IV. VEGETATION: ADDITIONS AND CHANGES— THE FISHER ISLAND FIELD STATION

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(With 1 plate and 1 text figure)

INTRODUCTION

Fisher Island lies in Franklin Sound between Flinders and Cape Barren Islands in Eastern Bass Strait and has attained fame as the focal point of the C.S.I.R.O. investigation into the mutton bird (*Puffinus tenuirostris*) begun in 1947 under the leadership of Dr. D. L. Serventy.

A general account of the island appeared in this journal in February 1958 (Guiler, Serventy and Willis) but further facts have come to light regarding the vegetation and it seems appropriate to record these for use by subsequent workers at the field station.

Thanks to the generosity of the C.S.I.R.O. Wildlife Survey Section, the author was able to spend a large part of three summers (1958-1960) at the research hut. Mr. J. H. Willis, Assistant Government Botanist at the National Herbarium of Victoria, who is responsible for the only other published information on the Fisher Island flora, was able to spend only a few days on the island. Unfortunately his stay, in April 1954, coincided with the end of a long dry summer when the plant life was at its sparsest. Adding his records to those of plants sent to him from the island by C.S.I.R.O. personnel in 1948, 1949 and 1952, he was able to list 47 species—33 natives and 14 aliens. The 1958 to 1960 seasons yielded a further 48 species—23 natives and 25 aliens—and the author is indebted to Mr. Willis and his staff for checking the identifications of these.

The 95 species recorded up to March 1960 are listed below.

Table 1

SPECIES RECORDED ON FISHER ISLAND UP TO MARCH, 1960

x = alien sp.; H = in Fisher I. herbarium; M = Fisher I. plant identified at Melbourne herbarium; m = specimen from another Bass Strait I. identified at Melbourne herbarium; W = recorded by Willis, 1958. (z) = having xeromorphic features.

H m	Posidonia australis
HM	Zostera tasmanica
HM	Zostera muelleri
HM	Cymodocea antarctica
H	Halophila ovalis
xHM W	Dactylis glomerata
xHM W	Vulpia bromoides
xHM W	Bromus mollis
xHM	Bromus diandrus
xHM W	Briza maxima
xHM	Briza minor
(z) HM W	Poa poiformis
H mW	Deyeuxia quadriseta
HM W	Dichelachne crinita
H m	Agrostis avenacea
(z) H mW	Stipa teretifolia
xH mW	Holcus lanatus
xH mW	Aira caryophyllea
xHM	Avena strigosa
xH mW	Avena sativa
xH m	Lolium perenne
(z) H mW	Parapholis incurva
(z) M	Monerma cylindrica
HM	Isolepis platycarpus
HM	Isolepsis cernuus
HM	Centrolepsis strigosa
HM	Juncus bufonius
(z) H mW	Juncus pallidus
(z) H mW	Dianella revoluta
(z) H mW	Bulbine semibarbata
HM W	Microtis unifolia
HM W	Muehlenbeckia adpressa
xH m	Atriplex hastata
(z) HM W	Rhagodia baccata
(z) H m	Suaeda maritima
(z) HM W	Salicornia australis
(z) HM W	Arthrocnemum arbusculum
(z) HM	Hemichroa pentandra
(z) H mW	Disphyma australe
(z) H mW	Carpobrotus rossii
(z) H mW	Tetragonia implexicoma
(z) HM W	Calandrinia calyptrata
xH m	Stellaria media
HM	Stellaria multiflora
xHM	Cerastium glomeratum
xHM	Moenchia erecta
xHM	Sagina apetela
(z) HM W	Spergularia media
HM	Polycarpon tetraphyllum
xHMm	Tunica prolifera
xH m	Silene gallica
x W	Silene anglica
(z) H mW	Clematis microphylla
(z) H mW	Lepidium foliosum
xHM	Hymenolobus procumbens
(z)-HM W	Crassula sieberiana

HM	Acaena anserinifolia
(z) H mW	Acacia longifolia v. sophorae
(z) H mW	Acacia mucronata?
x M	Trifolium campestre
xHM W	Trifolium dubium
xHM	Trifolium cernuum
x m	Trifolium fragiferum
xHM	Trifolium glomeratum
xHM	Trifolium subterraneum
xHM	Trifolium arvense
xHM	Trigonella ornithopodioides
xH m	Medicago sativa
xHM W	Melilotus indica
H mW	Pelargonium australe
xHM	Geranium molle
H mW	Oxalis corniculata
x M	Lavatera arborea
HM	Daucus glochidiatus
(z) H mW	Apium prostratum
(z) H mW	Leucopogon parviflorus
xH m	Anagallis arvensis
H m	Centaurium pulchellum
(z) H m	Alyxia buxifolia
xHM	Plantago coronopus
(z)xHM W	Coprosma repens
(z) H mW	Stylidium graminifolium
H mW	Lagenophora stipitata
H mW	Brachycome diversifolium v. maritimum
(z) HM W	Olearia stellulata
(z) H mW	Helichrysum bracteatum v. albidum
(z) H m	Gnaphalium luteo-album
HM	Cotula vulgaris v. australasica
(z) HMm	Cotula coronopifolia
mW	Senecio linearifolius
HMmW	Senecio glomeratus
xHM W	Hypochoeris radicata
xHM	Hypochoeris glabra
xHM	Sonchus oleraceus
xH mW	Sonchus asper

56 native spp. 39 introduced spp. = 41%

FLORISTIC COMPONENTS

31 families are represented in the above list, 5 of them by aliens only, viz. Papilionaceae (10 species), Malvaceae, Primulaceae, Plantaginaceae and Rubiaceae. (*Hemichroa* has been placed in the Chenopodiaceae, not the Amaranthaceae). Analysis of the 7 families best represented is included below.

Components of the 7 Best Represented Families.

Family	Number of species		
	Native	Introduced	Total
Gramineae	7	11	18
Compositae	9	4	13
Caryophyllaceae	3	7	10
Papilionaceae	0	10	10
Chenopodiaceae	5	1	6
Potamogetonaceae	4	0	4
Aizoaceae	3	0	3

7 further families are represented by 2 species each and 17 families by 1 species.

Deyeuxia, Stylidium and *Lagenophora* have not been recorded since 1954, *Lavatera* not since 1958.

This vegetation differs fundamentally from that of Flinders and Cape Barren Islands in that it lacks almost all the woody sclerophylls which dominate the larger islands. These woody families, principally Myrtaceae, Proteaceae, Epacridaceae and Mimosaceae, are represented on Fisher Island only by the localised *Leucopogon parviflorus* and *Acacia longifolia* var. *sophorae.*

Exposure to wind and spray undoubtedly contributes to the paucity of shrubs, as pointed out by Willis, but the poor shallow soils which he cites are probably not so important. On adjacent islands it is these very soils, situated on granite outcrops, which support the major shrub growth, the deeper soils between having been denuded of woody plants partly by the big population of burrowing birds and partly by the periodic burning which is practised.

Most of the Fisher Island species occur as components of the impoverished coastal flora of the larger islands but *Lepidium foliosum* was found only on the smaller islets and reefs. Although no doubt once more widespread, this cress does best in the absence of grazing mammals and the presence of defaecating seabirds.

The Fisher Island species list is a great deal longer than that for any other island of equivalent size (2.1 acres) and exposure visited in the Furneaux Group. This is mainly accounted for by the high incidence of aliens crossing from the nearby crayfish and mutton bird port of Lady Barron on Flinders Island, the frequent traffic of scientists to and from the 'Island Stores' and the landing of loads of firewood, the only cooking fuel.

SOIL FACTORS

The Devonian granite weathers to give an acid, siliceous sand, the pH of 12 samples taken from various parts of the island averaging 4.75 and ranging from 4.0 to 7.0, with only 1 sample, a coastal one, approaching neutral. This pH does not differ significantly from that of the commercial mutton bird islands, but the proportion of organic matter in the Fisher Island soil is very much larger than on these. Soil ignited in a tin on the cooking fire loses more than half its volume and the average weight loss on ignition for 2 hours at 900°C of 12 samples previously dried to 105°C by Mr. J. T. Hutton of the C.S.I.R.O. Division of Soils, Adelaide, was 28%. Figures ranged from 18% to 45% and represent the organic matter content fairly accurately as the mineral matter content of the samples was mostly coarse sand.

23 samples from the adjacent Little Green Island, which is regularly fired by the birders, averaged exactly half that of the Fisher Island soils (14%), while 17 samples from Great Dog Island (also regularly burned) averaged only 9.4% of organic matter. The unburned islet of Inner Possum Reef, on the other hand, showed an average of 36% of organic matter (15 samples). The organic carbon figure for these samples is about 56% of the recorded loss on ignition.

A higher organic content in these sandy soils implies a higher water holding capacity, the average percentage moisture content for air-dry Fisher Island and Possum Reef samples being 5.2% and 6.6% respectively, that for Little Green and Great Dog Islands being 1.8% and 1.5%. Nevertheless, the thin skins of peat overlying much of the rock on Fisher Island dry out in summer until they become almost un-wettable. The greatest difficulty was experienced in watering even pulverised samples of this humic material in which seed viability experiments were being carried out, the water rolling off the surface in globules. Such soils are likely to remain sodden for longer than the native sands in winter but would be unable to absorb the light summer showers which can prolong plant growth into an unfavourably dry season. Many of the species which they support are winter annuals, even the succulent-leaved *Calandrinia calyptrata* and *Crassula sieberiana* dying off as the summer advances.

Typical species of the shallow peats overlying inland rocks are *Centrolepis strigosa, Juncus bufonius, Stellaria multiflora, Cerastium glomeratum* and *Moenchae erecta*. The most typical species of the coastal peat fringe which encroaches onto the granite shoreline is *Cotula vulgaris* var. *australasica* which forms a narrow zone below the marginal belt of *Disphyma australe*. The latter, with *Carpobrotus rossii* and *Hemichroa pentandra,* with which it shares these thin peat crusts, are creepers, tapping a wider range of soils than the annuals and often rooted in deep crevices.

Deeper soils with a higher sand content are burrowed by shearwaters, which ensure a more adequate mixing of the organic and mineral fractions than when the surface deposites remain undisturbed.

Table 3 shows the characteristics of 12 soils from various parts of Fisher Island.

Table 2

SOME CHARACTERISTICS OF SOIL FROM TWELVE SAMPLES COLLECTED ON FISHER ISLAND

No.	Part of Island	Depth of Sample (inches)	Soil Colour	Undecayed Plant Material	Loss on Ignition	Organic Carbon	Moisture in the Field	Moisture in air-dry Soil	pH	Rookery	Dominant vegetation of the immediate Sample Area
					%	%		%	%		
1.	South ..	2	Black	Small	25	..	Wet	5.9	7.0	Snake Gully	*Tetragonia*, *Apium*, *Poa* and *Disphyma*
2.	South ..	10	L. Brown	Large	33	..	V. Wet	7.3	4.5		
3.	Centre ..	2	D. Brown	Medium	32	..	Dry	5.6	4.0	South	*Dactylis*, *Avena*, *Dianella* and *Bromus*
4.	Centre ..	10	Black	Small	19	..	Damp	3.9	4.0		
5.	East ..	2	Brown	Large	40	21	Dry	6.3	4.0	Potts Point	*Poa*, *Briza* and *Coprosma*
6.	East ..	10	Brown	Large	45	..	Dry	7.4	4.5		
7.	North ..	2	Brown	Large	24	..	Dry	3.7	4.5	Home	*Poa and Bromus*
8.	North ..	10	Brown	Large	18	..	Damp	3.0	4.0		
9.	Southwest ..	2	Black	Small	40	..	Wet	7.9	4.5	None	*Disphyma*
10.	Northeast ..	2	Black	Small	36	20	Wet	7.8	6.0	None	*Cotula*
11.	North ..	2	Black	Large	22	..	Damp	3.6	4.0	Home	*Poa*
12.	Centre ..	2	Black	Large	39	22	Damp	8.1	6.0	None	*Poa*
	AVERAGES ..	..	..	..	28	..	..	5.2	4.75	..	..

Loss on ignition is equivalent to content of organic matter (% by wt.). Organic carbon is equivalent to 56% of total organic matter.

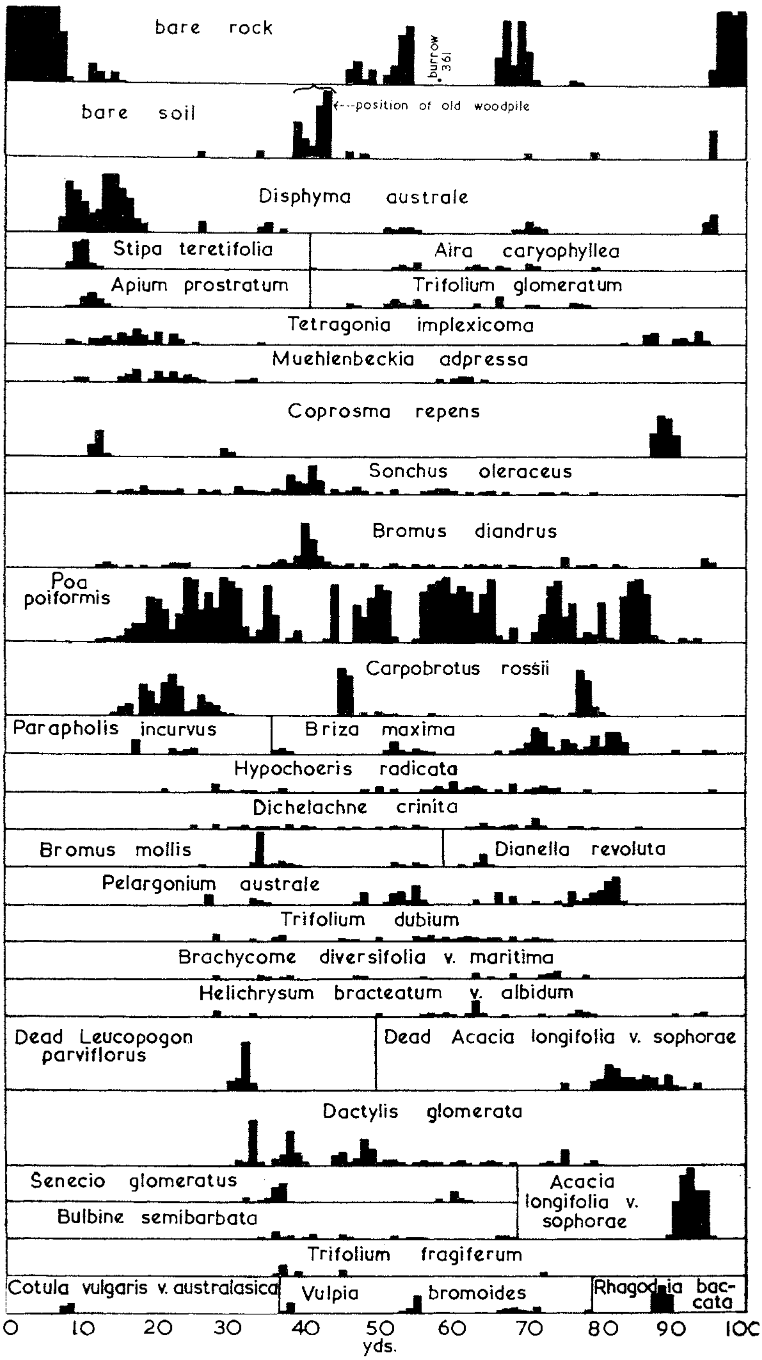
SUMMER DROUGHT

With so many mesophytic annuals in the flora, summer drought can be a limiting factor to a high proportion of the Fisher Island plants. Although the average annual rainfall is about 30 inches (760 mm.) per annum, or approximately the same as on Skokholm Island in West Wales (Goodman & Gillham, 1954), little of this falls in the summer months (December to February) (Serventy, 1958). The Southern Hemisphere Island (Lat 40°S) experiences a higher evaporation rate than the Northern Hemisphere one (Lat. 52° N) and the ratio of xerophytes to mesophytes among the perennial plants is consequently higher.

Willis, 1958, remarks that almost all the plants present on Fisher Island in April 1954 possessed xeromorphic characters, but this is only true of those species perennating above ground during the summer. Only 32 species, or a third of the total, are xeromorphs and these are prefixed with (z) in the accompanying species list. 5 other species are marine and submerged by all tides and a few are aestivating geophytes, but most of the non-xeromorphs are ephemerals, accomplishing one or more generations during the moister conditions of autumn, winter and spring. (There is neither frost nor snow to check winter growth.) The most numerous groups in this category are in three of the four best represented families, viz the grasses, clovers and Caryophyllaceous 'weeds'.

As in the 1954 drought, most of these species disappeared during the unusually dry summers of 1959 and 1960. (Shade temperatures rose to 101°F (38.3°C) in January 1960.) Even the most succulent and sclerophyllous plants suffered severe wilting during this period and a high proportion of the withered *Coprosma* leaves, normally evergreen, were exfoliated. The 3 Aizoaceous species recovered turgidity apparently by the absorption of dew or atmospheric moisture as only one fall of rain, of considerably less than 1 inch (25 mm.) occurred during the subsequent 2 months and this was scarcely sufficient to wet the parched soil. All 3 species bore a high proportion of small reddish drought-resistant leaves. *Bulbine semibarbata, Lepidium foliosum* and other perennials remained dwarf, *Poa poiformis* and *Stipa teretifolia* shoots were dry and brittle and few annuals survived the prolonged heatwave.

FISHER ISLAND VEGETATION IN RELATION TO EXPOSURE
Belt transect (100 X 1 yd.) from H.W.M. on W. to H.W.M. on E.
percentage cover histogram. 24. 1. 58.



EXPOSURE TO WIND AND SEA SPRAY

a. *Land Flora*

The accompanying histogram shows the percentage ground cover of plant species along a 100 yd. (92.3m.) belt transect running from the exposed western coast of the island to the sheltered eastern coast. The overall zonation is from succulent *Disphyma australe* through the main central zone of *Poa poiformis* tussock to *Acacia longifolia* var. *sophorae* scrub. The more salient features of the zonation revealed by the transect can be summed up as follows:

The most seaward *Disphyma* mingles with the coastal fringe of *Cotula vulgaris* var. *australasica* and is superceded on the inland side by a belt of *Stipa teretifolia*. This coastal tussock grass borders the more exposed west and south sides of the island, withstanding slightly less sea salt than *Disphyma*, athough more maritime in its distribution in that it does not reappear on inand rocks.

The next belt is of mixed *Apium prostratum* and *Coprosma repens*, followed by a broader zone of *Tetragonia implexicoma* which merges into a similarly broad zone of *Carpobrotus rossii* with a little *Parapholis incurva* and *Muehlenbeckia adpressa*. The last, like *M. complexa* in New Zealand (Gillham, 1960), is typically associated with *Poa* tussock in areas subjected to considerable wind but not too much salt spray. The mesophytic leaves suffer readily from salt scorch and woody galls, each housing from 1 to 3 grubs ½-1" long, occur on the creeping woody stems.

Poa poiformis, the island dominant, begins to appear at the inner margin of the *Stipa* zone, increasing to a fairly overall cover beyond the more essentially coastal plants cited above. On inland rock outcrops it gives way to *Disphyma* and *Carpobrotus* associated with less halophytic saxicoles, principally *Bulbine semibarbata*, *Pelargonium australe* and *Brachycome diversifolia* var. *maritima*. Smaller subordinates featuring less conspicuously in the transect are the winter ephemerals of the peat crusts.

Shrubs other than *Coprosma repens* appear only towards the east end of the transect. The alien *Coprosma* from New Zealand appears by its distribution on all the islands to be more exposure resistant than any of the native shrubs. With *Rhagodia baccata* semi-shrubs it protects the windward side of the *Acacia longifolia* var. *sophorae* clump which appears in the transect and is, nevertheless, dead or severely wind-scorched except on its leeward fringe. *Rhagodia*, although a succulent-leaved Chenopodiaceous halophyte, shuns the most exposed situations and grows much less tall than the sheltering *Coprosma*. Below the eastern *Acacia* scrub the granite drops away to a wave cut platform in a more or less vertical cliff and the coastal belts are telescoped, *Carpobrotus* and *Tetragonia* leading down to *Disphyma* and sparse *Spergularia media*.

b. *Marine flora*

The fetch is greater to the south of Fisher Island than to the west (Guiler, 1958), so wave action is likely to be most intense on the south coast. It is never great, however, and, although brown algae predominate in the south and west, these do not include the larger surf lovers. Some, such as *D'Urvillea antarctica* and *Macrocystis pyrifera*, wash ashore, presumably from regions outside Franklin Sound, but the main species found attached are members of the Fucales. *Hormosira banksii* forms a continuous belt around the island but species of *Cystophora*, *Cystoseira*, *Sargassum* and *Scaberia* are more localised. Passing eastward, particularly along the land facing north coast, large members of the Siphonales become conspicuous, among them *Caulerpa cactoides*, *C. simpliuscula*, *C. sedoides* and *Codium muelleri*.

Fine growths of marine angiosperms cover the silty sea bed off the north and north east shores. *Posidonia australis* is dominant, bordered on its upper fringe by the smaller *Zostera tasmanica* and *Z. muelleri*. A little *Cymodocea antarctica* occurs in lower parts of the *Posidonia* 'meadows', which are uncovered only by low springs. (Tidal range around Fisher Island is only just under 6 ft. (2 m.), 2 ft. more at springs and 2 ft. less at neaps.). *Halophila ovalis* grows sparsely among the other Monocotyledons but is more often found in driftweed.

After heavy weather on February 1st 1960 considerable quantities of *Posidonia* fruits, open capsules and winged seeds were washed up into crevices. This phenomenon had not been observed before on Flinders Island by local naturalists, nor in the Eastern States by Mr. J. H. Willis, but is apparently not uncommon in Western Australia. 3 weeks later, on 20th February, 1960, many of the seeds were seen to have germinated in the shallows around the east and south east coasts. The average shoot length at this time was 1-2 inches 2-5 cm.) but some were longer and showed incipient rhizome formation where the juvenile leaves had died away. Internodes were short and the earliest formed leaves bore only rudimentary laminae, the leaf sheaths terminating in auricular like outgrowths. Many seedlings had been washed from their roothold and it was obvious that there was considerable wastage at this stage—provided for by the prolific, though irregular, seed production.

VEGETATION CHANGES DURING THE 1950's.

During the 8 years after the vegetation was mapped by Mr. G. M. Storr in 1952 *Acacia*, *Leucopogon* and *Carpobrotus* decreased and *Olearia*, *Rhagodia*, *Tetragonia*, *Coprosma*, *Stipa* and exotic grasses increased, though much of the *Rhagodia* subsequently died back.

Willis, 1958, comments that both *Acacia* and *Leucopogon* had been dying back, with minor recuperations, since 1950. He estimated that the *Acacia* covered 350 sq. yd. or 3.3% of the island's area in 1954, but the area was much less in 1960. The 1958 transect shows a width of only 2 yd. (less than 2 m.) at the east margin of the *Acacia* thicket to consist of still living bushes. A further 5 yd. (4½ m.) strip showed incipient die back and completely dead bushes occupied a belt 14 yd. (12½ m.) wide to windward of this. No regeneration was noticeable. The phyllodes of otherwise healthy plants were badly infested by black and white scale insects during the early part of 1960.

Leucopogon parviflorus in 1954 formed scattered clumps up to 10 yd. (c. 9 m.) across in the centre, south east and south west of the island. By 1958 all these bushes were dead but a small clump had grown up on North Point and been subsequently killed back to leave few living shoots. By 1960 this too had died out, but a number of saplings about 1 ft. (30 cm.) high were found scattered throughout the island. As existing plants have not been seen to set seed, it is likely that this regeneration was from succulent fruits brought from other islands by gulls. The life expectancy of individual *Leucopogon* bushes on Fisher Island seems to be short at present. That this has not always been the case is shown by the existance of old trunks of both this species and *Acacia,* of vastly greater girth than anything living today.

Shrubs as a group occupied less ground in 1960 than in 1952 but there had been a pectacular increase in the amount of *Coprosma repens.* This species does not figure at all on the detailed 1952 map but was much the most widespread and tallest shrub on the island in 1960, reaching commonly to 5-6 ft. (1.5-1.8 m.) in height. It showed ready establishment in rock crevices on the north west corner, but plants remained dwarf and wind trimmed there, often only the leeward one of the 4 rows of leaves and shoots remaining alive.

Although most of the larger *Olearia stellulata* bushes showed die-back, a number of young ones were becoming established in the north, east and south. *Rhagodia baccata* also showed cyclic change, dying in some areas, particularly in the south and south east, and regenerating in others.

It is evident that degeneration and regeneration of shrubs proceed side by side, but there appears to have been an overall retrogression over the past ten years, with only part of the damage made good. Over a period this would account for the smaller maximum size of existing shrubs as well as the smaller ground coverage.

Similar fluctuations occur among herbaceous species but damage to these is more readily repaired and long term changes are less pronounced. Willis mentions dying back of *Disphyma, Carpobrotus* and *Tetragonia* in 1954, but recovery of these may be effected within a few months in suitable weather—as shown by plants on Reef Island, just offshore after the entire vegetation there had been browned by a salt storm. These 3, *Coprosma* and others all suffered considerable drought damage in January 1960 but had more or less recovered 2 months later, in spite of negligible rainfall.

The progressive succession of plants where soil and shelter are adequate is from succulents to tussock grass and so to shrubs, but in 1960 there was more evidence of retrogressive succession, *Poa* tussocks growing up through the disintegrating shrubs and being overrun themselves in places by *Disphyma* or *Tetragonia.*

VEGETATION OF SHEARWATER ROOKERIES

It seems that the burrowing birds may be playing a significant role in producing long term changes in the Fisher Island plant communities and short term changes in the immediate vicinity of burrows. Floristic analyses were made in the 3 mutton bird rookeries and table 4 summarises their main points. The 251 m. valence squares in each community were random except in so far as each incuded a burrow entrance. In the Home Rookery, where burrows were closest, 9 of the squares contained more than a single entrance.

The persistence of a certain amount of woody vegetation and the relative sparsity of burrows in the Potts Point Rookery of the east suggests that this may be less old established than the other 2 but there is no historical evidence for this belief. The birds certainly appear to have had less influence on the vegetation here than elsewhere, one contributory reason being that the effect of their soil disturbance and guano deposition is less aggravated here by abrasive winds and salt spray deposition.

The Home Rookery of the north is heavily populated by birds whereas the area analysed west of South Rookery and Snake Gully (see Serventy, 1958) is a colony that has passd its zenith and the scars left by the bird are in process of healing.

77% of the burrows in the 25 valence squares analysed in the newer(?) Potts Point Rookery (I) were habitable, 63% in the well established Home Rookery (II) and only 32% in the degraded South West Rookery (III). The remainder had collapsed or were overgrown. Bare soil was greatest in II and least in III, facilitating the entry of a sparse covering of many ' weed ' species between the *Poa* tussocks of II. 59% of these colonists were aliens, this number dropping to 38% in III where much of the bare soil at burrow entrances had been overgrown by more permanent vegetation. The percentage of annuals dropped similarly, from 47% in II to 31% in III.

Table 3.

Floristic Analysis of Three Types of Shearwater Rookery.

Locality:	I. Potts Point Rookery	II. Home Rookery	III. W. of main South Rookery
Type of rookery:	Fairly sparsely burrowed	Heavily burrowed	Degenerate; many burrows overgrown
% of occupied burrows:	77%	63%	32%
% of collapsed and/or overgrown burrows:	23%	37%	68%
% of bare ground in 25 valence squares (random, but each containing at least 1 burrow):	16.5%	52%	7.5%
Shrubs:	Some persisting in community but only dead twigs in valence squares.	None	None
No. of species in 15 valence squares:	12	17	13
% of aliens:	58%	59%	38%
% of natives:	42%	41%	62%
% of succulents:	12.5%	18%	35%
% of annuals:	42%	47%	31%
% of perennials:	58%	53%	69%
% ground cover of Poa poiformis:	68%	34%	31%
% ground cover of Tetragonia implexicoma:	7%	5%	50%

Poa poiformis dominated rookeries I and II, occupying twice as much ground in I where there was less bird excavation and no tussock cutting by man as in II. *Tetragonia implexicoma* dominated rookery III, having occupied most of the previously bared soil and grown over both *Poa* and burrow entrances. Some of the existing nest holes were roofed solely by the *Tetragonia* mat and the soil of the whole area was shallow, resembling a rookery which has degenerated due to loss of soil where erosion has followed trampling or burning. This is the most windswept corner of the island where erosion might have occurred when there was much soil bared at the burrow entrances before the *Tetragonia* gave protection. The only other modifying factor is likely to be trampling by humans. Whatever the cause of the degeneration, it illustrates the instability of rookeries on shallow soil and emphasises the danger of worsening conditions in such rookeries by fire or any other practice which exposes bare ground.

In 1958-60 the *Tetragonia* gave stability and made possible the persistence of burrows in soil only a few inches deep. It has, nevertheless, been suggested (Serventy, 1958) that the *Tetragonia* mat hinders and possibly prevents burrowing. This seems unlikely, in view of the fact that the interweaving stems of the 'bower spinach' seldom constitute so formidable a barrier to peneration as the close-knit stools of the grass tussocks, which hinder the birds not at all. On loose sandy soil the 'spinach', like bracken, can be of undoubted benefit as a stabiliser, but it may, like bracken, have more subtle effects in deterring the birds where this stabilising property is of no advantage.

Many of the numbered pegs indicating previously occupied burrows in the degenerating South West Rookery could not be related even to an overgrown hollow in 1960, showing where a burrow might once have existed.

Some chicks in the Potts Point Rookery were seen on the ground surface beneath 'bowers' of *Tetragonia*. Dead *Acacia* stems formed a framework for these bowers, which had grown over the *Poa* tussocks following after the *Acacia* in the degenerative plant succession. This is a small scale version of the general sequence for shearwater colonies, viz.

Phase 1. Scrub (in this case *Acacia* with *Rhagodia* and *Olearia*) burrowed by shearwater whose dung initiates their death and allows the shorter *Poa* to compete adequately. It is a late stage of this phase which occurs in the Potts Point Rookery.

Phase 2. Supremacy of *Poa* tussock with considerable bare soil on which casuals, particularly *Sonchus oleraceus*, can become established but none of which become common, e.g. the Home Rookery.

Phase 3. Degeneration of the *Poa* possibly due to senility, possibly hastened by bird disturbance and erosion and followed by overrunning with guano-loving *Tetragonia*. On the west margin of the Home Rookery this, like *Disphyma*, is able to overgrow healthy tussocks, but it naturally competes better where the *Poa* is degenerating, e.g. the South West Rookery where the *Poa* is inhibited to some extent by blown sea spray.

In the Home Rookery 22 occupied burrows showed an average ground cover of 3.2% *Tetragonia* whereas 13 disused burrows showed a 7% cover. (These figures represent the percentage cover in the 1 m. valence squares, not in the burrow entrances alone).

The nest site of the sooty oyster catchers (*Haematopus unicolor*) is another small scale example of the overrunning of *Poa* by a succulent creeper in a bird disturbed habitat. 1958 photographs of the nest show upstanding *Poa* on its seaward side. By 1960 this was dead and the prostrate shoots covered over by *Disphyma*.

OLD GULL COLONIES

In the 1948-49 breeding season silver gulls (*Larus novae-hollandiae*) nested between the eastern *Acacia* scrub and the North East Boat Harbour (Serventy, pers. com.) *Poa* is still dominant here (or has resumed dominance) but the gulls may be responsible for the abundance of the succulent ornithocoprophile, *Bulbine semibarbata* and the alien annual, *Briza maxima*. *Bulbine* also becomes locally dominant just below the granite slab by the hut where food scraps are thrown for the gulls. Its associates here are the equally coprophilous *Disphyma* and, in spring, alien grasses.

In the 1950-51 breeding season 15 gulls' nests were built west of the hut but no eggs were laid (Serventy, pers. com.). This area either coincides with or is very close to that in which *Coprosma repens* has been increasing in recent years. The influx of gulls was followed by an influx of the prickly fruited, animal dispersed *Acaena anserinifolia*, most of which has since been pulled out by hand to prevent further spread.

PLANT DISTRIBUTION BY GULLS AND STARLINGS

Apart from the *Acaena* referred to above, the species most obviously spread by birds (although originally introduced by Miss Liela Barrett) is *Coprosma*. The numerous small saplings which are becoming established in coastal crevices, particularly in the north west where gulls congregate to await the after-meal scraps from the hut, have presumably been brought by the birds. When feeding on the copious crop of orange two-seeded drupes in February, March and April, silver gulls usually hover just above the bushes, reaching downwards to take the clustered fruits several at a time, but are sometimes seen to alight on the twigs. In the summer of 1960 *Coprosma* seed pellets ejected from their crops were common throughout the island. One containing 40 seeds in a matrix of damaged skins was sown on peat in a seed box and tended for 7 weeks but showed only those signs of germination seen in newly expectorated seeds, viz. the hinged triangular flap at one end lifted or broken away to expose the embryo. *Coprosma* fruits are also eaten by a pet galah (*Kakatoë roseicapilla*).

Starlings (*Sturnus vulgaris*) are very fond of *Coprosma* fruits, dividing their attention between the older established bushes west of the hut and the largest of the newly established colonies which is superceding the *Acacia* in the east. Here they habitually congregate on the *Acacia* twigs, which form the nearest suitable perch to their nesting crevices in the east cliff beneath. Germination of the pairs of hard seeds defaecated onto the ground beneath is almost certainly responsible for the present growth of *Coprosma* saplings.

When feeding on the succulent red fruits of *Tetragonia*, silver gulls will settle on mounds of this species among fairly dense tussock where their view of approaching danger is unusually restricted. Crop pellets of *Tetragonia* seeds are common at certain seasons.

A small sapling of *Alyxia buxifolia*, another succulent fruited shrub, was recorded for the first time in 1960. It was in a northern area much frequented by gulls and where two recent invasions of the succulent fruited *Leucopogon parviflorus* had occurred, both species very likely brought by the gulls.

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PLATE 1.—Dead *Acacia longifolia* var. *sophorae* trunk, much larger than any of those now existing. The *Coprosma repens* sapling (probably planted by fruit-eating starlings perching on the *Acacia* above their nest crevices) shows exfoliation due to drought and salt scorch. East Fisher Island, Summer, 1960.

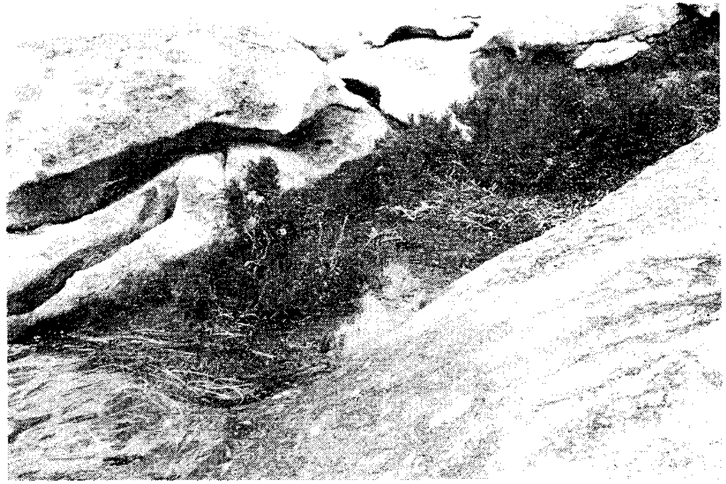

PLATE 2.—*Arthrocnemum arbusculum* grading downwards through *Suaeda maritima* to *Salicornia autralis* in the island's only "salt marsh". Note drifted leaves of *Posidonia australis*. North East Fisher Island, Summer, 1960.

PLATE 3.—Coastal zonation on exposed shore; upwards from *Disphyma australe* through *Stipa teretifolia* and *Coprosma repens* to *Poa poiformis*. West Fisher Island, Summer, 1960.

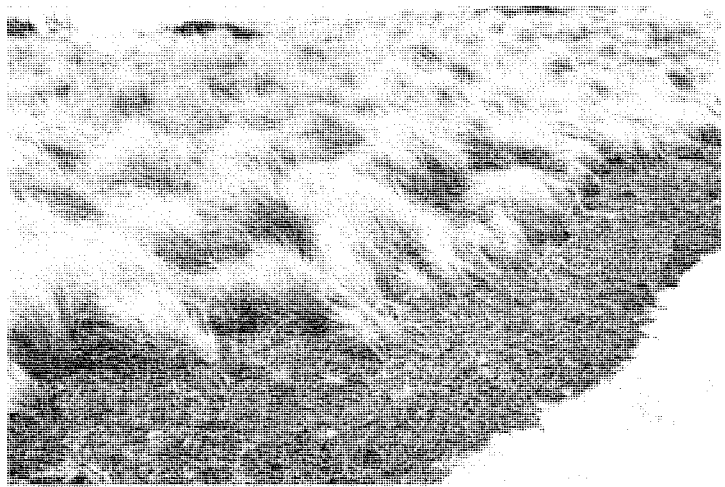

PLATE 4.—Modified coastal zonation where the vegetation does not approach nearer than 18 m. to the sea. *Disphyma australe* bordering the windswept *Poa poiformis* which is the island's dominant plant. Stunted *Leucopogon parviflorus* in the distance, near North Point. North West Fisher Island, Summer, 1960.