Part 3. Applications to conservation measurement

Conservation measurement and the underlying information enables a plethora of conservation achievement measures to be reported. The challenge is to select the variables reported on, and to structure the reporting in a way that is most likely to achieve high-level conservation goals. Target goals are to:

- provide a defensible and auditable basis for conservation decision-making
- facilitate manager accountability for conservation output
- raise society's willingness to invest in conservation.

The first two goals are pre-requisites for the third. All three goals depend on a robust system for reporting on the state of natural heritage and the difference made by conservation management. The third goal depends on society believing that conservation resources are being efficiently allocated. Central to this, is being able to demonstrate that the most cost-effective conservation projects are being implemented in places that are clearly priorities for conservation action. Thus a decision support system is needed to help managers identify priority places and the most cost-effective conservation projects. The combined and integrated system for reporting, decision support and information acquisition and management is the Natural Heritage Management System depicted in Fig. 46.

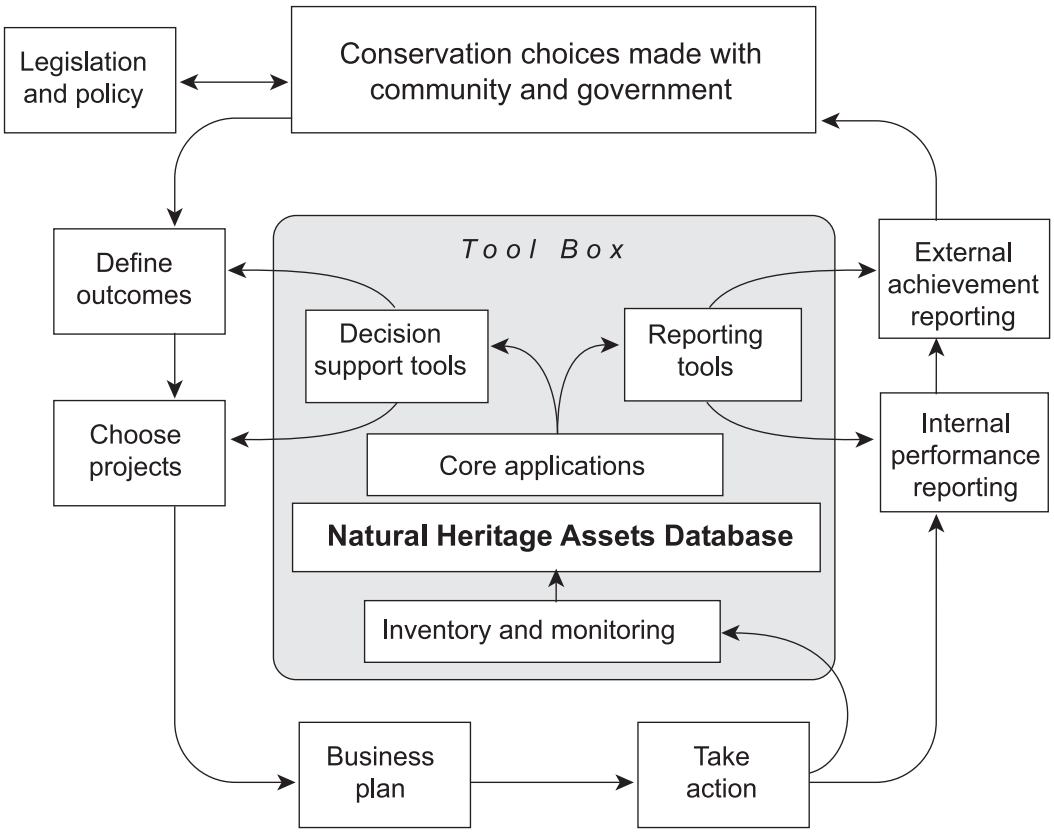


Figure 46. A system for the management of natural heritage. In the grand scheme, there is a cycle which starts with choosing what the community wants from conservation (as directed by legislation, the Government, policies and strategies) and then defining the outcomes which these choices will lead to. Then comes choosing projects to achieve the outcomes: business planning and performance reporting. This leads to reporting to the wider community on what has been achieved which, in turn, influences the community in choosing what conservation is wanted. The process is a continuous cycle where the conservation work done and the outcomes achieved modify the expectations of the community. The natural heritage management system is represented as a process for taking inventory, and monitoring the condition, of natural heritage; recording the data; applying a set of tools to assist managers in defining outcomes; choosing projects; and reporting on the effect of that work on the overall state of natural heritage.

14. A framework for achievement reporting

Conservation managers work at several levels in a large conservation organisation such as DOC. Programme managers (Level I) are focused on individual projects. Area Managers (Level II) are concerned with conservation over the whole administrative area. Conservators (Level III) are required to manage the balance of effort between areas, environments and across threats, and to have a robust logical basis for the conservation work undertaken. Regional General Managers (Level IV) are concerned with the adequacy of protection nationally, trends in the condition of natural heritage and the status of threatened native species. The Director General (Level V) needs to be able to show what differences DOC is making, whether the decline has been reversed and to demonstrate the value added by DOC's management to the flow of benefits supplied by natural heritage.

14.1 NATIONAL PRIORITY OUTCOMES

The DOC purchase agreement with the Minister of Conservation has three national priority outcomes for natural heritage and aims to report on the measures listed for each.

National Priority Outcome 1

Maintain and restore the natural character of the full range of environments represented in places managed by the Department.

- change over time in pressure on natural heritage
- change over time in condition of natural heritage

National Priority Outcome 2

There are no species extinctions; representative populations of all native species are secure in natural habitats.

- number of extinct species
- number of threatened species for which decline continues or has been halted

National Priority Outcome 3

A more comprehensive range of environments is legally protected.

- change in the percentage of each environment under legal protection

At each of the five organisational levels in DOC, these performance measures can be re-framed as questions:

Level V

What difference is DOC making?

Is DOC halting the decline?

Level IV

Does each environment have an adequate level of protection?

What is the pressure on natural heritage in each of NZ's environments and how is it changing over time?

(How is the condition of natural heritage changing over time in each of NZ's environments?)

(How is the status of native threatened species changing over time?)

Level III

(What difference have legal protection services made to the level of protection in each environment?)

What difference is current conservation management making to pressure (and condition) on land managed by DOC within each environment?

Level II

What difference to pressure (and condition) is being made by:

1. animal pest control
2. fencing
3. weed control
4. (fire control)

by environment and on each conservation management unit?

Level I

How much difference does each conservation project make to pressure on natural heritage?

Thus the combination of priority outcomes and performance measures for each role level in DOC provides the basis for a robust reporting framework that should facilitate accountability for conservation achievement and offer much improved transparency to conservation performance. To achieve this, conservation achievement reporting should be:

- an informative narrative that describes the state of natural heritage and the difference made by current and proposed conservation action
- underpinned by quantitative information and explicit models that enable consistent application of transparent assumptions.

The following sections demonstrate how conservation measurement information assembled in Part Two can be applied in this framework for National Priority Outcomes 1 and 3.

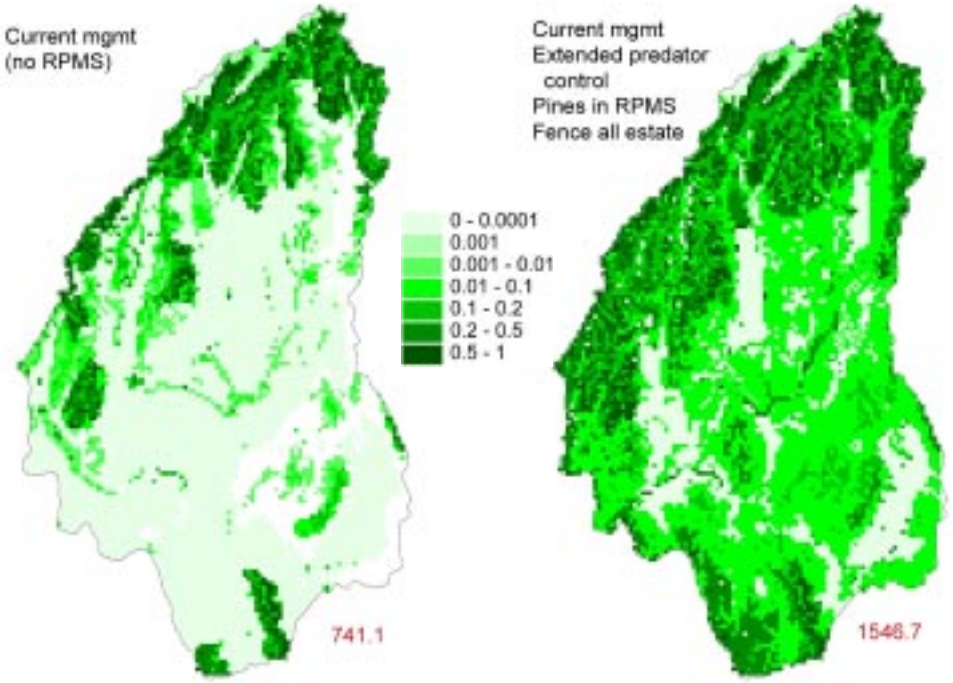


Figure 47. Pressure difference under two management scenarios defined in Table 12. The nett difference is given at the lower right of each map.

TABLE 12. PRESSURE DIFFERENCE ACHIEVED ON LANDS OF DIFFERENT TENURE FOR TWO SCENARIOS. It is assumed that rabbits become immune to RHD and so increase to former high levels of abundance. Values are the sums of pressure differences with and without management.

MANAGEMENT SCENARIOS (RABBITS RHD IMMUNE)	CONSERVATION LAND	OTHER CROWN LAND	PRIVATE LAND	WHOLE AREA
Current projects (pines not in RPMS)	698.0	34.6	8.5	741.1
Current projects with pines in RPMS; all conservation land fenced; extended predator control	792.1	460.8	293.8	1546.7

Questions not addressed (in brackets above) relate to condition, threatened species and fire associated performance measures. The Level III question '*What difference have legal protection services made to the level of protection in each environment?*' is not addressed because confidential and sensitive negotiations with leaseholders preclude discussion of possible acquisitions of Crown pastoral lease land for conservation purposes. Note also that Level V and IV measures demand a national perspective but the Twizel study area is at a local/regional scale. Thus, for the purpose of demonstrating Level IV and V measures, the Twizel study area must be thought of as the whole country. At Level III, the study area should be thought of as a whole conservancy but at Levels II and I, this is a full-scale demonstration.

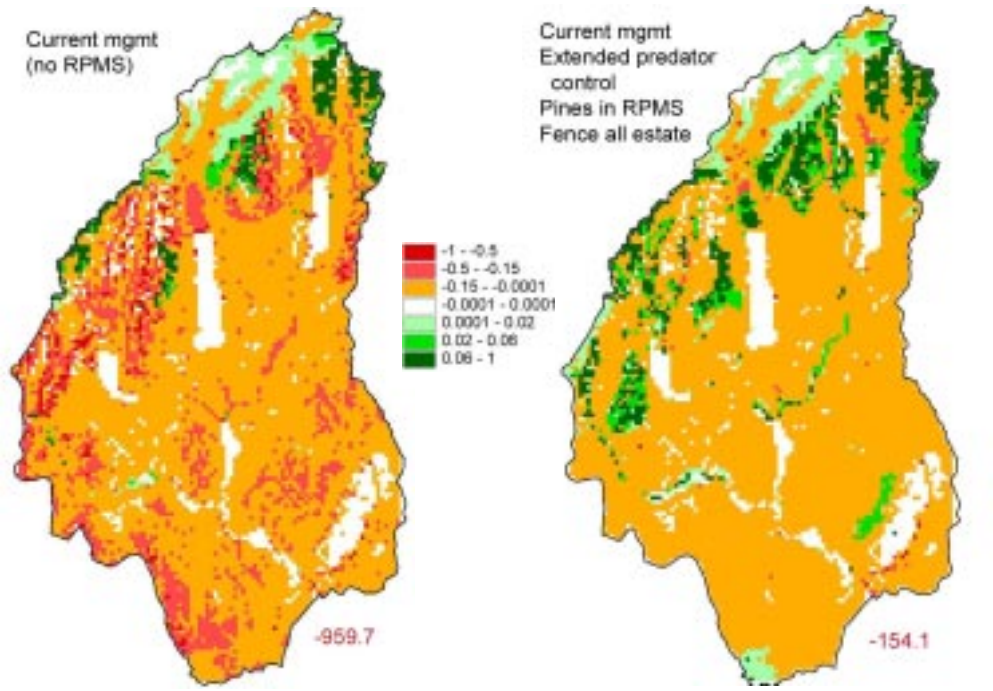


Figure 48. Pressure reductions and increases under two management scenarios. The nett gain or loss (negative values) are given at the lower right of each map.

$$\Sigma(\text{Natural character}_{\text{With Projects}} - \text{Natural character}_{\text{Now}})$$

TABLE 13. CONSERVATION GAINS AND LOSSES ON LANDS OF DIFFERENT TENURE FOR TWO SCENARIOS. It is assumed that rabbits will become immune to RHD and so will increase to former high levels of abundance. Values are the sums of the pixel pressure differences now and with management. Negative values indicate degradation.

MANAGEMENT SCENARIOS (RABBITS RHD IMMUNE)	CONSERVATION LAND	OTHER CROWN LAND	PRIVATE LAND	WHOLE AREA
Current projects (pines not in RPMS)	-11.6	-475.2	-473.0	-959.7
Current projects with pines in RPMS; all conservation land fenced; extended predator control	82.5	-49.0	-187.7	-154.1

14.2 LEVEL V REPORTING

There are two key questions for the Director General (Level V manager) to report on. This first is: "What difference are we making?" The difference made by conservation management can be described by the change in pressure brought about by conservation action. This can be shown spatially (Fig. 47) and can be quantified in an index (Table 12) by summing the differences in pressure with and without conservation management:

$$\Sigma(\text{Pressure}_{\text{Without projects}} - \text{Pressure}_{\text{With projects}})$$

The current conservation management regime will make most difference on Crown lands in the mountains and least difference in the lakes and on pastoral grazing lands. Additional conservation effort (i.e. wilding pines into the RPMS; all conservation lands stock fenced; extended predator control) will make much more difference to private land and to other Crown lands not managed for conservation purposes.

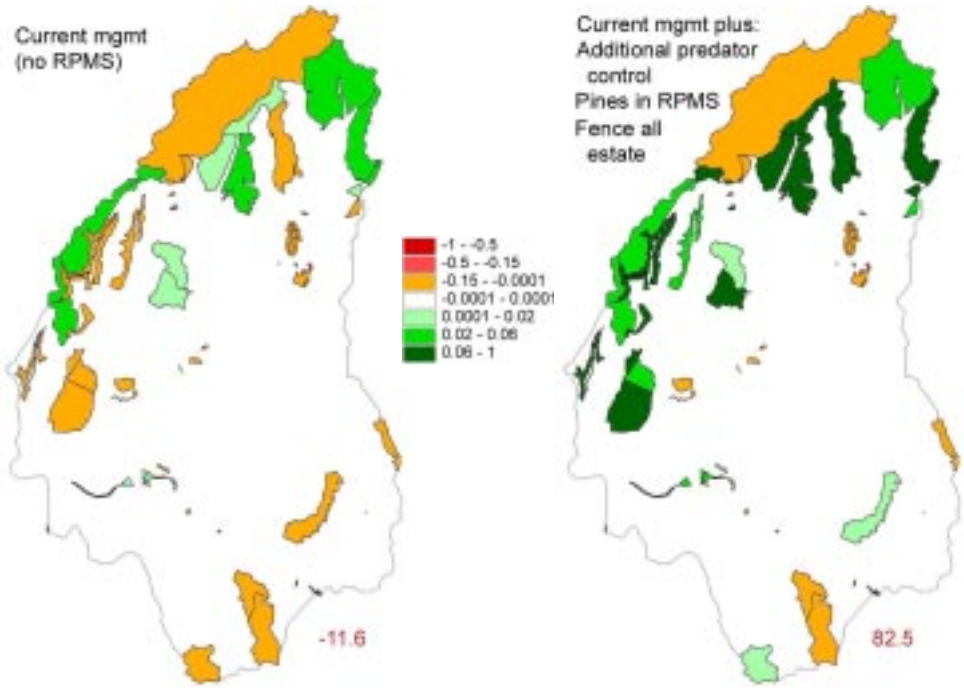


Figure 49. Pressure reductions and increases on Crown land managed for conservation under two management scenarios. The nett gain or loss is given at the lower right of each map.

The second Level V question to report on is derived from the New Zealand Biodiversity Strategy (Anon. 2000) which sets out what DOC would like to achieve by 2020. In summary, this is to:

'*Halt the decline in New Zealand's indigenous biodiversity'.*

One component of 'halting the decline' is halting the increase in pressure. Improvement and deterioration in pressure can be shown spatially by mapping the difference between pressure now and predicted pressure (Fig. 48) resulting from current management programmes and can be quantified in an index (Table 13) by summing the differences in pressure with and without conservation management:

$$\Sigma(\text{Pressure}_{\text{Without projects}} - \text{Pressure}_{\text{Now}})$$

This can be positive or negative, depending on the relative magnitudes of gains and losses across the landscape. Negative values indicate increasing pressure and loss of natural heritage.

An overall net increase in pressure (–959.7) is predicted. The increase will not be evenly distributed. The bulk will occur on private land (–473.0) and on tenure review lands (–475.2) with a small increase on conservation land (–11.6). If, in addition to current management, wilding pines are included in the RPMS, all Crown land managed for conservation is fenced to exclude stock and predator control is extended, then increases in pressure on tenure review and private lands will be greater and the increasing pressure on conservation land will be reversed (Table 13). However, the increasing pressure will not be halted on private land nor on other Crown land not managed for conservation and there will still be a net increase in pressure over the whole Twizel Area.

The most significant gains and losses are predicted to occur on larger land parcels (Fig. 49), primarily because of their size (e.g. Mt Cook National Park suffers a very small increase in average pressure but this is spread over a very big area) and on parcels where the average gain or loss is high. On Crown land

managed for conservation with the current management regime, pressure gains are predicted to be more frequent but generally smaller than the losses (16 parcels lose; 48 parcels gain), leading to a small net increase for conservation land. For Crown lands not managed for conservation, the situation is predicted to be considerably worse. None of the 76 land parcels will have a reduction in pressure under the current management regime. With more management effort (wilding pines in the RPMS; all conservation land stock fenced and extended predator control on the river beds), pressure will be reduced on 33 conservation land units and will increase on 31 units. Pressure will be reduced on only 4 of the 76 parcels of Crown land not managed for conservation purposes.

14.3 LEVEL IV REPORTING

There are two key Level IV reporting questions. The first is "Does each environment have an adequate level of protection?"

If the full range of New Zealand's natural heritage is to be protected, then sufficient areas of each environment must be legally protected and managed for conservation purposes in order to sustain the heritage associated with those environments. 'Sufficient' for the purposes of this demonstration is 10% of the area of each environment legally protected.

At present, twelve of the twenty-four environments have less than 10% of their areas protected and of these, four have less than 1% protected (Fig. 50). The best protected environments are the high elevation and steep mountain environments (71, 74, 15, 42 and 45) and the poorly protected areas are flat or rolling but well drained lowland environments (Fig. 51). Note also that environment 88 appears to be well protected (35.4% of its 304.2 km^2 is protected) but the land units in this environment are mainly small in size (< 2 km^2) or linear in shape. Consequently, these land areas are not well described by 1 km^2 pixels and so cannot be assessed adequately at the 1 km^2 pixel scale used here.

The second Level IV question is: "What is the pressure on natural heritage in each of NZ's environments and how is it changing over time?"

Pressure is currently lowest in the mountain environments but highest in the intensively farmed lowland basin of the McKenzie Basin and river terrace environments of the Hakataramea and Ahuriri Valleys, and in the riverbeds flooded by hydro-electric power development (Figs 52 and 53). Average pressure over the whole study area is currently 0.728, implying that the Twizel Area now has 27.2% (i.e. 100% × (1–0.728)) similarity to the natural biota that would be present in absence of the various human-induced disturbances. This inference requires the highly unlikely assumption that each of the five components of human disturbance pressure successfully measures the condition loss associated with that component, and that there is little interaction between the five components of pressure. With no structured attempt to characterise the relationship between component indices and biota loss, there is no basis for confirming the validity of these assumptions.

With successful implementation of currently funded animal and plant pest control projects (assuming rabbits become immune to RHD and recover to former abundance), average pressure for the whole area is predicted to increase

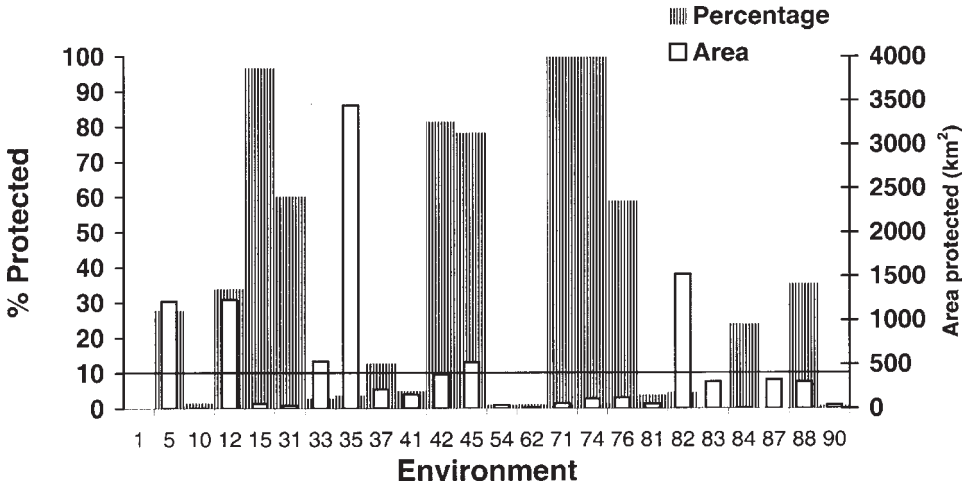


Figure 50. Representativeness of lands managed for conservation purposes. Environment area and the percentage area of each represented in lands managed for conservation purposes are shown.

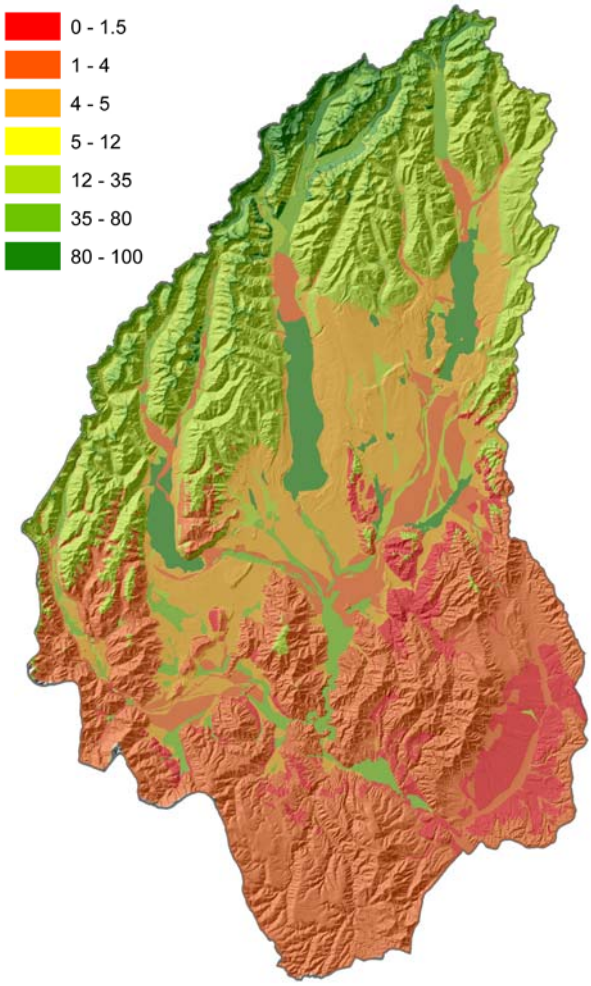


Figure 51. Representativeness of environments in land managed for conservation purposes. Each environment is coloured according to its percentage area in land managed for conservation purposes. Environments in green have more than 10% of their area legally protected in lands managed for conservation purposes.

from the current 0.728 to 0.818. This implies that the suite of management projects currently underway will not be sufficient to halt the increase in pressure (and by implication, decline in condition) over the whole Twizel Area. Even if the Black Stilt riverbed predator control programme were extended, wilding pines were included in the RPMS and, if all land managed for

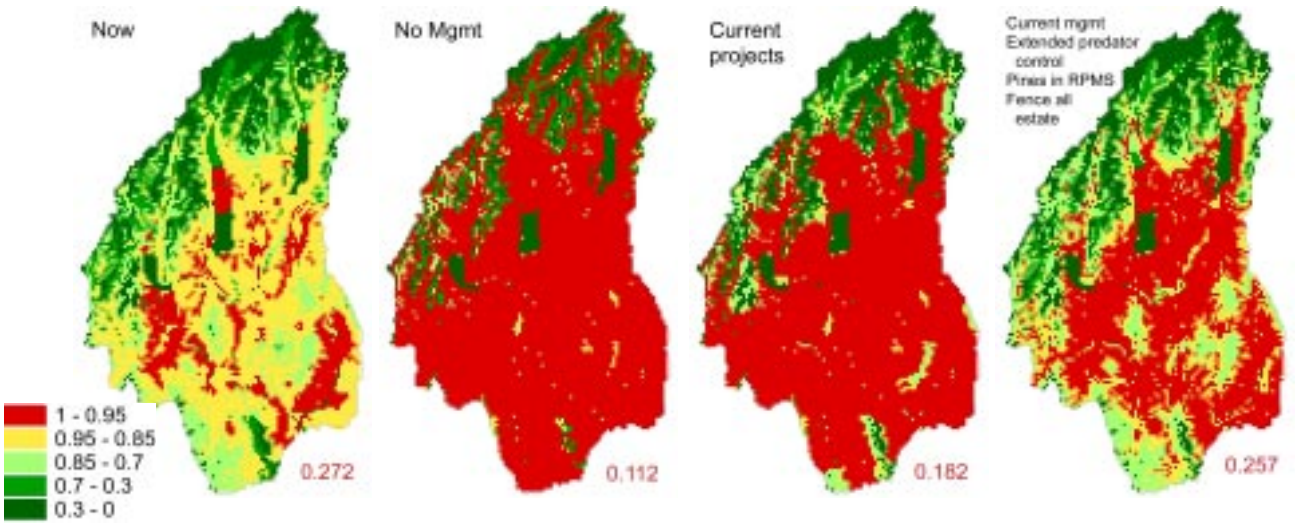
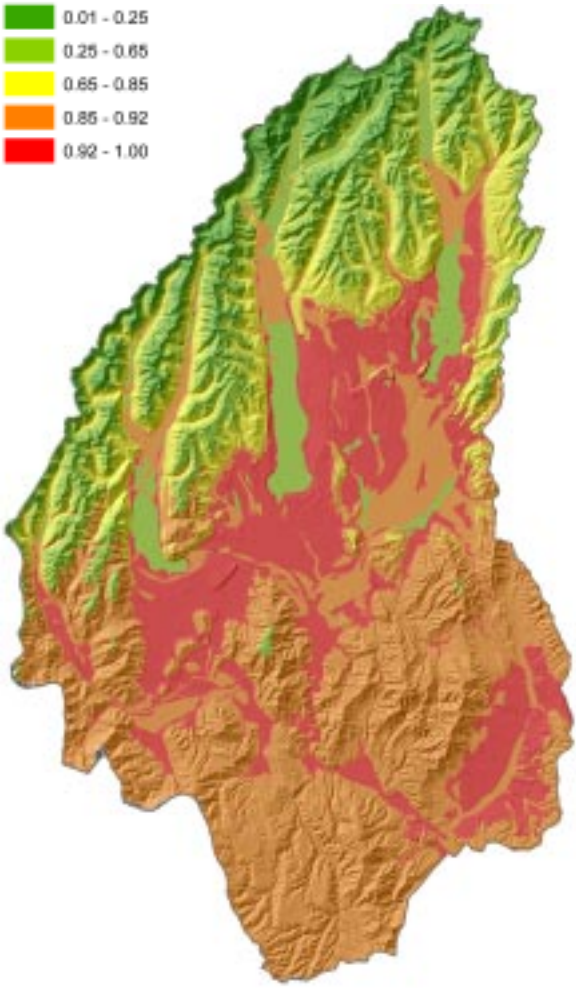


Figure 52. Pressure now and with three management scenarios. The pressure index for the whole area is shown at the lower right of each map.

Figure 53. The mean pressure (now) on each environment.



conservation were fenced, the average pressure for the whole area would still decline slightly to 0.743.

An improvement in pressure is predicted only for environments 74 and 45. The greatest pressure increases are expected in environments 5, 35, 31, 33 and 81 (Table 14).

14.4 LEVEL III REPORTING

There is one key Level III reporting question: "What difference is current conservation management making to pressure on land managed by DOC within each environment?"

On conservation land (Fig. 54), where most conservation effort is directed, average pressure is somewhat lower (0.416) than for the whole Twizel Area (0.728; see Table 15). If current and planned conservation projects are successfully implemented, pressure on conservation land will increase slightly to 0.421. If wilding pines are included in the RPMS, riverbed predator control is extended and all land managed for conservation is stock-fenced, then average pressure on conservation land will decrease to 0.382. Without management, average pressure on conservation land will increase to 0.712. Thus conservation management will prevent a substantial increase in average pressure from 0.416 to 0.712.

There is sufficient land managed by DOC in 14 of the 24 environments to identify a difference made by management. The greatest difference is made in environments 71, 45, 12 and 5 (Table 16).

TABLE 14. CHANGE IN THE MEAN PRESSURE PREDICTED FOR EACH ENVIRONMENT FOR LANDS OF ALL TENURES ACROSS THE TWIZEL STUDY AREA. Negative values indicate degradation associated with increased pressure.

ENVIRONMENT		MEAN PRESSURE		CHANGE
NO.	AREA (km^2)	NOW	WITH MGMT	
5	1216.6	0.669	0.796	–0.127
35	3445.6	0.858	0.964	–0.105
31	34.8	0.818	0.921	–0.103
33	535.3	0.886	0.986	–0.100
81	52.2	0.895	0.989	–0.094
10	1.7	0.906	0.998	–0.092
1	0.1	0.913	0.998	–0.085
87	329.1	0.915	0.998	–0.084
41	160.6	0.895	0.975	–0.080
37	217.4	0.899	0.973	–0.074
15	57.9	0.540	0.609	–0.069
82	1524.8	0.927	0.993	–0.066
12	1237.3	0.260	0.324	–0.064
54	40.0	0.942	0.998	–0.056
42	389.8	0.489	0.513	–0.024
83	306.1	0.975	0.996	–0.021
88	304.2	0.973	0.987	–0.014
76	122.6	0.623	0.634	–0.011
62	9.8	0.994	0.998	–0.005
71	60.6	0.435	0.437	–0.001
90	38.2	0.999	1.000	–0.001
84	2.3	0.992	0.992	0.000
74	110.1	0.012	0.003	0.009
45	523.2	0.076	0.062	0.014
Total	10720.4	0.728	0.818	–0.090

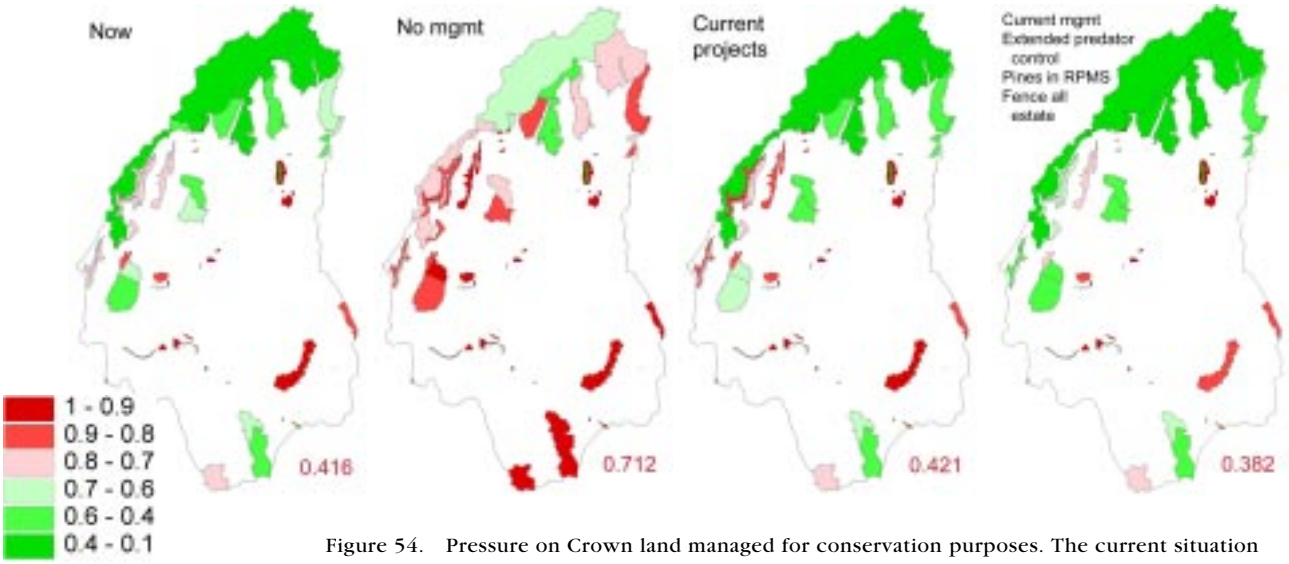


Figure 54. Pressure on Crown land managed for conservation purposes. The current situation (now) and three management scenarios are compared. Mean pressure for conservation land is shown at the lower right of each map.

Crown land not managed for conservation purposes also has a low average pressure index (0.692) relative to the Twizel Area as a whole. Without conservation management, this is projected to rise to 0.892, a rise which will be little affected by current conservation management. Average pressure on Crown land not managed for conservation is predicted to rise to 0.879. Much additional conservation effort will be required to halt the pressure increase on this land. Even if wilding pines are included in the RPMS, predator control extended and conservation lands stock fenced, the average pressure on other Crown lands will rise to 0.768.

14.5 LEVEL II REPORTING

Level II managers work at the scale of environments and land units. The key Level II reporting question is: "What difference is animal pest control making to consumption and infestation pressure in each environment and on each conservation land unit?"

Animal pest control projects are predicted to reduce consumption pressure most in environments 71, 15, 45, 12 and 76 (Fig. 55) but will make no difference in environments 10, 62 and 84. Greatest reductions are predicted in the Lake Tekapo Scientific Reserve, Ohau, St Mary's Range, Godley and Hunters Hills conservation areas. Least reduction is predicted in the Ahuriri, Dobson, Hopkins and Huxley forests (Fig. 56).

Weeds control projects are predicted to make most difference to infestation pressure in environments 71, 15, 45 and 5 but no difference in environments 90, 87, 84, 83, 62, 54, 41, 10 and 1 (Fig. 57). Greatest reductions in infestation pressure are predicted in the Mt Ida, Hunters Hills, St Mary's Range and Ruataniwha conservation areas (Fig. 58).

TABLE 15. AVERAGE PRESSURE NOW AND UNDER THREE MANAGEMENT SCENARIOS FOR CROWN LANDS MANAGED FOR CONSERVATION, OTHER CROWN LAND AND FOR THE WHOLE TWIZEL AREA.

RPMS	CURRENT SITUATION	NO MANAGEMENT	WILDING PINES *NOT* IN RPMS	WILDING PINES IN RPMS
RHD SCENARIO	NO IMMUNITY	RHD IMMUNITY DEVELOPS		
PREDATOR CONTROL ON RIVER BEDS	✓	–	CURRENT PREDATOR CONTROL	EXTENDED PREDATOR CONTROL
STOCK FENCING SCENARIOS	✓	–	MAINTAIN EXISTING FENCES	FENCE ALL CONSERVATION LAND
Conservation lands	0.416	0.712	0.421	0.382
Other Crown land	0.692	0.893	0.879	0.711
Private land	0.875	0.959	0.957	0.907
Whole Twizel Area	0.728	0.888	0.818	0.743

TABLE 16. THE VALUE ADDED BY DOC ON CONSERVATION LAND. Data are not shown for environments where conservation land units are small relative to 1 km^2 pixels.

ENVIRONMENT		MEAN PRESSURE			CHANGE	VALUE ADDED BY DOC
NO.	% PROTECTED	NOW	WITHOUT MGMT	WITH MGMT		
71	100.0	0.435	0.94	0.437	-0.002	0.503
45	78.3	0.074	0.389	0.058	0.016	0.331
12	34.0	0.21	0.515	0.189	0.021	0.326
5	27.8	0.554	0.881	0.568	-0.014	0.313
15	96.7	0.54	0.882	0.609	-0.069	0.273
35	3.8	0.667	0.944	0.695	-0.028	0.249
81	3.8	0.433	0.999	0.821	-0.388	0.178
76	58.9	0.595	0.743	0.61	-0.015	0.133
33	2.9	0.863	0.999	0.901	-0.038	0.098
31	60.2	0.708	0.848	0.752	-0.044	0.096
37	12.8	0.755	0.912	0.817	-0.062	0.095
82	4.5	0.906	0.999	0.966	-0.06	0.033
42	81.5	0.545	0.61	0.587	-0.042	0.023
74	100.0	0.012	0.026	0.003	0.009	0.023
10	1.5					
88	35.4					
84	23.8					
41	5.0					
62	1.2					
54	1.0					
90	0.8					
83	0.2					
87	0.0					
1	0.0					

Figure 55. Difference made by animal pest control to the mean consumption pressure in each environment.

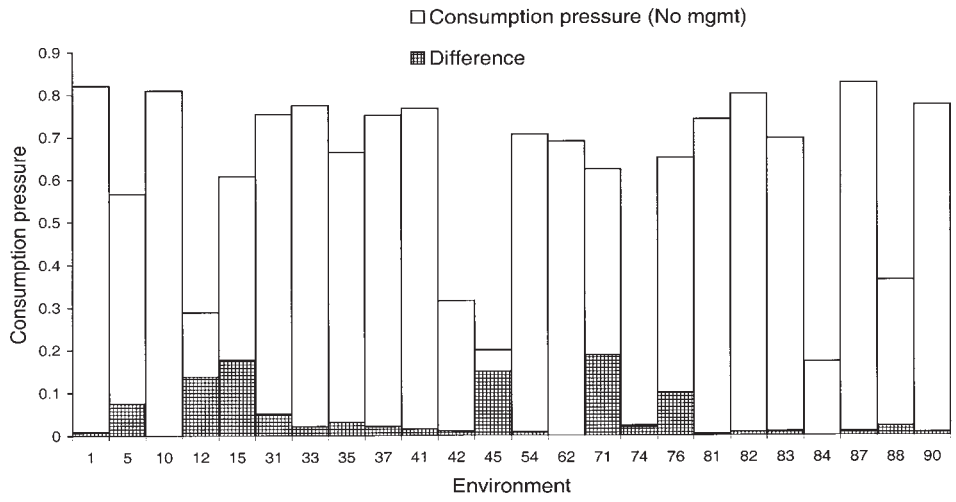


Figure 56. Difference made by animal pest control to the mean consumption pressure on land units managed for conservation purposes.

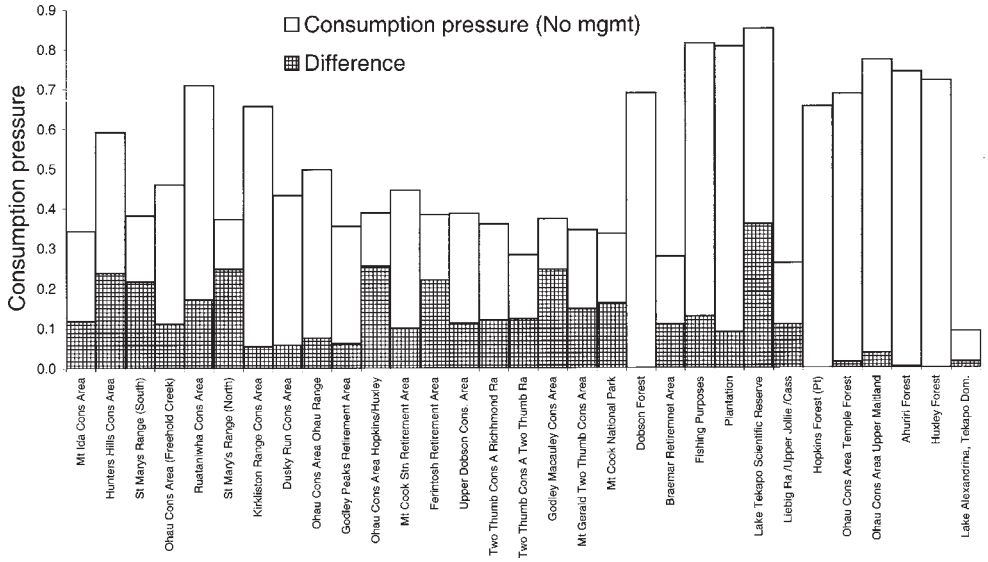
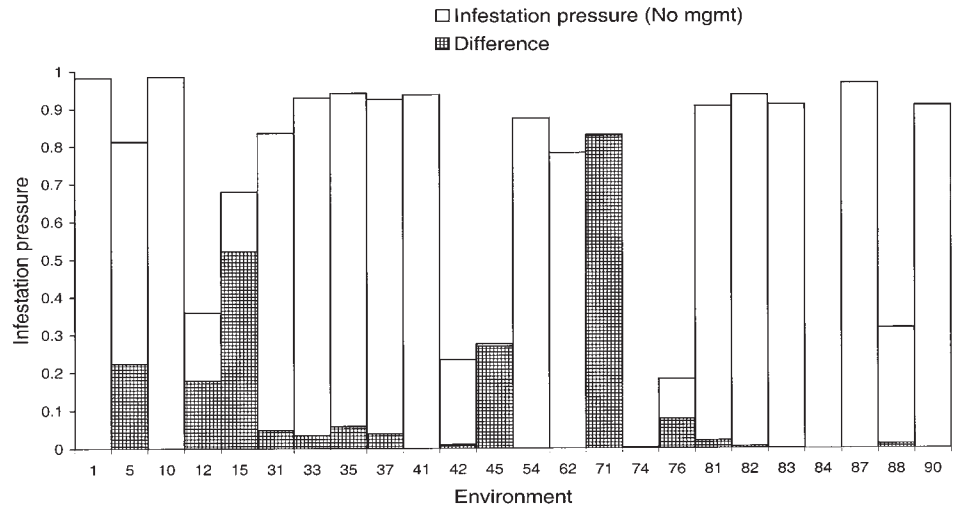


Figure 57. Difference made by weed control to the mean infestation pressure in each environment.



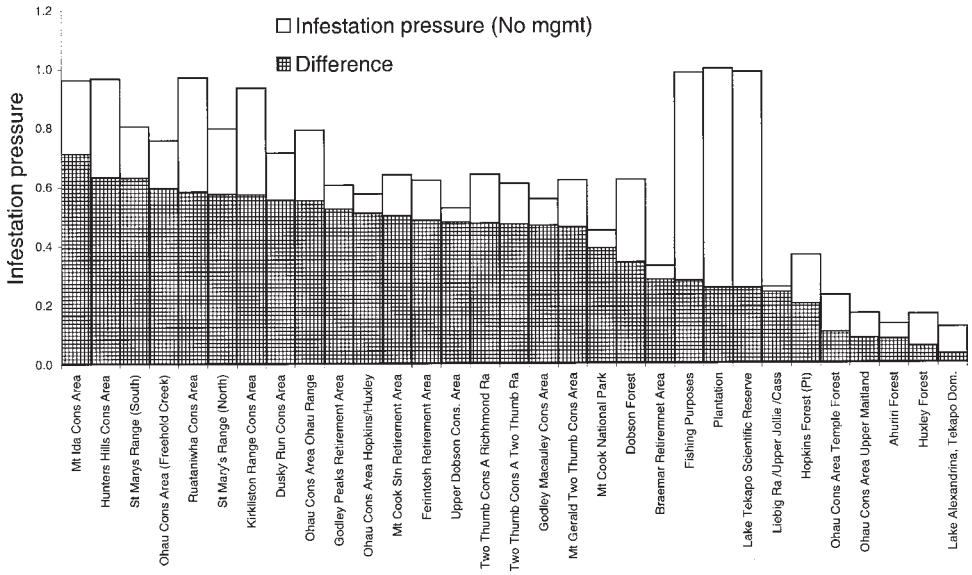


Figure 58. Difference made by weed control to the mean infestation pressure on land units managed for conservation purposes.

14.6 LEVEL I REPORTING

Level I managers work at the scale of individual projects. They need to know: "How much difference does each conservation project make to pressure on natural heritage?"

The total decrease in pressure for a project ($\Sigma\Delta P$) measures how much difference successful implementation of a project (or group of projects) will make. There are two components to this difference: the magnitude of difference made per unit area and the area over which a difference is made (Fig. 59). The wilding pine control projects, thar control and stock fencing projects make most difference while rabbit, gorse, yellow tree lupin and pig control make least difference. The majority of projects make most difference on conservation land. Project River Recovery (PRR) will make most difference on private land (Table 17).

14.7 FEATURES OF THE PRESSURE MODEL AND ESTIMATES OF 'THE DIFFERENCE MADE'

Comparing the difference made by contrasting projects and project combinations reveal a number of the key features of the underlying pressure model. The model states that integrated control of several pests at a place will make more difference than the sum of differences made by control of each pest separately. Thus the infestation pressure model states that controlling just one of a suite of competing weeds makes little difference. This is because the model assumes that most of the space made available by removal of one weed will be occupied by a competing weed, with little space becoming available to native communities. All competing weeds have to be controlled to free up significant space for native communities. Project River Recovery (PRR) aims to control all the riverbed weeds. Consequently, the $\Sigma\Delta P$ associated with PRR (i.e. 6.63 in Fig. 59) is greater than the sum of the five $\Sigma\Delta P$ values associated with controlling each of the five weeds independently (0.21+0.77+0.12+1.34+1.05 = 3.54).

Similarly, the consumption pressure model states that impact of one introduced predator alone is greater than if that same predator occurs at the same density

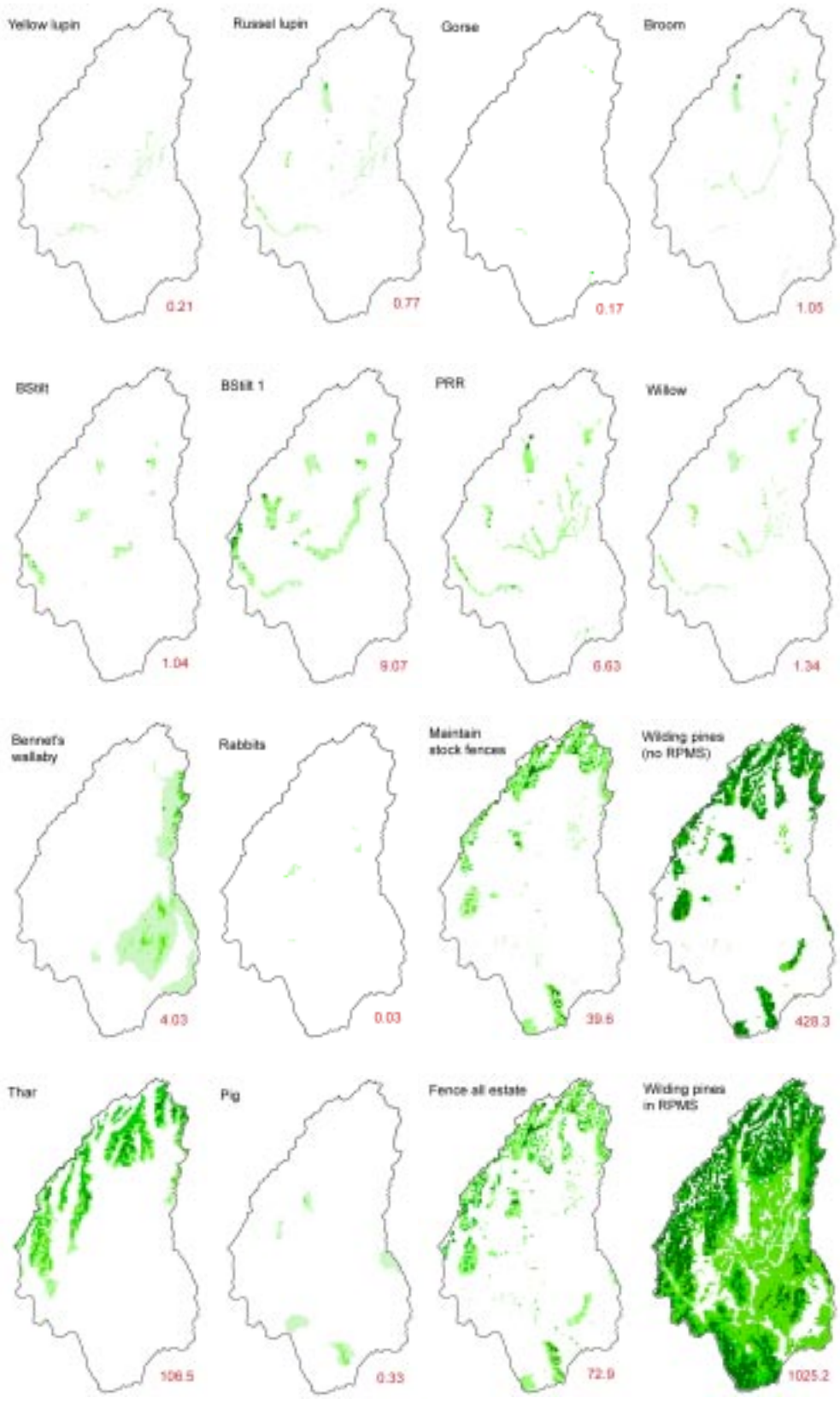


Figure 59. Project sites and pressure reduction. Project sites are the set of pixels for which the project makes a difference. The total pressure reduction (the value at the lower right of each map) is the sum of differences for all affected pixels.

among other introduced predators. The Black Stilt recovery programme (BStilt) includes intensive control of four mammal predators, but does not aim to remove all alien mammals from the vicinity of black stilt habitat. The ΣΔP

associated with BStilt (i.e. 1.03) is greater than the sum of the four ΣΔP values associated with controlling each of the four predators independently (0.72).

The pressure model defines the synergy gained with integrated management of pressure components. If weed control and predator control and/or physical resource restoration (e.g. hydrology) occur at the same place, then the pressure model predicts a greater pressure reduction than if these activities take place independently. Consequently, ΣΔP associated with the integrated PRR and BStilt programme (i.e. PRRBS in Table 14) is considerably greater (9.25) than the sum of the nine parts (4.24).

The ΣΔP with maintaining existing fences (39.6) is a little more than half that of fencing all conservation lands (72.88). The ΣΔP of fencing all Pastoral Lease lands is 111.96. These values are large compared with the feral pig control project (0.33) and control of Bennett's wallaby (4.03). Thar control makes a much greater difference over a larger area and so has correspondingly greater ΣΔP of 106.49. However, the ΣΔPs of all these projects are small compared to those of the two wilding pine control projects. If wilding pines are only controlled on conservation land (i.e. the current situation), ΣΔP is 428.2 and if the pines are controlled in all areas except designated plantations and shelter belts, ΣΔP is 1025.19.

TABLE 17. PRESSURE REDUCTIONS FOR PROJECTS (ΣΔP) BY LAND TENURE. PROJECT CODES REFER TO THE PROJECT DESCRIPTIONS AND SCENARIO COMPOSITIONS DESCRIBED IN TABLE 3.

PROJECT CODE	CONSERVATION LAND	PASTORAL LEASE LAND	PRIVATE LAND	WHOLE AREA
Broom	0.43	0.001	0.62	1.05
Gorse	0.01	0.002	0.16	0.17
Rlupin	0.18	0.147	0.44	0.77
Ylupin	0.18	0.001	0.03	0.21
Willow	0.002	0.25	1.09	1.34
PRR	1.12	0.96	4.57	6.63
Cat	0.003	0.12	0.15	0.27
Ferret	0.003	0.15	0.19	0.35
Hedge	0.000	0.02	0.000	0.02
Stoat	0.000	0.02	0.06	0.07
Bstilt	0.008	0.43	0.60	1.03
PRRBS	1.24	1.81	6.19	9.25
Cat1	0.65	0.35	0.70	1.69
Ferret1	0.80	0.43	0.88	2.10
Hedge1	1.62	0.38	0.05	2.04
Stoat1	0.50	0.21	0.28	0.99
BStilt1	4.48	1.84	2.76	9.07
PineDOC	426.71	0.70	0.79	428.20
PineRPMS	427.18	386.34	211.67	1025.19
StockCL	70.52	0.27	2.09	72.88
StockSQ	39.53	0.01	0.06	39.60
StockTR	70.52	39.35	2.09	111.96
Thar	75.35	30.64	0.50	106.49
Pig	0.29	0.03	0.01	0.33
Rabbit	0.010	0.01	0.004	0.03
Bennetts	1.99	1.10	0.94	4.03