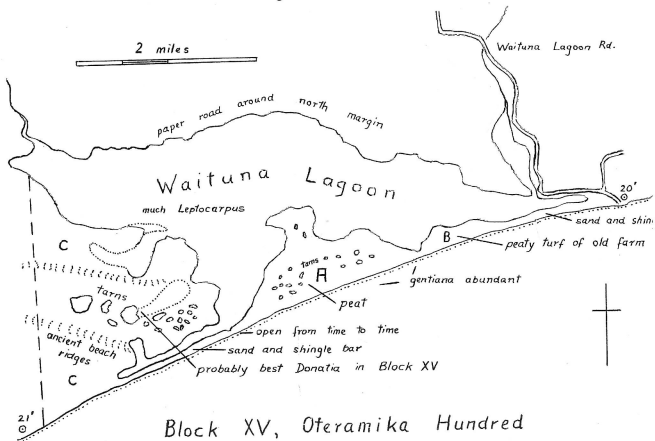


Fig. 1.—Locality Map.



Block XV, Oteramika Hundred

Fig. 2.—Waituna Lagoon and environs.

# Waituna Lagoon, Foveaux Strait

*G. C. Kelly, Christchurch.*

IN March 1967 two days were spent on the south-eastern Southland Plains searching for a site which would preserve a sample of "the remarkable Awarua Bog", as Dr L. M. Cranwell once called it, and the notes and species list which follow mention some of the more obvious features in the neighbourhood of the Waituna lagoon. Though several botanists (Martin, Crosby-Smith, Cockayne) have referred to this part of Southland, apart from the "moss" of the Awarua Plain the area is botanically little known. Advancing agriculture and indiscriminate firing are reducing the chances of knowing the flora.

The low-lying southeast corner of Southland is an Ice Age to post-Ice Age outwash plain of quartz-rich river gravels. To the west the plains are bounded by the ancient intrusives of the Longwood Ranges, and to the north and east there is Mesozoic greywacke forming the Hokonui Hills and the Catlins stretching eastwards to Chaslands. This greywacke block is cut by the south-flowing Oreti and Mataura rivers, the valleys of which form the major access routes. The gravel plain extends to the former island Bluff Hill, and outgrowth now is achieved by longshore drift and accumulation building beach ridges and bars. Behind Toetoes Bay this has led to ponding and impeded drainage on the alluvial plain, for slope is slight (5 — 10 ft per mile) and elevation little above sea-level, except where older terraces of the Mataura River rise up to 50 ft or so a few miles inland. From the air, peat tarns are a conspicuous feature of the coastal zone, though on the ground their presence would not be anticipated.

A thick blanket of peat has slowly developed under the prevailing conditions of low, generally equable temperatures (annual mean 49°F.), well distributed rainfall (more than 200 days per annum, though only about 50 inches in total), and frequently overcast skies (only 1600-1800 hours bright sunshine per annum). This peat now covers most of the land behind Toetoes Bay, and extends for some miles inland. The whole area is known as the Awarua Plain, but the part behind Toetoes Bay was called the "Seaward Moss", named for its unique moor-like vegetation characterised by herbs and shrubs adapted to cold peaty conditions. The flora contains many montane to subalpine plants growing here at sea-level. The number of species in the "moss" of the original nutrient-lacking deep peat is small (Appendix); however, there is a richer flora in the neighbourhood of the Waituna Lagoon, where in addition to the peat moss communities

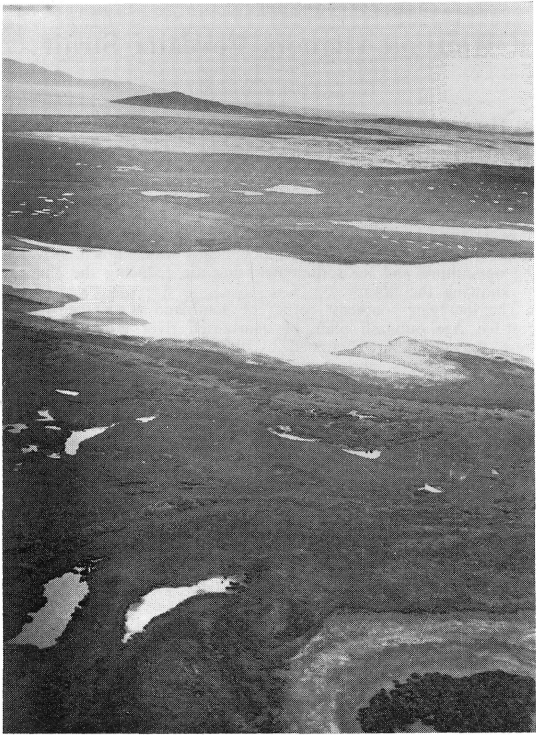


Photo: G. C. Kelly

Fig. 3.—Photo (plotted on Fig. 1) from above the eastern arm of Waituna Lagoon looking a little south of west, 5 p.m. 4/3/67. Foreground area A on Fig. 2, with tarns, bog, and manuka scrub particularly around silt-accumulation ridges, and with lagoon-edge herbaceous turf around the darker island in lower right. Middleground the Lagoon, with Block 15 behind including the three large tarns, and the *Leptocarpus*-ringed Lagoon arm to the right. Behind this the Awarua Bay arm of Bluff Harbour, then Bluff Hill (868 ft) and peninsula, and on the skyline Stewart Island, with Mt Anglem (3214 ft) on far left 35 miles distant. Flat peat-tarn dotted landscape of this type is unusual in the New Zealand landscape.

there is a little stunted coastal rimu forest on better drained parts of the peat, several kinds of lagoon-edge vegetation (salt marsh and allied communities are extremely well developed in south-eastern New Zealand), and finally coastal species along the shore.

The primitive cover on the peat varied with the surface relief and drainage, and ranged from peat tarns to stunted rimu forest, with vast areas of open moor vegetation, much of which was dominated by sphagnum and *Donatia novae-zelandiae*. Good remnants survive in areas A and C of Block XV, Oteramika Hundred (Fig. 2). Most of the land is covered with a layer of peat 4—8 ft thick resting on quartz gravel; area A is not sand as shown on the one-mile topographical map.

The difficulty of preserving peat bog in perpetuity is brought home at Waituna, for deep ditches show a tangle of trunks from a former manuka forest which flourished perhaps several thousand years ago, and which is now buried between 3 ft 6 in. and 4 ft 6 in. down in the peat. Around the Waituna Lagoon rootstocks still in place (together with fallen trunks and branches) have been exposed at a comparable level (Fig. 4). These suggest that drier conditions may have curtailed the growth of peat over a period of several centuries or more. The peat probably preserves a record of most of post-glacial time.



Photo: G. C. Kelly

Fig. 4.—*In situ* rootstocks of a former manuka forest exposed by wave action in the south-western arm of the lagoon. Buried trunks and branches can be seen in the peat section, with *Leptocarpus* prominent above.



## VEGETATION

Four more or less distinct groups of communities are found, with a surprising wealth of species.

### 1. Peat

Cushion bog is the most interesting feature of the vegetation, for it "had as its dominant species *Donatia novae zelandiae*, a species elsewhere restricted to subalpine bogs. In this association the subalpine element was strongly represented . . . the occurrence here in quantity of *Herpolirion novae-zelandiae*, *Oreostylidium subulatum*, *Oreobolus pectinatus*, *Carpha alpina*, and many other species elsewhere montane and supalpine gave these bogs a unique character . . ." (Martin, 1960).

The vegetation of the boggy areas varies considerably. There are several aquatic species (e.g. *Utricularia monanthos*) recorded by Crosby-Smith from standing water, and in shallow tarns the sedge *Cladium huttonii* is quite common. Wet concave surfaces more or less at water-table have sphagnum and the cushion plants *Gaimardia ciliata* and *Oreobolus pectinatus*, together with tussocks of *Schoenus pauciflorus* and the wire-rush *Hypolaena lateriflora*. In some parts there is umbrella fern (*Gleichenia circinata*), and

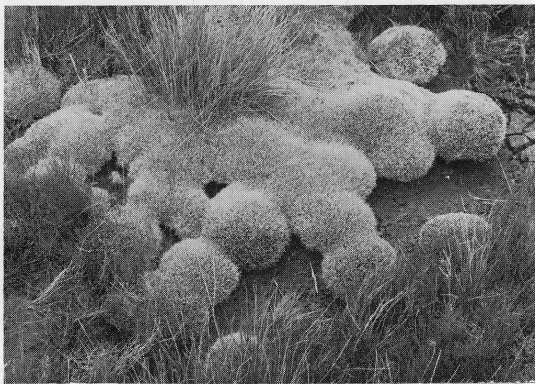


Photo: G. C. Kelly

Fig. 5.—*Gaimardia ciliata* cushions in a normally wet hollow, but at the time showing signs of drought. *Schoenus pauciflorus* tussocks to rear and front, with much wirerush.

on bare peat a variety of species including sundews *Drosera spatulata* and *D. binata*, *Pernettya macrostigma*, *Gaimardia*, *Carpha*, *Schizaea fistulosa*, *Herpolirion*, *Lycopodium ramulosum*, *Hemiphues suffocata*, *Nertera scapanioides* and *N. balfouriana*. On slightly convex or higher ground where the peat is always wet but unlikely to be submerged, *Donatia* cushion bog is best developed, together with many of the species listed 'P' in the Appendix. *Hypolaena* and *Gleichenia* may be prominent, especially in slightly drier parts; fire has probably assisted in creating stands of this vegetation. (*Donatia* bog is described in more detail by Crosby-Smith (1927) and Martin (1960)).

With a slight increase in elevation and aeration of the undulating peat, several larger plants appear, including the shrub *Dracophyllum longifolium* (and red tussock on the plains to the north), and an attractive boggy shrubland results. At about this stage in the natural vegetation manuka is able to compete, and an open manuka-*Dracophyllum* scrub with many bog species surviving below is common on suitable parts of area A (Fig. 6). This phase lasts a long time, but with continued litter accumulation other species of shrubs and trees would enter, ultimately forming the rimu-dominated stunted coastal forest typical of the area.

With repeated firing this sequence breaks down, for each time the plants are burnt the top of the peat is scorched and damaged. With even slight artificial drainage, conditions are so greatly altered that in the end manuka is able to establish as a first coloniser on the peat crust, and the other more usual peat species are crowded out. Soon vast areas come to be dominated entirely by manuka, where formerly a much more interesting vegetation prevailed.

Area A has probably not been burnt as much as the mainland, and all stages of peat vegetation up to manuka and *Dracophyllum* are present. Area B differs in that it has been cleared at some stage for farming, and now the native plants are reinvading it. At present there is a predominance of turf-forming herbs (Appendix) on the peaty area. Area C has good bog vegetation, and includes all stages up to large areas of fire-induced dense manuka.

## 2. Lagoon edge

Two communities are prominent. The jointed rush *Leptocarpus simplex* dominates considerable areas just above average water level, and may form vast stands in abandoned water channels and embayments. Associated species are few, for the growth of *Leptocarpus* is dense. The second community is found along the strand area which is inundated from time to time. It is composed entirely of small herbs up to an inch or so tall; 24 species were seen and careful examination would reveal more. The generally



Fig. 6.—Manuka — *Dracophyllum longifolium* open shrubland with hummocks of *Donatia* (some moribund) and *Oreobolus*, with many peat herbs.

rare *Schizeilema cockaynei* was found to be abundant in some places, and one of the commonest turf plants, *Schoenus nitens* var. *concinus*, is a new record for Southland. The miniature *Euphrasia repens* with its disproportionally large flowers is also locally abundant. The various species tend to arrange themselves into groups according to salinity and substrate particle size. For example there is *Schoenus*, *Selliera radicans*, *Cotula dioica* and *Lilaeopsis novae-zelandiae* on sandy areas with some salt; *Eleocharis gracilis*, *Schoenus*, *Scirpus cernuus* and *S. basilaris*, *Tillaea moschata*, *Lachnagrostis striata* and *Chenopodium ambiguum* in shingly fine silt of more freshwater areas, and *Schizeilema*, *Euphrasia*, *Plantago triandra* and *Schoenus* forming a turf on the firmer silt in the bayheads.

### 3. Seashore and sand

The white-flowered *Gentiana saxosa* is the most spectacular feature of the coastal vegetation. On peat capped with storm-washed shingle this gentian may form dense turf with *Selliera*, and everywhere on less exposed shingle spreading plants are common amongst *Scirpus nodosus* and silver tussock.



Photo: G. C. Kelly

Fig. 7.—*Gentiana saxosa* in quartz gravel over peat, with *Poa* tussocks behind. This gentian is abundant along the sea-eroded edge of the peat.

The seashore also has the usual coastal plants like *Scirpus nodosus*, sand convolvulus (*Calystegia soldanella*), coastal tussock (*Poa triodioides*), *Ranunculus acaulis*, prostrate pimeleas, and abundant *Selliera* which is in places acting as a sand binder and extends further into the salt spray than any other species. On the lee side of the spit, especially in area B, there are large areas of *Apium australe* and *Salicornia* forming an unusual hummocky vegetation giving about 50% cover in fine gravel. Interesting features of the sand ridge include occasional pingao (which is very rare in Southland), and several species of mat-daisy (*Raoulia glabra*, which is usually an inland species, a variety of *R. hookeri*, and possibly a third one equivalent to the one recognised by Cockayne as *R. beauverdii* in 1914). There is also *Muehlenbeckia axillaris*, sand-binding *Hydrocotyle novae-zelandiae* var. *montana*, the sea-shore forget-me-not *Myosotis pygmaea* var. *pygmaea* and the small coastal *Geranium sessiliflorum* var. *arenarium*.

Altogether the coastal herbs are a striking feature of the area, and form a distinct assemblage not found north of Southland.

#### 4. Turf

Along the tracks between the peat and the shore, and over much of area B where an attempt at farming has been made, there is a mixture of plants (marked "T" in the list) which reflect the disturbance to these areas. In the "pasture" on peat, bog plants are prominent, but both lagoon edge species and coastal species can also be found, together with patches of introduced plants, and weeds including gorse and blackberry. Near the track the amount of sand on the peat increases, and there are several characteristic plants including silver tussock, a variety of *Carex comans*, *Potentilla anserinoides*, *Acaena novae-zelandiae* and *Libertia peregrinans*. Some of these would have been dune hollow plants in the undisturbed vegetation.

#### CONCLUSIONS

At the present time the area of wetland in New Zealand is shrinking rapidly. This is of particular concern to ornithologists, but also interests botanists, for the vegetation of our wetlands does vary considerably between North Cape and Bluff. The coastal peat moor of Southland is unique, and well merits preservation. Further, the lagoon and its environs undoubtedly form one of the outstanding waterfowl habitats in the county. It is under study at the present time; more than 50 species of native or migratory birds have been recorded there, some of them rarely seen elsewhere in the country.

I do not claim that Block XV includes the very best example of lowland *Donatia* bog still surviving — better areas may still be found east of Awarua Bay Road (for example, in the grid square immediately south-east of the end of Hall Rd., N.Z.M.S. S182). However, it is likely that the areas A and C offer the best geographical and cultural chance to preserve wetland, and accordingly they have been recommended as a reserve.

#### ACKNOWLEDGEMENT

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APPENDIX: HIGHER PLANTS NATIVE TO THE AREA.

(N.B.: This list is not a complete flora.)

- P usually on peat  
 L lagoon edge  
 S seashore  
 T tracks and "pasture"  
 † montane to subalpine species not usually found at sea level  
 \* specimen at Botany Division Herbarium, Lincoln
- T \**Acaena novae-zelandiae*  
 T A. sp.  
 L †\**Agrostis pallescens*  
 S \**Apium australe*
- P *Blechnum* sp. (*B. capense* aggr. of Allan)  
 P *B. minus*  
 P \**B. pennamarina*  
 P *B. procerum* (*B. minus* of Allan)
- L *Callitriche petriei* ssp. *petriei*  
 S *Calystegia soldanella*  
 S, T \**Carex comans* var.  
 P *C. coriacea*  
 S, T \**C.* sp. (*C. lucida* of Cheeseman in part)  
 S *C. pumila*  
 P *C. secta*  
 P †*Carpha alpina* (lowland in Westland pakihi)  
 P \**Cassinia julvida*  
 P, T \**Celmisia gracilentia*  
 T *Centella uniflora*  
 S, L \**Chenopodium ambiguum*  
 P *Chionochloa rubra*  
 P \**Cladium huttonii*  
 P *C. rubiginosum* (*C. glomeratum* of Cheeseman)  
 L \**C. tenax* (*C. gunnii* of Cheeseman)  
 S *Colobanthus muelleri*  
 S *Coprosma propinqua*  
 P \**C.* sp. (*C. rugosa* or *C. brunnea*)  
 P, L *Cortaderia richardii*  
 L, T *Cotula dioica*  
 L *C.* sp.  
 P *Cyathodes empetrifolia*  
 P, T *C. fraseri*  
 P \**C. juniperina*
- S *Desmoschoenus spiralis* (rare)  
 P *Dianella intermedia* var. *norfolkiana*  
 P †*Donatia novae-zelandiae*  
 P \**Dracophyllum longifolium*  
 P *Drosera binata*  
 P *D. spatulata*

L	* <i>Eleocharis gracilis</i>
P	<i>E. sphacelata</i>
S	<i>Epilobium</i> sp.
P, T	<i>E. sp.</i>
P	†* <i>Euphrasia</i> sp. ( <i>E. dyeri</i> ?)
L, T	* <i>E. repens</i>
P	†* <i>Gaimardia ciliata</i> (lowland in Westland pakihi)
P, T	* <i>Gentiana grisebachii</i>
P	†* <i>G. lineata</i>
S	* <i>G. saxosa</i>
S	* <i>Geranium sessiliflorum</i> var. <i>arenarium</i>
P	<i>Gleichenia circinata</i>
L	<i>Glossostigma elatinoides</i>
S, T	<i>Gnaphalium luteo-album</i>
P, T	* <i>Gunnera prorepens</i>
T, L	<i>Haloragis depressa</i>
T, P	<i>H. micrantha</i>
T, S	<i>Helichrysum filicaule</i>
P	* <i>Hemiphues suffocata</i>
P	<i>Herpolirion novae-zelandiae</i>
P	* <i>Hierochloe redolens</i> s.s.
L	<i>Hydrocotyle hydrophila</i>
S	<i>H. novae-zelandiae</i> var. <i>montana</i>
P	<i>Hypolaena lateriflora</i>
P	<i>Juncus antarcticus</i>
T	* <i>J. pallidus</i>
T	* <i>J. pauciflorus</i>
P	<i>J. planifolius</i>
T	<i>J. sp.</i>
L	†* <i>Lachnagrostis striata</i> ( <i>Deyeuxia forsteri</i> var. <i>humilior</i> of Cheeseman, in part)
T	<i>Lagenophora pumila</i>
P	<i>Lepidosperma australe</i>
L, S	<i>Leptocarpus simplex</i>
P, T	<i>Leptospermum scoparium</i>
S, T	* <i>Libertia peregrinans</i>
L, T	<i>Lilaeopsis novae-zelandiae</i>
L	<i>Limosella lineata</i>
P	* <i>Lycopodium ramulosum</i>
T	* <i>Mazus radicans</i>
T	<i>Mentha cunninghamii</i>
S	* <i>Muehlenbeckia axillaris</i>
S	<i>Myosotis pygmaea</i> var. <i>pygmaea</i>
L, T	<i>Myriophyllum pedunculatum</i>
L	<i>M. propinquum</i>
P	†* <i>Nertera balfouriana</i>
T	<i>N. sp.</i>
P	<i>N. scapanioides</i>
T	<i>Ophioglossum</i> sp.
P	†* <i>Oreobolus pectinatus</i>
P	†* <i>O. strictus</i> (lowland in Westland pakihi)
T	<i>Oreomyrrhis colensoi</i>
P	<i>Oreostylidium subulatum</i>

P	† <i>Pentachondra pumila</i>
P, T	<i>Pernettya macrostigma</i>
P	<i>Phormium tenax</i>
S	<i>Pimelea lyalli</i>
S	<i>P. prostrata</i>
T	<i>Plantago raoulii</i>
L, T	<i>P. triandra</i>
S, T	<i>Poa laevis</i>
S	<i>P. triodioides</i> ( <i>Festuca littoralis</i> of Cheeseman)
T, L	* <i>Potentilla anserinoides</i>
P	* <i>Prasophyllum colensoi</i>
T	<i>Pratia angulata</i>
P, T	<i>Pteridium aquilinum</i> var. <i>esculentum</i>
S	<i>Ranunculus acaulis</i>
S	* <i>Raoulia glabra</i>
S	* <i>R. hookeri</i>
S	* <i>R. sp.</i> ( <i>R. beauverdii?</i> )
L	<i>Ruppia</i> sp.
S	<i>Salicornia australis</i>
P, L, T	<i>Samolus repens</i>
P	* <i>Schizaea fistulosa</i>
L, T	* <i>Schizeilema cockaynei</i>
L, T	* <i>Schoenus nitens</i> var. <i>concinus</i>
P, T	<i>S. pauciflorus</i>
L	† <i>Scirpus aucklandicus</i>
L	* <i>S. basilaris</i>
L, T	* <i>S. cernuus</i>
S, L	<i>S. nodosus</i>
P	* <i>S. sulcatus</i> var. <i>distigmatus</i>
S, L, T	* <i>Selliera radicans</i>
S, P	<i>Senecio biserratus</i>
P, T	* <i>Thelymitra longifolia</i>
P	* <i>T. pachyphylla</i>
P	* <i>T. pulchella</i>
P	* <i>T. venosa</i>
S, L, T	<i>Tillaea moschata</i>
S, L, T	<i>Triglochin striatum</i> var. <i>filifolium</i>
T	* <i>Uncinia silvestris</i> var. <i>squamata</i>
T	<i>Viola cunninghamii</i>

Crosby-Smith records the following additional plants as characteristic of the Awarua peat:

*Astelia cockaynei*  
*Cassinia vauvilliersii*,  
*Cyathodes pumila*,  
*Elatine gratioloides*,  
*Gaultheria depressa*,  
*Gunnera albocarpa*,  
*Microlaena thompsonii*  
*Montia fontana*,  
*Notodanthonia* sp.,  
*Utricularia monanthos*,  
*Viola filicaulis*