

Figure 11. A: Rate of change in indigenous cover (as a percentage of remaining indigenous cover in 1996/97). B: Change in susceptibility to biodiversity loss (SBL) in Level IV land environments from 1996/97 to 2001/02.

The general pattern of increase in SBL (shown in Fig. 10C & D) was:

- Large increases in SBL in a few, Acutely Threatened environments (e.g. N2.1d - South Canterbury Plains, C3.2c - Coastal Rangitikei and Manawatu, B6.1b and B1.1c - terraces of the Awatere and Wairau Valleys in Marlborough, N3.1f - upper Maniototo and Strath Taieri Plains in Otago).
- Somewhat smaller increases in several Acutely Threatened, Chronically Threatened and At Risk environments.
- Minor increases in SBL in a high percentage of environments across all threat categories.

Figure 11B shows the geographic distribution of change in SBL within New Zealand's Level IV land environments.

4.5.4 Loss of indigenous cover and change in SBL across council areas

In our final analysis, we calculated change in indigenous cover from 1996/97 to 2001/02 in each council area, and the contribution of the indigenous cover loss in each to the total change in SBL across the 500 Level IV land environments nationally. These statistics are tabulated for councils and DOC conservancies and areas (Tables 19-22). The loss and change in those councils contributing most to total indigenous cover loss and to summed change in SBL is illustrated in Figure 12.

Tables 19 to 21 and Figure 12 show that the high proportions of the total loss of indigenous cover, the loss of indigenous cover not protected in threatened environments (INPTE) and the summed change in SBL occurred in a relatively small number of districts and DOC conservancies and areas.

More than 50% of the total loss of indigenous cover occurred in six council districts (Marlborough, Far North, Tasman, Central Otago, Southland and Gisborne), and more than 50% of loss of INPTE occurred in five council districts (Far North, Central Otago, Gisborne, Marlborough and Southland). Hastings, Marlborough and Horowhenua council districts contributed 57% of the summed increase in SBL across all land environments, with Central Otago, South Taranaki and Tasman districts together contributing another 17%. In 13 districts or cities (Auckland, Christchurch, Franklin, Gore, Hamilton, Kaikoura, Kawerau, Napier, Papakura, Queenstown Lakes, Selwyn, Tauranga, Waitakere), no indigenous cover loss at all was recorded (and, therefore, no increase in SBL).

Among DOC conservancies (Table 20), East Coast/Hawke's Bay contributed 37% of the summed increase in SBL (Napier Area alone accounted for 33%; Table 21), Nelson/Marlborough contributed 21% (South Marlborough Area accounted for 15%) and Wanganui contributed 17% (Palmerston North Area accounted for 15%).

Table 22 shows that Masterton, South Taranaki and Tararua districts had the largest area losses of indigenous cover from Acutely Threatened environments, while Central Otago, Far North and Gisborne districts lost the largest areas of indigenous cover in Chronically Threatened environments. Among DOC conservancies (Table 23) Wellington and Wanganui lost the largest area of indigenous cover from Acutely Threatened environments, while East Coast/Hawke's Bay and Otago lost the largest area of indigenous cover in Chronically Threatened environments.

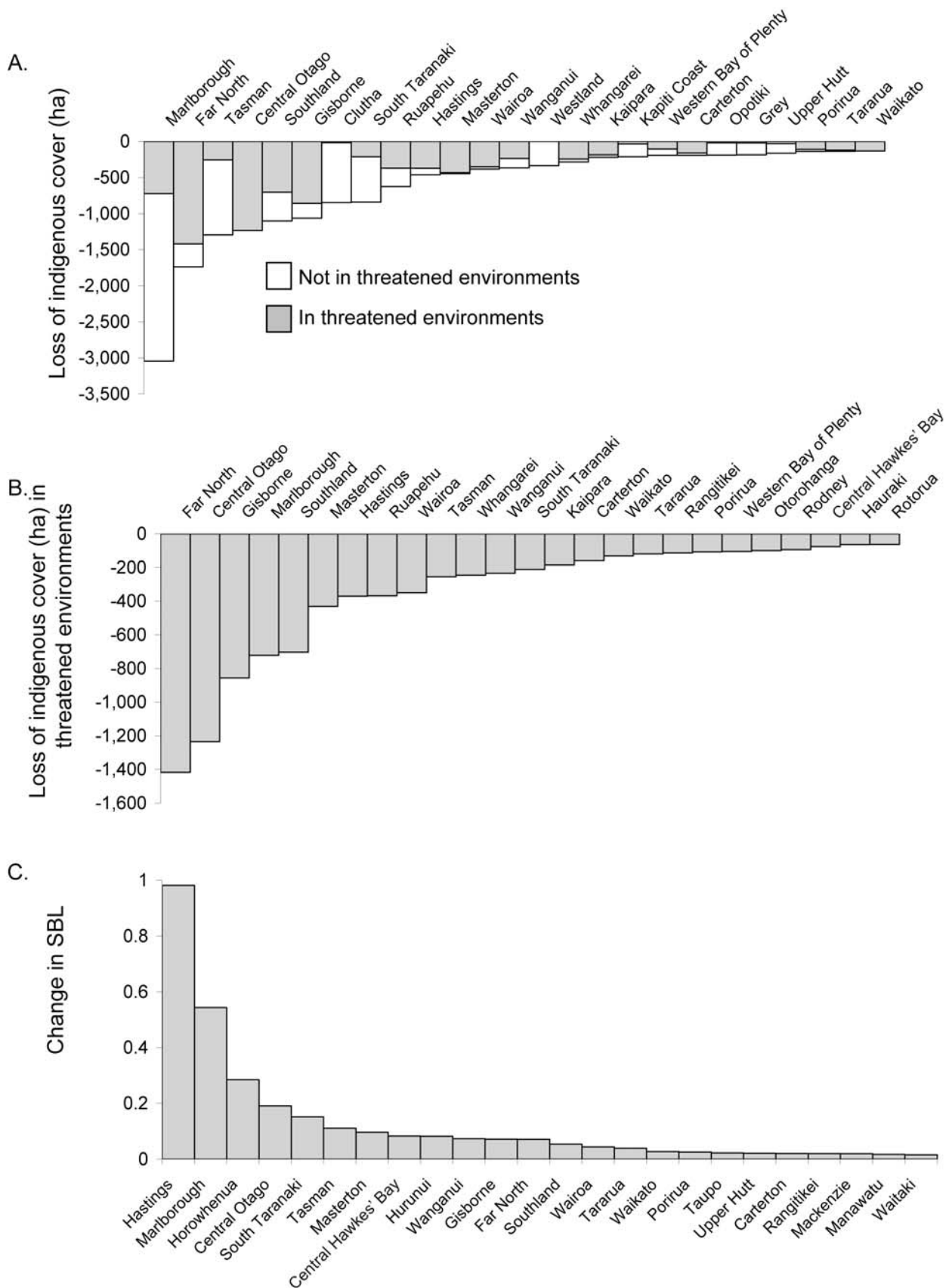


Figure 12. Contribution of top-ranking district and city council to national loss of indigenous cover and increase in susceptibility to biodiversity loss (SBL), in rank order. A: Loss of indigenous cover. B: Loss of indigenous cover in threatened environments only. C: Summed change in SBL due to loss of indigenous cover in that district.

TABLE 19. LOSS OF INDIGENOUS COVER BY COUNCIL AREA, AND CONTRIBUTION TO SUMMED NATIONAL CHANGE IN SUSCEPTIBILITY TO BIODIVERSITY LOSS (SBL) ACROSS ALL LEVEL IV LAND ENVIRONMENTS (ALL) AND THE FIVE THREATENED ENVIRONMENT CATEGORIES (THREATENED), FROM 1996/97 TO 2001/02. COUNCIL RANK (RK) INDICATES A COUNCIL'S CONTRIBUTION TO EACH LOSS STATISTIC, WHICH WERE DETERMINED AT LEVEL IV OF LENZ.

COUNCIL	LOSS OF INDIGENOUS COVER				LOSS OF INP				CHANGE IN SBL		
	ALL		THREATENED		ALL		THREATENED		CHANGE	PERCENTAGE OF SUMMED CHANGE	RK
	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK			
Ashburton	9	55	1	55	9	54	1	55	0.002	0.07	45
Auckland	0	61	0	58	0	60	0	58	0.000	0.00	61
Banks Peninsula	16	51	16	44	16	50	16	43	0.004	0.14	37
Buller	29	42	21	37	49	35	20	37	0.002	0.07	43
Carterton	191	19	159	15	191	18	159	15	0.021	0.64	20
Central Hawke's Bay	81	31	75	23	80	30	74	22	0.083	2.60	8
Central Otago	1234	4	1234	2	1233	3	1233	2	0.191	5.95	4
Christchurch	0	61	0	58	0	60	0	58	0.000	0.00	61
Clutha	847	7	16	45	839	7	16	44	0.006	0.18	31
Dunedin	55	34	55	27	54	33	54	25	0.006	0.18	32
Far North	1737	2	1418	1	1695	2	1389	1	0.072	2.23	12
Franklin	0	61	0	58	0	60	0	58	0.000	0.00	61
Gisborne	1063	6	856	3	1035	6	839	3	0.072	2.25	11
Gore	0	61	0	58	0	60	0	58	0.000	0.00	61
Grey	186	21	20	39	129	23	20	38	0.002	0.07	46
Hamilton	0	61	0	58	0	60	0	58	0.000	0.00	61
Hastings	460	10	370	7	458	10	369	7	0.982	30.66	1
Hauraki	84	30	63	24	83	29	62	23	0.003	0.10	40
Horowhenua	24	44	14	46	24	44	14	46	0.285	8.90	3
Hurunui	38	39	36	29	38	39	36	28	0.082	2.57	9
Invercargill	6	57	0	58	6	56	0	58	0.000	0.00	59
Kaikoura	0	61	0	58	0	60	0	58	0.000	0.00	61
Kaipara	219	16	185	14	219	15	185	14	0.008	0.24	29
Kapiti Coast	213	17	35	30	213	16	35	29	0.008	0.25	28
Kawerau	0	61	0	58	0	60	0	58	0.000	0.00	61
Lower Hutt	42	38	3	54	42	38	3	54	0.001	0.03	53
Mackenzie	17	49	17	42	17	49	17	42	0.020	0.62	22
Manawatu	43	37	43	28	43	37	43	27	0.018	0.56	23
Manukau	17	50	17	43	16	51	16	44	0.000	0.00	58
Marlborough	3044	1	722	4	2972	1	699	4	0.544	16.98	2
Masterton	446	11	431	6	443	11	428	6	0.096	3.00	7
Matamata-Piako	1	60	1	57	1	59	1	57	0.000	0.01	55
Napier	0	61	0	58	0	60	0	58	0.000	0.00	61
Nelson	7	56	7	50	7	55	7	50	0.003	0.08	41
New Plymouth	36	40	9	49	36	41	9	49	0.002	0.08	42
North Shore	6	57	6	51	6	56	6	51	0.000	0.00	60
Opotiki	188	20	19	40	185	19	19	39	0.005	0.14	36
Otorohanga	122	28	99	21	121	26	99	21	0.002	0.05	47
Palmerston North	1	59	1	56	1	58	1	56	0.000	0.01	56
Papakura	0	61	0	58	0	60	0	58	0.000	0.00	61
Porirua	138	23	107	19	138	21	107	19	0.026	0.81	17
Queenstown Lakes	0	61	0	58	0	60	0	58	0.000	0.00	61
Rangitikei	129	26	113	18	114	27	111	18	0.020	0.63	21

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Table 19—continued

COUNCIL	LOSS OF INDIGENOUS COVER				LOSS OF INP				CHANGE IN SBL		
	ALL		THREATENED		ALL		THREATENED		CHANGE	PERCENTAGE OF SUMMED CHANGE	RK
	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK			
Rodney	98	29	93	22	107	28	102	20	0.002	0.07	44
Rotorua	79	32	62	25	64	31	49	26	0.015	0.48	25
Ruapehu	623	9	368	8	623	8	368	8	0.006	0.18	30
Selwyn	0	61	0	58	0	60	0	58	0.000	0.00	61
South Taranaki	839	8	212	13	532	9	208	13	0.152	4.75	5
South Waikato	30	41	25	32	30	42	25	32	0.005	0.16	34
South Wairarapa	122	27	24	33	122	25	24	33	0.005	0.15	35
Southland	1101	5	703	5	1093	5	694	5	0.054	1.68	13
Stratford	44	36	18	41	44	36	18	41	0.000	0.01	54
Tararua	136	24	119	17	135	22	117	17	0.039	1.22	15
Tasman	1294	3	255	10	1221	4	251	10	0.111	3.47	6
Taupo	52	35	56	26	51	34	54	24	0.023	0.71	18
Tauranga	0	61	0	58	0	60	0	58	0.000	0.00	61
Thames-Coromandel	58	33	5	52	58	32	5	52	0.002	0.05	48
Timaru	23	47	23	35	23	47	23	35	0.011	0.35	26
Upper Hutt	163	22	30	31	163	20	30	30	0.021	0.67	19
Waikato	131	25	130	16	126	24	126	16	0.027	0.85	16
Waimakariri	20	48	20	38	19	48	19	40	0.011	0.33	27
Waimate	11	53	11	47	11	52	11	47	0.006	0.17	33
Waipa	23	45	22	36	23	45	22	36	0.004	0.14	38
Wairoa	383	12	350	9	383	12	350	9	0.044	1.38	14
Waitakere	0	61	0	58	0	60	0	58	0.000	0.00	61
Waitaki	11	53	11	47	11	52	11	47	0.016	0.49	24
Waitomo	23	46	23	34	23	46	23	34	0.001	0.04	50
Wanganui	366	13	234	12	365	13	234	12	0.073	2.29	10
Wellington	24	43	5	53	24	43	5	53	0.000	0.01	57
Western Bay of Plenty	191	18	105	20	37	40	26	31	0.001	0.03	52
Westland	335	14	0	58	194	17	0	58	0.001	0.04	51
Whakatane	11	52	-3	73	-3	73	-3	73	0.001	0.05	49
Whangarei	284	15	245	11	279	14	240	11	0.004	0.12	39

TABLE 20. LOSS OF INDIGENOUS COVER BY DOC CONSERVANCY, AND CONTRIBUTION TO SUMMED NATIONAL CHANGE IN SUSCEPTIBILITY TO BIODIVERSITY LOSS (SBL) ACROSS ALL LEVEL IV LAND ENVIRONMENTS (ALL ENV.) AND THE FIVE THREATENED ENVIRONMENT CATEGORIES (THREATENED), FROM 1996/97 TO 2001/02. RANK (RK) INDICATES A CONSERVANCY'S CONTRIBUTION TO EACH LOSS STATISTIC.

CONSERVANCY	LOSS OF INDIGENOUS COVER				LOSS OF INP				CHANGE IN SBL		
	ALL		THREATENED		ALL		THREATENED		CHANGE	PERCENTAGE OF SUMMED CHANGE	RK
	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK			
Auckland	121	13	116	11	129	13	124	9	0.003	0.1	13
Bay Of Plenty	299	11	191	9	130	12	99	11	0.024	0.8	10
Canterbury	134	12	125	10	132	11	123	10	0.136	4.2	6
East Coast/Hawke's Bay	2241	2	1695	2	2181	3	1675	2	1.188	37.1	1
Nelson/Marlborough	4301	1	983	4	4160	1	957	4	0.657	20.5	2
Northland	2241	3	1848	1	2194	2	1814	1	0.083	2.6	7
Otago	2180	4	1319	3	2169	4	1316	3	0.218	6.8	4
Southland	1074	7	701	6	1066	7	692	6	0.053	1.7	8
Tongariro/Taupo	301	10	79	12	299	10	78	12	0.023	0.7	11
Waikato	890	8	676	7	884	8	670	7	0.044	1.4	9
Wanganui	1383	6	653	8	1074	6	649	8	0.552	17.2	3
Wellington	1445	5	888	5	1440	5	884	5	0.215	6.7	5
West Coast Tai Poutini	594	9	41	13	413	9	40	13	0.006	0.2	12

TABLE 21. LOSS OF INDIGENOUS COVER BY DOC AREA, AND CONTRIBUTION TO SUMMED NATIONAL CHANGE IN SUSCEPTIBILITY TO BIODIVERSITY LOSS (SBL) ACROSS ALL LEVEL IV LAND ENVIRONMENTS (ALL ENV.) AND THE FIVE THREATENED ENVIRONMENT CATEGORIES (THREATENED), FROM 1996/97 TO 2001/02. RANK (RK) INDICATES AN AREA'S CONTRIBUTION TO EACH LOSS STATISTIC. LAND ENVIRONMENT CATEGORIES WERE DETERMINED AT LEVEL IV OF LENZ.

DOC AREA	LOSS OF INDIGENOUS COVER				LOSS OF INP				CHANGE IN SBL		
	ALL		THREATENED		ALL		THREATENED		CHANGE	PERCENTAGE OF SUMMED CHANGE	RK
	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK			
Aniwaniwa	14	37	1	38	2	39	1	38	0.000	0.0	39
Aoraki	0	40	0	39	0	40	0	39	0.000	0.0	40
Auckland	38	35	36	32	37	35	35	32	0.000	0.0	38
Bay of Islands	1345	3	1188	3	1316	3	1160	3	0.057	1.8	11
Buller-Kawatiri	-51	49	-5	49	-25	49	-5	49	0.000	0.0	49
Central Otago	1234	4	1234	1	1233	4	1233	1	0.191	6.0	4
Coastal Otago	946	8	85	19	936	7	83	19	0.028	0.9	18
Franz Josef-Waiiau	0	40	0	39	0	40	0	39	0.000	0.0	40
Gisborne	1409	2	1205	2	1382	2	1188	2	0.116	3.6	7
Golden Bay	612	10	37	31	569	11	37	30	0.053	1.6	12
Great Barrier Island	0	40	0	39	0	40	0	39	0.000	0.0	40
Greymouth-Mawheranui	310	18	46	26	244	20	45	26	0.005	0.2	26
Hauraki	113	28	39	29	113	27	39	28	0.003	0.1	33

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Table 21—continued

DOC AREA	LOSS OF INDIGENOUS COVER				LOSS OF INP				CHANGE IN SBL		
	ALL		THREATENED		ALL		THREATENED		CHANGE	PERCENTAGE OF SUMMED CHANGE	RK
	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK			
Hokitika	335	17	0	39	194	24	0	39	0.001	0.0	37
Kaitaia	114	27	108	18	113	26	107	17	0.004	0.1	31
Kapiti	360	15	142	15	360	14	142	15	0.034	1.1	17
Kauri Coast	361	14	169	14	348	15	169	14	0.017	0.5	22
Maniapoto	536	12	409	8	535	12	408	8	0.006	0.2	24
Motueka	296	19	183	13	274	17	180	13	0.043	1.3	14
Murihiku	982	6	661	5	977	6	656	5	0.049	1.5	13
Napier	594	11	469	7	577	10	467	7	1.067	33.3	1
New Plymouth	32	36	6	36	32	36	6	36	0.002	0.1	36
North Canterbury	65	32	63	22	64	31	62	21	0.092	2.9	9
Opotiki	225	24	19	34	221	23	19	34	0.005	0.2	29
Palmerston North	140	26	137	16	140	25	137	16	0.320	10.0	3
Poneke	229	23	38	30	229	22	38	29	0.023	0.7	19
Rangitaiki	3	39	3	37	3	38	3	37	0.004	0.1	32
Rotorua Lakes	80	31	63	22	65	30	50	24	0.016	0.5	23
Ruakapuka	60	33	52	24	59	33	52	22	0.039	1.2	15
Ruapehu	247	21	28	33	246	19	28	33	0.003	0.1	34
Solander Island	0	40	0	39	0	40	0	39	0.000	0.0	40
Sounds	1825	1	76	21	1776	1	76	20	0.062	1.9	10
South Marlborough	1219	5	645	6	1196	5	623	6	0.481	15.0	2
South Westland-Weheka	0	40	0	39	0	40	0	39	0.000	0.0	40
Southern Islands	0	40	0	39	0	40	0	39	0.000	0.0	40
St Arnaud	350	16	41	27	345	16	41	27	0.018	0.6	21
Stratford	254	20	195	12	253	18	194	12	0.132	4.1	6
Tauranga	216	25	125	17	62	32	45	25	0.005	0.2	28
Te Anau	93	29	40	28	89	29	36	31	0.005	0.1	30
Turangi	54	34	52	25	53	34	50	23	0.020	0.6	20
Twizel	0	40	0	39	0	40	0	39	0.000	0.0	40
Waikato	241	22	228	11	236	21	223	11	0.035	1.1	16
Waimakariri	9	38	9	35	9	37	9	35	0.005	0.2	27
Wairarapa	856	9	708	4	851	8	704	4	0.159	5.0	5
Wakatipu	0	40	0	39	0	40	0	39	0.000	0.0	40
Wanaka	0	40	0	39	0	40	0	39	0.000	0.0	40
Wanganui	957	7	315	10	649	9	311	10	0.097	3.0	8
Warkworth	83	30	80	20	92	28	88	18	0.002	0.1	35
Whangarei	421	13	382	9	416	13	377	9	0.005	0.2	25

TABLE 22. LOSS OF INDIGENOUS COVER, INCLUDING INDIGENOUS COVER NOT PROTECTED (INP) IN ACUTELY THREATENED AND CHRONICALLY THREATENED ENVIRONMENT CATEGORIES, BY COUNCIL AREA, FROM 1996/97 TO 2001/02. RANK (RK) INDICATES A COUNCIL'S CONTRIBUTION TO EACH LOSS STATISTIC. LAND ENVIRONMENT CATEGORIES WERE DETERMINED AT LEVEL IV OF LENZ.

COUNCIL	LOSS OF INDIGENOUS COVER				LOSS OF INP			
	ACUTELY		CHRONICALLY		ACUTELY		CHRONICALLY	
	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK
Ashburton	1	42	0	34	1	43	0	34
Auckland	0	50	0	35	0	50	0	35
Banks Peninsula	3	37	6	23	3	37	6	23
Buller	0	50	0	35	0	50	0	35
Carterton	16	21	1	31	16	21	1	31
Central Hawke's Bay	36	9	26	12	35	9	26	12
Central Otago	9	29	461	1	9	29	460	1
Christchurch	0	50	0	35	0	50	0	35
Clutha	16	22	0	35	16	22	0	35
Dunedin	13	27	0	35	13	27	0	35
Far North	49	7	364	3	49	8	363	3
Franklin	0	50	0	35	0	50	0	35
Gisborne	27	14	450	2	27	14	450	2
Gore	0	50	0	35	0	50	0	35
Grey	0	50	0	35	0	50	0	35
Hamilton	0	50	0	35	0	50	0	35
Hastings	50	6	321	4	49	7	320	4
Hauraki	2	39	18	16	2	39	18	16
Horowhenua	14	26	0	35	14	26	0	35
Hurunui	9	28	27	11	9	28	27	11
Invercargill	0	50	0	35	0	50	0	35
Kaikoura	0	50	0	35	0	50	0	35
Kaipara	5	33	13	17	5	33	13	17
Kapiti Coast	34	11	0	35	34	11	0	35
Kawerau	0	50	0	35	0	50	0	35
Lower Hutt	1	46	0	32	1	46	0	32
Mackenzie	5	32	12	18	5	32	12	18
Manawatu	19	18	24	14	19	17	24	14
Manukau	0	50	0	35	0	50	0	35
Marlborough	34	10	267	5	34	10	245	5
Masterton	194	1	25	13	192	1	25	13
Matamata-Piako	1	47	0	35	1	47	0	35
Napier	0	50	0	35	0	50	0	35
Nelson	1	43	0	35	1	42	0	35
New Plymouth	4	35	0	35	4	35	0	35
North Shore	0	50	0	35	0	50	0	35
Opotiki	18	19	1	29	18	18	1	29
Otorohanga	1	40	0	35	1	40	0	35
Palmerston North	0	50	1	29	0	50	1	29
Papakura	0	50	0	35	0	50	0	35
Porirua	30	13	0	35	30	13	0	35
Queenstown Lakes	0	50	0	35	0	50	0	35
Rangitikei	72	4	37	9	70	4	37	9
Rodney	1	44	-5	73	1	44	-1	73
Rotorua	25	15	0	35	22	15	0	35
Ruapehu	0	50	0	72	0	50	0	72
Selwyn	0	50	0	35	0	50	0	35
South Taranaki	99	2	0	35	99	2	0	35
South Waikato	21	17	0	33	21	16	0	33

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Table 22—continued

COUNCIL	LOSS OF INDIGENOUS COVER				LOSS OF INP			
	ACUTELY		CHRONICALLY		ACUTELY		CHRONICALLY	
	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK
South Wairarapa	8	30	3	26	8	30	3	26
Southland	44	8	201	6	53	6	184	6
Stratford	1	48	0	35	1	48	0	35
Tararua	74	3	6	24	73	3	5	24
Tasman	16	23	83	8	16	23	79	8
Taupo	53	5	0	35	53	5	0	35
Tauranga	0	50	0	35	0	50	0	35
Thames-Coromandel	1	40	1	28	1	40	1	28
Timaru	15	24	7	22	15	24	7	21
Upper Hutt	15	25	11	19	15	25	11	19
Waikato	21	16	2	27	18	19	2	27
Waimakariri	1	49	20	15	1	49	18	15
Waimate	6	31	0	35	6	31	0	35
Waipa	18	20	0	35	18	20	0	35
Wairoa	0	50	97	7	0	50	97	7
Waitakere	0	50	0	35	0	50	0	35
Waitaki	5	34	5	25	5	34	5	25
Waitomo	2	38	0	35	2	38	0	35
Wanganui	31	12	27	10	31	12	27	10
Wellington	0	50	0	35	0	50	0	35
Western Bay of Plenty	0	50	0	35	0	50	0	35
Westland	0	50	0	35	0	50	0	35
Whakatane	1	44	8	21	1	44	8	20
Whangarei	4	36	10	20	4	36	6	22

TABLE 23. LOSS OF INDIGENOUS COVER, INCLUDING INDIGENOUS COVER NOT PROTECTED (INP) IN ACUTELY AND CHRONICALLY THREATENED ENVIRONMENT CATEGORIES, BY DOC CONSERVANCY, FROM 1996/97 TO 2001/02. RANK (RK) INDICATES A CONSERVANCY'S CONTRIBUTION TO EACH LOSS STATISTIC. LAND ENVIRONMENT CATEGORIES WERE DETERMINED AT LEVEL IV OF LENZ.

CONSERVANCY	LOSS OF INDIGENOUS COVER				LOSS OF INP			
	ACUTELY		CHRONICALLY		ACUTELY		CHRONICALLY	
	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK	AREA (ha)	RK
Auckland	1	12	-5	13	1	12	-1	13
Bay Of Plenty	48	7	8	10	45	10	8	10
Canterbury	41	11	72	7	41	11	70	7
East Coast/Hawke's Bay	142	3	898	1	141	3	897	1
Nelson/Marlborough	51	5	350	4	51	5	324	4
Northland	58	4	387	3	58	4	383	3
Otago	45	9	466	2	45	9	465	2
Southland	42	10	201	5	51	6	184	5
Tongariro/Taupo	47	8	0	11	47	8	0	11
Waikato	50	6	21	9	47	7	21	9
Wanganui	240	2	89	6	238	2	89	6
Wellington	361	1	42	8	357	1	42	8
West Coast Tai Poutini	0	13	0	11	0	13	0	11

4.6 CHANGES DUE TO DATABASE REFINEMENTS AND/OR ACTUAL LOSS OF INDIGENOUS COVER?

Work completed in 2004 for MfE (i.e. Rutledge et al. (2004) and MfE et al. (2004)) pre-dated the release of LCDB 2 and LCDB 1 and is based on LCDB 1_2. Figures produced in our analyses for this work, therefore, differ from that previous work. Table 24 compares estimates from the three databases. It also shows the extent to which the different estimates based on LCDB 2 are due to improved classification (from 14 to 43 classes of cover) and to habitat loss.

5. Discussion

5.1 RISK TO REMAINING BIODIVERSITY IN NEW ZEALAND

New Zealand's indigenous biodiversity exists in a state of virtual extinction in some warm, flat, fertile eastern lowland environments, and is more intact and well protected in cold, wet, steep western environments. This variation reflects the uneven distribution of human development pressures (including

TABLE 24. AREAS (ha) OF REMAINING INDIGENOUS COVER NOT PROTECTED (INP) IN ACUTELY AND CHRONICALLY THREATENED ENVIRONMENT CATEGORIES, IDENTIFIED USING THE THREE DIFFERENT LAND COVER DATABASES: LCDB 1_2 (14 COVER CLASSES), LCDB 1 AND LCDB 2 (BOTH 43 COVER CLASSES).

	LCDB 1_2* (1996/97)	LCDB 1 (1996/97)	LCDB 2 (2001/02)	CHANGE IN ESTIMATED INP FROM LCDB 1 TO LCDB 2 AS A CONSEQUENCE OF:	
				IMPROVED CLASSIFICATION (LCDB 1_21 TO LCDB 1)	INDIGENOUS HABITAT CHANGE (1996/97 TO 2001/02)
Environment threat classification at LENZ Level IV					
Acutely Threatened	187 543	173 249	182 573	-14 294	9324
Chronically Threatened	282 757	298 343	285 416	15 587	-12 928
(Acutely Threatened + Chronically Threatened)	(470 300)	(471 592)	(467 988)	(1293)	(-3604)
All environments	5 936 173	4 810 907	4 794 636	-1 125 266	-16 271
Environment threat classification at LENZ Level II					
Acutely Threatened	179 564	185 476	183 726	5912	-1750
Chronically Threatened	261 412	187 756	186 287	-73 656	-1468
(Acutely Threatened + Chronically Threatened)	(440 976)	(373 232)	(370 014)	(-67 744)	(-3218)
All environments	5 936 173	4 810 907	4 794 636	-1 125 266	-16 271

* Data used in Rutledge et al. (2004) and MfE et al. (2004).

the pressure to clear indigenous cover), and legal protection for biodiversity for conservation purposes across New Zealand's land environments. Flat, warm, fertile environments have been almost entirely cleared of indigenous cover, and what little remains is poorly protected and threatened. Conversely, indigenous cover remains more intact and well protected in those environments that have been residual (or surplus) to productive uses, and hence under less threat from direct land clearance and the effects of fragmentation.

Remaining indigenous cover that is not protected in threatened land environments supports high proportions of New Zealand's threatened ecosystems and species. Its protection is, therefore, essential for halting the decline in indigenous biodiversity nationally, regionally and locally.

Advanced loss of habitat area is just one of many factors that may contribute to the high risk of loss to, and therefore vulnerability of, remaining indigenous biodiversity. Isolation, edge effects, co-extinctions and increased susceptibility to exotic pests and weeds are other factors that need to be considered in a comprehensive and realistic assessment of threat to the persistence of New Zealand's indigenous biota. These pressures and threats require active and ongoing management to halt the decline of biodiversity in most indigenous habitats (e.g. Perley et al. 2001). In the face of them, poor legal protection (associated with an absence of basic management inputs such as fencing and pest control) is the another major contributing factor to the vulnerability of biodiversity.

Poor legal protection is a particularly important risk factor in seral (successional) communities where percentage indigenous cover is an inadequate estimate of the extent of past habitat loss, and risk to remaining indigenous biodiversity. For example, tall-tussock grasslands in the eastern South Island were largely created by the intentional burning of diverse shrublands and forests by early Polynesians, and were subsequently depleted by fires set by Europeans and by mammalian grazing. Although still largely indigenous and, therefore, mainly classified as Critically Underprotected and Underprotected, environments supporting such seral communities probably now support only a fraction of their original biodiversity. Further clearance of their remnant shrublands, forests and wetlands and the loss of opportunities for their recovery and restoration would, therefore, pose severe risks to their remaining biodiversity. Recognition of threatened status in the future management of these land environments will be important to maintain their biodiversity and to secure a disproportionately large number of threatened species (Rogers et al. 2004).

5.2 PATTERN OF LOSS OF INDIGENOUS COVER

There was indigenous cover loss in almost half (49%) of the Level IV land environments in the 5 years from 1996/97 to 2001/02. More than 95% of this loss was of indigenous cover not legally protected (INP); in other words, lack of legal protection appears to a very strong predictor of loss. However, there appears to be some randomness in the pattern of recent loss of INP across land environments. We anticipate that in many environments, INP not cleared in this 5-year period may have suffered loss in the next 5 years (ending 2006/07). Similarly, some environments where loss occurred in this 5-year period may not lose indigenous cover in the next.

Indigenous cover that is not protected in the most threatened environments (e.g. Acutely Threatened and Chronically Threatened) now remains mainly on soils and landscape types of relatively low value for agricultural production. However, comparison of cover in 1996/97 and 2001/02 suggests that the trend is now for indigenous cover clearance on more marginal land. Overall, the greatest increase in risk to indigenous biodiversity (measured as change in SBL) in that 5-year period was in Acutely Threatened environments. However, the highest rates of loss of indigenous cover were in Chronically Threatened, At Risk, Critically Underprotected and Underprotected environments, where there was more indigenous cover left to lose than in Acutely Threatened environments.

Exotic afforestation was the major cause of indigenous cover loss in the period from 1996/97 to 2001/02, accounting for about 66% of it. Of the total increase in exotic afforestation across New Zealand in this period (c. 139 600 ha), at least 8.3% (c. 11 500 ha) involved clearance of indigenous cover. At least 3.8% (c. 5300 ha) of new afforestation involved clearance of remaining indigenous cover types in threatened environments. The future land use of an additional c. 2000 ha of cleared indigenous forest (c. 11% of total loss) is unknown. A proportion of this indigenous forest loss occurred in logging coupes within indigenous forest tracts that may slowly regenerate (e.g. in the Longwoods in Southland). However, some of the remainder may have been felled in preparation for planting in exotic forestry species or for pastoral use.

A further 29 198 ha of exotic forestry was established in vegetation classed in 1996/97 as Low-Producing Grassland (e.g. large areas in Southland, Clutha, Waitaki, Timaru, Hurunui and Marlborough districts). The Low-Producing Grassland cover class is a mixture of indigenous and non-indigenous vegetation types, and we expected, therefore, that indigenous cover loss due to forestry would be greater than the minimum estimate of c. 11 500 ha, perhaps considerably greater. Clearance for low-production pasture was a secondary cause of indigenous cover loss, intensive pasture development was a relatively minor contributor (< 6%), and loss to invasive weeds was minor (c. 1%).

Much of the remaining indigenous vegetation that was cleared (both in threatened environments and in those not classified as 'threatened') was forest or seral shrubland, or tall-tussock grassland. The greatest loss in a single class was in the Broadleaved Indigenous Hardwoods cover class (principally in Marlborough, South Taranaki and Ruapehu districts)—comprising broadleaved hardwood species, such as wineberry (*Aristotelia serrata*), mahoe (*Melicactus ramiflorus*), *Pseudopanax* spp., *Pittosporum* spp., *Fuchsia* spp., ngaio (*Myoporum laetum*) and titoki (*Alectryon excelsus*), together with tutu (*Coriaria* spp.) and tree ferns (Thompson et al. 2003). This vegetation type is usually in an advanced seral stage back to indigenous forest, but also includes primary coastal broadleaved forest. Loss of vegetation classed as Manuka and/or Kanuka Shrubland (principally in Marlborough, Gisborne, Tasman and Far North districts), Primary Indigenous Forest (principally in Far North and Southland districts), and Tall-Tussock Grassland (principally in Central Otago, Clutha and Southland districts) also accounted for significant portions of the total loss. In the past, seral (regenerating) woody vegetation may have been dismissed as insufficiently pristine to warrant protection. However, successional shrubland is probably of high importance for biodiversity in New Zealand. For example, Perley et al. (2001) highlighted general observational and quantified comparative studies that suggest that in

New Zealand late-successional shrubland communities are richer in insects than are tall, undisturbed forest (e.g. Dugdale & Hutcheson 1997; Hutcheson & Jones 1999).

We caution that because Low-Producing Grassland is a mixture of indigenous and non-indigenous vegetation types, we cannot estimate the extent of indigenous vegetation loss (e.g. short-tussock grassland) from this class. Our estimate of total loss and, therefore, increased SBL within New Zealand environments is probably an underestimate.

5.3 THE MOST APPROPRIATE LENZ LEVEL

As mentioned earlier, Leathwick et al. (2003a, b) suggested that LENZ Level II is useful for providing overview information at a national scale, but is less useful and relevant for applications at local, district and regional scales than Levels III and IV. Our work strongly supports this suggestion. We also advise that regional, district and local protection for biodiversity should be directed by a threat classification at Level IV rather than Level II.

First, we consider that a national threat classification to guide local authority protection for biodiversity should be relevant at the appropriate scale. Patterns of biodiversity, as well as of present and past land clearance, occur and are perceived at regional, district and local scales that are better depicted at Level IV than at Level II. A threat classification at Level II, therefore, is less appropriate for identifying vulnerable biodiversity at regional, district and local scales than a Level IV threat classification.

Second, we show that substantial areas of INPTE identified by threat classification at Level IV are *not* identified as threatened if classification is performed at Level II. Almost a third (31.2%) of INPTE area in Acutely Threatened and Chronically Threatened environments and almost a quarter (23.5%) of INPTE area in all five threatened environment categories are not classified as threatened if classification is carried out at Level II. In three of the 73 districts, the proportion of INPTE not identified is over 90%, and in more than a quarter of council areas it is greater than 50%. These underestimates are substantial and concerning, firstly, because the threat categories we assign are conservative (i.e. understated) rather than precautionary estimates of risk to remaining biodiversity, and, secondly, because indigenous biodiversity associated with environments not identified as threatened at Level II is known to contain some of New Zealand's most threatened species and ecosystems. These underestimates will also diminish the credibility of LENZ-based protection guidelines, especially in those districts where the error is large.

It has been suggested that the inefficiency cost of poorer targeting at Level II could be reduced by identifying only those areas of INP within environments classified as 'threatened' at Level II that are also within Level IV environments classified as 'threatened' at Level IV. This approach would:

- Introduce greater conceptual and computational complexity than is involved in undertaking a threat classification at Level IV of LENZ directly
- Nullify any perceived or actual advantage to implementation associated with the comparative simplicity of Level II threat classification

- Fail to mitigate the serious primary drawbacks of poor targetin—substantially less plausible and less effective identification of the biodiversity protection need

We, therefore, strongly recommend that Level IV is the most appropriate level of LENZ at which to classify threatened environments for the protection of vulnerable indigenous biodiversity at local, district and regional scales.

Level II of LENZ may be an appropriate level at which to present national and regional summaries of INPTE. However, it is more appropriate to summarise a threat classification performed at Level IV (cf. Walker et al. 2004) than to carry out a separate threat classification based on percentage indigenous cover remaining at Level II. For example, summarising areas of Level IV INPTE up to Level II both maintains constant estimates of national, regional and district INPTE areas and removes the considerable problems of less plausible, effective and efficient identification of threatened unprotected indigenous cover that arise from Level II threat classification. An example of such a summary is presented in Table A2.3.

5.4 DISSEMINATION OF THREAT CLASSIFICATION INFORMATION

Threat classification information is equally straightforward to disseminate and apply whether environments are classified at Level IV or Level II (all LENZ users have all four levels at their disposal).

The threat classification information can be tabulated and distributed to end-users such as council planners and ecological consultants in the form of a small (40KB for Level IV) ASCII text file (and, if desired, an associated GIS legend file of 4KB). The table can be joined to the LENZ grid table in a GIS (an operation that takes a few seconds at most). This converts the information to a national map (25-m resolution at LENZ Level IV) that can be accessed interactively and used for a wide variety of purposes such as consents processing, significance assessment, reserve planning, prioritising pest control.

We distributed Level IV threat classification information as described above to a small group of DOC, environmental NGOs, and regional council staff in October and November 2004 for testing. These end-users successfully trialed the LENZ Level IV threat classification across a variety of applications. It was used by DOC staff to inform policy and significance assessment for tenure review, by environmental NGOs for information, advocacy and resource consent hearings, and by regional council staff to inform priorities for pest control, and in submissions on proposed protected areas. A sample application of the interactive map is depicted in Appendix 4.

Our feedback from this trial suggests that (1) Level IV is an appropriate scale at which to assess the vulnerability of indigenous cover at a regional, district and local (i.e. property) scales and (2) the technical complexity of disseminating threat classification information at Level IV of LENZ (rather than Level II) is more perceived than actual: the threat classification was readily taken up and adopted by trial end-users with a range of skill levels and needs. The major

limitation to use that we saw is the use and uptake of LENZ by end-users; however, LENZ is now widely distributed across local authorities (Cieraad 2007; Walker et al. 2007), and remaining software constraints to uptake (e.g. conversion of LENZ for MapInfo users) are being resolved.

5.5 LIMITATIONS OF THE ENVIRONMENT THREAT CATEGORIES FOR IDENTIFYING SIGNIFICANT INDIGENOUS VEGETATION

Indigenous vegetation may be significant for its contribution to maintaining a wide range of different value types (i.e. not only biodiversity, but also landscape, recreation, public access, ecosystem services, etc.), and is usually identified by applying a range of criteria (e.g. representativeness, rarity, distinctiveness). Significance is not given only to inherent values that are threatened or rare. For example, the definition of significant inherent values in the Crown Pastoral Lands Act 1998 uses the terms ‘importance’, ‘nature’ and ‘quality’ as well as ‘rarity’. An area may also be considered significant at a range of scales (e.g. national, regional, local).

Land environment threat categories can help to identify indigenous cover that is significant (i.e. deserves protection) for the maintenance of indigenous biodiversity (a single value set) at a national scale. Specifically, the environment threat categories can assist by improving the objectivity of the assessment of representativeness. Representativeness (i.e. contribution to the maintenance of the full range) is generally used as the primary criterion for the assessment of significance of ecological values. High representative value (i.e. high significance on the basis of the representativeness criterion) is given to a community or ecosystem that exhibits one of the following:

1. Has large overall areas in a region or district
2. Has been reduced from their former extent
3. Is poorly represented in reserves (Myers et al. 1987)

Therefore, the representativeness criterion includes communities or ecosystems that have been significantly reduced and/or are poorly protected, but extends beyond these.

Remaining indigenous ecosystems, habitats and species in the five categories of threatened land environments are parts of the full range of biodiversity that have been significantly reduced and/or are poorly protected and, therefore, meet conditions 2 and 3 of the representativeness criterion above. Consequently, indigenous vegetation in threatened environments, although typically highly modified, would certainly be considered significant. However, there will be many areas of indigenous vegetation important for maintaining indigenous biodiversity in land environments that are not assigned to any of our five threat categories. For example:

- Some large areas of remaining indigenous vegetation (i.e. communities or ecosystems that have large overall areas in a region or district; 1, above) will not typically be located in threatened environments. High representative value is given to large areas because these are needed to maintain indigenous

species, habitats and ecological processes that require large areas to persist (e.g. species that are: large-bodied; host-dependent; habitat-specialist, or dependent on large contiguous habitats; or that have a narrow range).

- Remaining small-scale ecosystems and habitat types such as limestone outcrops (karst), geothermal and various wetland and floodplain ecosystem types are much reduced and/or poorly protected, but are not consistently identified by LENZ or other databases. These special habitats would meet conditions 2 and 3 of the representativeness criterion, but are not yet consistently mapped in New Zealand.
- An environment may not have lost more than 70% of its indigenous cover nationally, but remaining cover may be highly modified or disproportionately reduced within a particular region. In these cases, the cover may be judged to be significant, since its protection will contribute to the maintenance of the full range of biodiversity within that region.

6. Conclusions

New Zealand's coastal, lowland and montane environments have experienced substantial indigenous habitat loss, and what indigenous cover remains in these environments today has little legal protection.

The much-reduced and highly modified areas of indigenous cover in these threatened environments support a disproportionately large percentage of New Zealand's most seriously threatened species, habitats and ecosystems. The protection of what remains in these environments is essential to halt the decline of New Zealand's indigenous biodiversity.

Clearance and loss of indigenous cover and associated indigenous biodiversity continues across New Zealand, including in those environments where past loss has been extreme. Because the consequences of continued indigenous cover clearance for biodiversity (i.e. biodiversity loss and increased risk to what remains) are most severe in environments where little indigenous cover remains, the current pattern of clearance greatly exacerbates the status of biodiversity in New Zealand.

Although, historically, clearance of indigenous cover has been concentrated on land of high value for agricultural production, it appears that the trend is now for clearance of indigenous cover on more marginal land (i.e. Land-use Capability Classes VI, VII and VIII), notably for exotic forestry.

This evidence suggests that public awareness and education, voluntary protection, provisions of the Resource Management Act 1998 and formal legal protection of remaining indigenous biodiversity have not halted the clearance of vulnerable indigenous biodiversity in much reduced and poorly protected ecosystems and habitats.

7. Recommendations

Two characteristics of land environments can help to identify ‘habitats and ecosystems important for indigenous biodiversity that are not represented within the existing protected area network, or that are at significant risk of irreversible loss or decline...’ (DOC & MfE 2000: 41). These characteristics are (1) poor legal protection (reflected by low percentages of areas being legally protected) and (2) past habitat loss (reflected by low percentages of indigenous cover). This work led to the following recommendations:

- Based on these two characteristics, we recommend five categories of threatened environments to identify environments containing indigenous biodiversity that is at most risk of loss from land clearance and the effects of fragmentation. The biodiversity that remains in these threatened environments is some of the most severely threatened in New Zealand.
- Note that threatened environments do not identify places where biodiversity is most vulnerable to pressures that damage ecosystem processes (e.g. predators, feral and domestic herbivores, weeds, pollution, fire, drainage, and/or extractive land uses such as selective logging). These pressures threaten biodiversity processes in all environments in New Zealand, not just in those environments that are much reduced and poorly protected. Spatially explicit measures and estimates of process disruption are not yet available to reveal how these other risks to biodiversity are distributed across the landscape.
- We recommend that Level IV of LENZ is the most appropriate level to identify environments that are most vulnerable to biodiversity loss, in order to effectively protect biodiversity at district and local (property) scales. Information based on a Level IV classification of threatened environments may be summarised to higher levels (e.g. Level I or II) for national or regional summaries.
- Existing databases (e.g. LENZ, LCDB) do not identify many rare and distinctive ecosystems and habitats that also have reduced indigenous vegetation cover and are poorly represented in the network of protected natural areas. We, therefore, recommend that such rare and distinctive habitats and ecosystems also be regarded as threatened.
- We recommend the investigation and comparison of the social, economic and regulatory drivers of indigenous vegetation protection and loss in councils where most loss (e.g. Far North, Central Otago and Marlborough districts) and least loss (e.g. Kaikoura District, Waitakere City, Queenstown Lakes District) have occurred. This may help policy makers to understand some of the key factors for successful biodiversity conservation on private land.
- This analysis cannot be repeated in the future, unless further full national updates of the Land Cover Database are produced, using satellite imagery taken over as short a time period as possible (e.g. a single summer). We recommend that the interval between releases of comprehensive national land cover database updates be no more than 5 years, so that progress towards halting the decline in biodiversity can be monitored within relevant time frames. It is time to initiate work on LCDB 3.

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Appendix 1

INDIGENOUS ('1') AND NON-INDIGENOUS ('0') COVER CLASSES (LCDB 1 AND LCDB 2)

CLASS NO.	CLASS NAME	COVER TYPE
1	Built-up Area	0
2	Urban Parkland/Open Space	0
3	Surface Mine	0
4	Dump	0
5	Transport Infrastructure	0
10	Coastal Sand and Gravel	1
11	River and Lakeshore Gravel and Rock	1
12	Landslide	1
13	Alpine Gravel and Rock	1
14	Permanent Snow and Ice	1
15	Alpine Grass/Herbfield	1
20	Lake and Pond	1
21	River	1
22	Estuarine Open Water	1
30	Short-rotation Cropland	0
31	Vineyard	0
32	Orchard and Other Perennial Crops	0
40	High-Producing Exotic Grassland	0
41	Low-Producing Grassland	0
43	Tall-Tussock Grassland	1
44	Depleted Grassland	1
45	Herbaceous Freshwater Vegetation	1
46	Herbaceous Saline Vegetation	1
47	Flaxland	1
50	Fernland	1
51	Gorse and/or Broom	0
52	Manuka and/or Kanuka	1
53	Matagouri	1
54	Broadleaved Indigenous Hardwoods	1
55	Subalpine Shrubland	1
56	Mixed Exotic Shrubland	0
57	Grey Scrub	1
60	Minor Shelterbelts	0
61	Major Shelterbelts	0
62	Afforestation (not imaged)	0
63	Afforestation (imaged, post LCDB 1)	0
64	Forest-Harvested	0
65	Pine Forest-Open Canopy	0
66	Pine Forest-Closed Canopy	0
67	Other Exotic Forest	0
68	Deciduous Hardwoods	0
69	Indigenous Forest	1
70	Mangrove	1

Appendix 2

AREA OF INDIGENOUS VEGETATION NOT PROTECTED IN LENZ ENVIRONMENTS

TABLE A2.1. AREA OF INDIGENOUS VEGETATION NOT PROTECTED (INP) IN THE 42 LENZ LEVEL II ENVIRONMENTS WITH LESS THAN 20% INDIGENOUS VEGETATION REMAINING NATIONALLY, BY DISTRICT.

Bold type represents environments with < 10% indigenous vegetation remaining. 0–10% = Acutely Threatened environments, 10–20% = Chronically Threatened environments, 0–20% = Acutely and Chronically Threatened environments. Figures in parentheses are district totals when threat categories are determined as level IV of LENZ (see Table A2.3).

Table A2.1

LEVEL II ENVIRONMENT	PERCENTAGE REMAINING	ASHBURTON DISTRICT	AUCKLAND CITY	BANKS PENINSULA DISTRICT	BULLER DISTRICT	CARTERTON DISTRICT	CENTRAL HAWKE'S BAY DISTRICT	CENTRAL OTAGO DISTRICT	CHRISTCHURCH CITY	CLUTHA DISTRICT	DUNEDIN CITY	FAR NORTH DISTRICT	FRANKLIN DISTRICT	GISBORNE DISTRICT	GORE DISTRICT	GREY DISTRICT	HAMILTON CITY	HASTINGS DISTRICT	HAURAKI DISTRICT
A5	7.5		393									3149	722	517			44	37	1145
A7	5.6		408									3034	4480	423			220		162
B1	6.3						2254												1993
B2	6.3						1568							10					1286
B3	13.0	154		5															
B4	4.5																		
B5	1.5						5							199					380
B6	1.4			4					6										
B7	3.6						0												783
B9	6.9								9										
C1	12.1				302								6	18					
C2	4.0					139	93												71
C3	2.1					84	1156												17
D3	16.3						15						17	51946			0	14781	55
E3	6.6	790		0				90											
F3	15.0	3		11954					308										
F4	7.9					3044	3255												290
F5	10.3				691														
G3	11.6		187				1					4214	337	3568			4	136	4
G4	8.0		0										370	4					135
G6	10.2													1857				21	2
H3	8.9				7														
I2	3.2					97	167												27
I3	10.5	9		376					50										
I4	7.8																		
I5	1.4						2							218					210
I6	7.5													29					26
J1	6.5																		
J2	6.0	894		331					211										
J3	12.6																		
J4	7.7					333	293												193
K3	18.5	1						1766											
L1	7.5	120						101	533	485					132				
L2	11.8								445	154									
L4	2.8							118	6792	2678					201				
L5	13.0								59						10				
N1	0.8	267		4				0	75										
N2	0.7	638						5	54	108					0				
N3	5.3	11						11286	15	2401									
N5	2.6							1946											
N7	14.0							959											
N8	5.6							1843											
District totals: 0-10%																			
		2719	801	340	7	3696	8794	15389	301	7395	5672	6183	5572	1400	332	0	264	5313	1442
		(1898)	(446)	(2841)	(0)	(2266)	(6458)	(5282)	(471)	(9859)	(4290)	(3643)	(4192)	(3815)	(743)	(0)	(285)	(3363)	(1603)
District totals: 10-20%																			
		167	187	12334	993	0	16	2725	358	504	154	4214	360	57389	10	0	4	14938	60
		(838)	(480)	(4863)	(711)	(1630)	(4261)	(28006)	(167)	(5151)	(6694)	(8561)	(6145)	(47601)	(83)	(0)	(7)	(17195)	(179)

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Table A2.1—continued

LEVEL II ENVIRONMENT	HOROWHENUA DISTRICT	HURUNUI DISTRICT	INVERCARGILL DISTRICT	KAIKOURA DISTRICT	KAIAPARA DISTRICT	KAPITI COAST DISTRICT	KAWERAU DISTRICT	LOWER HUTT CITY	MACKENZIE DISTRICT	MANAWATU DISTRICT	MANUKAU CITY	MARLBOROUGH DISTRICT	MASTERTON DISTRICT	MATAMATA-PIAKO DISTRICT	NAPIER CITY	NELSON CITY	NEW PLYMOUTH DISTRICT	NORTH SHORE CITY	OPOTIKI DISTRICT
A5					2084						131			227			12	8	180
A7					397		30				347			410			4	96	1050
B1										160		691				212			
B2																			
B3	21064			506					40			439							
B4												60							
B5															25				
B6	7			18								356							
B7				159								931			4				
B9				291								797							
C1	0					0				5	6			12			512		49
C2	369					453		595		1139			240						
C3	595					552		77		403			443						
D3														11	25				21
E3	149								828			5							
F3												11							
F4	1					12		7		41			6187						
F5								2				1355				50	5295		
G3				1339			48				21			15	13		45		631
G4											61			524					
G6														0					
H3												141					56		
I2	133					6				53			77						
I3		9										418							
I4				9								25							
I5															36				
I6															113				
J1				7								1530					118		
J2	1344			20					1552			287							
J3	124			1511								1							
J4	1329					310		157		1086			375						
K3									1394										
L1				790					219										
L2																			
L4																			
L5				171															
N1	1861			9					62			2							
N2	122			0					599			14							
N3	15								913										
N5									699										
N7									315										
N8									0										
District totals: 0–10%																			
	2428	3497	790	513	2481	1332	30	837	4873	2881	540	4838	7321	1161	178	398	16	104	1230
	(1556)	(7226)	(274)	(770)	(1675)	(1270)	(78)	(596)	(2440)	(4594)	(403)	(3183)	(4621)	(1392)	(216)	(398)	(3960)	(51)	(2228)
District totals: 10–20%																			
	0	21198	171	2017	1339	0	48	2	1749	5	27	2225	0	38	38	50	5852	0	701
	(1166)	(10219)	(126)	(1994)	(4397)	(300)	(58)	(310)	(8834)	(5311)	(163)	(9080)	(4808)	(114)	(0)	(213)	(147)	(63)	(1099)

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Table A2.1—continued

LEVEL II ENVIRONMENT	OTOROHANGA DISTRICT	PALMERSTON NORTH CITY	PAPAKURA CITY	PORIRUA CITY	QUEENSTOWN LAKES DISTRICT	RANGITIKEI DISTRICT	RODNEY DISTRICT	ROTORUA DISTRICT	RUAPEHU DISTRICT	SELWYN DISTRICT	SOUTH TARANAKI DISTRICT	SOUTH WAIKATO DISTRICT	SOUTH WAIRARAPA DISTRICT	SOUTHLAND DISTRICT	STRATFORD DISTRICT	TARARUA DISTRICT	TASMAN DISTRICT	TAUPO DISTRICT	TAURANGA DISTRICT
A5	68		18				564	16			45	18						0	238
A7	29		73				1642	75				31							408
B1						1258			0		25		19				1818	1	
B2						43			51									5	
B3					17					449									
B4																			
B5																			
B6																			
B7																			
B9																			
C1	260					220		172	1449		248	0			10		223	1632	
C2		750		439		1345			30		261		482			1389			
C3		22		45		599					239		609			263			
D3	2					182		1				89						0	
E3					6					226									
F3					21					288									
F4			117			109					4		9129			5726			
F5						2				4519				1235			1602		
G3	23						729	32			7	33						1	
G4			23				0					1							39
G6							0												
H3											44				60		77		
I2		30		6		14							331			15			
I3										457									
I4																			
I5																			
I6																			
J1																			1477
J2										622									
J3																			
J4		130		16		871			226		445		731			670			
K3					895														
L1					172									5733					
L2																			
L4														989					
L5														3129					
N1					3					207				3					
N2					30					478				105			1		
N3					31									98					
N5					584														
N7					5														
N8					33														
District totals: 0–10%	98	932	114	622	860	4238	2205	91	306	1532	1063	50	11301	6930	60	8062	3417	6	685
	(744)	(356)	(113)	(494)	(1471)	(11128)	(1006)	(1339)	(743)	(1940)	(6003)	(849)	(6377)	(9132)	(1089)	(11237)	(3277)	(3715)	(628)
District totals: 10–20%	284	0	0	0	938	404	730	205	1449	1194	4774	122	0	3129	1245	0	1827	1633	0
	(773)	(1147)	(5)	(136)	(2913)	(4929)	(2111)	(1470)	(2709)	(746)	(146)	(164)	(5804)	(12146)	(133)	(8189)	(6232)	(284)	(1)

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Table A2.1—continued

LEVEL II ENVIRONMENT	THAMES-COROMANDEL DISTRICT	TIMARU DISTRICT	UPPER HUTT CITY	WAIKATO DISTRICT	WAIMAKARIRI DISTRICT	WAIMATE DISTRICT	WAIAPA DISTRICT	WAIROA DISTRICT	WAITAKERE CITY	WAITAKI DISTRICT	WAITOMO DISTRICT	WANGANUI DISTRICT	WELLINGTON CITY	WESTERN BAY OF PLENTY DISTRICT	WESTLAND DISTRICT	WHAKATANE DISTRICT	WHANGAREI DISTRICT	TOTAL INDIGENOUS COVER NOT PROTECTED
A5	387			1688			285	659	9		114			255		104	1164	14281
A7	1125			1690			529	1048	279		0			2675		140	1302	22108
B1												2341						10770
B2												276						3239
B3		17		360														23051
B4																		117
B5												9						618
B6				2														392
B7											0							1877
B9																		1097
C1			119				60				1214	6		4		214		6741
C2			449									512	324					9080
C3			73									339	62					5577
D3	77			32			31	29 858				0				5		97148
E3		758		687	87													3626
F3				24														12610
F4			2									123	40					28085
F5											61	248						15059
G3				448			122	451	14		0			18		991	2206	15637
G4	1153			796			79		4					144		71		3403
G6	5							33										1918
H3												6						390
I2													28					984
I3		46		25	62													1451
I4																		34
I5																		467
I6																		168
J1																		3132
J2		346		302						4								5913
J3																		1637
J4			9					2			20	273	34					7502
K3		133				117				1070								5376
L1		265				334				194								9077
L2		106				2				70								777
L4										172								10951
L5																		3368
N1		24		204	100													2821
N2		204		363	364					179								3264
N3		1642				2840				9489								28741
N5						47				843								4118
N7						2				235								1515
N8						0				19								1895
District totals: 0–10%																		
	2665	3239	532	4174	1558	3771	892	1710	292	10900	134	3878	488	3073	0	315	2467	183 726
	(1275)	(2263)	(675)	(6124)	(1558)	(2373)	(2436)	(1453)	(251)	(4145)	(1437)	(1995)	(446)	(2910)	(0)	(1628)	(1575)	(182573)
District totals: 10–20%																		
	81	302	119	481	408	183	214	30343	14	1375	1275	255	0	22	0	1211	2206	186287
	(1366)	(1132)	(343)	(4921)	(408)	(2630)	(287)	(19804)	(210)	(14735)	(192)	(2614)	(15)	(4)	(0)	(2395)	(3351)	(285416)

TABLE A2.2 AREA OF INDIGENOUS VEGETATION NOT PROTECTED (INP) IN THE 42 LENZ LEVEL II ENVIRONMENTS WITH LESS THAN 20% INDIGENOUS VEGETATION REMAINING NATIONALLY, ACROSS 16 REGIONS.

Bold type represents environments with < 10% indigenous vegetation remaining. Figures in brackets are district totals when threat categories are determined at Level IV of LENZ (see Table A2.3). 0–10% = Acutely Threatened environments, 10–20% = Chronically Threatened environments, 0–20% = Acutely and Chronically Threatened environments.

LEVEL II ENVIRONMENT	AUCKLAND	BAY OF PLENTY	CANTERBURY	GISBORNE	HAWKE'S BAY	MANAWATU-WANGANUI	MARLBOROUGH	NELSON CITY	NORTHLAND	OTAGO	SOUTHLAND	TARANAKI	TASMAN	WAIKATO	WELLINGTON	WEST COAST	TOTAL INP
A5	1252	790		517	697				6398			57		4572			14281
A7	5875	4375		423	1048				4734			4		5648			22108
B1					4279	3727	691	212				25	1818	1	19		10770
B2				10	2873	351								5			3239
B3			22594				439			17			1				23051
B4							60	13					45				117
B5				199	410	9											618
B6				37			356										392
B7				159	787		931										1877
B9				300			797										1097
C1	12	467		18	10	1680						770	223	3140	119	302	6741
C2					165	5534						261			3121		9080
C3					1173	2189						239			1976		5577
D3	1	27		51946	44862									312			97148
E3			3526				5			96							3626
F3			12577				11			21							12610
F4					3544	5419						4			19118		28085
F5						263	1355	50				11036	1602	61	2	691	15059
G3	1132	1721		3568	601				7758			52		805			15637
G4	157	253		4										2988			3403
G6				1857	54									6			1918
H3						12	141	56				98	77			7	390
I2					194	244									545		984
I3			1033				418										1451
I4			9				25										34
I5				218	249												467
I6				29	139												168
J1			7				1530	118					1477				3132
J2			5626				287										5913
J3			1636				1										1637
J4					488	4532						446		20	2016		7502
K3			2708							2668							5376
L1			1009							1413	6655						9077
L2			107							669							777
L4										9761	1190						10951
L5										59	3310						3368
N1			2813				2			3	3						2821
N2			2771				14			372	105		1				3264
N3			6505							22137	98						28741
N5			1588							2530							4118
N7										963							1515
N8			20							1876							1895

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Table A2.2—continued

LEVEL II ENVIRONMENT	AUCKLAND	BAY OF PLENTY	CANTERBURY	GISBORNE	HAWKE'S BAY	MANAWATU-WANGANUI	MARLBOROUGH	NELSON CITY	NORTHLAND	OTAGO	SOUTHLAND	TARANAKI	TASMAN	WAIKATO	WELLINGTON	WEST COAST	TOTAL INP
Region totals: 0–10%	7284 (3464)	5418 (8636)	24368 (25077)	1400 (3815)	16047 (12128)	22017 (30883)	4838 (3183)	398 (398)	11131 (6893)	38189 (23748)	8052 (10149)	1133 (11034)	3417 (3277)	13234 (22484)	26794 (17404)	7 (0)	183726 (182573)
Region totals: 10–20%	1146 (5299)	2214 (5027)	41207 (36836)	57389 (47601)	45527 (41481)	1943 (25878)	2225 (9080)	50 (213)	7758 (16308)	4398 (52494)	3310 (12355)	11858 (307)	1827 (6232)	4325 (12161)	120 (13434)	993 (711)	186287 (285416)
Region totals: 0–20%	8430 (8763)	7632 (13663)	65575 (61913)	58788 (51416)	61574 (53609)	23960 (56761)	7062 (12263)	448 (611)	18890 (23202)	42586 (76242)	11362 (22504)	12992 (11341)	5244 (9509)	17558 (34645)	26914 (30838)	1000 (711)	37 014 (467988)

TABLE A2.3 AREA OF INDIGENOUS VEGETATION NOT PROTECTED (INP) IN THE 232 LEVEL IV ENVIRONMENTS WITH LESS THAN 20% INDIGENOUS VEGETATION REMAINING NATIONALLY, ACROSS 16 REGIONS.

The data are grouped within the 61 Level II environments represented. No. Lvl IV = number of Level IV environments; 0–10% = Acutely Threatened environments, 10–20% = Chronically Threatened environments, 0–20% = Acutely and Chronically Threatened environments.

LEVEL II ENVIRONMENT	NO. LEVEL IV	AUCKLAND	BAY OF PLENTY	CANTERBURY	GISBORNE	HAWKE'S BAY	MANAWATU-WANGANUI	MARLBOROUGH	NELSON CITY	NORTHLAND	OTAGO	SOUTHLAND	TARANAKI	TASMAN	WAIKATO	WELLINGTON	WEST COAST	TOTAL AREA
A1	1	42								1733								1776
A4	1														1			1
A5	9	1118	650		312	697				6397			57		4288			13519
A6	2	303	75		16					2782					174			3350
A7	7	5875	4375		423	290				4734			4		5644			21345
B1	8					4279	3727	691	212				25	1818	1	19		10770
B2	4				10	2873	351								5			3239
B3	4			15814				439			17			1				16271
B4	2							60	13					45				117
B5	5				199	410	9											618
B6	4			37				356										392
B7	4			159		787		931										1877
B8	1			6				1563					1					1569
B9	3			300				797										1097
C1	3	12	263		18		3						594	223	1545	103	302	3063
C2	5					165	5534						261			3121		9080
C3	7					1173	2189						239			1976		5577

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Table A2.3—continued

LEVEL II ENVIRONMENT	NO. LEVEL IV	AUCKLAND	BAY OF PLENTY	CANTERBURY	GISBORNE	HAWKE'S BAY	MANAWATU-WANGANUI	MARLBOROUGH	NELSON CITY	NORTHLAND	OTAGO	SOUTHLAND	TARANAKI	TASMAN	WAIKATO	WELLINGTON	WEST COAST	TOTAL AREA
D2	1	41	73			3							94		10216			10427
D3	8	1	27		46361	34764									295			81448
E1	2			256				3663	163					3422				7503
E2	1							11						925				937
E3	2			3526				5			96							3626
E4	1			5046				363										5408
F1	6					2203	29147						33		278	3623		35283
F3	3			7569				3			21							7593
F4	6					3544	5419						4			19118		28085
F5	4						263	1355	50				8835	535	44	2	56	11139
F6	2	5	5172		2	42									5069			10289
F7	3		1155		7	660	4699						1		3133			9655
G1	1	93																93
G3	8	1115	1718		1856	601				7552			52		805			13699
G4	3	157	63		4										2988			3212
G6	4				1857	54									6			1918
H1	4					15	633			4			599	1061	127	438	354	3231
H2	2		93		104	2									6			203
H3	2						12	141	56				98					307
I2	4					194	244									545		984
I3	5			1033				75										1108
I4	1			9				15										24
I5	3				218	249												467
I6	2				29	139												168
J1	6			7				1530	118					1477				3132
J2	6			3173				250										3423
J3	3			1636				1										1637
J4	9					465	4532						446		20	1895		7358
K3	3			1113							970							2083
K5	1			1														1
L1	9			1009							1178	4913						7099
L2	2			107							36							143
L4	3										9761	1190						10951
L5	2											3155						3155
N1	6			2813				2			3	3						2821
N2	6			2771				14			372	105		1				3264
N3	9			6505							22137	98						28741
N4	3			4366							17806							22172
N5	4			1588							2530							4118
N6	1			2255							354							2609
N7	2			552							963							1515
N8	3			20							1876							1895
Q3	1										257	1668						1924
Q4	5			245							17864	11371						29480

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Table A2.3—continued

LEVEL II ENVIRONMENT	NO. LEVEL IV	AUCKLAND	BAY OF PLENTY	CANTERBURY	GISBORNE	HAWKE'S BAY	MANAWATU-WANGANUI	MARLBOROUGH	NELSON CITY	NORTHLAND	OTAGO	SOUTHLAND	TARANAKI	TASMAN	WAIKATO	WELLINGTON	WEST COAST	TOTAL AREA
Region totals: 0–10%																		
No. Lvl IV	18	17	46	31	45	36	28	7	7	40	16	20	9	27	27	0	158	
Area	3464	8636	25077	3815	12128	30883	3183	398	6893	23748	10149	11034	3277	22484	17404	0	182573	
Region totals: 10–20%																		
No. Lvl IV	12	13	25	15	25	15	13	2	6	17	6	7	9	18	14	3	74	
Area	5299	5027	36836	47601	41481	25878	9080	213	16308	52494	12355	307	6232	12161	13434	711285	416	
Region totals: 0–20%																		
No. Lvl IV	30	30	71	46	70	51	41	9	13	57	22	27	18	45	41	3	232	
Area	8763	13663	61913	51416	53609	56761	12263	611	23202	76242	22504	11341	9509	34645	30838	711467	988	

Appendix 3

LEVEL IV ENVIRONMENTS COMPARED WITH LEVEL II ENVIRONMENT F1

This appendix illustrates differences among Level IV environments within one Level II environment. Environment F1 extends from the western Waikato through inland Taranaki and northern Manawatu to the ranges of Hawke's Bay and Wairarapa, through Wellington and southward to the Marlborough and Tasman regions. On average, 48.4% (886 270 ha) of the total 1 832 582 ha in environment F1 remains in indigenous cover, and 22.8% of the total area is protected (Table A3.1). Therefore F1 is assigned to 'no threat category' if threat classification is carried out at Level II.

If threat classification is carried out at Level IV, 12 of the 19 Level IV environments in F1 are classified as threatened, and all five threat categories are represented (Fig. A3.1, Table A3.1). Three environments are Acutely Threatened (F1.3d in central Rangitikei District, F1.1f in northwestern Manawatu, Tararua and northern Masterton districts, F1.1g in Tararua District). Indigenous cover in Level IV environments varies between 4.5% (F1.1g in Tararua District) and 78.5% (F1.1a in Tasman District). The percentage of a Level IV environment protected is positively correlated with indigenous cover remaining ($R^2 = 0.69$, $P < 0.001$), and ranges from 1.4% to 58.4%.

Figure A3.2 shows the distribution across environment F1 of broad potential natural vegetation cover classes (20 potential forest types defined using statistical modelling techniques to combine extensive plot data with environmental data layers: Leathwick et al. 2004). This figure shows the likely variation in one component of the undisturbed biodiversity pattern across F1 (i.e. the forest canopy). Table A3.1 shows wide variation in the percentage of each predicted forest type across Level IV environments. For example, Rimu-matai-miro-totara/kamaha forest was previously most abundant in the now almost entirely deforested environments F1.1g (Acutely Threatened, 1.1% of indigenous forest cover today) and F1.4d (Chronically Threatened, 4.9% indigenous forest cover) in Central Tararua District. A high proportion of Kahikatea-matai/tawa-totara forest was in environment F1.2c (Critically Underprotected, with 4.9% remaining in indigenous forest cover today).

Figure A3.3 shows the distribution of the major present LCDB 2 cover classes across F1. Table A3.1 shows the percentage areas of LCDB 2 in each cover class, as well as a selection of environmental characteristics. The land cover on the most fertile soils (indicated by high acid-soluble phosphate in F1.1g), and on sites with little slope (e.g. F1.1e and F1.1f) have generally been converted to pasture. Areas of less fertile soils where early attempts at pastoral farming were frustrated by soil nutrient deficiencies support regenerating forests and scrub (e.g. F1.2d in South Wairarapa). Extensive areas of indigenous forest still survive, mostly on steeper slopes and in more topographically challenging and remote areas (e.g. F1.1d in Ruapehu, South Taranaki and Wanganui districts).

These data demonstrate that environmental differences driving patterns of biodiversity as well as present and past land clearance, occur at finer scales than Level II of LENZ (represented here by F1), and that biodiversity and clearance patterns are better depicted at Level IV than at Level II. These patterns also vary considerably between different district council areas containing parts of a Level II environment.