VEGETATION CHANGES ON THE HAWDON RIVER FLOODPLAIN, WAIMAKARIRI BASIN, CANTERBURY

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INTRODUCTION

River floodplains in the Canterbury mountains have a distinctive flora and vegetation, with many specialised native plants. They are good places for observing the vegetation phenomena associated with periodic substrate disturbance (by flooding) and developing plant cover on newly-formed land surfaces.

The basic material of the floodplains of the Rangitata, Rakaia or Waimakariri Rivers is the abundant hard sandstone gravel eroded from the Southern Alps. In fair weather narrow, braided streams of clear water wind their way across the gray gravel expanses of the floodplains, occupying only a small fraction of their width. During nor'west storms in the mountains rampaging muddy brown flood water may spread across the whole width of the floodplains. Often the immediate local floodplain landscape then changes, as powerful flood streams cut new channels, erode some of the formerly stable surfaces and deposit new sheets of gravel. When the flood recedes the resulting terrain is complex, with inter-twining stream courses and old, abandoned channels, between relatively level, stabilised, plateau-like surfaces, often of lenticular shape (long and narrow, with pointed ends). There may be steep banks, or gradual slopes at their margins. The substrate is also complex; areas of well-rounded boulders, or cobbles, occur where the flood currents were strong. Where the water flowed more gently are deposits of pebbles, sand and small amounts of silt. In any place the rock fragments of different size occur in varied proportions, though extensive sheets of any particular size may also be present. Floods also transport plant remains (logs, twigs, leaves, roots, whole plants) and these may be deposited in places over the floodplain.

Since 1850 there has been considerable ingress of foreign plants to the floodplains. They include some such as russell and yellow lupins, gorse and broom that tend to take over extensive areas. Nevertheless, in the upper valleys the native component of lichens, mosses and flowering plants dominates.

Rabbits, hares and domestic stock disturb the floodplain substrate. Cattle are especially devastating to the landforms and plant cover. Near settlements and bridges there is nearly always some disturbance, in the form of vehicle tracks, stop-banks, groynes and willow-plantings.

The present study was undertaken in an area where natural processes prevail, on the Hawdon River floodplain near where that river enters the Waimakariri River. The aim was to examine the changes in plant composition, size and total cover on stabilised surfaces formed at intervals over several decades.

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METHODS

Sites

Four surfaces were chosen, to form a chronoseries: **A** stable for about 5 years; **B** 8 years; **C** 12-15 years; **D** 25-30 years. Note that these estimated ages may not be quite correct. The substrate on each surface consisted mainly of pebbles (2 mm - 10 cm diameter), sand (0.02 - 2 mm diameter) and a few cobbles (10 - 25 cm diameter). Each surface was about 30 - 50 m long and 15 - 20 m wide and raised 25 - 50 cm above adjacent channels. The surfaces sloped very gently southward and, apart from irregularities caused by projecting stones, or logs and other plant debris, had only minor hollows and hummocks.

Recordings

All species on each surface were listed (Table 1), the amount of cover of the vascular plants and moss was estimated (Table 2) and the maximum diameters of all discrete *Raoulia* plants (Table 3) and lengths of longest branches of *Discaria toumatou* and *Helichrysum depressum* bushes (Table 4) were measured.

RESULTS AND DISCUSSION

Flora

It is noteable that many of the same plant species occur on all four surfaces. A similar total number is present on surfaces A, B, C, while D has appreciably more. Some species occur only on the younger two, and others on the older two surfaces. From experience elsewhere, it is known that most of these are not necessarily restricted, respectively, to freshly-disturbed, or well-vegetated sites. Exceptions appear to be the relatively uncommon *Myosotis uniflora* and the common *Raoulia tenuicaulis* (only on younger surfaces) and *Colobanthus strictus, Leptinella perpusilla* and *Stellaria gracilenta* (only on older surfaces). Appreciable numbers of plants have nitrogen-fixing associations (*Rhizobium* bacteria on legumes; *Frankia* actinobacteria on *Discaria* and *Coriaria*). Grasses and daisies are also common (Table 1).

Cover

Percentage cover of vascular plants, mosses and lichens increases very markedly A - D (Table 2). A striking sequence of colour changes (imparted by dominant plants) is evident. A appears light grey (gravel) with patches of red (*Epilobium melanocaulon*) and bright green (*Raoulia* spp); B is whitish (*Racomitrium lanuginosum*) and brown (*Muehlenbeckia axillaris*); C is very dark grey (*Neofuscelia* spp on rocks) and pale to bright green (*Raoulia australis*), D is olive green (grasses and *Raoulia* spp).

Raoulia Cushions

As only *R. hookeri* and *R. australis* occurred on all four surfaces they are the most useful for consideration of changes in the sizes and numbers of *Raoulia* cushions. *R. hookeri* is one of the most important early colonists of newly-formed sites (along with *R. tenuicaulis* and *Epilobium melanocaulon*). Its population size increased substantially from surface A - B - C, with small cushions indicating continued recruitment. On surface D it appeared to be

losing vigour and large cushions were being overgrown by species such as *Muehlenbeckia axillaris, Coprosma atropurpurea* and *Leucopogon fraseri*. Note that not all of its cushions on surface D were counted because some very large, diffuse and overgrown cushions were not measured, as they might have consisted of several individual plants which had coalesced.

R. australis shows a clear-cut sequence of increase in population size and mean size of the larger cushions across the chronoseries. Some remarkably large cushions grow on surface D.

Discaria and *Helichrysum*

There is a somewhat erratic distribution of population sizes of the two larger shrubby species across the chronoseries. This partly accounts for disparities in the sizes of the largest plants. Surface C has smaller *Discaria* plants than expected. *Helichrysum* shows regular increase in size (except on surface C) but numbers are relatively constant across the chronoseries. Surface C may have been partly damaged by a flood subsequent to its first formation and colonisation.

Both *Discaria* and *Helichrysum* established early and their growth rates, though slower than those of some other species, nevertheless are impressive. As no *Helichrysum* occurs on surfaces much older than those studied it appears to be restricted to the disturbed floodplain type of habitat. *Discaria* plants, some up to 3 m high, occur on older, stabilised floodplain surfaces, so it seems to be a very versatile and persistent species.

CONCLUSION

This study exemplifies the value of intensive examination of small areas. Some really interesting botany was revealed, including the point that, on time sequences of vegetation development, many of the species which occur late in the sequence establish very early. Some other early colonists grow so vigorously that they tend to overshadow the slower-growing species.

The potential of Canterbury river floodplains as sites for chronoseries studies has been evident since the time of Leonard Cockayne, but there has been very little published on the subject. Further research is warranted, especially on the reproductive ecology and dynamic interactions of species in the vegetation, on nutrient relationships and on the parallel development of vegetation and soils.

REFERENCES

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Table 1: COMPLETE FLORA ON EACH SURFACE

SURFACE	A (youngest)	B	C	D (oldest)
Acaena inermis	+	-	+	+
**Agrostis capillaris* G	+	+	+	+
**Aira caryophyllea* G	+	-	+	+
**Anthoxanthum odoratum* G	+	+	+	+
Cardamine cf. *debilis*	+	-	-	-
Carex breviculmis	-	-	+	-
Carmichaelia uniflora L	-	+	-	-
**Cerastium cf. fontanum*	+	-	+	+
Colobanthus strictus	-	-	+	+
Coprosma acerosum	-	+	-	-
C. atro-purpurea	+	-	+	+
Coriaria cf. *plumosa* F	-	-	-	+
C. sarmentosa F	+	+	-	+
**Crepis capillaris* D	+	-	-	-
Discaria toumatou F	+	+	+	+
Elymus rectisetus G	-	+	-	+
Epilobium melanocaulon	+	+	+	+
E. microphyllum	+	+	+	-
E. rostratum	-	-	+	+
**Festuca rubra* G	-	-	+	+
Geranium sessiliflorum	-	-	+	+
Helichrysum depressum D	+	+	+	+
H. filicaule D	+	-	-	-
**Hieracium* cf. *caespitosum* D	+	-	-	-
**H. pilosella* D	-	-	-	+
**Holcus lanatus* G	+	-	-	-
Hydrocotyle novae-zelandiae	-	+	-	-
**Hypochoeris radicata* D	-	+	+	+
Koeleria sp. G	+	+	+	+
Lachnagrostis sp. G	+	-	-	+
Leptinella cf. *pusilla* D	-	-	-	+
Leucopogon fraseri	-	-	+	+
**Linum catharticum*	-	-	+	-
Luzula rufa	+	+	+	+
Muehlenbeckia axillaris	+	+	+	+
Myosotis uniflora	+	-	-	-
Parahebe decora	+	-	+	-
P. lyallii	-	-	-	+
Pimelea prostrata	+	+	+	+
Poa cita G	+	-	-	-
P. lindsayi G	+	+	+	+
Pyrrhanthera exigua G	-	-	-	+
Raoulia australis D	+	+	+	+
R. glabra D	+	+	+	+
R. haastii D	+	+	+	+
R. hookeri D	+	+	+	+
R. tenuicaulis D	+	+	-	-

SURFACE	A (youngest)	B	C	D (oldest)
**Rosa rubiginosa*	-	-	+	+
**Rumex acetosella*	+	-	+	+
Scleranthus sp.	+	-	+	+
**Sedum acre*	-	-	-	+
Stellaria gracilenta	+	-	+	+
**Trifolium arvense* L	+	+	+	+
**T. dubium* L	+	-	-	+
**T. repens* L	+	+	-	+
**Verbascum thapsus*	+	-	-	-
**Veronica arvensis*	-	-	-	+
Vittadinia australis D	-	+	-	+
Wahlenbergia albomarginata	+	+	+	+
Mosses				
Polytrichum juniperinum	-	+	+	+
Racomitrium lanuginosum	+	+	+	+
unidentified small moss spp.	-	+	+	+
Lichens				
Neofuscelia spp.	-	+	+	+
Placopsis cribellans and *trachycarpa*	-	+	+	+

* adventive species
G grass; L (*Rhizobium* nodules); F (*Frankia* nodules); D daisy

Table 2: INCREASING COVER OF PLANTS (EXCLUDING LICHENS) ON THE CHRONOSERIES

SURFACE	A	B	C	D
Estimated Percentage Cover	10	40	60	90

Table 3: DIAMETERS OF *Raoulia* CUSHIONS ON THE CHRONOSERIES*

SURFACE	A	B	C	D
R. tenuicaulis				
Number of plants	4	9	-	-
Range of diameter (cm)	28 - 46	16 - 120		
Mean of 5 largest (cm)	**37.3 ± 7.6**	**67.4 ± 41.3**		
R. hookeri				
Number of plants	20	50	85	16*
Range of diameter (cm)	1 - 40	3 - 80	4 - 90	4 - 80*
Mean of 5 largest (cm)	**34.4 ± 4.7**	**52.4 ± 15.6**	**66.0 ± 17.7**	**42.0 ± 22.9**
R. australis				
Number of plants	6	10	29	110
Range of diameter (cm)	3 - 11	2 - 30	3 - 47	4 - 88
Mean of 5 largest (cm)	**7.2 ± 3.5**	**25.8 ± 4.8**	**42.8 ± 3.6**	**68.0 ± 14.5**
R. haastii				
Number of plants	-	13	-	-
Range of diameter (cm)		2 - 73		
Mean of 5 largest (cm)		**62.4 ± 9.0**		
R. glabra				
Number of plants	1	-	8	-
Range of diameter (cm)	7		6 - 31	
Mean of 5 largest (cm)			**20.0 ± 7.2**	

* on surface D *R. hookeri* cushions were often diffuse and interwoven with other low-growing species; these were not measured or counted because it was uncertain how many individuals were present.

Table 4: MAXIMUM STEM LENGTHS OF *Discaria toumatou* AND *Helichrysum depressum* SHRUBS ON THE CHRONOSERIES

SURFACE	A	B	C	D
Discaria				
Number of plants	4	1	11	21
Range of maximum stem lengths (cm)	150 - 370	530	190 - 350	230 - 1130
Helichrysum				
Number of plants	4	3	1	4
Range of maximum stem lengths (cm)	180 - 320	180 - 520	270	410 - 700