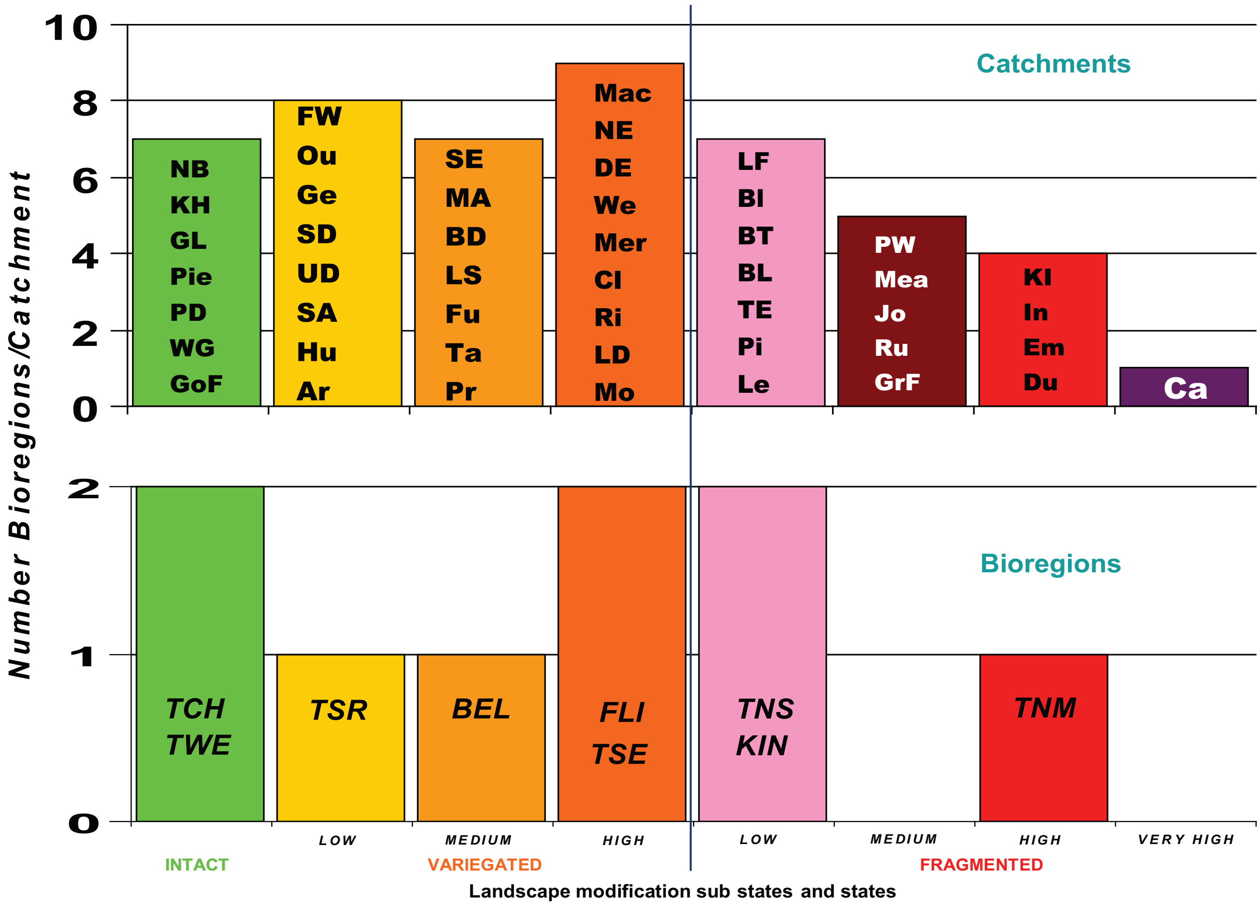


Figure 3. Catchments and bioregions by landscape states and sub-states. The 60% threshold is shown as a dark line between the variegated and fragmented states.

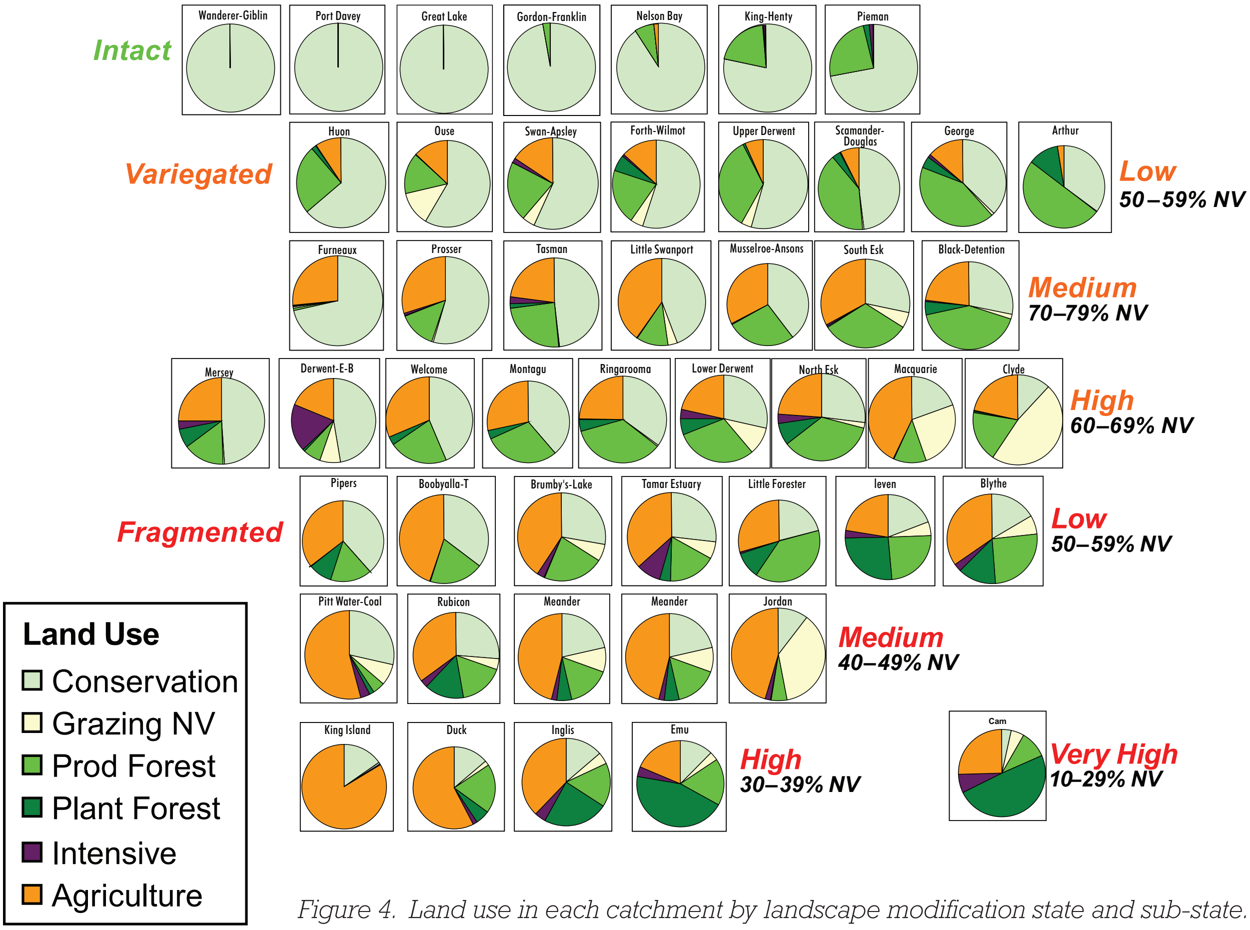


Figure 4. Land use in each catchment by landscape modification state and sub-state.

corresponding increase in the proportion of area in small/medium patches with increasing landscape modification (Figure 6). The remaining area of native vegetation not found as large patches was equally split between medium and small patches for assessed using the land modification sub-states. Small and medium patches are predominantly on freehold land with grazing a major land use (Figure 7). Large patches are predominantly on crown land with conservation and production forestry the major land uses.

The value of using buffers around remnant patches of native vegetation to help re-connect modified landscapes was evaluated using the Leven catchment in north western Tasmania as a case study. Fifty nine per cent of the catchment, by area,

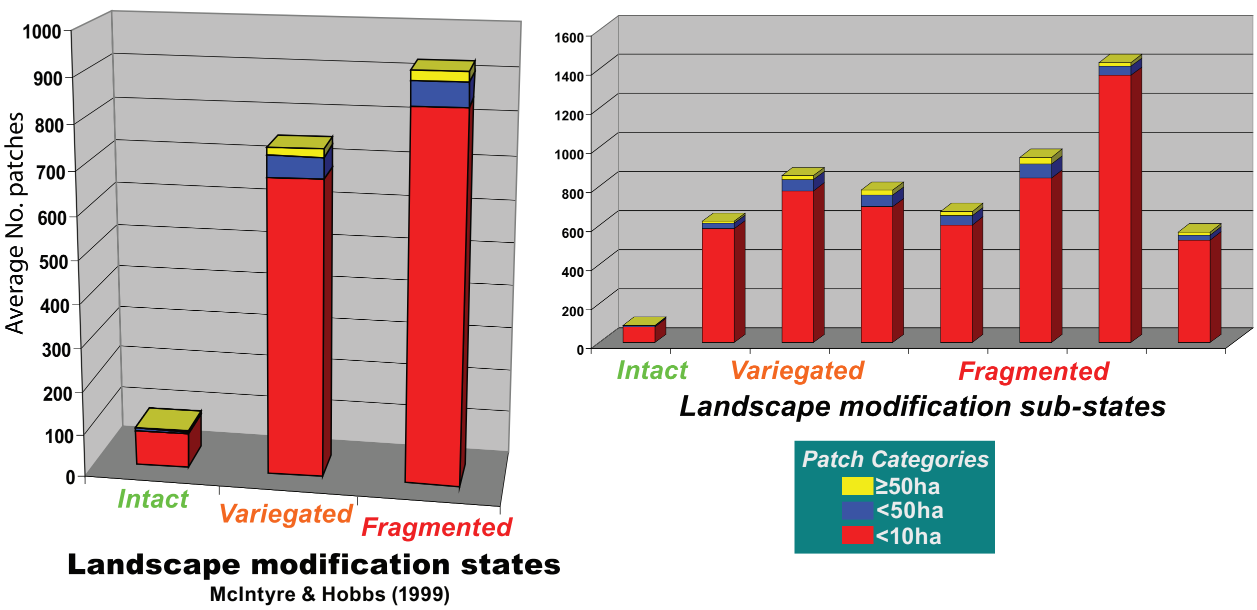


Figure 5. The average number of patches in each patch size category by landscape modification state and landscape modification sub-states.

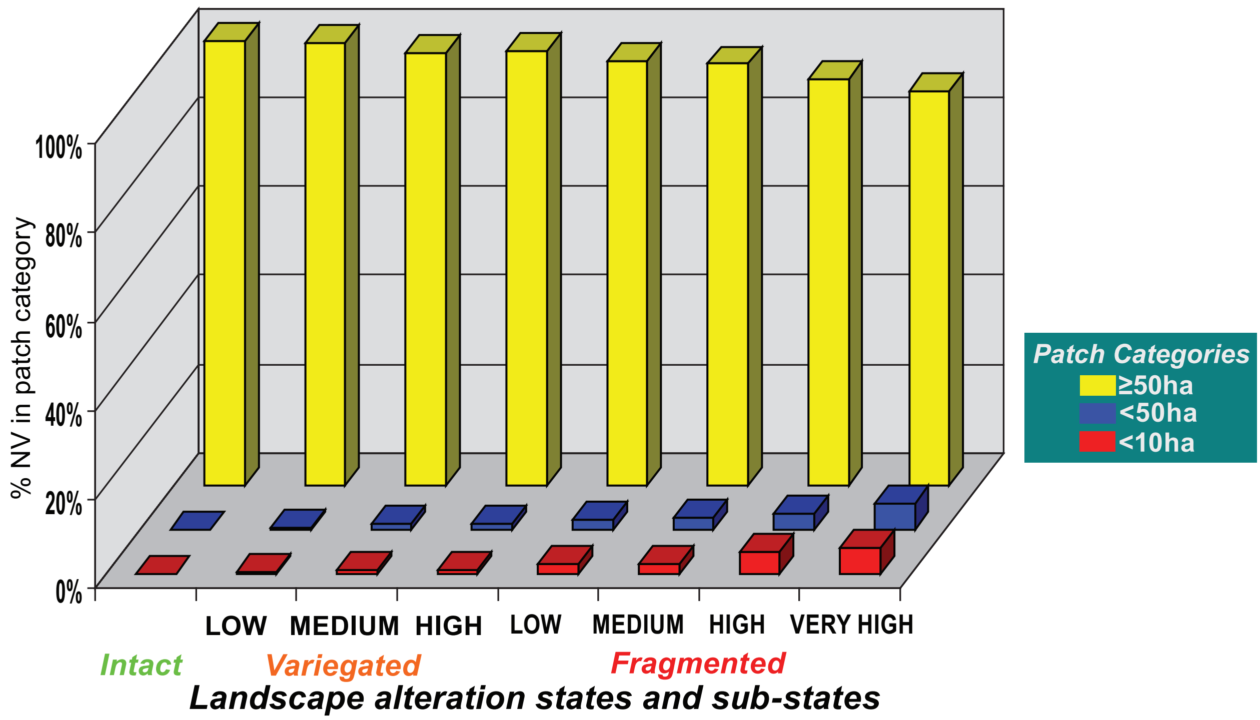


Figure 6. Average percentage of native vegetation in each patch area category and landscape modification sub-state.

retains native vegetation cover (a low fragmented landscape). The native vegetation consists of 751 patches (704 <10 ha in size, 35 10–50 ha in size and 12 >50 ha). The large patches (≥50 ha) are predominantly on land with conservation and production forestry as the major land uses, and small patches are predominantly on land with grazing as the major land use (Figure 8). Hypothetical buffers of 25 m, 50 m and 100 m in width were created around each patch of native vegetation < 10 ha in size to evaluate the effect on landscape connectivity (Figure 9).

As buffer width increased, there was a substantial decrease in both the total number of small patches and total number of patches. There was an increase in the number of medium sized patches (10–50 ha) and large patches (≥50 ha). These results demonstrate that the process of buffering small patches using targeted revegetation activities could help to consolidate native vegetation and increase landscape connectivity (see Bennett 1999, Hilty et al. 2006).

Evaluation of the state of landscape modification

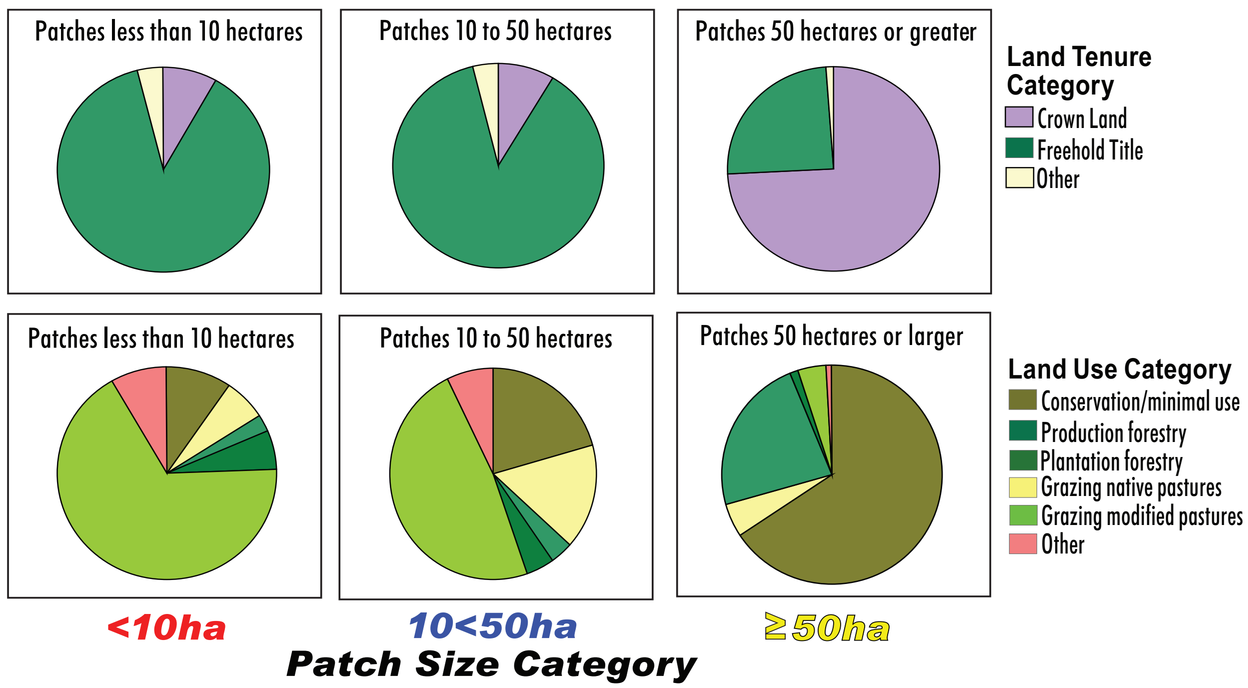


Figure 7. Proportion of native vegetation area in different land tenure and land use categories for each patch area size category

is scale dependent (Fischer and Lindenmayer 2007). For example, at the bioregional scale the Tasmanian Central Highlands is 'Intact'. However, modification in the form of vegetation loss has occurred predominantly in two catchments within this region, the Upper Derwent and the Ouse catchments. Both are characterised to be in a Low Variegated state. The King bioregion is fragmented, but catchments within this bioregion cover a range of landscape states and most modification has occurred in the high fragmented Duck catchment that (alone) represents a relatively small area of the bioregion. Bioregions align with defined climate classes reflecting major patterns in plant growth temperature, moisture indices and seasonality (Norton *et al.* 2007). These, in turn, reflect broad differences in cropping and other land use characteristics. However there are different scales of land use intensity within bioregions and this is seen more clearly at the catchment scale. Evaluating ecological processes and patterns across these scales is important for developing a reliable understanding of the dynamics of these systems.

The nature of landscape modification in Tasmania is not random. The vegetation of catchments such as Port Davey, Wanderer-Giblin, Gordon-Franklin and Nelson Bay is largely intact whereas the vegetation of the Rubicon, Mersey, Macquarie and Coal catchments at lower elevation has been cleared or highly modified to support intensive land use (Norton *et al.* 2007). The modification of native vegetation is generally most intense in landscapes suited for agriculture and other production systems (MacNally 1999; Williams *et al.* 2001; Kerr and Deguise 2004).

The connectivity of modified landscapes could be enhanced by the use of 'stepping stones' such as existing remnants of native vegetation (Davidson et al. 2007). Enlargement of these remnants through restoration, buffering and connection to similar or different habitat types would provide a diversity of habitat within a landscape, and could help to promote the dispersal and natural recolonisation of species (Weins and Bachelet 2010).

It was noted that small remnant patches of native vegetation (< 10 ha) on agricultural lands may provide important ecosystem services, provide refuges from which vestiges of native populations of plants and animals may be able to recover, function as stepping stones between larger blocks of vegetation and serve as a source for the colonisation of adjacent areas. They are valuable ecosystems and habitats for biodiversity. Our results suggest that buffering small patches, particularly in agricultural landscapes, could be useful for revegetation activities aimed at connecting and expanding native vegetation and enhancing its condition. The Millennium Ecosystem Assessment (2005) reported on the importance of landscape connectivity for ecological resilience and supporting the maintenance of ecosystem services and biodiversity.

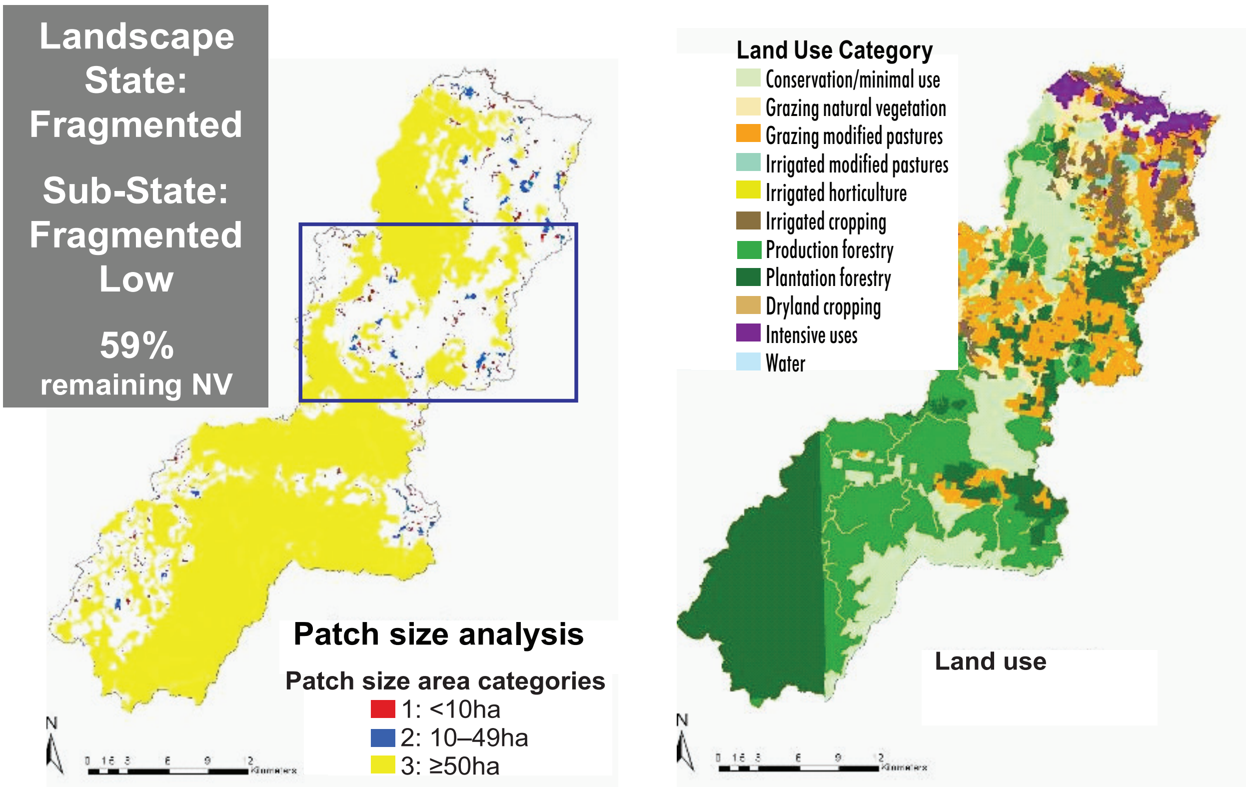


Figure 8. The Leven catchment showing the results of the FRAGSTATS patch size analysis (left) and land use categories (right). The box indicates the area used to illustrate changes in patch size categories following the application of various size buffers.

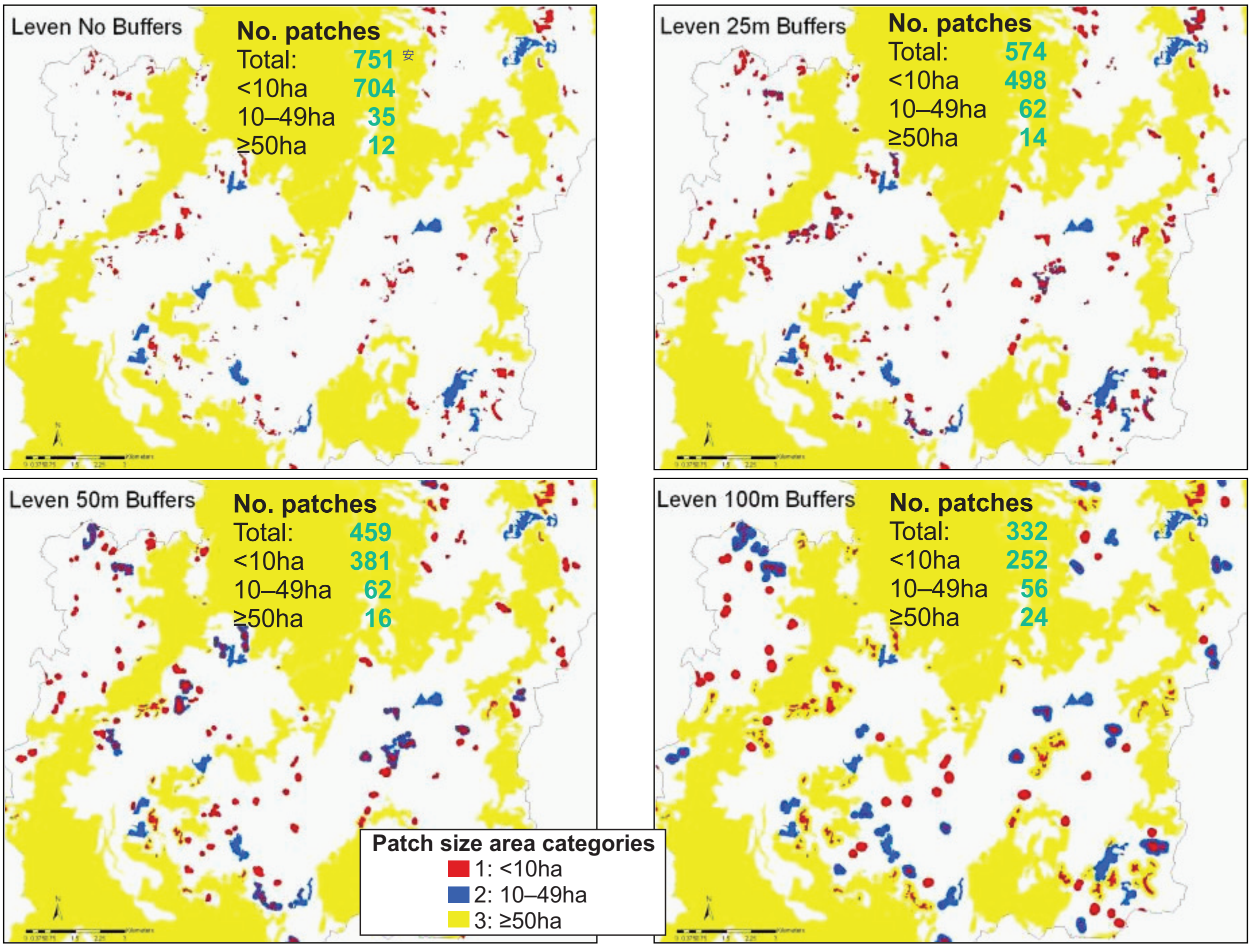


Figure 9. The number of patches in each patch size category with no buffers and with buffers of 25m, 50m and 100m.

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