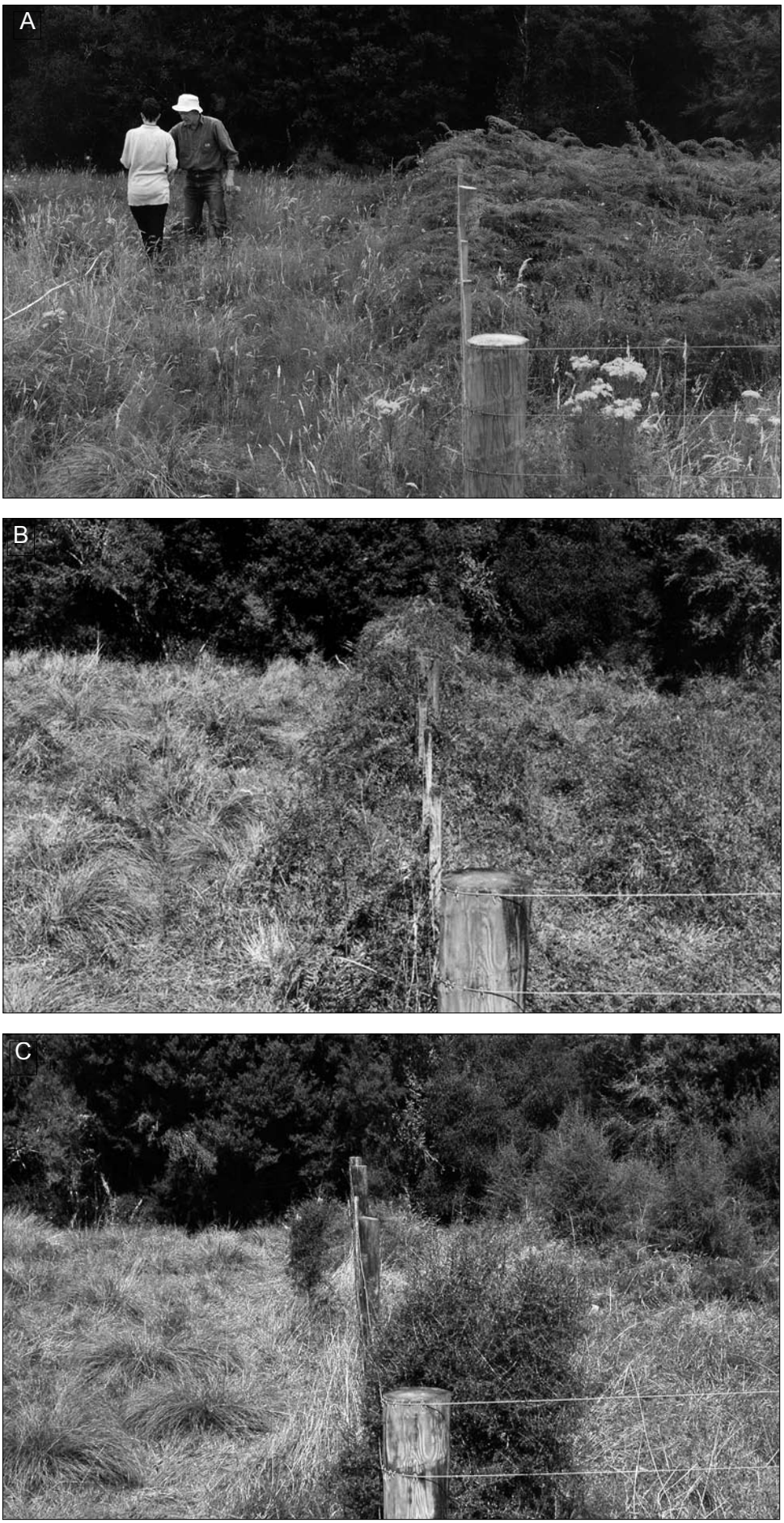

Figure 4. A sequence of photographs in the grassland portion of the exclosure in Cook Young Forest, showing A. *Pteridium esculentum* in 1994; B. its collapse in 1998; and C. shrub recruitment in 2002.

divaricata were the most frequently recruited species. Although the number of saplings increased in both plots, additional numbers were far greater in the control (492) than in the exclosure (124). Numbers of shrubs and trees increased in both plots, but more so in the exclosure (508 v. 162), particularly in the grassland (310 v. 76). The main species involved were *Coprosma* spp., *Myrsine divaricata*, *Melicytus ramiflorus* and *Pennantia corymbosa*.

4.4 COOK OLD FOREST

Litter cover increased from 80% to 90% in the exclosure, while bryophyte cover decreased from 9.6 to 1.5%. The percent frequency and height of herbs increased most consistently in the exclosure, which also gained more ferns (especially *Asplenium bulbiferum*); however, total herb abundance remained lower than in the control (means of 14.3 cf. 20.8 respectively). No exotic herbs were present in either plot.

There was little change in numbers of woody seedlings and saplings in either plot. Numbers of preferred shrubs, such as *Hedycarya arborea, Melicytus ramiflorus* and *Dicksonia squarrosa*, showed small decreases (c. 10%) in both control and exclosure plots.

At the time of the 2002 remeasurement, a very large *Prumnopitys taxifolia* tree (160 cm diameter at breast height (dbh)) that had been recorded in the southwest corner of the control plot (20-m line at 25 m) in 1990 had fallen into the exclosure, flattening the fence and many plants. The fence was repaired by 21 June 2002. This highlights the critical need for regular inspection and ongoing maintenance of exclosure fencing.

4.5 JACKSON RIVER

Overall vascular cover increased by about 10% at the expense of bryophyte cover, which decreased by 20.2% in the grassland portion of the exclosure. Similarly, herb height more than doubled with exclosure from 17.8 to 41.3 cm. However, vascular cover decreased in the exclosure ecotone, where litter cover increased by 19.5%, and bryophyte cover increased in the forested control, where litter cover decreased by 17.3%.

The percent frequency and diversity of herbaceous species decreased in the exclosure, while that of native herbs increased in the control. Total herb richness was 30 in controls but only 15 in exclosures for grassland. Similarly, numbers of woody seedlings (0–30 cm tall) decreased from 197 in controls to 133 in exclosures in the grassland.

Numbers of shrubs decreased in both plots, but more so in the exclosure. Most of this decrease resulted from three-fold fewer *Pseudowintera colorata* shrubs in the forested portion. In the tree layer of the exclosure, there was recruitment of preferred species such as *Schefflera digitata*, *Fuchsia excorticata* and *Aristotelia serrata*, all of which remained absent in the control.

4.6 ARAWHATA RIVER

Vascular cover became exclusively dominant in the grassland of both plots (99% in the controls and 92% in the exclosure). In the ecotone, vascular cover increased slightly more in the exclosure than in the control. Herb height increased accordingly. In the grassland, total and native richness of herbaceous species increased in the exclosure by 4–5 species on average.

Numbers of seedlings (0–30 cm tall) roughly doubled in both plots, but by greater numbers in the exclosure, particularly for *Nothofagus menziesii* and *Cyathea smithii*, both of which had also recruited into the shrub layer of the exclosure.

In both plots, the number of *Griselinia littoralis* seedlings increased up to13 per transect in 1999 but then decreased to 5 by 2004, presumably due to red deer (*Cervus elaphus*) browsing. Despite this, there had been recruitment of *Griselinia littoralis* into the shrub layer in the exclosure. However, other species preferred by deer, possums, or cattle such as *Schefflera digitata*, *Fuchsia excorticata*, *Melicytus ramiflorus* and *Hedycarya arborea,* had not increased in either plot.

Dacrycarpus dacrydioides numbers increased two-fold in the shrub layer of both plots, whereas *Pseudowintera colorata* numbers declined slightly in the shrub layer of both plots, as plants had recruited into the tree layer.

4.7 EFFECTS OF GRAZING ON VEGETATION LAYERS

The exclusion of stock has led to increased densities of preferred species in the shrub and tree layers at some sites. However, not only has this effect sometimes been masked by other processes, but the species involved may also vary between sites. For example, in the Jackson River exclosure, many preferred species were recruited into the tree layer, possibly reducing numbers in the shrub layer below through competition for light. In the Arawhata plots, numbers of avoided species, such as *Dacrycarpus dacrydioides* and *Nothofagus menziesii*, increased following protection from cattle, suggesting that other browsers (e.g. deer and/or possums) may have prevented the recruitment of preferred species. Below, we quantitatively assess the changes in numbers of plants seen in each of the different vegetation layers.

4.7.1 Herbs

The height of the tallest herb showed a greater increase in all exclosure plots (23.4 cm to 36.5 cm) than in the controls (25.0 cm to 27.1 cm). The percent frequency of herbs generally showed a greater decrease in the exclosures than in the controls (Table 3, Fig. 5). Some palatable herbs showed greater increases in percent frequency in exclosures than in controls, e.g. *Histiopteris incisa* in Whataroa Valley, *Astelia grandis* in Cook Swamp, and *Asplenium bulbiferum* at all sites where it occurs. Herb percent frequency varied greatly between habitats and sites (Table 3). Fencing reduced the number of herbs and species richness, particularly in grassland habitats (Fig. 6A, B). Similarly, herb species composition shifted from native to exotic dominance most dramatically in fenced grassland habitats (Fig. 7).

TABLE 3. ANOVA TABLE FOR HERB ABUNDANCE (NUMBER OF INDIVIDUALS PER TRANSECT).

The five Sites were Cook Young forest, Cook Swamp, Whataroa, Arawhata and Jackson. Cook Old Forest was excluded because it contained only forest habitat.
Factors include Site, Treatment (fenced, no fencing), Habitat (forest, ecotone, grassland), Year (initial, most recent) and Biostatus (Exotic, Native). Higher order interactions are not included here because of sample size limitations. Model overall error df = 64, SS = 1011.8.

SOURCE	df	SUM OF SQUARES	*F* RATIO	PROB > *F*
Site	4	25845.22	22.84	< 0.0001
Treatment	1	4721.09	16.7	< 0.0001
Year	1	1510.78	5.33	0.022
Habitat	2	224964.63	397.6	< 0.0001
Biostatus	1	11869.80	42.0	< 0.0001
Site × Treatment	4	1247.54	1.10	0.356
Site × Year	4	3788.89	3.35	0.012
Site × Habitat	8	30460.74	13.5	< 0.0001
Site × Biostatus	4	5741.48	5.07	0.001
Treatment × Year	1	3796.41	13.4	0.0003
Treatment × Habitat	2	4182.13	7.40	0.0007
Treatment × Biostatus	1	113.64	0.40	0.527
Year × Habitat	2	701.99	1.24	0.291
Year × Biostatus	1	90.01	0.32	0.573
Habitat × Biostatus	2	9433.96	16.7	< 0.0001

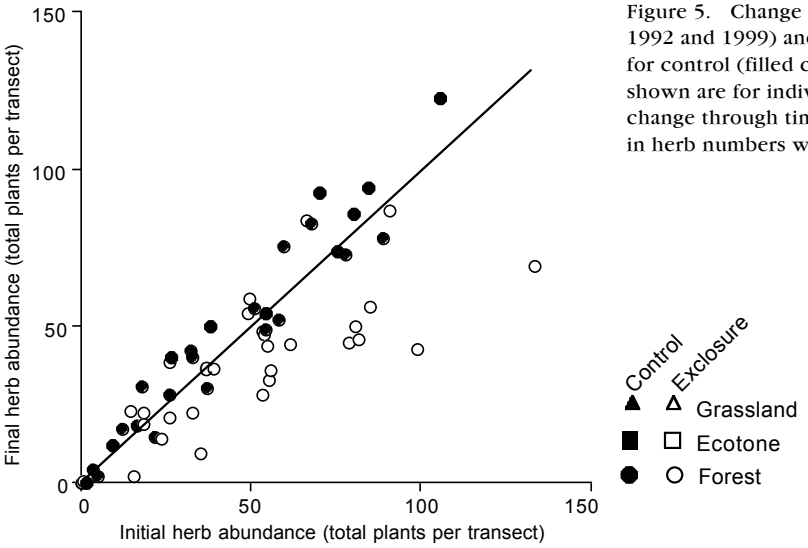

Figure 5. Change in the abundance of herbs between initial (1989–1992 and 1999) and most recent (2002 and 2004) remeasurements for control (filled circles) and exclosure (open circles) plots. Data shown are for individual transects. The 1:1 line represents no change through time: points below this line generally had declines in herb numbers while points above had increases.

4.7.2 Seedlings (< 10 cm)

Seedlings showed no consistent response to fencing, with numbers either declining or increasing depending upon site and habitat (Fig. 8). Although seedling species composition shifted at two sites in response to stock exclusion, fencing caused convergence in seedling species composition at Cook Young site but divergence at Whataroa Valley (Fig. 9).

4.7.3 Saplings (10–30 cm)

Fencing had no effect on sapling numbers, which varied greatly between sites and habitats (Fig. 10). Although sapling numbers increased two- to four-fold at the Cook Young Forest site, this change was not driven by stock exclusion,

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