Okia Flat, Otago Peninsula:

Botanical Values and Grazing

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1. Summary

* Assessment of botanical values (features of dune, wetland, and other native vegetation) within the 18 paddocks of Okia reserve show a concentration of highly rated sites along the inland half of the reserve.

* Retirement from grazing is unlikely to adversely affect tall native plants of dunes and dune hollows, but might result in low-stature vegetation (wetland turf and dune face native heath/herb communities) being displaced by released growth of jointed rush and browntop. Proposals are described for monitoring these processes.

* Okia Reserve is of high regional and local botanical conservation value, especially for its diversity of dune landforms, wetland types, native scrub and rock face vegetation, and its rich flora.

* Paddocks of high botanical value should not be grazed. Continued grazing of two paddocks is supported for firebreak purposes and to provide a control site against which to measure vegetation change. Grazing is discussed in relation to revegetation potential of the reserve.

2. Introduction

Okia Reserve (231 ha) occupies the coastal half of Okia Flat, Otago Peninsula. A management plan is currently being prepared by the Okia Reserve Management Committee, with representatives from the Yellow-eyed Penguin Trust, Dunedin City Council, Te Runanga Otakou, and the Department of Conservation.

The reserve land was retired from grazing at the time of purchase (July 1991). Questions have arisen as to whether grazing should resume in parts of the reserve. Arguments against grazing include protection of penguin habitat, native vegetation, wahitaoka, and land stability, and the enhancement of regeneration and revegetation potential. The case for grazing includes arguments that it would allow for easy travel for walking and for recreational pursuits such as orienteering, assist with weed control, reduce fire risk and aid fire containment, and generate income.

The reserve is still fenced internally to 18 paddocks (Fig 1). Paddocks G and P have been subject to renewed grazing by sheep as from April 1993, to act as a firebreak halfway along the reserve.

This report was requested by the Department of Conservation, to provide information on botanical values and their distribution within the reserve on a paddock by paddock basis, and to document the vegetation such that future changes can be monitored.

3. Background

Okia Flat Reserve comprises extensive low hummocky old sand dunes, accumulated against cliff bases and rock stacks of an ancient shoreline. The general vegetation pattern is:

* frontal dunes with marram grass, some lupin and young pines.
* crests of old dune hummocks mostly with bracken fern, and scattered lupin.
* flanks of old dunes, with pasture grasses, knobby clubrush, some silver tussock.
* Dune hollows, permanently or periodically wet, with various sedge, rush, turf, bog and pond communities.
* native scrub and forest on The Pyramids, and as very scattered shrubs on sand flats.

Vegetation, flora, and botanical values have been previously described for the dune country (Johnson, 1980, 1992, 1993), the wetlands (Johnson, 1986) and the forest and scrub (Johnson, 1979, 1986).

4. Objectives

- To ascertain botanical values within each of the 18 paddocks, in order to assist with management decisions on the future of grazing.
- To comment on possible impacts of lack of grazing on wet and dry turf communities.
- To gather baseline information on vegetation against which future changes can be measured, and to describe vegetation monitoring required.
- To comment on local and regional importance of reserve for vegetation.

5. Methods

The study was assisted by the 1:15,000 map produced by the Dunedin Orienteering Club (revised Don Bruce, 1986), which shows all fencelines within the reserve. The numbering system for paddocks was provided by the Okia Reserve Management Committee (Fig 1).

Field work was carried out on 3 and 6 May 1993, in fine weather. I traversed all paddocks, gained views within each one from the higher dune crests, and climbed the Pyramids for an overview. Visual estimates were made of percent cover of bracken, lupin, knobby clubrush, and silver tussock within each paddock.

Comparative assessment of existing botanical values, paddock by paddock, was based on a rating system (scores ranging from 0 = low to 3 = high) for key native plant features both of dune hollow wetlands and the drier dune crests. The scored features are detailed in Table 2.

Observations were made in passing on the location of troublesome weeds (Table 3), and on the condition of the vegetation in relation to naturalised plants and other influences of past management.

6. Results

Table 1 lists estimates of cover for principal dune plants, and the presence of key native plant species. Table 2 gives ratings for wetland, dune, and special features for each paddock. Table 3 gives locations of weeds requiring control. Figures 2, 3, and 4 are photos showing some of the botanical highlights of Okia Flat.

6.1 Foredune vegetation

The relatively narrow foredune strip with marram grass, scattered lupins, and a strip of young pines does not contain much in the way of native vegetation, with the notable exception of pingao plants and clumps as mapped in Johnson (1993).

6.2 Dune crest vegetation

Bracken fern covers most dune crests within the reserve, comprising between about 15 and 30% cover of each paddock (Table 1), with the exception of paddock B which has only 5% cover. Paddock B was disced 5-6 years ago, and given a light fertiliser application when it was farmed by Bob Clearwater (personal communication). The bracken is generally dense, mostly 0.5 to 0.8 m tall, but reaches 1.6 m tall along the

inland edge of northern paddocks, where occasional broadleaf seedlings to 20 cm tall can be found under the bracken.

Lupin (*Lupinus arboreus*) is present at 2-5% cover among the bracken in most paddocks, but was not recorded from paddocks C and D (inland ones at the north end) and reaches its highest cover of about 10% cover in paddock M. Lupin cover has decreased markedly following the nationwide spread of the fungus disease *Colletotrichum* since 1987. This is especially noticeable at the south end of Okia Flat where lupins were mapped as the predominant cover by Johnson (1980) in what is now paddocks J,K,L,M, and N, now having mostly 2-5% lupin cover.

Knobby clubrush (*Isolepis nodosa*) and silver tussock (*Poa cita*) are the two most common native plants, other than bracken, on dune crests. Both vary in cover between paddocks (Table 1). Their combined contribution to the vegetation is rated as one item (S) in Table 2; they are of greatest importance in the group of paddocks D-H and P-R.

Flax (*Phormium tenax*) is making an appearance as scattered young plants to 0.8 m tall within bracken on dune crests in the northern half of the reserve, as far south as paddocks G and P.

6.3 The dune grasslands

Old pasture, mainly browntop, covers the sides of the rolling dunes throughout the reserve, and extends across dune crests where bracken is sparse, and across the floors of the drier dune hollows, especially those of the more seaward paddocks. Browntop (*Agrostis capillaris*) is usually the dominant grass (about 60-80% cover as a sward 40 cm tall) but sweet vernal (*Anthoxanthum odoratum*) is common also on the driest sites.

Grassland composition changes towards moister and more fertile ground. Yorkshire fog and cocksfoot, together with taller browntop and some red clover, form dense swards in moist parts of paddocks A and B, and the hill-toe slip face of paddock D, but an almost complete cover in paddocks K,L,M,N, and O. These southern and seaward parts of the reserve with the really dense grassland more-or-less coincide with the former pattern of dense lupins (Johnson, 1980), and with low ratings for native dune and wetland features (Table 2).

6.4 Native heath and herb vegetation of dune faces

Steep portions of dune faces and some crests have a distinctive flora of native low heath and herbaceous plants. This community occurs where the bracken, browntop and sweet vernal is low and sparse, probably very drought-prone sites. The characteristic native plants are the small heaths patotara and snowberry, nine native herb species, and nine species of lichen. (Appendix 1 has details of this community).

6.5 Forest, scrub and other special features

Paddocks D and E have been rated highly for special features (Table 2) partly because they contain remnants of native forest, and diverse native scrub communities. These have been described previously (Johnson, 1980, 1982). Botanical highlights of the Pyramids area are noted in Johnson (1986) along with a listing of the considerable number of plant species whose occurrence on Otago Peninsula is wholly or primarily near the Pyramids.

Some of the common plants of native scrub on The Pyramids are illustrated in Fig 3. Communities of Easter orchid (Fig 2A) are particularly well developed on the faces of The Pyramids. Two small old rock stacks with scrub and orchids add to the value of paddock C.

Scattered isolated native trees and shrubs across Okia Flat are the last survivors to indicate a former forest and scrub cover upon the dune country. Two small trees of Hall's totara grow in paddocks D and E. Two broadleaf trees, about 5m tall, grow in paddocks G (Fig 2F) and J. *Coprosma crassifolia* shrubs can be found in paddocks J and K (Fig 2D), along with *C. propinqua* and *Myrsine australis* in paddock K, on the southernmost dune face. Kanuka trees also persist in the east of paddock K (Moira Parker, personal communication).

Tall tussocks can be found in paddocks F and H. They appear to be intermediate between narrow-leaved snow tussock (*Chionochloa rigida*) and red tussock (*C. rubra*) and are probably of hybrid origin, though neither of these putative parent species occur on Otago Peninsula. Similar tussocks occur elsewhere on the peninsula only on sand flats behind Allans Beach.

6.6 Dune hollow rushland and sedgeland

The wetland vegetation of Okia Flat dune hollows is so diverse as to enable and warrant rating many of the component features. Table 1 notes the distribution of key native species, including many of the rushes and sedges illustrated in Fig 4. Table 2 demonstrates that ratings for extent of wetlands, and of wetland features, are highest in paddock E, and substantially high in most of the inland line of paddocks except those towards the south end.

Flax, growing as tall clumps, is a feature of deeper dune hollows in paddocks G to H and also P.

The native rush *Juncus gregiflorus* is the most widespread of tall wetland plants in the reserve, and is often the only wetland species in paddocks with few moist dune hollows. *Carex dipsacea* is the next most common rush/sedgeland plant. The assortment of other rush and sedge species, and their varied distribution, illustrates the

diversity of dune hollow habitats, some being barely moist, others subject to periodic ponding in wet seasons or years, and others again being permanently wet yet apparently not subject to much ponding.

6.7 Wetland turf, bog, and ponds

A perimeter zone of turf communities surrounds those hollows having periodic water level fluctuations. The turf contains numerous plant species, such as are typically found on the margins of inland lakes, and not otherwise known from dune topography in Otago (Johnson, 1992). Turf is restricted to paddocks C to J, and best represented in paddock E.

Hollows of apparently permanent wetness can be fringed instead with something approaching bog vegetation on more peaty soils. Paddocks G and H are of special interest in having sphagnum moss, the only sphagnum known on Otago Peninsula, and a species *S. novo-zelandicum* which is generally uncommon in New Zealand. The bog sedges *Baumea rubiginosa* (found also behind Allans Beach) and *B. tenax* (a new record for Otago Peninsula) grow with the sphagnum.

Details of dune hollow wetland communities are given in Appendix 2.

8. Discussion

8.1 Importance of Okia Reserve for botanical features.

The recent inventory of South Island dune and beach vegetation identifies Victory Beach as the most highly rated site for the Otago coast between Oamaru and the Clutha River mouth (Johnson, 1992). This high rating largely reflects the extent and diversity of dune flat and dune hollow vegetation, the best example of such landforms in this section of coast.

In the context of the Otago Ecological Region, the dune hollow vegetation here is the best example, the dune crest communities are representative of the Region, while the native scrub and associated communities of The Pyramids are floristically rich examples for the Region. In the context of Otago Peninsula, the dune hollows and The Pyramids are especially important for the diversity of native plants, including some 17 species not found elsewhere on Otago Peninsula, and another 23 species which are known from only one or two other peninsula sites (Johnson, 1986).

8.2 Botanical ratings within Okia Reserve.

Total ratings for botanical values for each paddock are listed in Table 2 and indicated on Fig. 1. Paddocks E,F, and G form a nucleus of sites with the highest total ratings of 25 to 30. Considering paddocks with a total rating of 18 or more, we see the contiguous sequence of paddocks C to H as a core area of high existing botanical value. Supposing a situation where a case was being made for reserve acquisition primarily for botanical values, it is these paddocks one would seek as the prime areas to protect.

The prime botanical values would not be greatly affected by continued sheep grazing of the other paddocks. But this of course does not take into account the need to protect both existing and potential penguin habitat, revegetation work already underway, or the desirability of not grazing sites of historic importance. Nor should the potential for enhancement of vegetation cover and botanical diversity be overlooked.

An ambitious aim would be towards re-establishment of native forest and scrub vegetation on the dune crests throughout the reserve. It is likely that the low dune ridges would have supported a cover of forest and scrub in the days before human impact, probably with relatively drought-tolerant dominants such as totara, broadleaf, kowhai, matipo, kanuka, manuka perhaps, and coprosmas. To re-establish such vegetation may not be an easy or rapid task, and would require careful planning for a sequence of vegetation establishment, with planting spread over many years.

But one of the helpful pre-requisites will be to enable the soils to redevelop more moisture-holding capacity. From one viewpoint, ungrazed grass and bracken that has been allowed to grow tall might be labelled as rank, perceived as unsightly, as a waste of potential pasturage, regarded as a fire risk, or as an impediment to access. But on the other hand, the unseen accumulation of litter, and of humus, over years, will be contributing to this soil development process.

From a productive grazing point of view, the most attractive land is in the southern end paddocks K,L,M,N, and O, which have the most lush grass growth, with abundant cocksfoot and Yorkshire fog, and low total botanical ratings. But at the same time these seemingly more fertile paddocks are also ones where revegetation by native trees might show most rapid response.

8.3 Possible impacts of lack of grazing upon turf and heathland

Since cessation of grazing in 1991, formerly grazed or trampled plants have grown taller and more dense. This is most noticeable with the pasture grasses, especially browntop. While relatively tall native dominants such as the rushes, sedges, flax, bracken, knobby clubrush, silver tussock, and snow tussock should not be overcome by released growth of formerly grazed plants, the same might not hold for the low-growing native communities.

It is already apparent that some (but not all) turf vegetation surrounding dune hollow wetlands has become more of a sward with the increased abundance of jointed rush (*Juncus articulatus*), formerly kept low by grazing. The other low vegetation type which could diminish in the absence of grazing is the native heath and herb community of dune faces, as a result of invasion and overtopping by bracken, browntop, and sweet vernal.

A reduction in the extent of turf and heath/herb communities might be an inevitable, and not necessarily unacceptable consequence of adoption of a non-grazing management regime. For one thing, these communities may have been partly induced, or at least favoured, during 150 years of grazing, and might not in fact wholly represent the original plant cover. But the impacts of not grazing can only properly be assessed by monitoring the future course of vegetation change.

8.4 Vegetation monitoring required.

To record vegetation changes to the possibly more vulnerable turf and heath/herb communities, as well as to follow changes in other vegetation types, I propose the setting up of permanent transects spanning the sequence from dune hollow rushland, through the marginal turf zone, to grassland and dune crest vegetation. Transects should be permanently marked with tanalised stakes, and the vegetation recorded using the Scott height-frequency method, with additional measurement of plant species frequency and cover within 0.5 x 0.5m gridded quadrats in vegetation of low stature. Initially six main transects should be sufficient, three in ungrazed areas (paddocks E and F) and three in comparable sites within paddock G where grazing is to continue. Remeasurement annually for the first two years should give an indication of frequency of monitoring needed thereafter.

8.5 Weeds and grazing

I do not believe that grazing will be of any assistance for weed control. Gorse is present as small, low, and very scattered infestations, most of which show signs of having been sprayed previously. My observations of weed localities (Table 3) are intended to assist the weed control actions by the Yellow-eyed Penguin Trust. Ragwort and thistles are present very locally in sites of most vigorous grass growth; further establishment of these weeds is less likely to occur in the absence of grazing.

9. Conclusions

From the viewpoint of protecting existing botanical values it is essential that paddocks E and F be protected from grazing in order to allow recovery of the native forest and scrub vegetation, and highly desirable that paddocks C,D,E,F, and H remain ungrazed because of their native dune and wetland vegetation. Grazing of paddocks G and P by

sheep is desirable from the point of view of retaining a firebreak across the middle of the reserve, but also recommended in order that these can act as control sites for vegetation monitoring. The question whether to graze the remaining paddocks should be determined on the basis of other conservation factors, but keeping in mind the desirability of allowing for eventual revegetation throughout the reserve.

10. References

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Table 1 Okia Flat, Otago Peninsula. Distribution of vegetation features within paddocks A to R (refer Fig 1).

Estimates are given for percentage cover for the following:
B = Bracken, *Pteridium esculentum*
L = Lupin, *Lupinus arboreus*
K = Knobby clubrush, *Isolepis nodosa*
S = Silver tussock, *Poa cita*

Presence is noted of the following key native species, being especially those indicative of wetland diversity:

BR = *Baumea rubiginosa*
BT = *Baumea tenax*
CD = *Carex dipsacea*
CL = *Carex lessoniana*
CS = *Carex secta*
CV = *Carex virgata*
CR = *Chionochloa rigida x rubra*
EA = *Eleocharis acuta*
JG = *juncus gregiflorus*
LA = *Lepidosperma australe*
LS = *Leptocarpus similis*
SN = *Sphagnum novo-zelandicum*

Paddock no.	% cover:				key species:											
	B	L	K	S	BR	BT	CD	CL	CS	CV	CR	EA	JG	LA	LS	SN
A	30	2	2	1												
B	5	2	1													
C	15		5	2			+			+		+	+			
D	30		20				+			+		+	+	+		
E	15	2	20	2			+	+	+	+		+	+	+		
F	25	2	20	2			+			+	+	+	+		+	
G	25	5	15	5	+		+			+		+	+	+		+
H	25	2	15	5		+	+		+	+	+	+	+	+		+
I	25	2	5	2		+	+						+	+		
J	20	5	5			+	+						+			
K	20	2	1	1									+			
L	15	5	2													
M	20	10	2										+			
N	25	5	10	1												
O	25	5	10	1				+		+			+			
P	20	1	20	10			+	+					+	+		
Q	25	5	20										+			
R	30	5	25	2			+			+			+			

Table 2 Okia Flat, Otago Peninsula, assessment of botanical values within paddocks A to R (refer to Fig 1).

Ratings are assessed on a 0-3 scale for these features:

Wetland extent: the relative contribution of dune hollow wetlands to the area of each paddock.

Wetland features, the relative abundance and diversity of:
F = Flax clumps in dune hollows
J = *Juncus gregiflorus* rushland
C = *Carex dipsacea* sedgeland
O = Other rush and sedge communities
T = Turf vegetation
P = Pools or bog vegetation

Dune features:
F = Flax regeneration on dunes
S = Silver tussock and knobby clubrush
H = Heath and herb native vegetation

Special features, such as the presence of native scrub, isolated native trees, and *Chionochloa* tussocks.

Paddock No.	Wetland Extent	Features: Wetland						dune			special	total rating
		F	J	C	O	T	P	F	S	H		
A	0							1	1	1		3
B	0								1			1
C	2		1	2	2	2	2	1	2	3	1	18
D	2		3	2	2	1	3		3	1	3	20
E	3	3	2	3	3	3	3	2	3	2	3	30
F	2	2	3	2	2	2	3	3	3	3	1	26
G	2	3	2	2	3	2	2	2	3	3	1	25
H	2	1	2	2	3	2	2	1	3	2	1	21
I	2		1	2	2	2			1	2		12
J	2		1	1	1	2			1	2	1	11
K	1		1						1		1	4
L	0								1			1
M	1		1						1			3
N	0								2			2
O	1		1		1				2			5
P	1	2	2	1	1			1	3	1		12
Q	1		1						3	2		7
R	1		1	1				1	3	2		9

Table 3 Okia Flat, Otago Peninsula, location of weeds requiring control, May 1993.

Paddock			
A	gorse	*	SW corner, 50 m east of gate, 10 m patch
C	holly	*	between two old rock stacks, 2m bush
D	gorse	*	30 m west of SW gate, 1 plant
E	gorse	*	between the two Pyramids, scattered plants (also broom here)
		*	east of lone pine east of small Pyramid (1 plant).
		*	on edge of dune hollow, NE of a steep dune hummock, 250 m NE of small Pyramid (1 plant).
		*	20 m seaward of totara bush at N end of paddock (2 plants).
	broom	*	S flank of small Pyramid (not to be confused with the more olive, twiggy native broom here).
		*	E ridge of small Pyramid. This site needs careful treatment, not spraying which would endanger adjacent communities of Easter orchid; suggest instead cutting broom off at base and poisoning cut stumps.
	pines	*	a few wildings east of small Pyramid
F	gorse	*	50 m NE from SE end of triangular pine plantation.
G	gorse	*	NW of centre of paddock, scattered plants
P	gorse	*	near centre of paddock
Q	gorse	*	in NW corner, scattered plants
R	gorse	*	S end of damp hollow at N end of paddock (patch 10 m wide).

Appendix 1. Principal plant species of native heath and herb community of dune faces on Okia Flat, Otago Peninsula.

1. Low heaths: patotara (*Leucopogon fraseri*) and snowberry (*Pernettya macrostigma*).

2. Native herbs (in order of decreasing abundance): *Helichrysum filicaule, Celmisia gracilenta, Centella uniflora, Gonocarpus micranthus, Viola cunninghamii, Nertera setulosa, Geranium microphyllum, Hydrocotyle "montana"* and *Gnapluzlium ruahinicum*.

3. Naturalised species (in order of decreasing abundance): *Anthoxanthum odoratum, Crepis capillaris, Hypochoeris radicata, Agrostis capillaris, Hieracium pilosella.*

4. Lichens (in order of decreasing abundance): *Cladonia chlorophaea, Cladonia ochrochlora, Cladia aggregata, Cladina leptoclada, Cladia retipora, Stereocaulon ramulosum, Peltigera dolichorhiza, Cladonia subdigitata,* and *Cladonia squamosa.*

Appendix 2. Dune hollow wetland plant associations, Okia Reserve, Otago Peninsula. In each group species are listed in approximate order of decreasing abundance.

1. Rushes, sedges and other dominants of dune hollow bases: *Juncus gregiflorus, Carex dipsacea, Eleocharis acuta, Juncus articulatus, Phormium tenax, Carex virgata, C. flagellifera, C. buchananii, Leptocarpus similis, Juncus pallidus, J. sarophorus.*

2. Species of peaty hollows: *Lepidosperma australe, Baumea rubiginosa, B. tenax, Gonocarpus micranthus, Lachnagrostis* sp., *Sphagnum novo-zelandicum, Isolepis inundata.*

3. In hollows with damp grassland: *Holcus lanatus, Poa pratensis, Dactylis glomerata, Isolepis nodosa, Cirsium vulgare.*

4. Fertile hollows subject to ponding: *Juncus effusus, Carex secta, C. lessoniana, Agrostis stolonifera, Rumex crispus, Ranunculus repens, Carex coriacea.*

5. Floating on ponds: *Azolla filiculoides, Lemna minor, Wolffia arrhiza.*

6. In ponds at centre of damp hollows: *Eleocharis acuta, Juncus articulatus, Drepanocladus* sp., *Potamogeton cheesemanii, Glyceria declinata, Myriophyllum propinquum, M. triphyllum, Ranunculus glabrifolius, Epilobium chionanthum, Hydrocotyle novae-zelandiae, Potentilla anserinoides, Gnaphalium involucratum.*

7. Turf on dune hollow margins: *Centella uniflora, Schoenus maschalinus, Gonocarpus micranthus, Juncus antarcticus, J. bufonius, Viola cunninghamii, Pratia perpusilla, Hypericum japonicum, Hydrocotyle hydrophila, Lagenifera petiolata, Selliera radicans, Triglochin striata, Prasophyllum colensoi, Hydrocotyle "montana ", Nertera setulosa, Crepis capillaris, Gnaphalium ruahinicum, G. traversii, Carex cirrhosa, Gratiola sexdentata, Isolepis habra, Galium perpusillum, Juncus pusillus, Neopaxia australasica, Gentiana grisebachii, Callitriche petriei.*

8. Species formerly recorded from dune hollow wetlands but not seen at Okia Flat in recent years: *Carex litorosa, Elatine gratioloides, Myosurus minimus subsp. novae-zelandiae, Parahebe canescens, Glossostigma elatinoides.*

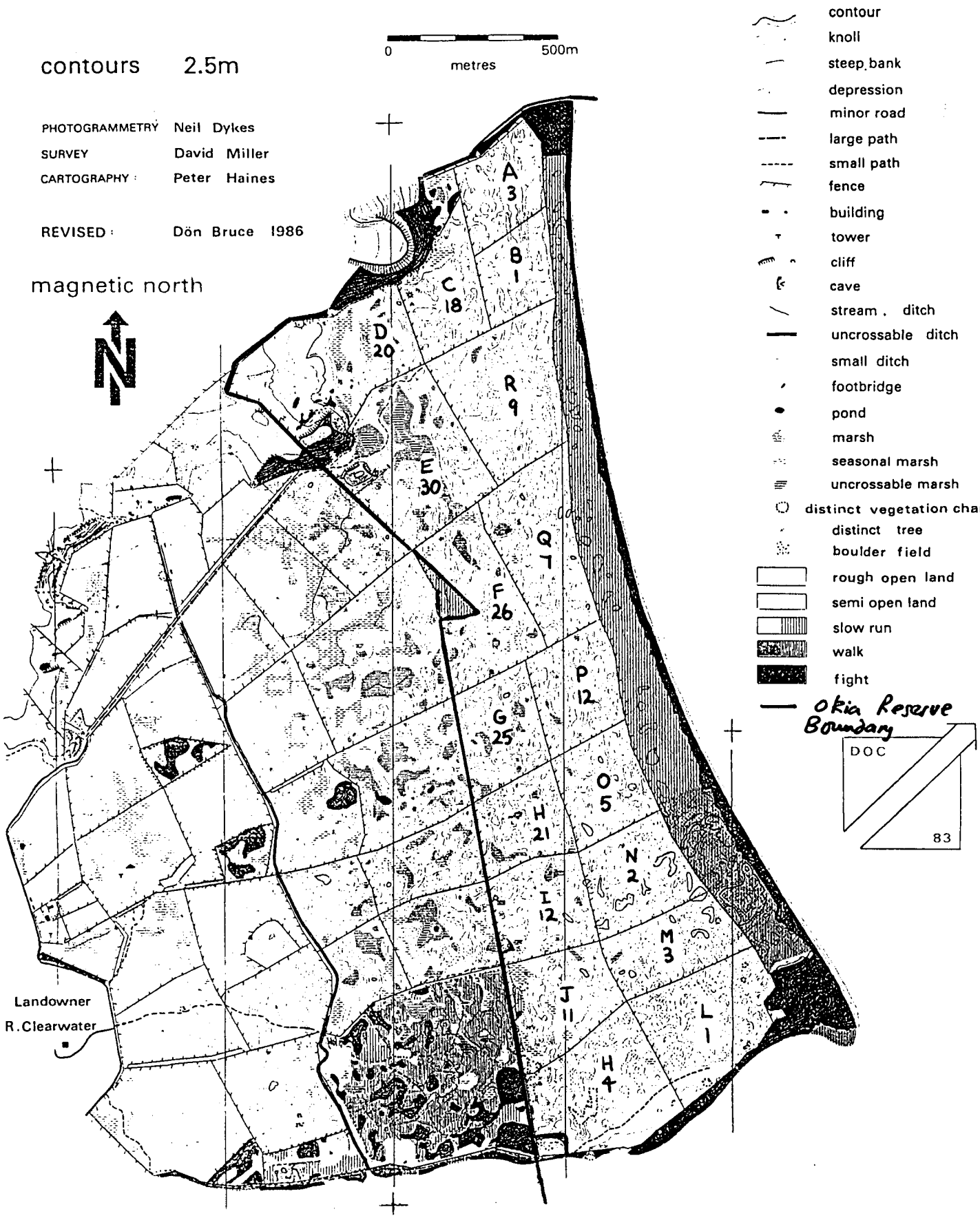

Fig 1. Okia Reserve, Otago Peninsula, showing paddocks A to R and their total rankings for botanical values. Map based on that prepared by Dunedin Orienteering Club.

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