Rats, mice, possums, hares and chamois could not be included because insufficient was known of their distribution and abundance.

Current perceptions are that mammal predators of native vertebrates (cat, stoat and ferret) at very low abundance have a large incremental effect on native birds and lizards. The incremental effect is thought to diminish with increasing predator abundance. This suggests that the functional relationship between alien predator abundance and the loss of native vertebrates should be characterised by a steeply rising curve of diminishing slope. Conversely, the effect of stock on both invertebrates and vertebrates is thought to only become significant at high stock densities. This suggests that the functional relationship between stock abundance and native animal loss should be characterised by a slowly rising curve of increasing slope.

The relationships were scaled on the basis of conservation manager's perceptions of the impact of each pest at particular densities (Fig. 30). For example, the level at which cat abundance was expected to halve native vertebrate populations was set at a rate of 0.3 cats per 100 trap-nights. An empirical basis for characterisation of the relationship between animal pest abundance would add much to the robustness of the consumption pressure index.

The losses associated with each pest were then combined in three exponential functions (one for each of the three community components), designed to recognise dietary overlap and the diminishing impact of successive pest additions to the system. The consumption pressure index was the average loss for each of the three community components.

$$\text{Plantpress} = 1 - \exp\left(-\left(\text{Plantloss}_{p1} + \text{Plantloss}_{p2} \ldots\right)\right)$$

$$\text{Invertpress} = 1 - \exp\left(-\left(\text{Invertloss}_{p1} + \text{Invertloss}_{p2} \ldots\right)\right)$$

$$\text{Vertpress} = 1 - \exp\left(-\left(\text{Vertloss}_{p1} + \text{Vertloss}_{p2} \ldots\right)\right)$$

$$\text{Consumption pressure} = \frac{\text{Plantpress} + \text{Invertpress} + \text{Vertpress}}{3}$$

where Plantpress is pressure on native vegetation, Invertpress is pressure on native invertebrates, and Vertpress on native vertebrates (e.g. reptiles, birds etc.). Plantloss_{p1} is loss of plant cover caused by pest p_i, etc. The consumption pressure index was calculated for each 1 km^2 pixel (Fig. 31).

Consumption pressure is currently highest around the intensively farmed Hakataramea Valley and lowest in the mountains and lakes. Without animal pest control, several pests (rabbit, thar and Bennett's wallaby) are expected to extend their ranges and become more abundant, thereby increasing consumption pressure, particularly in the McKenzie Basin. In about 5 years, rabbits are expected to become immune to RHD and will probably return to their former abundance along with cats and ferrets, mitigated only by reduced hedgehog numbers. This scenario will increase the average consumption pressure for the whole Twizel area from 0.500 to 0.603. The greatest increases will be in the basins and larger valleys. With currently planned management (and assuming RHD immunity develops), average consumption pressure will be 0.552, halfway between the current and no-management situation. If all land managed for conservation purposes were stock-fenced and the more extensive

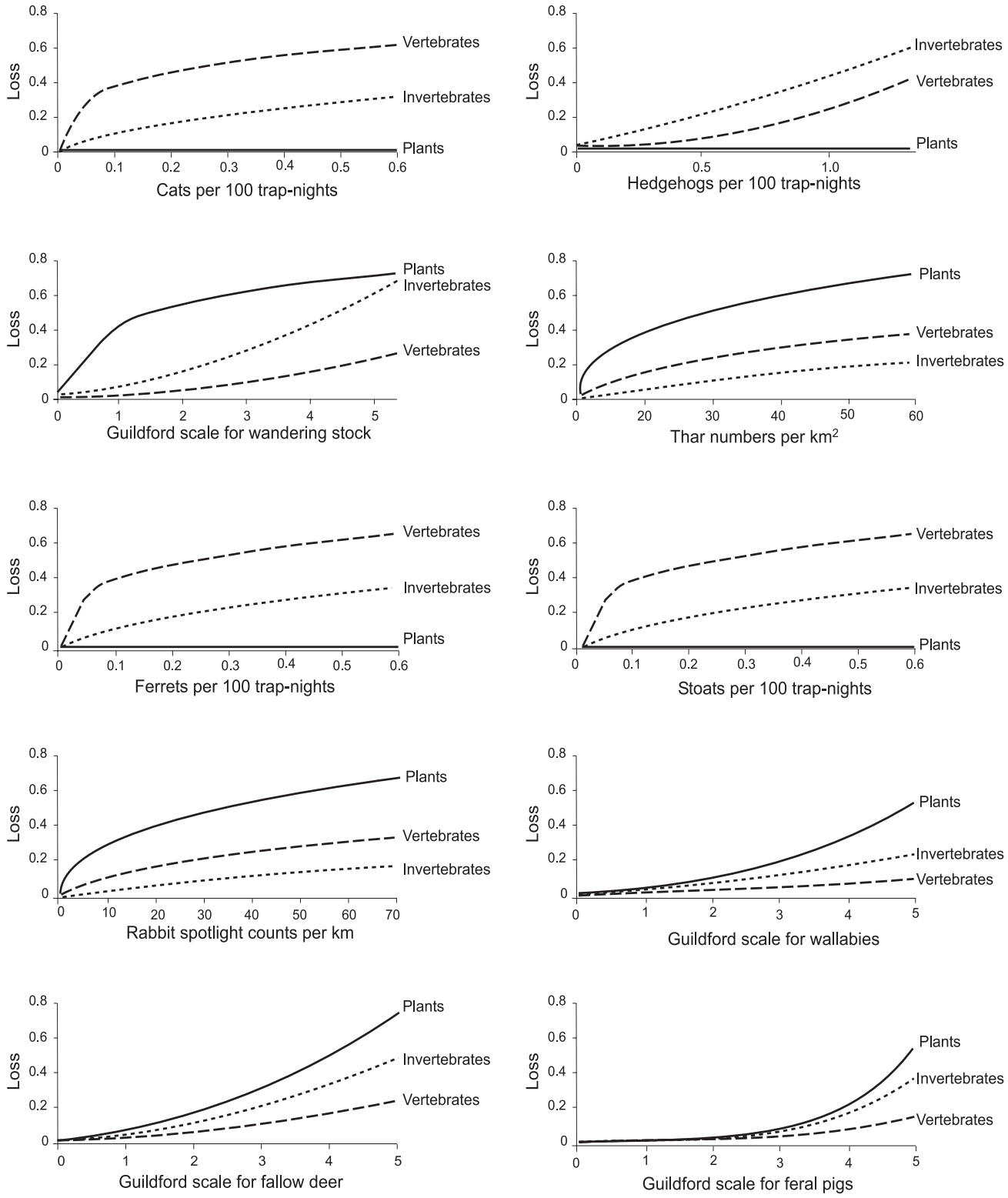

Figure 30. Pest impact—abundance relationships. These curves are an explicit expression of manager's (usually undeclared) perceptions of animal pest impact on native biota loss.

predator control programme were implemented, then average consumption pressure would fall to 0.529, still somewhat higher than the present situation.

For each scenario, consumption pressure is lowest on land managed for conservation and highest on private land (Table 1).

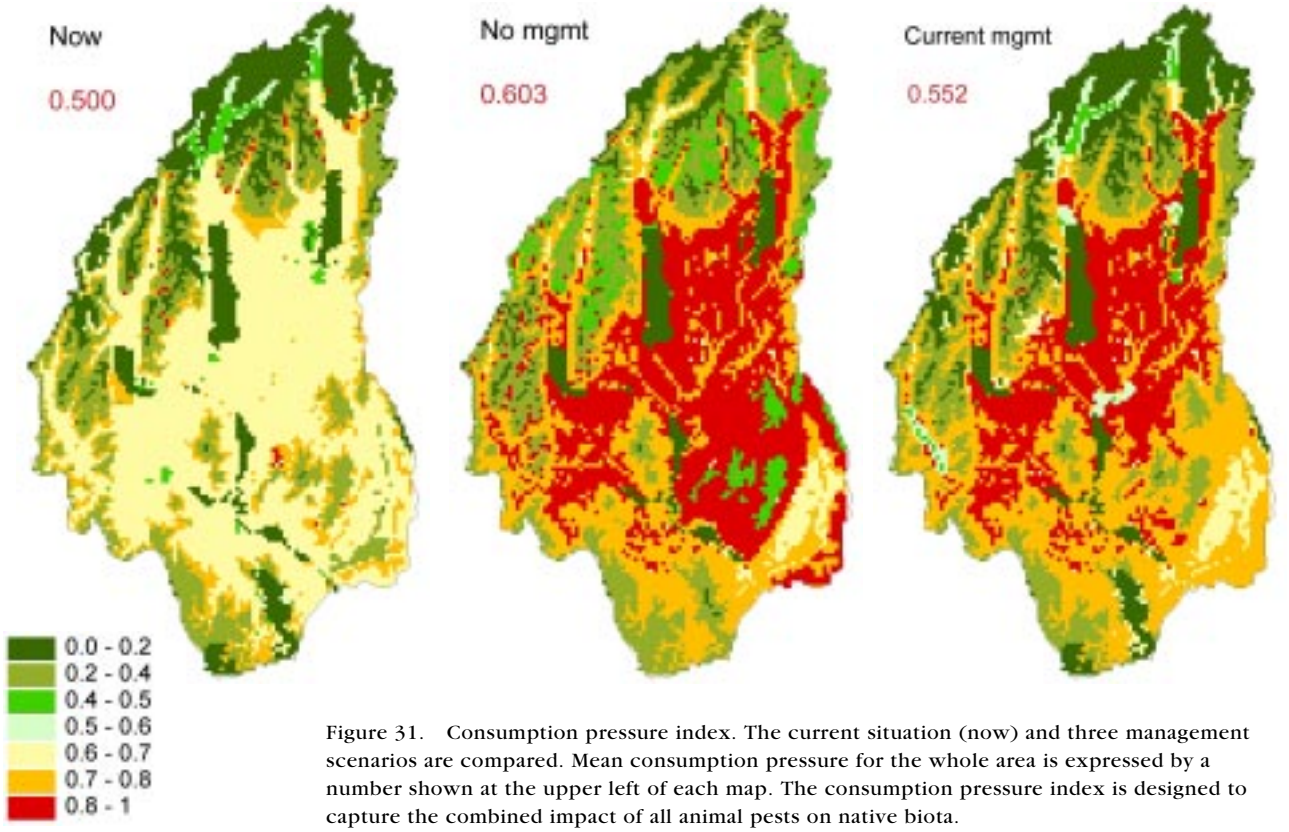

Figure 31. Consumption pressure index. The current situation (now) and three management scenarios are compared. Mean consumption pressure for the whole area is expressed by a number shown at the upper left of each map. The consumption pressure index is designed to capture the combined impact of all animal pests on native biota.

TABLE 1. VARIATION IN AVERAGE CONSUMPTION PRESSURE ACROSS LAND TENURE WITH FIVE MANAGEMENT SCENARIOS.

MANAGEMENT SCENARIOS	CONSERVATION LAND	OTHER CROWN LAND	PRIVATE LAND	WHOLE AREA
Current situation	0.261	0.472	0.613	0.500
No future management	0.411	0.529	0.716	0.603
Current projects (maintain existing fences)	0.260	0.493	0.700	0.552
Current projects and more predator control	0.255	0.485	0.687	0.542
Current projects, more predator control and all conservation land fenced	0.197	0.485	0.687	0.529

8.4 WEED COVER

The infestation pressure index measures displacement of native plants by introduced plants from their resources. In terrestrial environments, space to grow is indicative of access to a range of resources such as light, nutrients, water and substrate, so the index is based on the space occupied by introduced plants. Essential input information is the mapped percentage cover of each weed.

Nine significant weed groups were identified and mapped over the Twizel Area: wilding pine, willow, Russell lupin, yellow tree lupin, broom, *Cotoneaster* spp., *Hieracium* spp., gorse and pasture grasses.

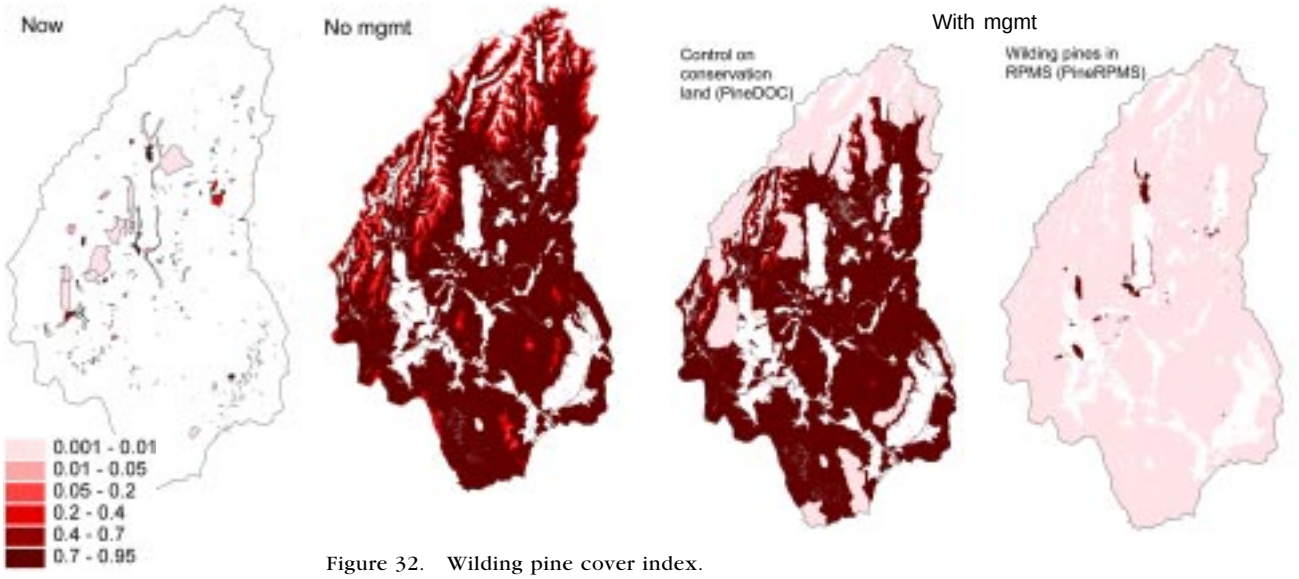

Figure 32. Wilding pine cover index.

Weed cover mapping was based on the LCDB, recent field survey and the knowledge of the field staff responsible for their management. Thus the maps which follow reflect a combination of robust data and current perceptions of managers. Their accuracy is largely unknown.

Wilding pines in the Twizel area include four species: *Pinus contorta*, *P. nigra*, *P. radiata* and *Pseudotsuga menziesii* (Douglas fir). They (mainly *P. contorta*) are rapidly spreading, invading tussock, scrub and wetland communities. Modelling their spread suggests that without control, much of the Twizel area will have a near-closed canopy (70% to 95% cover) of pines in 40 to 50 years (Fig. 32). Only lakes, areas above 2000 m and areas where intensive agriculture prevents establishment (the 'primarily pastoral' LCDB cover class) can be expected to remain free of wilding pine. Rabbits are not expected to significantly slow wilding pine spread outside intensively grazed areas. From 1600 m to 2000 m altitude, pines are expected to reach about 30% cover. Two management scenarios were considered:

- control on conservation land but no control on private land
- control on conservation land but with wilding pines included in the Regional Pest Management Strategy (RPMS), requiring pines outside designated plantations and shelter belts to be controlled by landowners.

The map of current pine cover was based on a recent survey of wilding pines undertaken by the Twizel Area Office, and on the 'Plantation forest' cover class in the LCDB.

Willow cover (mostly *Salix fragilis*) was mapped primarily on the basis of staff knowledge with some additional data from the LCDB (willow is one of the 12 cover classes). Willows currently occupy most of the suitable river bed habitat downstream of the three glacial lakes (Fig. 33). Without management, some further spread at the top of the lakes is expected with an increase in cover where it is already present. The management intention is to remove willows completely where this is possible and to reduce them to less than 1% cover where re-invasion precludes complete removal. Almost all willow control is undertaken by Project River Recovery (PRR).

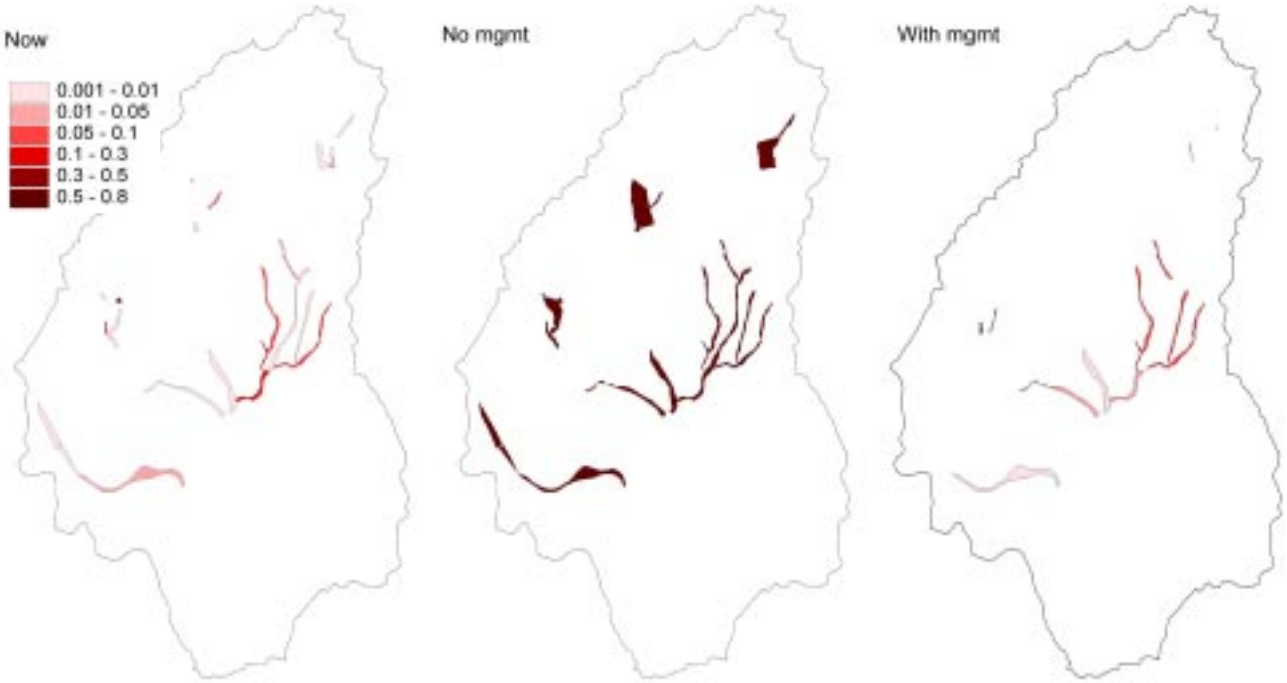

Figure 33. Willow cover index.

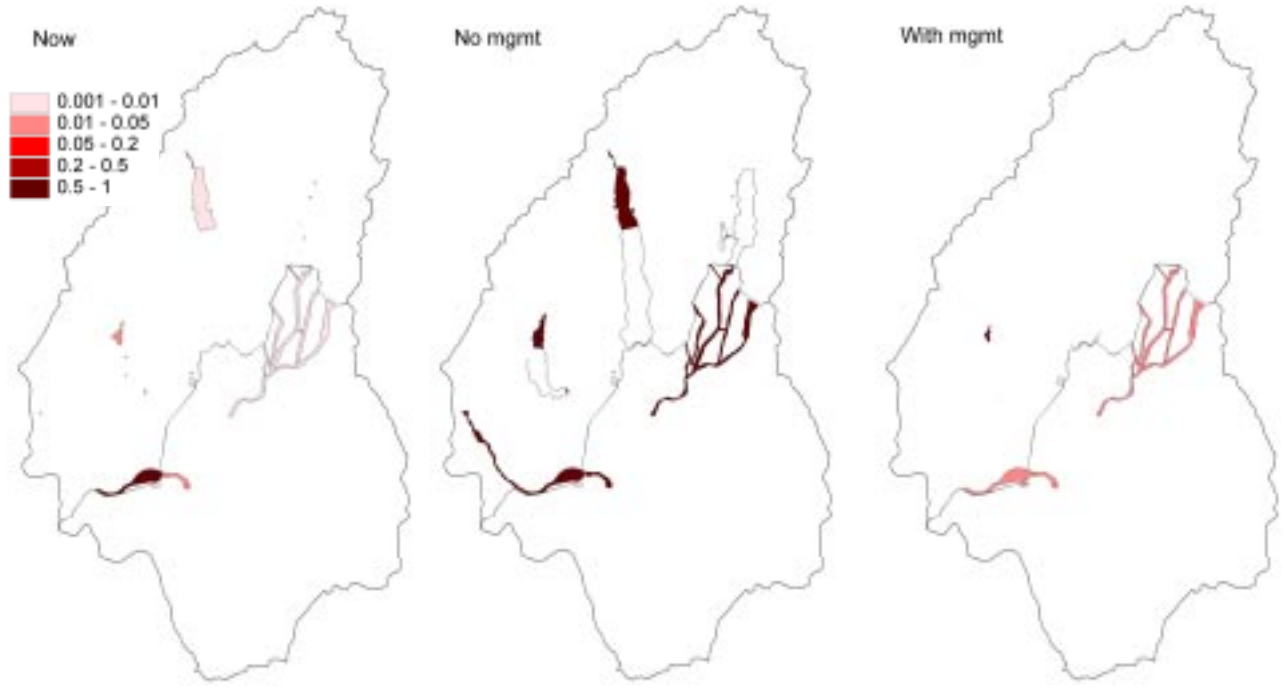

Figure 34. Russell lupin cover index.

Russell lupin is a riverbed weed, with high cover on river beds downstream of the lakes and low cover around the lake shores and on beds of the tributary rivers (Fig. 34). In 50 years without management, Russell lupin is expected to dominate the plant cover in the river beds and to spread around the lake shores and into tributary river beds, especially the Tasman River. Current management (a component of PRR) aims to maintain low cover on the rivers and eliminate it from the Tasman River and from some small sites in the Ahuriri River.

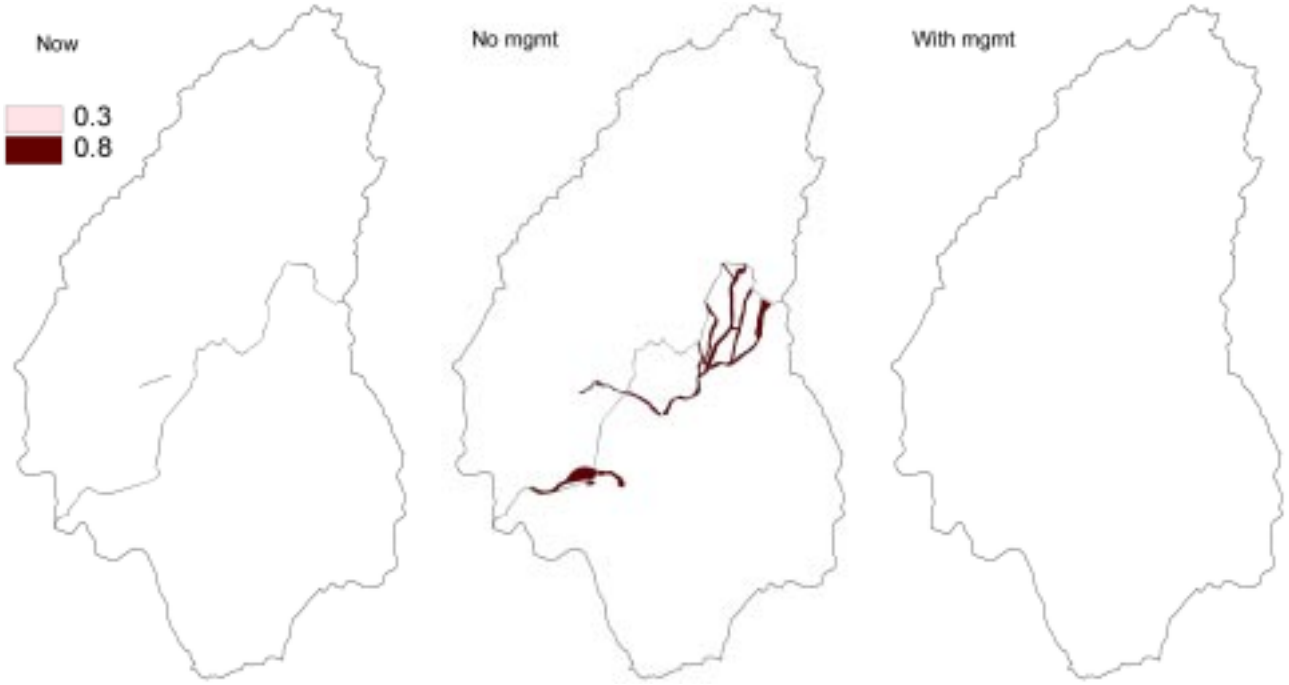

Figure 35. Yellow tree lupin cover index.

Figure 36. Gorse cover index.

Russell lupin was mapped entirely from staff knowledge of its distribution and cover.

Yellow tree lupin is a potential river bed weed currently confined to the main highway verges and the outlet of Lake Tekapo (Fig. 35). It was mapped entirely from staff knowledge. Without management, yellow lupin is expected to spread

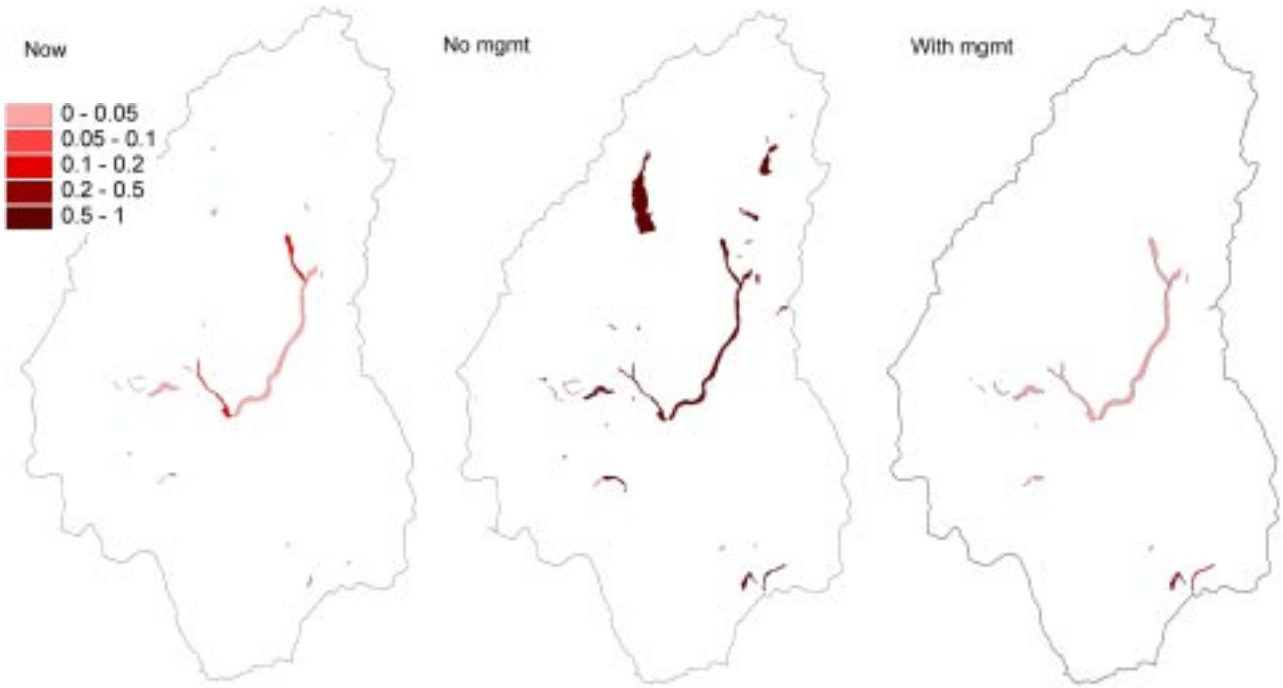

Figure 37. Broom cover index.

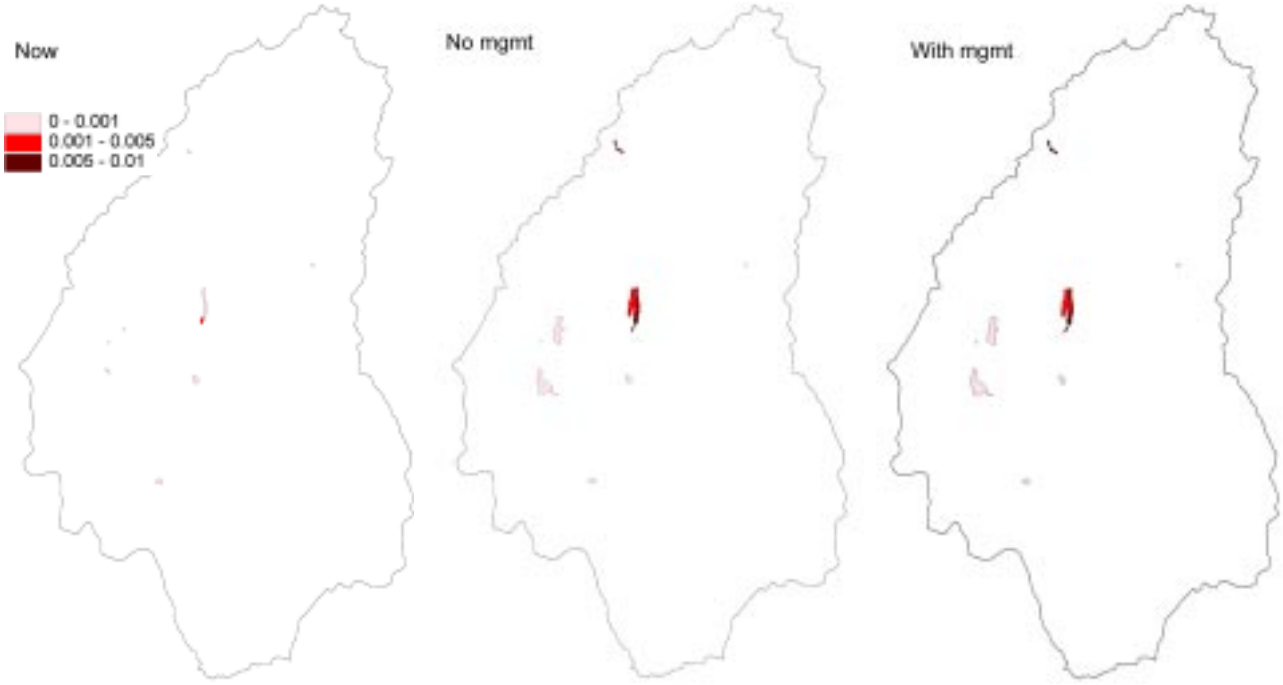

Figure 38. *Cotoneaster* spp. cover index.

into the river beds. Current management aims to eradicate yellow lupin from the Twizel area before this happens. Yellow lupin control is included among the projects comprising PRR.

Gorse is confined to some scattered sites in a variety of habitats. Some spread is expected in absence of control, particularly in the lower Hakataramea Valley

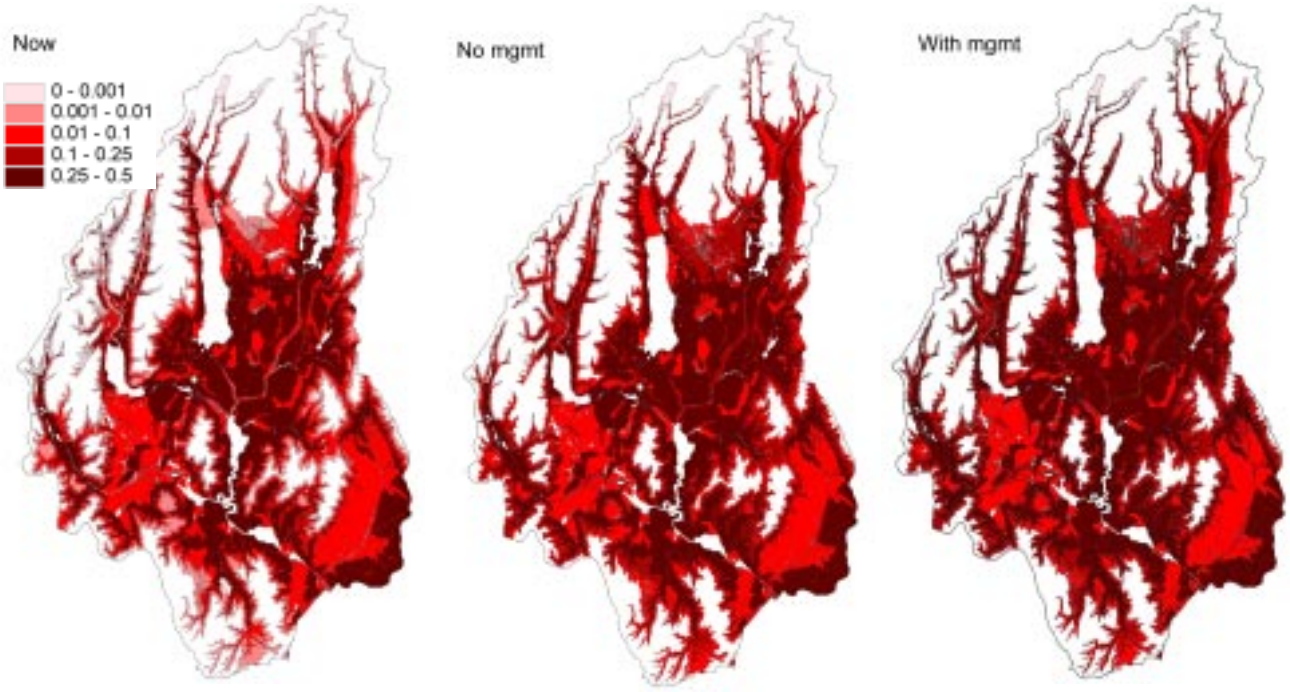

Figure 39. *Hieracium* spp. cover index.

(Fig. 36). Current management aims to control or remove gorse from all conservation land. The largest infestation expected to remain will be on private land in the lower Hakataramea Valley. Gorse was mapped entirely from staff knowledge of its distribution and cover.

Broom occurs mainly in the river beds but also in scattered sites in other habitats (Fig. 37). It was mapped from staff knowledge. Without management, its cover is expected to increase with some spread, notably in the Tasman River and the lower Hakataramea Valley. The aim of current management is to control broom on the river beds, remove it from isolated sites and so prevent its northward spread. Broom control is a component of PRR.

Cotoneaster spp.occur mostly as scattered plants in a number of hill and gully sites (Fig. 38). It is expected to slowly spread and its cover is expected to increase. It is not controlled.

Hieracium spp. are probably present in all suitable habitats (Fig. 39) and are not controlled. One species (*H. lepidium*) is both spreading and increasing its cover in beech forest areas. Cover is expected to increase in some of the river beds (e.g. Tasman River). Mapping was based on staff estimates of percentage cover associated with each LCDB land cover class and an altitude limit at 1400 m.

Pasture grasses have invaded all habitable environments (Fig. 40) but their cover is expected to increase, particularly in grazed tussock. There is no control of grasses. Maps were based on staff perceptions of the percentage cover associated with each LCDB cover class and an upper altitude limit of 1600 m. Pasture grass cover is probably functionally related to stock grazing but was treated independently in this trial.