A CASE FOR CONTROLLING THE DISTRIBUTION OF THE TREE DAISY (*OLEARIA LYALLII*) HOOK.F. IN ITS TYPE LOCALITY, AUCKLAND ISLANDS

D. J. CAMPBELL AND M. R. RUDGE

Ecology Division, DSIR, P.O. Box 30466, Lower Hutt

SUMMARY: *Olearia lyallii* occurs on forested islands south of mainland New Zealand. It was apparently introduced accidentally to the Auckland Islands by sealers in the early 19th century. It is still spreading, but is not yet found beyond Port Ross, three of the Port Ross islands and the north-east shores of the main island. It supplants the dominant forest tree, *Metrosideros umbellata*, because it has greater tolerance to partial shade and salt spray; it grows faster and taller and is not browsed. *Olearia* forest is floristically simpler than *Metrosideros* forest. Seed can be dispersed by wind and possibly by visiting scientists. When the present juvenile plants mature the rate of spread will increase. The potential impact of *Olearia lyallii* on the indigenous vegetation should be considered in the management plans for the reserve.

INTRODUCTION

Olearia lyallii is a tree daisy which grows up to 10 m tall on favourable sites, and has large woolly ovate leaves up to 25 cm long. It dominates the vegetation on the Snares Islands, extends north to Stewart Island and some of its outliers, and south to the Auckland Islands (Fig. 1a). Its status on Auckland Islands has been examined by Godley (1965) who mapped its distribution on the Auckland Islands, and suggested that it was a recent immigrant, probably from the Snares Islands.

The species was initially described by J. D. Hooker from specimens collected by Lyall from Ewing Island in Port Ross, Auckland Islands. Hooker himself did not see the growing plants (nor did botanists from the French and American expeditions in early 1840), but from Lyall's description in Hooker (1844) the plant was rare, small, and shrubby, and was not flowering (20 Nov.-12 Dec. 1840). Hooker (1844) quotes a letter from Lyall who wrote "It is rare in the islands now under consideration, and will probably be found to be a native of the southern extremity of New Zealand". Hooker initially named it *Eurybia lyallii* after obtaining material of the closely related sub-alpine species *colensoi* from New Zealand, but later placed both species in the genus *Olearia* in his "Handbook of the New Zealand Flora" (1864, 1867). Recent revisions (Drury, 1968, Given, 1973) indicate that *Olearia lyallii* is one of a group of *Olearia* species of southern distribution, closely allied to the subantarctic genus *Pleurophyllum*. Most taxonomists now consider that *Olearia colensoi* var. *grandis*, a variety recognised by Allan (1961), is indistinguishable from *Olearia lyallii*, and the geographic range of *Olearia lyallii* would, therefore, include parts of Stewart Island and the islands to the west of Stewart Island (Wardle *et al.* 1971). *Olearia lyallii* is the only species of *Olearia* on the Auckland Islands.

Because *Olearia* was rare on the Auckland Islands and seemingly confined to the Auckland and the Snares Islands it was regarded as a subantarctic species of particular distinction (Hooker, 1844, Cockayne, 1904). In 1903 Cockayne noted that *Olearia* occupied only a narrow zone on the sheltered side of Ewing Island, and he considered that *Olearia* was a declining remnant of a previously extensive subantarctic forest (Cockayne, 1904). Falla (1948), pointed out that the plants at Erebus Cove were growing on a site which had been totally cleared in 1850 for the whaling settlement of Hardwicke, and suggested that the ground *Olearia* occupied on Ewing Island may also have been previously cleared. On Ewing Island, strakes of whaleboat planking inland from the later Marine Department boatshed are covered by peat and old mature *Olearia* (Falla pers. comm.).

Godley (1965) reviewed the earlier literature and questioned Cockayne's concept of a remnant subantarctic forest. He concluded that *Olearia* was a recent immigrant, and was still increasing its range on the Auckland Islands.

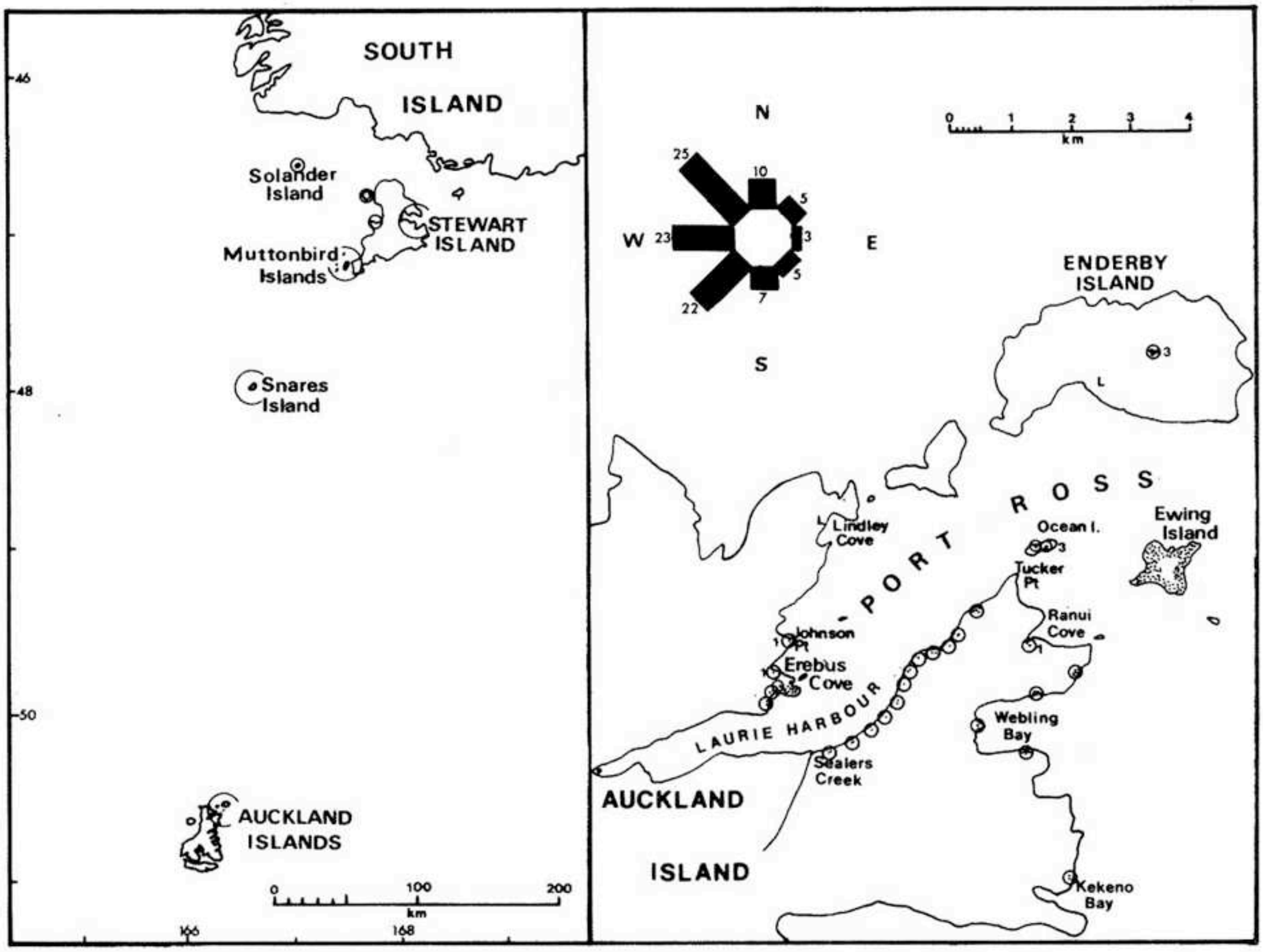

FIGURE 1A: *Occurrence of* Olearia lyallii *on the islands south of mainland New Zealand.*

FIGURE 1B: *The present distribution of* Olearia lyallii *on the Auckland Island.*
O=scattered plants; figures indicate number of individuals.
L=leaf only.
Stippled areas indicate closed Olearia *forest. The plants from Sealers Creek to Tucker Point are probably recently derived from the Erebus Cove population. The wind rose shows the percentage days on which wind blew from each direction from Dec.-June at Port Ross. (Data for the period 1941-1944 Meteorological Service records).*

OBSERVATIONS

History of Spread

Godley (1965) suggested that "the present populations are derived from a relatively recent immigration, probably in the early 19th century, with Ewing Island as the point of entry". He noted that the source would probably be the Snares (some 300 km to the north), but added that specimens from Stewart Island, Milford Sound and Bluff have been considered similar to, or identical with *Olearia lyallii*. The recent arrival of *Olearia* raises the question of why the species had not reached the Auckland Islands during the period of post-Pleistocene re-invasion, especially when southern rata *(Metrosideros umbellata)* has been present for a few thousand years (Moar, 1958). The evidence suggests that although *Olearia* seed has a pappus it is not as suited as rata for long distance dispersal, and the timing of the arrival of *Olearia* coincides so closely with the peak

FIGURE 2A: *View across the site of the former settlement of Hardwicke, towards the provision depot at Erebus Cove. (Photographer: Muir, Oct. 1891: by courtesy of the Hocken Library).*

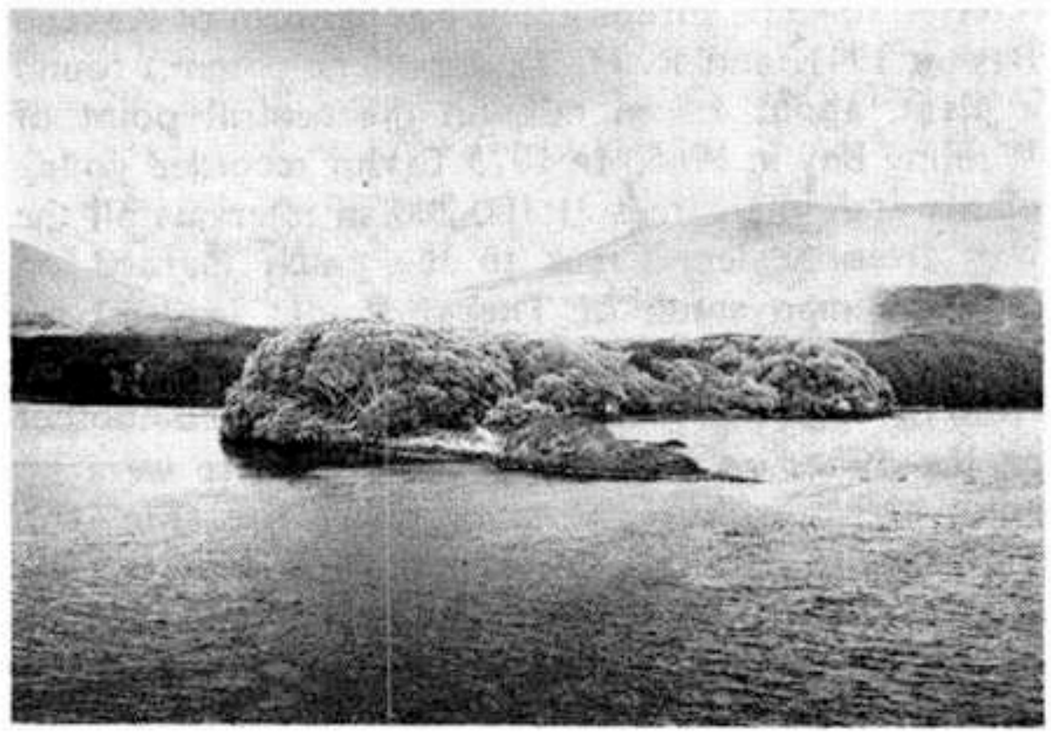

FIGURE 2B: *View Jan. 1973 of the* Olearia *growing on the peninsula shown in the foreground of Fig. 2a. The forest now extends almost halfway to the provision depot site, and isolated trees can be seen in the rata forest to the left of the photograph.*

years of sealing activity in the subantarctic that it points to man as the dispersing agent (Johnson and Campbell, 1975).

The following evidence tends to support this conclusion, and speculates on the means and timing of the dispersal from Ewing Island to Erebus Cove:

(i) To judge from the sizes of plants now growing on Enderby and Ocean Islands, the shrubs seen on Ewing Island by Lyall in 1840 were less than 20 years old.

(ii) Although the movements of ships were usually only vaguely recorded, partly for commercial reasons, McNab (1907) lists 101 shipping movements to Campbell Island and Macquarie Island between 1810 and 1830. Ships working from Sydney and Hobart often called at the Auckland Islands, and others (such as the "Henry" in 1825) went to the Auckland Island *via* Stewart Island (Cumpston, 1969).

(iii) Adventive plants had already reached the islands by the time of Hooker's visit in 1840; and at least one other which he considered native *(Carex ternaria),* has a distribution which now suggests that it could have been accidentally introduced by sealers (Johnson and Campbell, 1975).

(iv) As *Olearia* was a rare and showy shrub, found only in the Port Ross area, it is very likely that the Enderby settlers deliberately took this "most handsome shrub" (Hooker, 1844) from Ewing Island to Erebus Cove as a garden plant. The colonists were probably were aware that *Olearia* was a rare plant because Hooker's "Flora Antarctica" (1844-7) was published only two years before their departure from England in 1849. Colonel R. E. Bolton who was a correspondent of J. D. Hooker visited the Enderby settlement twice in 1850 (Godley, 1970), and sent a collection of nineteen plant species to Hooker, among which was *Olearia lyallii* (Hooker, 1864, 1867).

(v) When Captain Musgrave visited the abandoned site of the Enderby colony at Erebus Cove in 1865, he commented that "the ground everywhere . . . is choked up with a vigorous growth of thick long grass, and there is not the slightest sign of any edible vegetable, or even a single shrub that is not a native of the island, if we except a few flax bushes, . . . and two small trees" (Musgrave 1866). Musgrave had just spent 18 months marooned at the southern end of the Auckland Islands, and was thus familiar with the woody plants. We take it that his unknown "two small trees" were *Olearia lyallii,* growing up in the general regrowth of *Metrosideros umbellata* (southern rata), *Pseudopanax simplex, Dracophyllum longifolium, Myrsine divaricata,* and tussocks of *Poa litorosa.* By 1907 there were "a few trees" of *Olearia* in this neighbourhood (Cockayne, 1909) but they cannot be seen on a contemporary photograph (Fig. 2a), taken from a site now covered in tall *Olearia.* Today the stand covers about a hectare (Fig. 2b).

Distribution

Fig. 1b shows the present distribution based on the 1962-63 map (Godley, 1965) and our additional records in 1972-73 which were: single plants each about 30 cm high at Ranui Cove near the boat shed at Erebus Cove, on Johnson Point, and on a ridge approximately 400 m inland from the edge of the Erebus Cove population. E. F. Doley (*in litt.* 1972)

referred to some shrubs about 800 m north of Kekeno Bay in 1941, and R. H. Taylor (pers. comm.) found a plant, about 1.5 m tall, on the central point of Webling Bay in 1966. In 1973 Taylor recorded young plants and small trees at 100-200 m intervals all the way from Sealers Creek to the patch marked on Godley's map south of Tucker Point. In 1972 we found a single leaf in rata forest about 10 m inshore from the high tide mark at Lindley Cove, and another on the dunes on Enderby Island but there were no adult plants within 800 m of either site (Fig. 1b). The shrubs on Enderby Island, first reported by Godley (1965), were described and accurately mapped by Taylor (1971). Taylor (pers. comm.) saw no seedlings in either 1966 or 1973.

Site characteristics

Most areas where *Olearia* grows have been modified by man in the past. Enderby Island Taylor, 1971), Erebus Cove, and parts of the Ranui peninsula (Rudge and Campbell in prep.) have all been burnt or cleared; and probably so has much of the coastal strip between Sealers Creek and Tucker Point, and the eastern coast of the Ranui Peninsula. We found charcoal at Sealers Creek, but at Webling Bay the forest showed so sign of modification. Ocean Island had been stocked first with goats, and later with sheep (Taylor, 1968, Rudge and Campbell, in prep.).

Wherever we found *Olearia* it was on sites formerly occupied by rata forest except on Enderby Island and the northwest shore of the Ranui peninsula. On

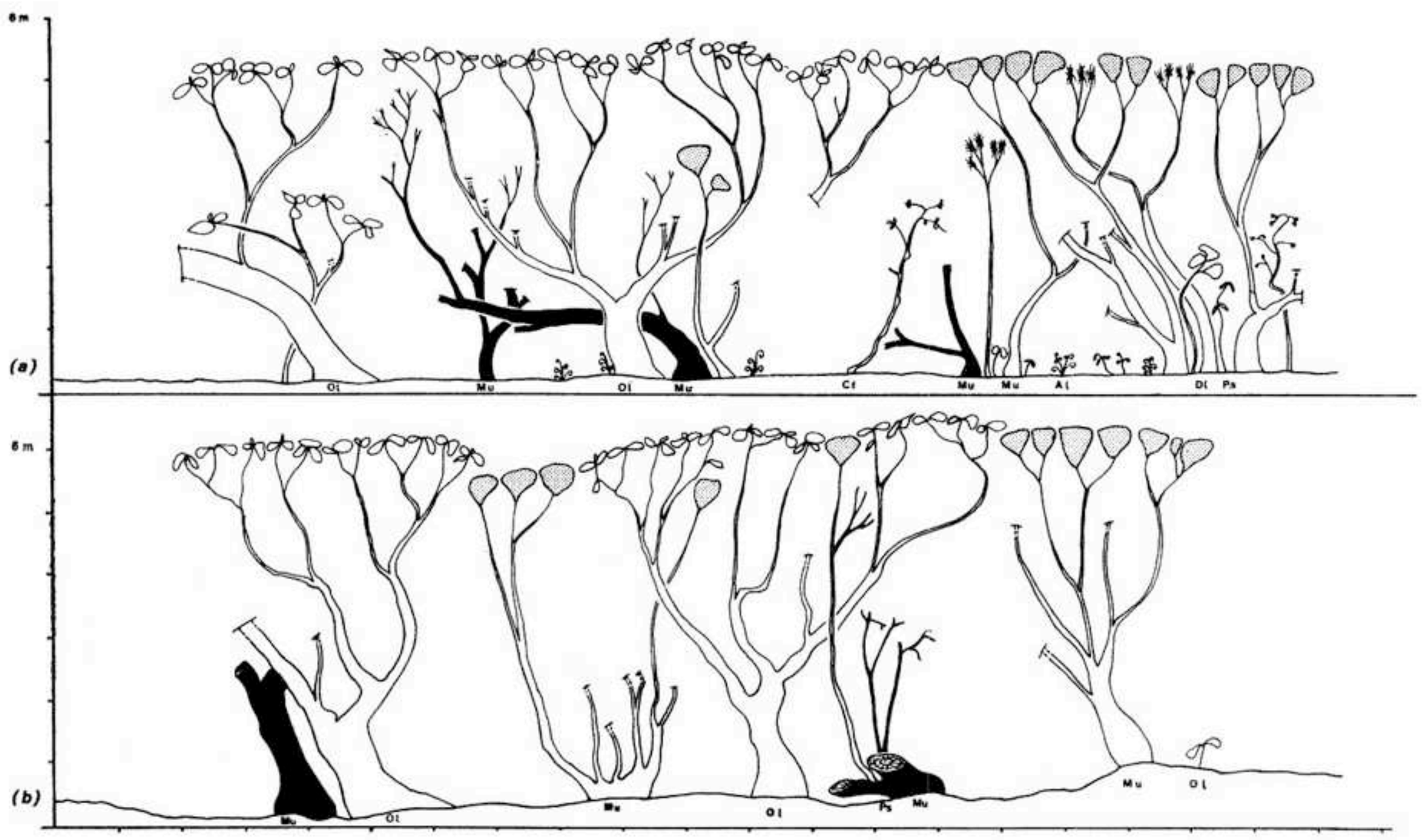

FIGURE 3: *Profiles through the transition zone between* Olearia *forest and rata forest on Ewing Island (a) and at Erebus Cove (b).*
Note that Olearia *overtops rata; that there are dead and dying rata branches beneath* Olearia *but not vice versa; and that seedling* Olearia *extend into the rata but there are no juvenile rata at all. To the left of each profile is continuous* Olearia *and to the right is continuous rata.*
Mu and Stipple=rata (Metrosideros umbellata)
Ol and large leaves=Olearia
Cf=Coprosma foetidissima
Ps=Pseudopanax simplex
Dl=Dracophyllum longifolium
Al=Asplenium lucidum
(for clarity, labels are not given against all individual plants).
Dead wood is black; sawn rata stumps are shown as bulls eyes. Scale divisions are in metres.

these two sites *Olearia* was taller than the surrounding scrub and was obviously less affected by exposure to the wind and wind-borne salt that stunts rata, *Dracophyllum* and *Myrsine*. *Olearia* has not yet been found in the upland woody vegetation on the Auckland Islands, so its performance relative to rata in the colder, wetter conditions at the upper altitudinal limit of rata is unknown.

Associations

Olearia forms forest up to 10 m tall on Ewing Island and at Erebus Cove, but elsewhere is represented by shrubs up to 4 m tall or by seedlings. Shrubs or seedlings occur in such diverse communities as a dense stand of flax at Ranui Cove; under a *Myrsine divaricata* bush at Erebus Cove boat shed; in the deep shade of regenerating rata forest on Johnson Point; and in open *Cassinia-Oreobolus* scrub-moorland on Enderby Island. Young rata were never found under *Olearia* trees but small *Olearia* plants on the other hand thrive below rata trees as well as below their parent canopy. This is shown in profile diagrams of the transition zone on Ewing Island and at Erebus Cove (Fig. 3a and 3b).

At Erebus Cove the floor of the *Olearia* forest was virtually bare except for scattered ferns *(Histiopteris incisa)*, mosses and occasional small seedlings of *Olearia*, *Dracophyllum* or *Myrsine*. However, *Olearia* and rata had both established on cleared ground and the rata forest also had a bare floor which is typical of a dense immature stand. Nonetheless on Ewing Island, where *Olearia* forest surrounded rata forest, understory plants were less common under the *Olearia* indicating that the bare interior is indeed a feature of the *Olearia* forest and not just characteristic of immature stands.

DISCUSSION

Olearia lyallii has clearly been a successful colonist on the Auckland Islands since it was first recorded there in 1840 as a few shrubs. Despite competition from indigenous species it now forms forest in two quite separate places. This is mainly because *Olearia* will tolerate shading, grow faster and grow taller than the only other forest forming tree, rata. *Olearia* seedlings grow both in full light and in shade and are better able to tolerate strong winds and salt.

Through an accident of history, the Auckland Islands are the type locality for *Olearia lyallii*. Nevertheless it is an aggressive recent arrival in what is now a biological reserve and, logically, could be given the same scrutiny as an alien mammal might receive: (a) how does it disrupt the local community?

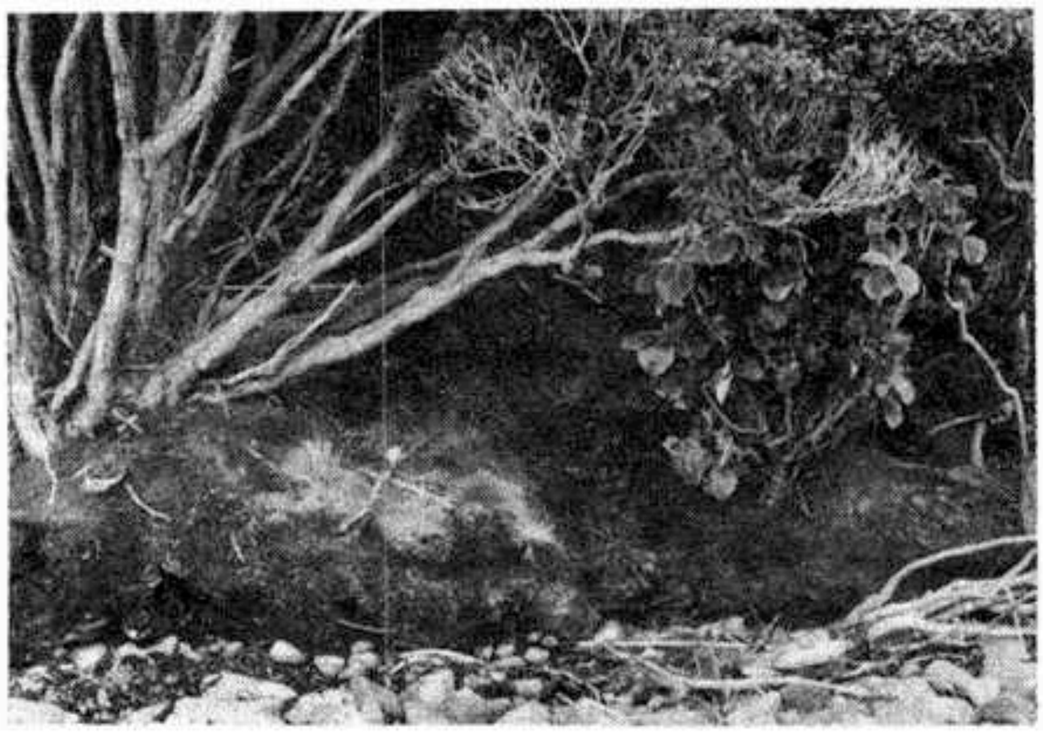

FIGURE 4: *Young plant of* Olearia *under the edge of rata forest, just above the shoreline, on the northern side of the Erebus Cove population. Part of the transact described in the Appendix.*

(b) will it spread? (c) is it an ephemeral or persistent colonist? (d) what indigenous values does it usurp?

(a) The simplest expression of the disruption caused by *Olearia* is that it totally replaces the indigenous rata forest. This is seen not only on the Auckland Islands but also on the Mutton-bird Islands (Fineran, 1973). The shrub and ground flora is less diverse beneath *Olearia* than rata, even on Ewing Island where there are no browsing mammals; but this is not only because *Olearia* has colonised sites that had been cleared by man. Cockayne (1928), commented on the lack of ground vegetation on the Snares Islands, and even on the floristically richer Mutton-bird Islands the structure of the *Olearia lyallii* forest is similar to that at the Snares (Fineran, 1969, 1973). There may perhaps be some toxic leachate in *Olearia* leaves which prevents the growth of other plant species: according to Gressitt and Wise (1971) *Olearia* forest on the Auckland Islands is almost barren of insect life.

(b) The potential for spread is very great, as the plants flower profusely every few years (Wardle *et al.*, 1971, Fineran, 1969) and produce large quantities of wind-borne seed. Westerly winds in the Port Ross area (Fig. 1b) during seeding months would blow a lot of seed out to sea but much would make landfall. The leaves which we found on shores well away from adult trees suggest that if seeds can tolerate immersion in salt water they too could be spread around Port Ross by water circulation. The most likely means by which *Olearia* originally arrived at the Auckland Islands was by man's movements. In the same way it can easily spread throughout the group particularly as summer scientific expeditions

have become more frequent and more mobile.*

Seedlings were not seen above 40 m altitude at any site. On Solander Island (Johnson, 1975) and Big South Cape (Fineran, 1973) *Olearia lyallii* reaches the shrub zone, which suggests that it is capable of spreading into the shrub zone on the Auckland Islands. If necessary this could be determined experimentally.

(c) There is nothing to suggest that *Olearia* is an ephemeral coloniser. It is competitively superior to indigenous trees and will certainly be a permanent feature of the flora and vegetation if permitted to remain. On Big South Cape Island and Solomon Island *Olearia lyallii* is capable of supplanting rata from all coastal sites, and perhaps also from inland sites (Fineran, 1973). To follow the history of established saplings growing under rata forest at Erebus Cove, the position and size of all *Olearia* plants were recorded on a permanently marked transect (see Appendix).

(d) Whether *Olearia* replaces rata throughout all or only part of the Auckland group, it will certainly change the visual character of some areas, and may affect the numbers of passerine and burrowing birds. On the main Snares Island which is entirely covered in *Olearia lyallii,* the honeyeaters (bell-bird and tui), are uncommon (Warham, 1967). We did not compare bird numbers in *Olearia* and rata forest except to note that on Ewing Island the native snipe used both forest types.

The main object of our visit to the Auckland Islands was to assess the status of an alien mammal, the feral goat, and its impact on the vegetation of the island. We concluded (Rudge and Campbell in prep.) that, far from threatening the forest cover, the goats were themselves being constrained by a combination of physical, biotic and climatic factors. We consider that a far greater threat to rata forest and other communities is posed by the aggressive *Olearia.* The expansion of the *Olearia* distribution deserves to be considered in the management plan for the reserve just as much as the status of the alien mammals which were our primary interest.

It may be argued that the spread of *Olearia* is intrinsically interesting, and should not be interfered with, but if this course is adopted it should be as a positive decision with all its implications. One such consequence is that the dominant forest over the archipelago, including unmodified Adams Island, could change from rata to *Olearia.* We are not convinced that this change is desirable even though the Auckland Islands are the type locality of the species. On the other hand, if *Olearia* is not to be allowed to spread beyond known sites, clear directives are required to allow control in an orderly and overt fashion. For example, all plants except those in the main colonies (Erebus and Ewing Islands) could be removed and the species still be studied without the threat of its spreading within, or beyond, the Port Ross area. Even if all present colonies are left untouched, Adams Island at least should be kept free. However, this will become increasingly difficult as juvenile plants such as those along the east shore of Port Ross, become mature and form new sources of seed. Persons moving from Erebus Cove or Ewing Island down to east coast fiords or to Carnley Harbour and Adams Island should be instructed to check their clothing and equipment for seeds; and any seedlings found on Adam Island should be reported and destroyed.

In his leader's report on the 1972/73 expedition, B. D. Bell mentions the ease with which *Olearia* seeds could be carried from Ewing Island to other areas. He records having to destroy some seeds on one occasion.

(Bell, B. D. *In* Yaldwyn, J. C. 1976, p. 38).

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APPENDIX

A permanently marked transect was established at Erebus Cove to follow the predicted continued invasion of rata forest by *Olearia*. Details are given to enable the transect to be remeasured. The transect begins about half way between the Erebus Cove boatshed and Davis Island (NZMS 220, June 1962), and runs parallel to the shore, 2-3 metres above the shoreline rocks. It is 30 metres long and each end is marked by an aluminium standard projecting about 1 m above ground.

The transect runs through bare rata forest which forms a canopy at 5 m. There are numerous juvenile *Olearia* but no adult trees. The main stand of *Olearia* is some 100 m from the south-east end of the transect.

Beginning at the south-east end, the positions of all woody plants were measured along, and to 7 m either side of, a tape run between the standards. The height was measured of all plants less than 2 m, and the stem circumference at 10 cm above the ground for plants taller than 2 m. Exact locations of all measured plants are given in the Appendix table.

TABLE 1. *Location and size of* Olearia lyallii *juveniles and other plants along a transect under rata canopy on the shoreline at Erebus Cove.*

	Distance along tape from south end (metres)	Distance from tape to seaward (s) or landward (l) (metres)	Height (h) or stem circumference (c) of plant (cm)
Dracophyllum	1.8	0.9 s	4 c
Metrosideros	2.5	0.7 s	7 c
Olearia	2.7	7.0 l	20 h
Metrosideros	3.8 (2 stems)	0.3 s	15 c
Dracophyllum	5.0	0.3 s	5 h
Dracophyllum	5.1	1.5 s	15 h
Myrsine	6.1	1.5 s	7 c
Myrsine	6.3	1.7 s	10 c
*Olearia	9.7	0.1 l	50 h
Phormium tenax	11.0	2.5 s	—
Olearia	13.5	5.0 s	40 h
Metrosideros	13.7	1.8 s	10 c
Olearia	16.7	1.0 s	7 c
Dracophyllum	18.1	1.2 s	—
Dracophyllum	18.1	1.5 s	30 h
Olearia	18.2	1.0 l	107 h
Dracophyllum	18.4	1.2 l	30 h
Dracophyllum	18.8	0.7 l	30 h
Olearia	20.0	0.7 l	30 h
Olearia	22.0	1.1 l	40 h
Olearia	24.4	4.0 l	15 h
Olearia	24.7	4.0 l	15 h
Dracophyllum	25.7	3.5 l	20 h
Olearia	28.0	3.0 s	70 h
Olearia	28.8	3.0 l	50 h
Olearia	29.8	1.6 l	100 h

* Plant shown in photo (Fig. 4).