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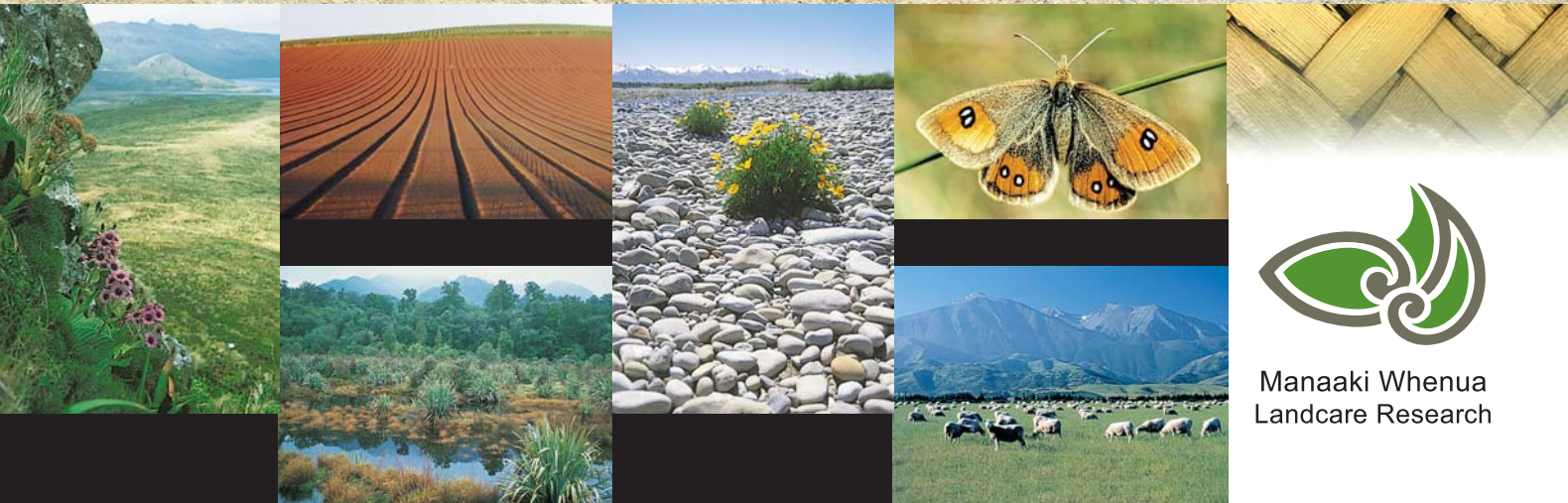

Manaaki Whenua
Landcare Research

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	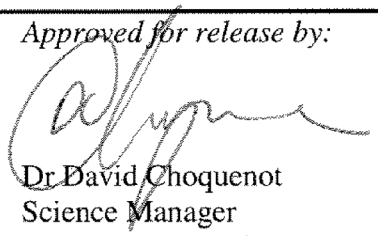
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Contents

Summary

Project and Client

This report summarises the methods used for and the overall results of an analysis of legally protected areas and their condition conducted for the Ministry for the Environment.

Objective

- Quantify the extent and condition of legal protection on public and private land by Land Environments of New Zealand Level II environment
- Extent refers to total area in hectares
- Condition refers to land cover as recorded at the time of the Land Cover Database Version 1 (1996/7)

Methods

- Collected spatial data layers for legally protected areas including Crown Conservation Estate, Nature Heritage Fund covenants, Nga Whenua Rahui covenants, and Queen Elizabeth II National Trust covenants
- Using purpose-built software, overlaid the spatial data layers and transferred the results to a relational database for storage and querying
- Using purpose-built software, prepared queries and tables to report analysis results via output to spreadsheets and corresponding maps

Results

- 8 210 570 ha (31.4%) of New Zealand's total land area of 26 209 052 hectares are legally protected
- 8 064 290 ha (98.2%) occur on public land (Crown Conservation Estate)
- 146 280 ha (1.8%) occur on private land (Nature Heritage Fund – 8607; Nga Whenua Rahui – 83 135; QE II Trust – 54 538)
- Legal protection levels for LENZ Level II environments vary by environment (0.44% to 100%) and by region (6.45% to 85.1%)
- Legally protected areas mostly support indigenous cover, although several environments have high proportions of legally protected areas in non-indigenous cover

Conclusions

- The analysis confirmed that legal protection to date has focused primarily on cooler, high-elevation environments with steep slopes and poorer quality soils, i.e. areas that are generally less economically attractive

Recommendations

- All agencies involved with land protection – on either public or private land – for biodiversity conservation should place high priority on producing accurate spatial data layers that show areas of legal protection under their jurisdiction
- One agency should take the lead in developing and maintaining a coordinated spatial data layer for legally protected areas that includes data from all central, regional, and local government organisations as well as from non-profit organisations. For reasons of privacy and protection of valuable resources, that information should be made available only in summary form for public consumption.

1. Introduction

The Ministry for the Environment, Department of Conservation, and Local Government New Zealand are jointly exploring whether to draft a National Policy Statement on Indigenous Biodiversity. They require information on the extent, level of protection, representativeness, and condition of New Zealand's ecosystems. In particular, they want to know the level of contribution that public and private protection each makes to the conservation of indigenous biodiversity. The parties will use this information 1) to help Ministers make informed decisions about the NPS, and 2) to report on the drivers of good environmental practice for biodiversity conservation on public and private land.

The Ministry for the Environment contracted Landcare Research to provide quantitative information on the extent and condition of legally protected land by compiling and summarising spatial data on the extent and condition of protected land within New Zealand. Specifically they asked Landcare Research to

- Assemble relevant spatial data layers related to legally protected land and New Zealand's indigenous ecosystems
- Prepare a database that allows for the assessment of the extent and condition of New Zealand's legally protected natural ecosystems, stratified by the Land Environments of New Zealand (Leathwick et al. 2003) Level IV (500 environments nationally), territorial local authorities, or combinations thereof
- Report summary information produced from the database for LENZ Level II (100 environments nationally) in colour maps and accompanying tables and graphs for publication by the Ministry.

This report documents the technical methods used during the analysis and provides a summary of the results. The Ministry for the Environment holds the full set of results in an electronic format including an associated database, spatial data layers, and map outputs.

2. Background

The New Zealand Biodiversity Strategy broadly calls for actions to halt the decline of indigenous biodiversity throughout New Zealand. Specifically the Strategy promotes two major goals for indigenous biodiversity:

- Maintain and restore the full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments
- Maintain and restore viable populations of all indigenous species and subspecies across their natural range, and maintain their genetic diversity.

New Zealand has been fortunate as a nation, as nearly a third of the land area (~ 8 000 000 hectares) is protected for scientific, scenic, recreational, historic or cultural reasons (DOC 2003). Despite such a high level of protection, indigenous ecosystems in many areas of New Zealand have undergone extensive modification, particularly productive, gently sloping

lowlands/areas with high production value on lower elevation and shallower slopes (Leathwick et al. 2003). In such areas, often only small remnants of the former natural ecosystems remain.

Given these trends, the government convened a Ministerial Advisory Committee on Biodiversity and Private Land to examine the role private land management decisions play in the decline of New Zealand's indigenous biodiversity (MAC 2000). Specifically, the committee was asked to develop an "agreed set of proposals that will lead to effective sustainable management of biodiversity outside the conservation estate" (MAC 2000, p. 3). They were also asked to provide advice on "how the Resource Management Act 1991 should be implemented through a national policy statement and the set of instruments that could be implemented alongside or in place of RMA measures (such as a national policy statement)" (MAC 2000, p. 3).

Based on their findings, the Ministerial Advisory Committee on biodiversity recommended a number of actions to the government. The recommendations most relevant to this project included:

1. Not to proceed with the development of a National Policy Statement at that time until other recommendations had been implemented
2. To support and facilitate better national and local tools for information collection and management in partnership with local government, including national and regional coordination of existing biodiversity information.

The committee also commented that many people expressed a lack of understanding of the "size of the problem." In other words, people wanted to know how much indigenous biodiversity remained and its rate of decline. In response, the committee compiled summary statistics from a more comprehensive report on biodiversity on private land (Froude 2000). The statistics reported the extent of protection on public and private land and potential for further protection on private lands by regions and districts. The committee also commented that detailed information was not easy to acquire.

3. Objectives

The project's objective was to provide quantitative information on the extent and condition of legally protected land at national, regional, and local levels. For the purposes of this report, legally protected land referred to any land within:

- Crown Conservation Estate (managed by the Department of Conservation)
- Private Land:
  - Nature Heritage Fund Covenants
  - Nga Whenua Rahui Covenants
  - Queen Elizabeth II National Trust Covenants.

The analysis did not include land managed for conservation purposes by other central government agencies, regional or district councils, or private organisations.

For this project, extent and condition were defined as follows:

- *Extent*: the proportion of legally protected land as stratified by

  - LENZ land environments (Leathwick et al. 2003a, Leathwick et al. 2003b)
  - Territorial authorities
  - Combinations of the above
- *Condition*: land cover in 1996/7 as classified by the New Zealand Land Cover Database (LCDB) Version 1.2.

The LCDB classified New Zealand into one of 16 possible land cover classes (Table 1). For the analysis, we considered 9 cover classes as indigenous cover, although current indigenous cover may not be consistent with what occurred before human settlement.

Table 1. New Zealand Cover Database Version 1 land cover classes. Classes marked with an asterisk (*) comprised the indigenous cover category for the analysis.

Bare Ground*	Mangroves*	Riparian Willows
Coastal Sands*	Mines & Dumps	Scrub*
Coastal Wetlands*	Planted Forest	Tussock*
Indigenous Forest*	Prime Horticultural	Urban Open Space
Inland Water*	Prime Pastoral	Urban
Inland Wetlands*		

4. Methods

We obtained the required spatial data layers for the analysis from the appropriate sources (Table 2), and created an analysis mask from the LENZ Level IV Classification layer. Using the mask, we converted any polygon coverage (e.g., shapefile) to grids with the same extent (east-west and north-south), grid resolution (25 m), and NoData values as LENZ Level IV. See Appendix 1 for the detailed methods used to produce the final coverages used for analysis.

For the Crown Conservation Estate, we used a coverage supplied by the Department of Conservation and subsequently modified by Landcare Research to indicate areas legally protected mostly for conservation value versus those protected for other (e.g., cultural heritage) values (Table 2).

For Queen Elizabeth II National Trust covenants, we used the covenant boundary layers provided by the QE II National Trust. At the time of the analysis, the Trust was still converting regional covenant surveys into a national spatial data layer. Therefore, some regions had near complete coverage, some had partial coverage, and some had little or no coverage (Table 3). For covenants without a boundary, we estimated the extent of the covenant by creating a circular buffer around point locations provided by the QE II National Trust with the same area as the covenant.

After preparing all spatial data layers and ensuring their integrity, we executed an in-house, purpose-built C++ program that generated a look-up table and summed the total count of 25-m grid cells for each unique combination of values from the input spatial data layers.

Table 2. Spatial data layers used in the analysis. See text for further explanation of layer processing.

Spatial Data Layer	Source	Version	Description	Possible values
Land Environments of New Zealand – Level IV Classification Layer	Ministry for the Environment	1.0	25 m grid	Unclassified: 0 Land Environment: 1–500
Ecological Regions & Districts Boundaries	Landcare Research	-	Polygon shapefile converted to 25 m grid	Regions: 1–77 Districts: 1–254
Political Regions & Districts Boundaries	Landcare Research	-	Polygon shapefile converted to 25 m grid	Regions: 1–16* Districts: 1–74
Crown Conservation Estate	Department of Conservation	-	Polygon coverage modified by Landcare Research to indicate areas primarily protected for natural	Not in Estate: 0 Natural Heritage Estate: 1 Other Conservation Estate: 2
Crown Covenants	Department of Conservation	-	Polygon coverage converted to 25 m grid	Not Crown Covenant: 0 Crown Covenant: 1
Nga Whenua Rahui Covenant	Department of Conservation	-	Polygon coverage converted to 25 m grid	Not Nga Whenua Rahui Covenant: 0 Nga Whenua Rahui Covenant: 1
Queen Elizabeth II Natural Heritage Trust Covenants	QE II National Trust	-	Polygon coverage converted to 25 m grid	Not QE II Covenant: 0 QE II Covenant Actual: 1 QE II Covenant Estimated: 2
New Zealand Land Cover Database	Ministry for the Environment	1.2	Polygon coverage converted to 25 m grid	Unclassified: 0 Land-cover class: 1–15

*Includes 4 unitary authorities

We then created a relational database containing the look-up tables and associated spatial data layer reference tables. During this process, we discovered some cells were classified as more than one type of protected area, e.g., both Crown Conservation Estate and QE II National Trust covenant. We only counted those cells once for reporting purposes, with Crown Conservation Estate receiving highest priority.

From the relational database, we executed an in-house, purpose-built Visual Basic program to generate Excel worksheets that reported the extent and condition of biodiversity protection both nationally and regionally. We summarised results at Level II per client requirements by summing the raw cell counts generated for LENZ Level IV into the appropriate LENZ Level II environments before performing any calculations. We queried the database to develop other summary information as appropriate.

Table 3. Total, actual, and estimated areas of QE II National Trust covenants used in the analysis.

Region	Total Area	Actual Area	Estimated Area
Auckland	1 195	716	479
Bay of Plenty	8 696	8 611	85
Canterbury	9 127	5 349	3 778
Gisborne	2 237		2 237
Hawkes Bay	7 223	6 819	404
Manawatu-Wanganui	9 665	8 897	3 501
Marlborough	3 536	35	129
Nelson	775	647	5
Northland	259	254	982
Otago	5 582	4 600	6 415
Southland	6 415		584
Taranaki	2 295	1 711	1 351
Tasman	1 351		798
Waikato	1 692	894	768
Wellington	4 465	3 780	685
WestCoast	272		272
Total	64 781	42 312	22 469

5. Results

The analysis reported a total area for New Zealand of 26 209 052 hectares, of which 8 210 570 (31.4%) hectares received public or private protection.

The spatial data layers for publicly and privately protected lands overlapped in some areas. That resulted in the potential to count the same area of land more than once during the analysis. Therefore we established a precedence hierarchy for reporting to insure that each cell was only counted once. The hierarchy was as follows:

Crown Conservation Estate > Nature Heritage Fund > Nga Whenua Rahui > QE II Trust

This means that the analysis considered land identified as Crown Conservation Estate as such regardless of other protected area status, and similarly down the hierarchy. Because a third of the QE II Trust Covenants depended on estimated area, we considered that layer least reliable and assigned it the lowest priority, which meant that analysis only counted areas identified solely as QE II National Trust covenants as QE II National Trust covenants. Areas identified as QE II National Trust and any other protected area class were counted as the other protection class.

The application of the precedence hierarchy caused an underreporting of 20 249 hectares of legally protected land (Table 4). QE II National Trust covenants accounted for half the underreporting, followed by Nature Heritage Fund covenants. Crown Conservation Estate and Nga Whenua Rahui covenants showed relatively low levels of underreporting as a percentage of total original area (0.04% and 0.20% respectively).

Of the 8 210 570 hectares of legally protected land, 8 064 290 hectares (98.2%) occurred on public land (Crown Conservation Estate) and 146 280 (1.8%) occurred on private land (Table 4). These figures amount to 30.8% and 0.6% of New Zealand's total land area, respectively. Nga Whenua Rahui covenants comprised half the legally protected private land (83 135 ha), followed by QEII National Trust covenants (54 538 ha), and finally Nature Heritage Fund covenants (6342 ha).

Table 4. Difference between original area and reported area for legally protected areas spatial data layers used in the analysis.

	Total Area			%
Spatial Data Layer	Original	Reported	Difference	Underreported
Crown Conservation Estate	8 067 775	8 064 290	3 485	0.04
Nature Heritage Fund	14 949	8 607	6 342	42.42
Nga Whenua Rahui Covenant	83 300	83 135	165	0.20
Queen Elizabeth II Natural Heritage Trust Covenants	64 795	54 538	10 257	15.83
Subtotal Private Land	163 044	146 280	16 764	10.28
Totals	8 230 819	8 210 570	20 249	0.25

South Island regions generally had higher amounts of legally protected lands than North Island regions (Table 5, Figure 1). Otago had the lowest percent of legally protected area on the South Island at 15.88%, followed by Canterbury at 20.65%. Conversely, North Island regions typically had less than 20% of total land area under legal protection, except for Bay of Plenty (38.08%), which included a very large area in Nga Whenua Rahui covenants.

The level of legal protection ranged widely for the LENZ Level II environments (Table 7). Of the 100 Level II environments, 63 had less than 20% legal protection, while 26 had greater

than 80% legal protection. Environment A3[1] (796 ha) had the highest level of legal protection (100%) while Environment B7[2] (53 089 ha) had the lowest (0.44%). In general, environments in warmer, low lying areas with gentler slopes and consequently more production values (e.g., Environments A to F, Environment N) had much lower levels of legal protection than environments in cooler, hilly and mountainous areas with steeper slopes.

Environments in low-lying areas also generally had lower levels of remaining indigenous cover (Figure 3, 4). Fifty-eight environments had more than 80% of their legally protected area in indigenous cover. Eleven environments had less than 20% of their legally protected area in indigenous cover (B5, B6, B7, B9, I4, J1, J2, N1, N2, N5, N8). Finally, of the total legal protected area, 229 526 ha or 2.8% did not contain indigenous cover at the time of LCDB I (Table 8).

[1] This environment is one of the smallest in the level II classification, consisting of small areas of gently sloping, imperfectly drained soils formed from andesitic alluvium on the tip of the North Cape. The climate of the environment is very similar to that of A1 and A2, with very warm temperatures, very high solar radiation and moderate annual water deficits. Soils are imperfectly drained and of moderate fertility.

[2] This environment occurs on low elevation hill-country both in Hawke's Bay and southeast from the Awatere River and around Cape Campbell. The climate is typified by warm temperatures, high solar radiation, moderate annual water deficits and high vapour pressure deficits. Soils of imperfect drainage and low fertility are formed from sandstone and mudstone (Hawke's Bay) and calcareous mudstones (Marlborough).

Table 5. Regional summary of legal protection status.

		AREA LEGALLY PROTECTED								NOT LEGALLY PROTECTED
		All	Public Land			Private Land				
REGION	Total Area	Total	Total	Included	Excluded	Total*	Nature Heritage Fund	Nga Whenua Rahui	QE II Trust	Total Area
Auckland	493 790	31 862	30 305	26 960	3 346	1 556	–	366	1 191	461 928
		6.45%	6.14%	5.46%	0.68%	0.32%	0.00%	0.07%	0.24%	93.55%
Bay of Plenty	1 196 087	455 504	411 598	410 464	1 135	43 906	1922	39 852	2 132	740 583
		38.08%	34.41%	34.32%	0.09%	3.67%	0.16%	3.33%	0.18%	61.92%
Canterbury	4 413 424	911 307	904 004	804 977	99 027	7 303	8	–	7 296	3 502 117
		20.65%	20.48%	18.24%	2.24%	0.17%	0.00%	0.00%	0.17%	79.35%
Gisborne	832 074	111 920	84 701	84 636	65	27 219	–	24 982	2 237	720 153
		13.45%	10.18%	10.17%	0.01%	3.27%	0.00%	3.00%	0.27%	86.55%
Hawkes Bay	1 406 406	263 150	253 594	250 194	3 400	9 556	38	2 308	7 210	1 143 256
		18.71%	18.03%	17.79%	0.24%	0.68%	0.00%	0.16%	0.51%	81.29%
Manawatu-Wanganui	2 206 707	403 494	391 026	388 442	2 585	12 468	235	8 743	3 490	1 803 213
		18.28%	17.72%	17.60%	0.12%	0.57%	0.01%	0.40%	0.16%	81.72%
Marlborough	1 041 183	323 019	322 252	312 945	9 307	767	–	–	767	718 164
		31.02%	30.95%	30.06%	0.89%	0.07%	0.00%	0.00%	0.07%	68.98%
Nelson City	42 252	13 854	13 606	13 241	365	248	–	–	248	28 398
		32.79%	32.20%	31.34%	0.86%	0.59%	0.00%	0.00%	0.59%	67.21%
Northland	1 243 406	168 103	160 941	156 597	4 344	7 162	–	1 629	5 533	1 075 303
		13.52%	12.94%	12.59%	0.35%	0.58%	0.00%	0.13%	0.44%	86.48%
Otago	3 097 891	491 865	486 001	466 690	19 311	5 865	1	–	5 864	2 606 025
		15.88%	15.69%	15.06%	0.62%	0.19%	0.00%	0.00%	0.19%	84.12%
Southland	3 081 191	1 779 836	1 777 731	1 743 310	34 421	2 105	33	129	1 942	1 301 355
		57.76%	57.70%	56.58%	1.12%	0.07%	0.00%	0.00%	0.06%	42.24%

		PROTECTED								UNPROTECTED
		All	Public Land			Private Land				
REGION	Total Area	Total Area	Total Area	Included	Excluded	Total Area*	Nature Heritage Fund	Nga Whenua Rahui	QE II Trust	Total Area
Taranaki	724 513	147 218	145 381	144 978	403	1 838	563	–	1 275	577 294
		20.32%	20.07%	20.01%	0.06%	0.25%	0.08%	0.00%	0.18%	79.68%
Tasman	956 025	613 257	611 784	606 868	4 916	1474	–	–	1 474	342 768
		64.15%	63.99%	63.48%	0.51%	0.15%	0.00%	0.00%	0.15%	35.85%
Waikato	2 371 248	398 474	383 875	375 518	8 357	14 599	126	5 093	9 380	1 972 774
		16.80%	16.19%	15.84%	0.35%	0.62%	0.01%	0.21%	0.40%	83.20%
Wellington	801 843	138 979	134 615	133 769	846	4364	77	32	4 255	662864
		17.33%	16.79%	16.68%	0.11%	0.54%	0.01%	0.00%	0.53%	82.67%
West Coast	2 301 014	1 958 727	1 952 876	1 930 746	22 130	5 851	5 606	–	244	342 287
		85.1%	84.9%	83.9%	1.0%	0.3%	0.24%	0.00%	0.01%	14.88%
New Zealand	26 209 053	8 210 570	8 064 290	7 850 333	213 956	146 280	8 607	83 135	54 538	17 998 494
		31.33%	30.77%	29.95%	0.82%	0.56%	0.03%	0.32%	0.21%	68.67%

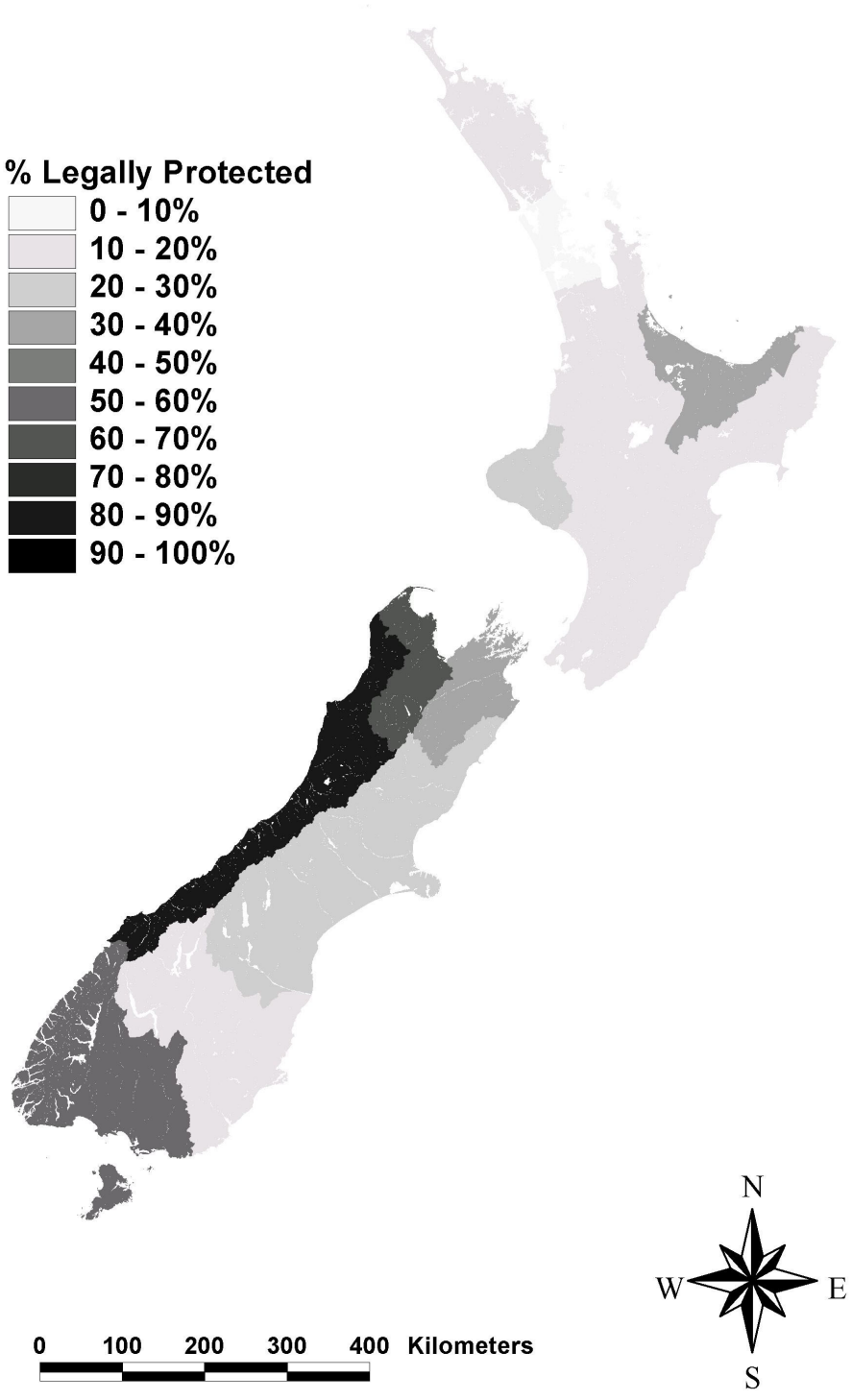

Figure 1. Percent of area under legal protection for biodiversity by political region.

Table 6. Summary of legally protected area by LENZ Level II (100 environments nationally).

LENZ Level II	Total Area (ha)	Area Legally Protected											
		Total		Public Land		Private Land							
		Area (ha)	% of Total	Area (ha)	% of Protected Area	Area (ha)	% of Protected Area	Nature Heritage Fund (ha)	% of Protected Area	Nga Whenua Rahui (ha)	% of Protected Area	QEII National Trust (ha)	% of Protected Area
A1	49 537	19 068	38.49%	19 066	99.99%	3	0.01%					3	0.01%
A2	30 834	5 302	17.20%	5 275	99.48%	28	0.52%					28	0.52%
A3	796	796	10	796	100.00%								
A4	9362	355	3.79%	352	99.31%	2	0.69%					2	0.69%
A5	383 312	19 489	5.08%	18 899	96.97%	590	3.03%	110	0.56%	244	1.25%	236	1.21%
A6	885 509	43 150	4.87%	38 197	88.52%	4 954	11.48%			2 046	4.74%	2908	6.74%
A7	473 105	6 565	1.39%	5 497	83.72%	1 069	16.28%	9	0.14%	613	9.34%	446	6.80%
B1	182 007	1 275	0.70%	622	48.82%	653	51.18%	20	1.53%	0	0.02%	633	49.62%
B2	69 059	1 471	2.13%	1 167	79.34%	304	20.66%	2	0.11%			302	20.55%
B3	187 533	2 541	1.36%	2 411	94.88%	130	5.12%	< 1	0.01%			130	5.11%
B4	2703	55	2.02%	55	100.00%								
B5	50 021	611	1.22%	120	19.62%	491	80.38%			414	67.81%	77	12.57%
B6	29 222	227	0.78%	220	96.78%	7	3.22%					7	3.22%
B7	53 089	234	0.44%	226	96.63%	8	3.37%					8	3.37%
B8	85 430	2 395	2.80%	2 208	92.21%	187	7.79%					187	7.79%
B9	18 671	589	3.15%	589	100.00%								
C1	83 454	4 156	4.98%	3 917	94.25%	239	5.75%	12	0.28%	148	3.55%	80	1.92%
C2	255 001	1 896	0.74%	1 572	82.91%	324	17.09%	66	3.48%	17	0.90%	241	12.71%
C3	293 928	1 332	0.45%	893	67.05%	439	32.95%	41	3.08%	8	0.57%	390	29.30%

LENZ Level II	Total Area (ha)	Area Legally Protected											
		Total		Public Land		Private Land							
		Area (ha)	% of Total	Area (ha)	% of Protected Area	Area (ha)	% of Protected Area	Nature Heritage Fund (ha)	% of Protected Area	Nga Whenua Rahui (ha)	% of Protected Area	QEII National Trust (ha)	% of Protected Area
D1	668 573	218 913	32.74%	189 757	86.68%	29 156	13.32%	266	0.12%	22 590	10.32%	6300	2.88%
D2	446 108	57 246	12.83%	53 613	93.65%	3 633	6.35%	4	0.01%	327	0.57%	3302	5.77%
D3	686 161	19 740	2.88%	12 529	63.47%	7 211	36.53%			4 657	23.59%	2555	12.94%
D4	311 310	160 381	51.52%	148 747	92.75%	11 634	7.25%	22	0.01%	11 447	7.14%	165	0.10%
E1	925 527	175 799	18.99%	172 065	97.88%	3 734	2.12%					3734	2.12%
E2	16 455	5 219	31.72%	5 168	99.03%	50	0.97%					50	0.97%
E3	68 824	1 378	2.00%	1 277	92.66%	101	7.34%	< 1	0.02%			101	7.32%
E4	316 663	38 155	12.05%	36 145	94.73%	2 010	5.27%					2010	5.27%
F1	1 832 883	419 753	22.90%	406 953	96.95%	12 800	3.05%	550	0.13%	4 871	1.16%	7379	1.76%
F2	13 406	5 675	42.33%	5 675	100.00%								
F3	96 263	4 579	4.76%	4 221	92.19%	358	7.81%	1	0.02%			357	7.80%
F4	377 564	2 468	0.65%	1 454	58.89%	1 015	41.11%			60	2.42%	955	38.69%
F5	296 556	16 510	5.57%	16 189	98.06%	321	1.94%	24	0.15%			297	1.80%
F6	1 205 644	366 989	30.44%	338 449	92.22%	28 540	7.78%	590	0.16%	24 945	6.80%	3004	0.82%
F7	1 407 198	239 553	17.02%	227 518	94.98%	12 035	5.02%	1 017	0.42%	8 655	3.61%	2364	0.99%
G1	103 273	20 173	19.53%	20 054	99.41%	119	0.59%			65	0.32%	54	0.27%
G2	7 729	666	8.61%	350	52.59%	316	47.41%			315	47.38%	< 1	0.03%
G3	149 141	3 788	2.54%	2 589	68.35%	1 199	31.65%			1 062	28.04%	137	3.61%
G4	56 426	2 703	4.79%	2 681	99.19%	22	0.81%			1	0.04%	21	0.77%
G5	279	41	14.66%	41	100.00%								
G6	19 676	300	1.52%	54	18.04%	246	81.96%			217	72.49%	28	9.47%

LENZ Level II	Total Area (ha)	Area Legally Protected											
		Total		Public Land		Private Land							
		Area (ha)	% of Total	Area (ha)	% of Protected Area	Area (ha)	% of Protected Area	Nature Heritage Fund (ha)	% of Protected Area	Nga Whenua Rahui (ha)	% of Protected Area	QEII National Trust (ha)	% of Protected Area
H1	51 825	6 397	12.34%	6 338	99.07%	59	0.93%	< 1	0.01%			59	0.92%
H2	60 504	14 176	23.43%	13 751	97.00%	425	3.00%	127	0.90%	179	1.26%	119	0.84%
H3	8218	431	5.25%	421	97.57%	11	2.43%	11	2.43%				
H4	13 942	11 467	82.25%	11 441	99.77%	26	0.23%					26	0.23%
I1	1627	143	8.77%	142	99.39%	1	0.61%					1	0.61%
I2	48 290	1 108	2.29%	825	74.45%	283	25.55%					283	25.55%
I3	27 440	2 662	9.70%	2 620	98.41%	42	1.59%					42	1.59%
I4	432	3	0.59%	3	100.00%								
I5	39 774	229	0.58%	226	98.58%	3	1.42%			3	1.42%		
I6	4166	261	6.28%	254	96.96%	8	3.04%					8	3.04%
J1	53 721	2 154	4.01%	1 991	92.44%	163	7.56%					163	7.56%
J2	116 133	13 727	11.82%	13 726	100.00%	< 1		< 1	< 0.01%				
J3	15 044	593	3.94%	593	100.00%								
J4	108 872	2 157	1.98%	1 961	90.93%	196	9.07%	18	0.83%	13	0.59%	165	7.65%
K1	96 322	23 880	24.79%	23 736	99.40%	144	0.60%					144	0.60%
K2	10 984	595	5.42%	595	100.00%								
K3	31 301	1 281	4.09%	1 281	100.00%								
K4	16,048	595	3.70%	595	99.99%	< 1	0.01%					< 1	0.01%
K5	4771	345	7.24%	345	100.00%								

LENZ Level II	Total Area (ha)	Area Legally Protected											
		Total		Public Land		Private Land							
		Area (ha)	% of Total	Area (ha)	% of Protected Area	Area (ha)	% of Protected Area	Nature Heritage Fund (ha)	% of Protected Area	Nga Whenua Rahui (ha)	% of Protected Area	QEII National Trust (ha)	% of Protected Area
L1	201 670	16 597	8.23%	16 556	99.75%	41	0.25%	1	0.01%	1	0.01%	38	0.23%
L2	9673	542	5.61%	301	55.57%	241	44.43%					241	44.43%
L3	110 435	35 572	32.21%	34 885	98.07%	688	1.93%	12	0.03%	118	0.33%	558	1.57%
L4	406 572	2 502	0.62%	2 307	92.20%	195	7.80%	< 1	< 0.01%			195	7.78%
L5	60 515	5 209	8.61%	5 113	98.15%	97	1.85%					97	1.85%
L6	12 137	11 778	97.04%	11 778	100.00%								
M1	90 358	35 488	39.27%	35 404	99.76%	84	0.24%	36	0.10%			48	0.13%
M2	74 700	21 886	29.30%	21 784	99.53%	102	0.47%	89	0.41%			13	0.06%
M3	397	208	52.53%	208	100.00%								
M4	55 021	54 203	98.51%	54 192	99.98%	12	0.02%	2		10	0.02%		
N1	402 929	4 701	1.17%	4 542	96.61%	159	3.39%					159	3.39%
N2	486 572	4 759	0.98%	4 711	99.00%	47	1.00%	< 1	0.01%			47	0.99%
N3	593 152	5 284	0.89%	4 880	92.35%	404	7.65%	1	0.02%			403	7.63%
N4	243 676	4 443	1.82%	4 337	97.62%	106	2.38%					106	2.38%
N5	162 647	1 568	0.96%	1 557	99.31%	11	0.69%					11	0.69%
N6	92 820	3 754	4.04%	3 739	99.58%	16	0.42%					16	0.42%
N7	11 964	495	4.13%	494	99.97%	< 1	0.03%					< 1	0.03%
N8	36 182	958	2.65%	958	99.99%	< 1	0.01%					< 1	0.01%
O1	485 927	318 143	65.47%	315 411	99.14%	2 732	0.86%	2 551	0.80%			181	0.06%
O2	479 351	463 154	96.62%	461 896	99.73%	1 258	0.27%	1 250	0.27%			8	< 0.01%
O3	88 121	58 009	65.83%	57 922	99.85%	86	0.15%	85	0.15%			2	< 0.01%
O4	148 400	134 940	90.93%	134 935	100.00%	6		< 1	< 0.01%			5	< 0.01%
O5	207 684	195 046	93.91%	195 046	100.00%								

LENZ Level II	Total Area (ha)	Area Legally Protected											
		Total		Public Land		Private Land							
		Area (ha)	% of Total	Area (ha)	% of Protected Area	Area (ha)	% of Protected Area	Nature Heritage Fund (ha)	% of Protected Area	Nga Whenua Rahui (ha)	% of Protected Area	QEII National Trust (ha)	% of Protected Area
P1	1 160 774	644 416	55.52%	643 152	99.80%	1 264	0.20%					1264	0.20%
P2	171 365	130 986	76.44%	130 980	100.00%	6						6	< 0.01%
P3	360 456	351 562	97.53%	350 057	99.57%	1 505	0.43%	1 505	0.43%				
P4	46 217	44 343	95.94%	44 343	100.00%								
P5	489 179	346 767	70.89%	346 301	99.87%	467	0.13%					467	0.13%
P6	410 255	290 794	70.88%	290 493	99.90%	302	0.10%					302	0.10%
P7	442 427	275 364	62.24%	273 251	99.23%	2 113	0.77%	61	0.02%	95	0.03%	1957	0.71%
P8	197 912	152 818	77.22%	152 590	99.85%	228	0.15%					228	0.15%
Q1	915 364	291 783	31.88%	286 968	98.35%	4 815	1.65%	4	< 0.01%			4812	1.65%
Q2	649 134	42 618	6.57%	41 135	96.52%	1 483	3.48%	4	0.01%			1479	3.47%
Q3	419 385	72 395	17.26%	72 172	99.69%	224	0.31%	4	< 0.01%			220	0.30%
Q4	1 292 459	190 378	14.73%	188 665	99.10%	1 713	0.90%	12	0.01%			1701	0.89%
R1	980 822	860 247	87.71%	859 829	99.95%	418	0.05%	86	0.01%			332	0.04%
R2	953 114	952 565	99.94%	952 565	100.00%								
S1	3 758	1 536	40.88%	1 536	100.00%								
S2	16 953	16 790	99.04%	16 790	100.00%								
S3	12 706	12 706	100.00%	12 706	100.00%								
T1	157 419	153 362	97.42%	153 361	100.00%	1						1	
WATER	210 811	46 163	21.90%	45 990	99.63%	173	0.37%	17	0.04%	12	0.03%	144	0.31%

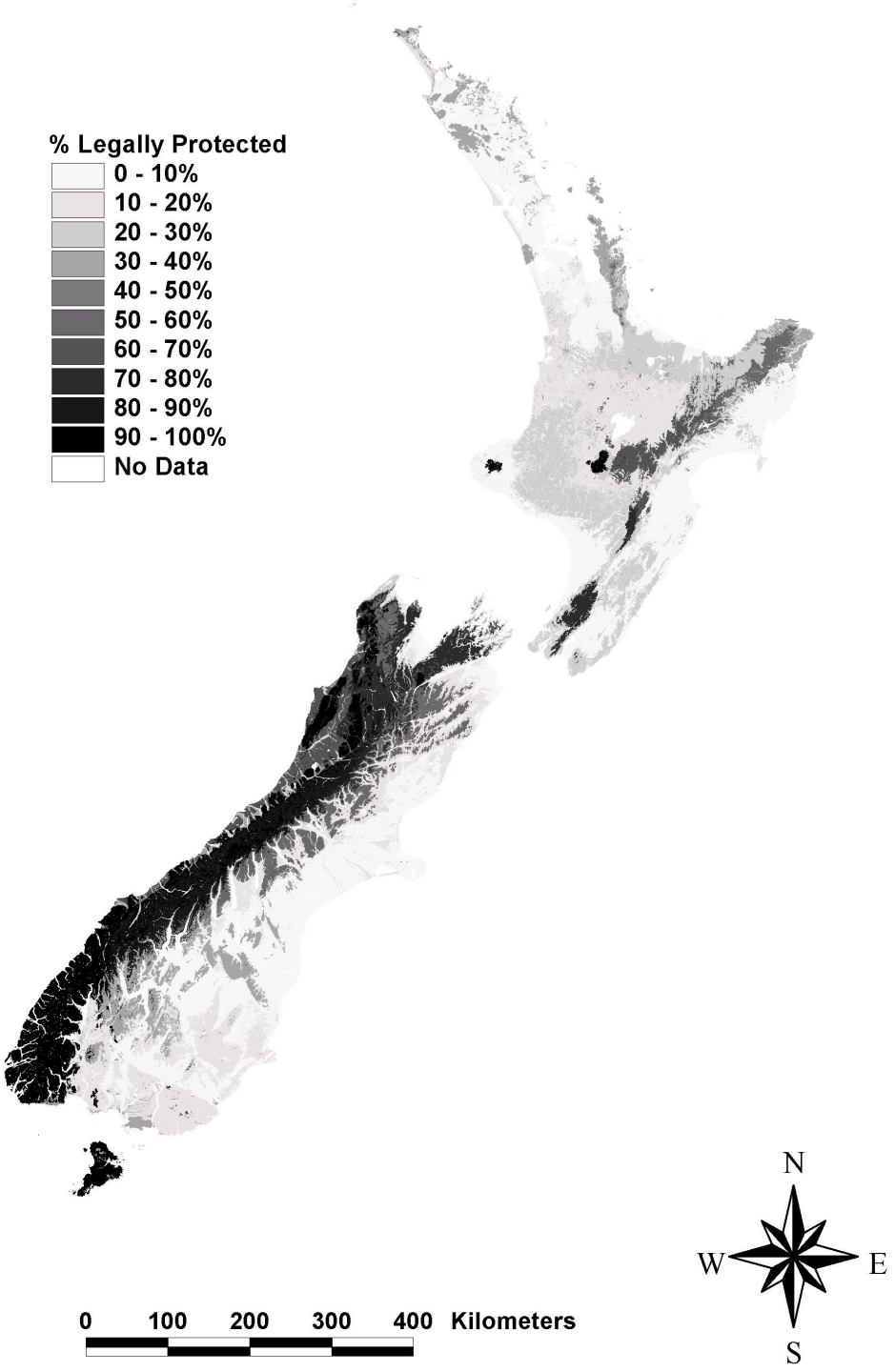

Figure 2. Percent of area legally protected by LENZ Level II (100 environments nationally).

Table 7. Level of legal protection for LENZ Level II environments.

Percent of Total Area Under Legal Protection (Public + Private)				
0 ≤ 20%	20% ≤ 40%	40 ≤ 60%	60% ≤ 80%	80% ≤ 100%
A2, A4, A5, A6, A7	H2	A1	D1, D4	A3
B1, B2, B3, B4, B5, B6, B7, B8, B9		E2	K1	F2
C1, C2, C3		F1, F6		H4
D2, D3		L3		L6
E1 E3 E4		M1, M2		M3, M4
F3, F4, F5, F7				O1, O2, O3, O4, O5
G1, G2, G3, G4, G5, G6				P1, P2, P3, P4, P5, P6, P7, P8
H1, H3				Q1
I1, I2, I3, I4, I5, I6				R1, R2
J1, J2, J3, J4				S1, S2, S3
K2, K3, K4, K5				T1
L1, L2, L4, L5				
N1, N2, N3, N4, N5, N6, N7, N8				
Q2, Q3, Q4				
63	1	7	3	26

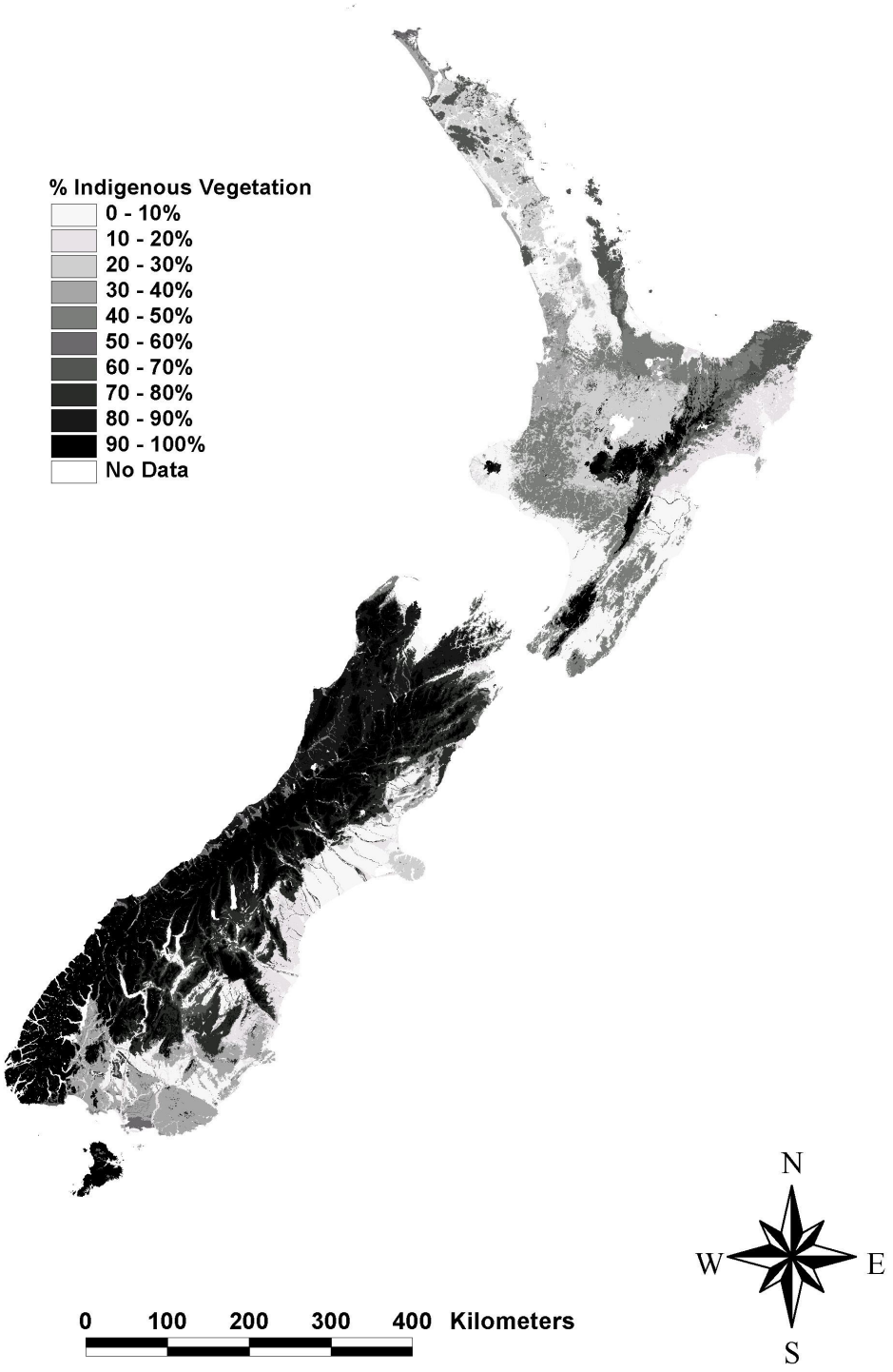

Figure 3. Percent area remaining in indigenous cover by LENZ Level II (100 environments nationally).

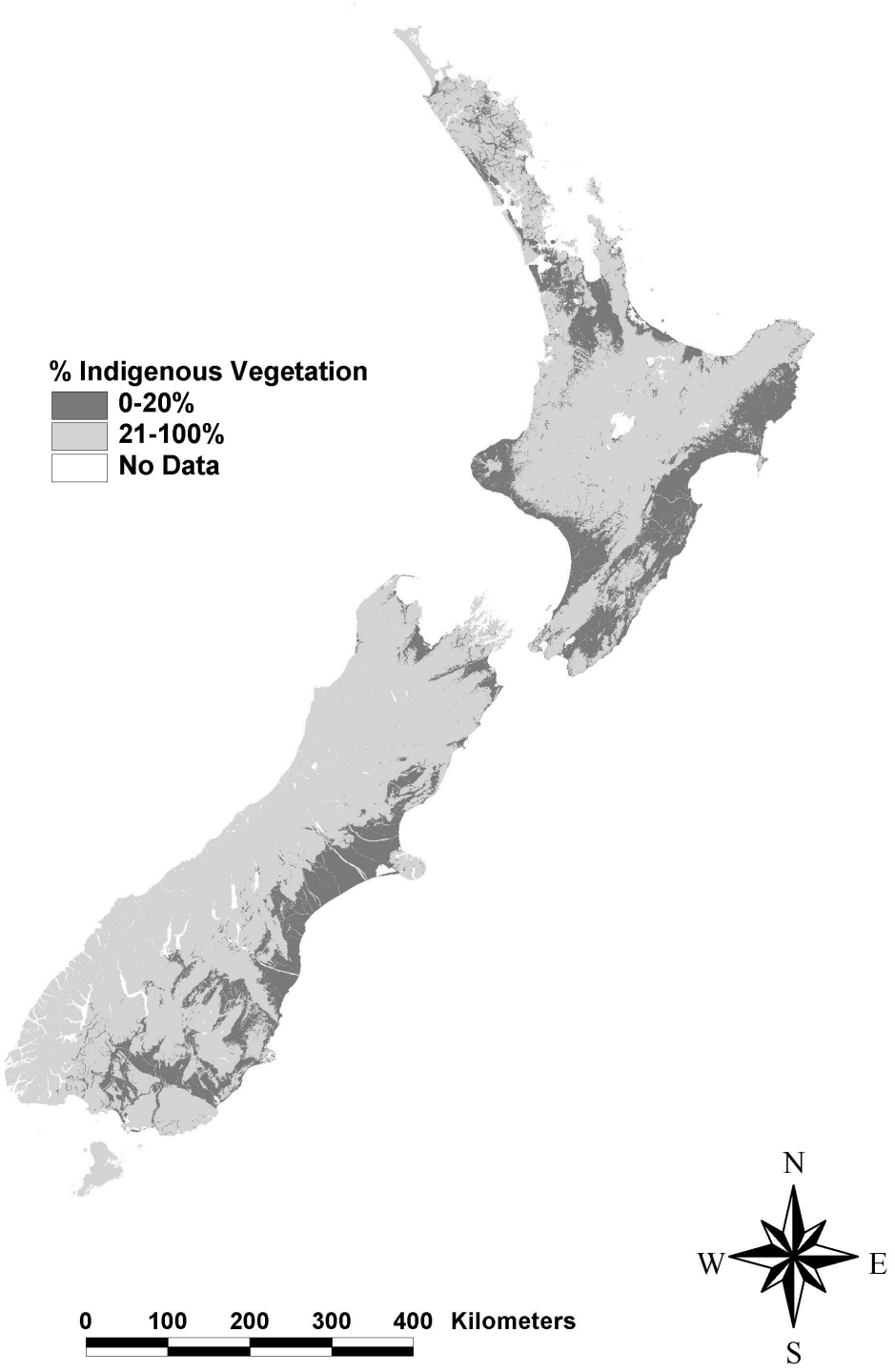

Figure 4. Areas with less than 20% indigenous cover remaining by LENZ Level II (100 environments nationally).

Table 8. Amount of legally protected area in indigenous and non-indigenous land cover for each LENZ Level II environment.

LENZ Level II	Total Area	Area Legally Protected			Area Not Legally Protected		
		Indigenous	Not Indigenous	Total	Indigenous	Not Indigenous	Total
TOTAL	26 209 053	7 981 044	229 526	8 210 570	6 055 940	11 942 543	17 998 483
A1	49 537	15 863	3 205	19 068	9 512	20 957	30 469
A2	30 834	4 745	557	5 302	6 277	19 254	25 531
A3	796	720	76	796	–	–	–
A4	9 362	201	154	355	2 047	6 961	9 008
A5	383 312	17 699	1 790	19 489	17 707	346 117	363 823
A6	885 509	38 791	4 359	43 150	201 514	640 845	842 359
A7	473 105	4 702	1 864	6 565	27 862	438 678	466 540
B1	182 007	760	515	1 275	13 555	167 177	180 732
B2	69 059	1 067	404	1 471	3 272	64 317	67 588
B3	187 533	1 683	859	2 541	56 023	128 968	184 991
B4	2 703	46	8	55	305	2 343	2 648
B5	50 021	51	560	611	806	48 604	49 410
B6	29 222	4	224	227	703	28 291	28 995
B7	53 089	37	197	234	2 448	50 408	52 856
B8	85 430	2 028	367	2 395	35 765	47 271	83 036
B9	18 671	91	498	589	1 337	16 745	18 082
C1	83 454	3 437	719	4 156	7 400	71 899	79 299
C2	255 001	1 233	663	1 896	10 187	242 918	253 105
C3	293 928	489	843	1 332	7 181	285 415	292 596
D1	668 573	208 983	9 929	218 913	232 549	217 112	449 660
D2	446 108	54 803	2 443	57 246	110 193	278 669	388 862
D3	686 161	14 092	5 649	19 740	98 422	567 998	666 420
D4	311 310	154 570	5 811	160 381	62 153	88 776	150 929
E1	925 527	173 223	2 577	175 799	542 335	207 393	749 728
E2	16 455	4 980	239	5 219	3 267	7 969	11 236
E3	68 824	1 001	377	1 378	15 835	51 611	67 446
E4	316 663	36 701	1 453	38 155	228 157	50 351	278 508
F1	1 832 883	406 197	13 556	419 753	505 747	907 382	1 413 130
F2	13 406	5 658	17	5 675	5 175	2 556	7 731
F3	96 263	2 740	1 839	4 579	19 289	72 396	91 685
F4	377 564	1 639	829	2 468	32 639	342 456	375 095
F5	296 556	15 479	1031	16 510	14 404	265 641	280 045
F6	1 205 644	343 418	23 571	366 989	189 645	649 010	838 655
F7	1 407 198	207 573	31 979	239 553	200 671	966 974	1 167 645

LENZ Level II	Total Area	Area Legally Protected			Area Not Legally Protected		
		Indigenous	Not Indigenous	Total	Indigenous	Not Indigenous	Total
G1	103 273	16 512	3 660	20 173	15 964	67 137	83 100
G2	7 729	502	164	666	4 475	2 589	7 064
G3	149 141	1 991	1 797	3 788	15 902	129 451	145 353
G4	56 426	2 070	633	2 703	4 165	49 559	53 723
G5	279	14	27	41	48	190	238
G6	19 676	81	219	300	1 982	17 395	19 377
H1	51 825	5 821	577	6 397	6 559	38 869	45 428
H2	60 504	13 301	876	14 176	10 226	36 102	46 328
H3	8218	299	133	431	469	7 318	7 787
H4	13 942	11 448	20	11 467	690	1 785	2 475
I1	1627	121	22	143	614	871	1 485
I2	48 290	416	692	1 108	1 252	45 930	47 182
I3	27 440	841	1 821	2 662	999	23 779	24 778
I4	432		3	3	39	390	429
I5	39 774	123	105	229	690	38 855	39 545
I6	4166	138	124	261	96	3 808	3 904
J1	53 721	278	1 876	2154	3 450	48 116	51 567
J2	116 133	1 627	12 100	13 727	16 542	85 865	102 407
J3	15 044	396	197	593	2 548	11 902	14 451
J4	108 872	771	1 386	2 157	8 642	98 073	106 715
K1	96 322	23 163	717	23 880	53 589	18 853	72 442
K2	10 984	592	3	595	9 718	671	10 388
K3	31 301	803	478	1 281	14 429	15 591	30 020
K4	16 048	565	30	595	10 539	4 914	15 453
K5	4771	161	185	345	1 692	2 733	4 425
L1	201 670	7 975	8 622	16 597	18 481	166 592	185 073
L2	9673	437	106	542	866	8 265	9 131
L3	110 435	34 733	839	35 572	24 785	50 078	74 863
L4	406 572	654	1 848	2 502	15 600	388 470	404 070
L5	60 515	4 438	771	5 209	3 629	51 676	55 305
L6	12 137	11 778		11 778	359		359
M1	90 358	32 361	3 127	35 488	13 511	41 359	54 870
M2	74 700	18 165	3 721	21 886	14 174	38 640	52 815
M3	397	146	63	208	181	7	188
M4	55 021	54 156	47	54 ,203	552	266	818

LENZ Level II	Total Area	Area Legally Protected			Area Not Legally Protected		
		Indigenous	Not Indigenous	Total	Indigenous	Not Indigenous	Total
N1	402 929	340	4 361	4 701	6 377	391 851	398 228
N2	486 572	745	4 014	4 759	9 984	471 830	481 814
N3	593 152	3 033	2 251	5 284	76 767	511 101	587 869
N4	243 676	1 908	2 536	4 443	159 973	79 260	239 233
N5	162 647	286	1 282	1 568	11 087	149 992	161 079
N6	92 820	3 288	466	3 754	62 254	26 812	89 066
N7	11 964	218	277	495	3 379	8 091	11 470
N8	36 182	143	815	958	3 183	32 040	35 223
O1	485 927	312 318	5 825	318 143	85 562	82 221	167 783
O2	479 351	462 670	484	463 154	13 790	2 407	16 197
O3	88 121	57 189	820	58 009	16 940	13 173	30 112
O4	148 400	134 623	317	134 940	9 032	4 428	13 460
O5	207 684	195 044	2	195 046	12 620	17	12 638
P1	1 160 774	643 937	479	644 416	514 491	1 867	516 358
P2	171 365	130 985	1	130 986	40 379	0	40 379
P3	360 456	351 453	109	351 562	8 742	152	8 894
P4	46 217	44 343		44 343	1 874		1874
P5	489 179	342 722	4 045	346 767	80 530	61 882	142 412
P6	410 255	286 815	3 979	290 794	56 741	62 720	119 461
P7	442 427	274 893	471	275 364	154 879	12 184	167 063
P8	197 912	151 838	980	152 818	38 404	6 690	45 094
Q1	915 364	289 709	2 074	291 783	596 329	27 252	623 581
Q2	649 134	38 298	4 321	42 618	432 567	173 949	606 516
Q3	419 385	67 873	4 522	72 395	256 572	90 418	346 990
Q4	1 292 459	179 514	10 864	190 378	215 043	887 039	1 102 081
R1	980 822	860 227	20	860 247	120 572	3	120 575
R2	953 114	952 535	30	952 565	548	1	549
S1	3758	1 513	23	1 536	1 562	660	2 221
S2	16 953	16 777	13	16 790	99	64	163
S3	12 706	12 706		12 706	0		0
T1	157 419	153 362		153 362	4 056		4 056
WATER	210 811	38 163	7999	46 163	119 768	44 880	164 648

6. Conclusions

The results of the analysis confirms the conventional wisdom that conservation efforts in New Zealand to date, while extremely successful, have been biased towards particular types of environments and therefore particular types of ecosystems. The analysis confirms that large expanses of relatively unproductive sections of the country receive high levels of legal protection and are in relatively good condition. Conversely, lower lying area have generally much lower levels of legal protection, and what is protected is often not in good condition.

The report also confirms that the vast majority of protection of New Zealand's biodiversity comes from public land, e.g., Crown Conservation estate. For some environments, however, private land affords a significant portion of current levels of protection (e.g. B1, B5, F4, G2, G6, and L2). Indeed, in lowland areas, private covenants or similar conservation efforts will likely remain as the major source of future protection efforts. However, covenanting by itself will not guarantee the future health and vitality of indigenous ecosystems. Proper management must take place to minimize threats and pressures from exotic species (e.g., predators and mammals) and give indigenous biodiversity the greatest chance to persist and thrive.

Finally, the summary results presented indicate conditions at LENZ Level II (100 environments nationally). LENZ has finer levels of classification (Level III – 200 and Level IV – 500 environments nationally). Reporting results at Level II may actually mask poor status at those levels.

7. Recommendations

Based on the results of the analysis, we make the following recommendations:

- All agencies involved with land protection – on either public or private land – for biodiversity conservation should place high priority on producing spatial data sets that show areas of legal protection under their jurisdiction
- One agency should take the lead in developing and maintaining a coordinated spatial data layer that shows all legally protected areas on public and private land. For reasons of privacy and protection of valuable resources, that information should be made available only in summary form for public consumption.

A centralised, consistent spatial database of all legally protected areas would help all parties interested in biodiversity conservation and restoration better focus efforts to meet the goals of the New Zealand Biodiversity Strategy.

8. Acknowledgements

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Appendix

Steps taken to prepare the spatial data layers for analysis. Due to faster processing speed, most processing occurred in ArcInfo on a Sun UNIX workstation, rather than on ArcGIS.

1. **Analysis Mask**
   Made an analysis mask (grid) using the LENZ Classification Layer Level IV layer, retaining NoData values for sea, rivers, lakes, etc.:

   nzmask=con(lenz_lvl_4>0,0)

Notes: **1 **All grids** use the origin and number of cells from this grid.*
2 All **final grids are masked using this grid to ensure that they are all consistent with the original LENZ Level IV Classification layer.*

2. **LENZ Level IV Classification**
   Used "as is."

3. **Crown Conservation Estate**
   (i) Converted two shapefiles *docestid* (Crown estate protected for natural heritage value) and *docested* (Crown estate protected for other values) to coverages
   (ii) Added item: INOUTID and reclassified for inclusive = 1, or exclusive = 2, and rivers, lakes, etc. = 10.
   (iii) Grided the coverages on INOUTID
   polygrid docested gdocested inoutid
   polygrid docestid gdocestid inoutid

   (v) Converted all nodata values to zero

   (vi) Joined the two grids and applied the analysis mask for no data values.
   NDOCEST1 = ndocestid + ndocested
   NDOCEST2 = con(ndocest1 = 3,2,ndocest)
   NDOCEST3 = con(ndocest2 = 10,1,con(ndocest2 =11,2,ndocest2))
   NDOCEST4 = con(ndocest3 > 2,0,ndocest3)
   NDOCESTFINAL = con(isnull(nzmask),nzmask,ndocest4)

4. **QEII Trust National Covenants**
   a. *Actual Covenants*
   QEII National Trust supplied full and partial data shapefiles, one per political region.
   (i) Converted the Waikato Region data from the NZGD UTM59S with Central Meridian (173), False Easting (1600000), and False Northing (10000000) to New Zealand Map Grid.
   (ii) Merged all shapefiles into one shapefile.
   (iii) Generated a grid from the merged shapefile.
   (iv) Reclassified all values to a 1 = QEII Actual

b. *Estimated Covenants*
QEII National Trust supplied point locations (as 7-digit map references) and areas (ha) for all QEII covenants.
(i) Calculated northing and easting coordinates based on 7-digit map reference for each point.
(ii) Determined the radius needed to produce a circle with the same area as that provided for each covenant.
(iii) Generated a point coverage using the calculated easting/northing.
(iv) Buffered each point with a circle equal in area to the size of the corresponding covenant.
(v) Generated a grid of the buffered points with value 2 = QEII Estimated.

c. Final (Merged) Coverage
(i) Unioned the Actual and Estimated coverage to identify estimated buffers that overlapped actual covenants
(ii) Removed overlaps
(iii) Generated final grid using analysis mask.

5. Nature Heritage Fund Covenants
(i) Generated grid from the shapefile.
(ii) Generated final grid using analysis mask.

6. Nga Whenua Rahui Covenants
(i) Generated grid from the shapefile.
(ii) Generated final grid using analysis mask.

7. District Council Boundaries
(i) Generated grid from the shapefile.
(ii) Generated final grid using analysis mask.

8. Regional Council Boundaries
(i) Generated grid from the shapefile.
(ii) Generated final grid using analysis mask.

Manaaki Whenua
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