

### III. Vegetation

As noted previously (p.4) the major climatic gradient across Tierra del Fuego, from oceanic conditions with high rainfall in the south and west to more continental conditions with much lower rainfall and more marked seasonal differences in the north and east, influences the soils and, together, they determine the broad pattern of vegetation throughout the archipelago. In response to this gradient four major vegetation zones (Fig. 2) are evident as one progresses from north and east to south and west: Fuegia - Patagonian Steppe, Deciduous Forest, Evergreen Forest and Magellanic Moorland - with a fifth zone, of Alpine Vegetation, at high elevations in the mountains. It should be noted that local edaphic, topographic and microclimatic conditions frequently result in communities characteristic of one of the major vegetation zones being present in another. The more prominent of these are noted in the account.

Within each of these principal vegetation zones numerous associations and communities, differing in their structure and floristic composition in response to local environmental conditions, can be recognised. In this account it is not possible to describe the full diversity of the vegetation in Tierra del Fuego and it aims only to indicate briefly the principal plant communities. Only the more interesting or important plant species present in each community are mentioned. More detailed information may be found in the publications mentioned in the account, the most recent and comprehensive survey being that of Pisano (1977a).

#### A. PATAGONIAN STEPPE

Within this zone plant communities belonging to grassland heath and shrub formations are recognised, as well as the remnants of an extinct forest described later (p.28).

#### a. Grassland

***Festuca gracillima* grassland.** The rolling grassy plains of northern Isla Grande are dominated by *Festuca gracillima*, typically with *Agropyron fuegianum*, *Agrostis flavidula*, *Festuca magellanica*, *Poa alopecurus* ssp. *alopecurus* and *Trisetum spicatum* as common associates or even, locally, co-dominants among the grasses, while in the moister facies of this grassland species such as *Alopecurus magellanicus*, *Deschampsia antarctica* and *Phleum alpinum* often become important. Apart from the grasses the following species are among the most frequent associates of *Festuca gracillima*: *Acaena pinnatifida*, *Armeria maritima*, *Calceolaria uniflora*, *Cerastium arvense*, *Draba magellanica*, *Erigeron myosotis*, *Leucheria halmii*, *L. purpurea*, *Luzula alopecurus*, *Phaiophleps biflorus*, *Senecio magellanicus*, *Silene magellanica*, *Sisyrinchium patagonicum*, *Taraxacum gilliesii*, *Vicia bijuga* and *Viola maculata*. The drier facies of this grassland may be recognised by the prominence of *Festuca pyrogea*, *Phacelia secunda* and *Valeriana carnosae*, and the occurrence of *Stipa chrysophylla* and *Rytidosperma virescens*.

**Mesic grassland** In areas along valleys or watercourses, and in depressions with a clay horizon below the surface which prevents downward, but not slow lateral, movement of water, the moist conditions support a mesic grassland forming the meadows or 'vegas' that grade into the moister facies of the *Festuca gracillima* grassland. A number of communities can be recognised, in which grasses, such as *Alopecurus magellanicus*, *Deschampsia antarctica*, *D. kingii*, *Hierochloa redolens* and *Hordeum comosum*, and graminoid herbs, such as *Carex acutis*, *C. curta*, *C. darwinii* and *Juncus scheuchzerioides*, are prominent or dominant. Among the species of other life-forms, *Gunnera magellanica* and *Samolus spathulatus* are locally dominant in such mesic grassland,

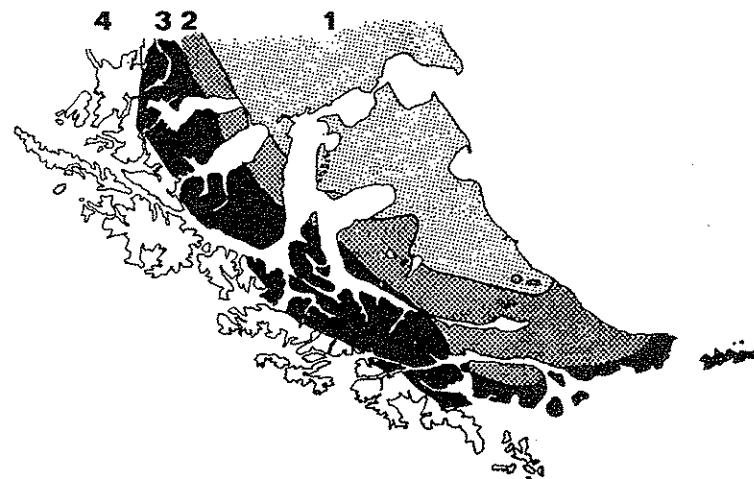


Fig. 2. Principal vegetation zones of Tierra del Fuego. 1 (grey). Fuegia-Patagonian steppe. 2 (dark grey). Deciduous forest. 3 (black). Evergreen forest. 4 (white). Magellanic moorland. High montane vegetation not indicated.

while predominant are, for example, *Acaena magellanica*, *Anagallis alternifolia*, *Azorella caespitosa*, *Blechnum penma-marina*, *Caltha sagittata*, *Euphrasia antarctica*, *Gentiana magellanica* and *Pratia longiflora*.

**Saline grassland.** Depressions in which there is no lateral movement of the subterranean water or, if so, evaporation exceeds the flow, accumulate salts. The resultant vernal wet saline soils support communities in which species of *Puccinellia*, particularly *P. magellanica* and *P. biflora*, are locally dominant. Among the important associates may be included *Arjona pusilla*, *Chenopodium antarcticum*, *Myosurus patagonicus*, *Plantago barbata* and *Salicornia ambigua*. Saline areas which remain moister longer, as around the margins of small pools and lakes, tend to support open communities dominated by *Eriachneium magellanicum*, with which most of the above species are associated as well as, for example, *Colobanthus quitensis*, *Suaeda argentinensis* and *Triglochin concinna*.

#### b. Scrub

***Lepidophyllum* scrub.** In the northern third of Isla Grande coastal sands frequently support a community dominated by the shrub *Lepidophyllum cypripesiforme*, as do some inland sands, notably

between Bahía Inútil and Bahía San Sebastián. Floristically, the community grades into the drier facies of *Festuca gracillima* grassland and also the saline grassland. The dominant, which reaches 0.5-1.4 m high, may be accompanied by *Berberis buxifolia* and *Senecio patagonicus* in the upper layer, while the lower layers include such species as *Acaena pinnatifida*, *Berberis empetrifolia*, *Boopis australis*, *Descurainia antarctica*, *Jaborosa magellanica*, *Oxalis emicophylla*, *Phacelia secunda*, and *Valeriana carnosae*, as well as the introduced *Leymus arenarius*.

***Chiliodactylon* scrub.** Towards the southern part of the area included in the Patagonian Steppe, where the annual rainfall approaches 350 mm, the *Festuca gracillima* grassland gradually gives way to communities dominated by *Chiliodactylon diffusum*. Since this evergreen shrub is prominent in communities in many open areas of the deciduous and evergreen forests it probably signals the ecotone between the grass steppe and the deciduous forest, but since the communities show strong floristic affinities with the former it is here included within the steppe zone, though it certainly transcends whatever boundary there might be. In addition to many species characteristic of the moister facies of the *Festuca gracillima* grassland, the *Chiliodactylon* scrub contains species indicating affinities with the

sheltered, mesic conditions of forest-margins, e.g. *Acaena ovalifolia*, *Adenocaulon chilense*, *Anemone multifida*, *Aster vahlii*, *Baccharis patagonica*, *Calceolaria biflora*, *Cotula scariosa*, *Schizaelema ranunculoides* and *Viola magellanica*.

### c. Heath

**Empetrum heath.** Throughout the steppe areas of northern Isla Grande the prevailing grassland and shrub communities locally give way to communities dominated by the ericoid dwarf shrub *Empetrum rubrum*. This heath develops over acid, permeable, often rather shallow, soils in which clay is absent at least in the upper horizons. Some of the commonest species associated with the dominant, such as *Arjona patagonica*, *Armeria maritima*, *Festuca gracillima*, *Oxalis enneaphylla* and *Poa alopecurus*, are widespread in the grass steppe but other prominent members of the heath support its distinctiveness, e.g. *Azorella caespitosa*, *Baccharis magellanica*, *Colobanthus subulatus*, *Luzula chilensis*, *Nassauvia darwinii* and *Perezia recurvata*. The *Empetrum* heath seems to have extended somewhat as a result of grazing in certain areas.

**Nardophyllum heath.** The cushions, lax or compact, of *Nardophyllum bryoides* occur as relatively minor components of both *Empetrum* heath and *Lepidophyllum* scrub, but on some coastal gravels the species assumes local dominance, as in parts of N.W. Isla Grande. Because of the ericoid leaves and habit of the dominant this community is here considered as a heath, with the most characteristic associated species including *Berberis empetrifolia*, *Euphorbia collina*, *Lepidophyllum cupressiforme*, *Oxalis enneaphylla* and *Suaeda argentinensis*.

## B. DECIDUOUS FOREST

South of the steppe zone, where the annual rainfall rises from about 400 mm to 800 mm, deciduous forest occurs along both flanks of the mountains, at altitudes from sea level to almost 500 m in sheltered areas. The dominant species are *Nothofagus pumilio* and, to a lesser extent, *N. antarctica*, but shrub, bog and grassland communities occur frequently in the zone. The deciduous forest has been modified by man in many areas, as a result of logging operations and clearing for sheep-grazing, but relatively unaltered communities are still comparatively common.

### a. Forest

**Nothofagus pumilio forest.** The best stands of

*Nothofagus pumilio*, with trees up to 25 m or so, occur at lower elevations on well-developed soils (brown forest podzols) with good drainage. Here the canopy is dense and relatively few species occur in the shrub and herb layers, the most frequent being *Adenocaulon chilense*, *Asplenium dareoides*, *Berberis ilicifolia*, *Maytenus disticha*, *Blechnum penna-marina*, *Codonorchis lessonii*, *Dryopsis glechomoides*, *Lagenifera hartioides* and *Marcrachaeum gracile*, with *Misodendrum punctulatum* and *M. quadriflorum* parasitising the dominant. Where the forest is more open, as a result of variation in the soil, available water or microclimate, the increased light permits other species to prosper. Thus, *Cardamine glacialis*, *Chrysosplenium macranthum*, *Gunnera magellanica* and *Senecio acanthifolius* flourish where the soils are wet, while under drier conditions are commonly found, for example, *Acaena ovalifolia*, *Cotula scariosa*, *Rubus goeides*, *Schizaelema ranunculoides* and *Viola magellanica*.

With increasing altitude and/or exposure the size of the *Nothofagus pumilio* decreases to give a medium height wood (rarely above 5 m) which, at timberline, is reduced to a scrub having a prostrate, "krumholz" habit. The above trend is generally accompanied by an increase of *N. antarctica* to provide a series of ecotonal communities leading to forest dominated by that species.

**Nothofagus antarctica forest.** The dominant species has a wider ecological amplitude than *N. pumilio*, with which it cannot compete successfully in the most favourable habitats, and so becomes prominent in places where shallower soils, higher water table, greater aridity etc. render them unsuitable for the latter species. The trees of *Nothofagus antarctica* rarely exceed 6 m in height, often have contorted trunks and in many cases are reduced to shrubs; furthermore, the tree layer is frequently rather open so that shrub and herb layers tend to be much richer than in *N. pumilio* forest. In addition to many of the associates listed in the preceding section, the *N. antarctica* communities include, for example, *Berberis buxifolia*, *Chilodictyon diffusum*, *Embothrium coccineum*, *Empetrum rubrum*, *Galium aparine*, *Luzula alopecurus*, *Osmorhiza chilensis*, *O. depauperata* and *Ranunculus peduncularis*, together with such species as *Anemone multifida* and *Vicia magellanica* in their drier facies, or *Pratia repens* and *Uncinia lechleriana* where the soil is wetter.

### b. Scrub

Around its margins and in clearings the deciduous *Nothofagus* forest is usually gradually replaced by shrub communities. These contain a mixture of

species present in the forest and the adjacent vegetation and probably represent transitional types, as suggested above (p. 25).

**Chilodictyon-Berberis buxifolia scrub.** As noted on p. 25, scrub dominated by *Chilodictyon diffusum* occupies a buffer zone between the grass-steppe and the deciduous forest. The co-dominance of *Berberis buxifolia* indicates the more mesic conditions closer to the forest, as does the local prominence of *Ribes magellanicum* and shrubby examples of *Maytenus magellanica* and *Embothrium coccineum*.

**Pernettya mucronata scrub.** In many areas the wetter facies of the deciduous forest grades into bog or wet grassland communities. In such places a scrub dominated by *Pernettya mucronata* develops at the forest margin. *Empetrum rubrum* is frequently important in such scrub, while both *Chilodictyon diffusum* and *Berberis ilicifolia* can be frequent.

### c. Heath

**Empetrum-Bolax heath.** Within the deciduous forest zone, particularly where *Nothofagus antarctica* is dominant, a dwarf-shrub heath develops over shallow, well-drained soils, especially if the sites are subjected to cold-air drainage or local "frost-pockets". Such heath is dominated by *Empetrum rubrum* and *Bolax gummiifera*, while among the emergent associates may be included *Abrotanella emarginata*, *Azorella lycopodioides*, *Drapetes muscosus*, *Festuca magellanica*, *Lycopodium magellanicum*, *Myrteola nummularia*, *Nanodea muscosa* and *Pernettya pumila*. A very similar heath frequently occurs at and above timberline as will be noted later (p. 30) when alpine vegetation is considered.

### d. Grassland

In flatter areas of the deciduous forest zone, where the ground water approaches the surface, as in parts of some river valleys, a mesophytic grassland develops. This has much the same aspect and many of the same species as the similar grassland developed within the steppe areas mentioned earlier (p. 24). However, the occurrence of species such as *Carex magellanica*, *C. microglochin*, *Cum* *magellanicum*, *Senecio acanthifolius* and *Uncinia lechleriana* gives it a distinctive appearance.

### e. Bogs

Where the water table reaches the surface various bog communities replace the deciduous forest, frequently grading into the mesophytic grassland.

**Sphagnum bog.** Communities dominated by the moss *Sphagnum magellanicum* are particularly widespread in the deciduous forest zone, though they do extend into the evergreen forest. The absorption of water by the moss means that the communities are raised above the general ground surface and this, together with the direct incorporation of rainwater, results in a low mineral content of the water. The most frequent associate is *Empetrum rubrum*, which may be locally co-dominant, together with such species as *Carex banksii*, *C. curta*, *C. magellanica*, *Gunnera magellanica*, *Marsippospermum grandiflorum*, *Perezia lactucoides*, *Pernettya pumila* and *Tetrorchium magellanicum*, while *Astelia pumila*, *Drosera uniflora* and *Pinguicula antarctica*, for example, are locally important. As the hummocks of this bog increasingly rise above the water table they may dry out to give an *Empetrum*-dominated community resembling facies of the heath described earlier (p. 26).

**Marsippospermum bog.** Under similar ground-water conditions to those of the above communities but where the general climate is drier, as towards the northern limits of the deciduous forest, *Marsippospermum grandiflorum* becomes dominant in the bog communities. Cushions of mosses, especially *Sphagnum*, and liverworts are important in the lowest layers of this community, while frequent associates such as *Carpina alpina*, *Cortaderia pilosa*, *Festuca contracta*, *Rostkovia magellanica*, *Schoenus antarcticus* and various *Carex* species give it a meadow-like appearance; indeed, these communities frequently intergrade with the mesophytic grassland described on p. 24.

## C. EVERGREEN FOREST

As, towards the south and west of Fuegia, the annual precipitation increasingly exceeds 800–850 mm the evergreen *Nothofagus betuloides* becomes important in the forest. Initially, *N. betuloides* is intermingled with *N. pumilio* in an association which has been distinguished as mixed evergreen-deciduous forest, "Bosque Magallánico Mixto" (Pisano 1973a, b, 1974) or evergreen transitional forest (Young, 1973), but which can be better considered ecotonal between the two life-forms (Moore 1978; Pisano 1977a). With increased precipitation *N. betuloides* assumes dominance in a series of communities that extend westwards and southwards into areas of up to at least 4,000 mm annual precipitation. Shrub and bog communities are also prominent in the zone.

## a. Forest

**Nothofagus betuloides forest.** The purest stands of *Nothofagus betuloides* develop away from the coasts, usually on rather shallow, peaty soils which, because of sloping parent rock or partly permeable substrates, do not accumulate excessive water. They extend from sea-level to about 350 m, although above 200 m the trees tend to follow glacial valleys, stream-sides and such sheltered areas, decreasing in stature to form a scrub which terminates in a "krumholz" timberline as described (p. 26) for the deciduous forest. In this forest such species as *Empetrum rubrum* and *Philesia magellanica* may become locally sub-dominant in the more open facies, while throughout the commonest associates include *Berberis ilicifolia*, *Lebetanthus myrsinites* and *Blechnum magellanicum* in the shrub layer and, in the herb layer, *Blechnum penma-marina*, *Gunnera magellanica*, *Hymenophyllum* spp. (especially *H. pectinatum*, *H. secundum* and *H. tortuosum*), *Luzuriaga marginata* and *Senecio acanthifolius*.

**Nothofagus betuloides-Drimys forest.** In coastal areas *Drimys winteri* becomes co-dominant or locally dominant within a mosaic with the *Nothofagus*; in better drained sites, as along watercourses, *Maytenus magellanica* and *Embothrium coccineum* may become locally important. The associated shrubs include all those noted above in the *Nothofagus betuloides* communities, together with the handsome *Desfontainia spinosa*. Because of edaphic and microclimatic factors, as well as the poverty of the soil microfauna, the decomposition of plant remains is slow and there is frequently a deep covering of at most partially decomposed tree-trunks on the forest floor. These conditions provide very suitable conditions for the filmy ferns, the *Hymenophyllum* spp. mentioned in the previous section, but with the prominent addition of *H. ferrugineum*, *H. peltatum*, and *Serpyllopsis caespitosa*; to the other important members of the ground layer already noted should be added *Acaena ovalifolia*, *Adenocaulon chilense* and *Dryopsis glechomoides*.

**Maytenus-Drimys forest.** In some protected areas of the Altos del Boquerón, along the north side of Bahía Inútil on Isla Grande, occasional specimens of *Drimys winteri* are to be found. There is convincing historical evidence that these are the remnants of a forest dominated by this species and *Maytenus magellanica* until the years 1880–1890 (Pisano, 1977a), when its destruction, and eventual extinction, began with its exploitation by Europeans for firewood and for charcoal production in the goldfields then developing. Little is known of the

floristic composition of this forest but, interestingly, *Embothrium coccineum* seems to have been important. Along the west coast of Isla Grande towards the entrance of Seno Almirantazgo scattered stands of *Embothrium* forest, with robust trees up to 5–8 m, are still to be found and it seems that local microclimatic and edaphic factors permitted this westerly finger of evergreen forest to reach northwards into the zone which, climatically, largely supports Patagonian steppe vegetation.

**Pilgerodendron forest.** The *Nothofagus-Drimys* coastal forest often incorporates specimens of *Pilgerodendron uvifera* when the soil becomes boggy. As these conditions progress to allow the development of *Sphagnum* communities on the ground surface *Pilgerodendron* frequently increases in importance, often forming pure stands, the dominant sometimes reaching 6–10 m but usually being much shorter in Fuegia to give communities which may better be considered as scrub. In addition to the associates of the *Nothofagus-Drimys* communities mentioned earlier the *Pilgerodendron* forest and scrub contains *Acaena pumila*, *Astelia pumila*, *Bolax caespitosa*, *Gleichenia quadripartita*, *Marsippospermum grandiflorum*, *Myrteola nummularia*, *Perezia magellanica* and *Schoenus antarcticus* as important members.

## b. Scrub

Towards its upper limit and as it approaches exposed or very boggy areas at lower elevations the *Nothofagus betuloides* is reduced to a shrubby habit, as noted earlier (p. 26). However, rather distinctive shrub communities are also present within the zone.

**Fuchsia scrub.** In coastal areas, often descending virtually to highwater mark, the *Nothofagus-Drimys* forest is fringed by a scrub reaching 1–2.5 m high in which *Fuchsia magellanica* is prominent. Both *Ribes magellanicum* and *Pernettya mucronata* may be locally dominant or co-dominant, while *Chilodendron diffusum* is often important, particularly with *P. mucronata*, to give a series of wet shrub communities flanking the major components of the evergreen forest. Many herbs of the coastal mixed forest occur in this scrub, but among the additional noteworthy species are, for example, *Cardamine geraniifolia* and *Ranunculus biternatus*.

**Hebe scrub.** More exposed coastal areas than those occupied by the *Fuchsia* communities support a dense scrub up to 1 m high, dominated by *Hebe elliptica*. This scrub, which reaches south to Cabo de Hornos, has a rather poor herb layer, though there are various associated shrubs, including *Berberis ilicifolia*, *Empetrum rubrum*, *Escallonia serrata*, *Lebetan-*

*thus myrsinites*, *Nothofagus betuloides* and *Pernettya mucronata*.

## c. Grassland

Where there are openings within the forest and scrub communities or along their margins, particularly where there is a degree of lateral water movement, such as where streams enter the sea, small areas of mesic grassland develop. Prominent species in such areas include *Poa alopecurus* ssp. *fuegiana*, *P. robusta*, *Hierochloa redolens*, *Carex banksii*, *Deschampsia kingii*, *Cardamine glacialis* and *Senecio smithii*.

## d. Bogs

**Sphagnum bog.** As pointed out previously (p. 27), raised bogs dominated by *Sphagnum magellanicum* occur most characteristically in the deciduous forest zone; nevertheless, they are not at all uncommon in the evergreen forest. The associates of the *Sphagnum* are generally similar to those already noted, but the occurrence of such species as *Donatia fascicularis*, *Oreobolus obtusangulus*, *Schoenus andinus* and *Senecio trifurcatus* indicates a partial transition towards the distinctive bogs of the Magellanic moorland. As the moss hummocks rise high enough above the water table to become somewhat drier they frequently permit the entry of *Pilgerodendron uvifera*, thus providing a gradation to those facies of the coastal forest in which that species is prominent (see p. 28).

## D. MAGELLANIC MOORLAND

In the high rainfall (2,000–5,000 mm) areas of westernmost and southernmost Tierra del Fuego is found a series of bog communities that, collectively, have been termed Magellanic moorland (Godley, 1960) or Tundra magallánica (Pisano, 1977a), which extends north through the outer Chilean archipelago to the Golfo de Peñas at 48°S lat. (Moore, 1979). In sheltered areas, even on the outermost islands, fragments of the evergreen forest, dominated by *Nothofagus betuloides*, *Drimys winteri* and *Pilgerodendron uvifera*, develop, but exposure to the fierce westerly gales results in Magellanic moorland, in which prostrate dwarf shrubs, cushion plants, grass-like plants and bryophytes can all be important, giving rise to a blanket peat the prevalence of which is one of the most characteristic features of the zone. The moorland seems to result from a combination of high rainfall, relatively low temperatures, exposure, poor drainage and intractable igneous rock. As

pointed out by Crow (1975) and Moore (1979) the moorland consists of a mosaic of communities, that may be small or quite extensive; a full description of them here is neither practicable nor necessary.

## a. Scrub

In crevices on rocky, better drained prominences in the Magellanic moorland zone a sparse scrub often develops, composed of dwarfed, often prostrate individuals of species such as *Berberis ilicifolia*, *Chilodendron diffusum*, *Drimys winteri*, *Embothrium coccineum*, *Empetrum rubrum*, *Escallonia serrata*, *Nothofagus antarctica*, *N. betuloides* and *Philesia magellanica*. Such scrub grades into the patches of evergreen forest which occur in the zone, as noted earlier, and also into the bog communities to be mentioned next.

## b. Bogs

The characteristic vegetation of the Magellanic moorland zone is provided by a series of bog communities in which prostrate dwarf shrubs, cushion plants, sedges or rushes and bryophytes can all be important.

**Cushion bog.** Probably the most notable communities of the areas with an annual precipitation of more than about 2,000 mm comprise a dense low covering of cushion plants. The most important of such species are *Astelia pumila*, *Bolax caespitosa*, *Caltha dioneifolia*, *Donatia fascicularis*, *Drapetes muscosus*, *Gaimardia australis* and *Phyllachne uliginosa*.

**Graminoid bog.** Although quite commonly associated with the principal components of the cushion bog just listed, the rather grass-like (graminoid) *Schoenus antarcticus*, *Tetroncium magellanicum* and *Uncinia kingii* locally become dominant to provide a bog of rather different appearance, superficially resembling rather the *Marsippospermum* bogs of the Deciduous Forest zone.

Amongst the associates of the various dominants noted above in the cushion and graminoid bog communities the following are examples of the most consistently encountered: *Acaena pumila*, *Carpina alpina*, *Drosera uniflora*, *Gaultheria antarctica*, *Gunnera lobata*, *Marsippospermum grandiflorum*, *Myrteola nummularia*, *Nanodea muscosa*, *Oreobolus obtusangulus*, *Perezia magellanica*, *Pernettya pumila*, *Tapetia pumila* and *Tribeles australis*. Apart from *Sphagnum*, which is virtually absent from the zone, mosses and, particularly, liverworts are prominent and locally dominant in these bog communities of the Magellanic moorland.

### c. Grassland

In some sheltered coastal localities the evergreen forest found there gives way to small extensions of grassland comparable to that found in sites with good drainage within the zone where such forest is dominant (see p. 29). In addition, a very distinctive grassland, to be described next, occurs within the Magellanic moorland zone.

**Maritime tussock grassland.** This is the most conspicuous vegetation on the coasts of some of the outermost islands of the southern Fuegian archipelago which have a markedly oceanic climate, extending to some of the islands off the north coast of Isla de los Estados (Crow, 1975). The dominant species is *Poa flabellata*, which forms tussocks up to 3 m high, each comprising a fibrous stock 1–1.5 m in diameter surmounted by a dense crown of leaves. At the maximum development of this grassland, as on the Islas Diego Ramírez (Pisano, 1972b), the leaves of adjoining tussocks interlace to form a canopy that excludes all associates. With reduction in the density of the cover *Crassula moschata* forms sparse mats between the tussocks, while openings resulting from the activities of penguins, albatrosses and seals allow an open community of *Colobanthus quitensis* and *Plantago barbata* to develop.

## E. ALPINE VEGETATION

In general the transition from forest to alpine vegetation in Tierra del Fuego is marked by a rather clear timberline, which usually comprises a dense belt of "Krumholz" formed by the *Nothofagus* species. The timberline lies at an average altitude of 500–600 m on Isla Grande, though it is lower on smaller peaks and higher on the larger mountain ranges. Towards the south and west of the archipelago the timberline becomes lower and often indistinct.

The vegetation of the alpine regions seems to be governed by 3 principal factors – exposure to wind, availability of water and the physical nature of the substrate (Moore, 1975).

### a. Heath.

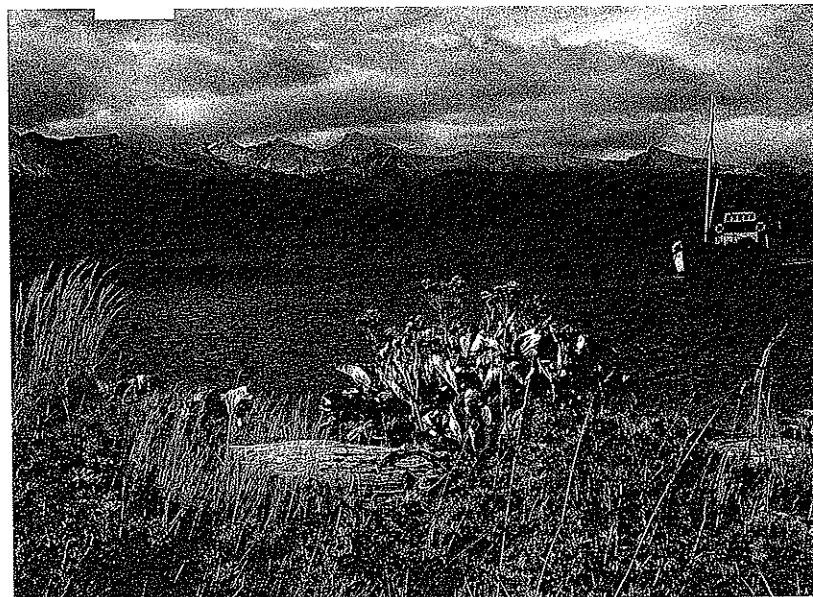
A series of communities in which heath-like plants, such as *Empetrum rubrum* and *Pernettya pumila*, are prominent are widespread in the Fuegian uplands. They closely resemble similar communities at lower elevations and form a rather complex mosaic within

which two intergrading groups may be discerned.

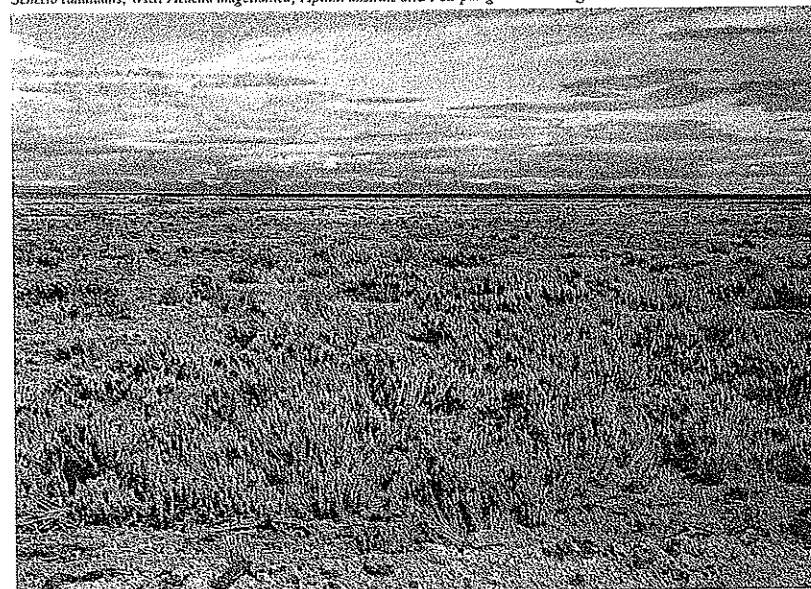
**Cushion heath.** This is well-developed at and just above timberline where *Bolax gummifera* forms prominent cushions up to 1 m or more high. Close associates usually include cushion-forming species such as *Abrotanella emarginata*, *Azorella lycopodioides*, *Colobanthus subulatus*, *Drapetes mucosus* and, under wetter conditions, *Bolax caespitosa*, *Caltha appendiculata*, *C. dioneifolia* and *Plantago barbata*. Upon and between the cushions *Empetrum rubrum* is conspicuous, together with *Acaena magellanica*, *Festuca contracta*, *Gamochaeta spiciformis*, *Luzula alopecurus*, *Pernettya pumila* and *Stipa rariflora*, for example, as well as *Saxifragodes albowiana* and *Tetrachondra patagonica*, which are virtually restricted to these communities.

With increasing altitude and exposure *Bolax* decreases in importance and the heath becomes more open, with smaller, lower cushions. Here *Armeria maritima*, *Azorella selago*, *Cerastium arvense*, *Draba magellanica*, *Leucheria hahnii*, *Onuris alismatifolia*, *Perezia magellanica* and *Trisetum spicatum* may be prominent. Towards its upper limit the cushion heath becomes increasingly open and impoverished until it is represented only by scattered cushions of *Saxifragella bicuspidata*, sometimes accompanied by *Azorella selago* or *Cerastium arvense*. The heath is also open where seepage water runs over the ground surface, which is frequently gravelly, and here *Viola tridentata* and the rare *Koenigia islandica* occur. In the mountains north of Lago Fagnano, where the cushion heath is developed over a deep clay soil, the substrate is often unstable on steep slopes as a result of wind or trampling by guanaco or sheep and often soil-runs develop. A few species of the open facies of the cushion heath, such as *Calandrinia caespitosa*, *Oxalis enneaphylla*, *Nassauvia pygmaea* and *Senecio alloeophyllus* can tolerate these conditions, to which *Phaiophleps biflora* ssp. *lyckholmi* and *Tristagma nivalis* are virtually restricted.

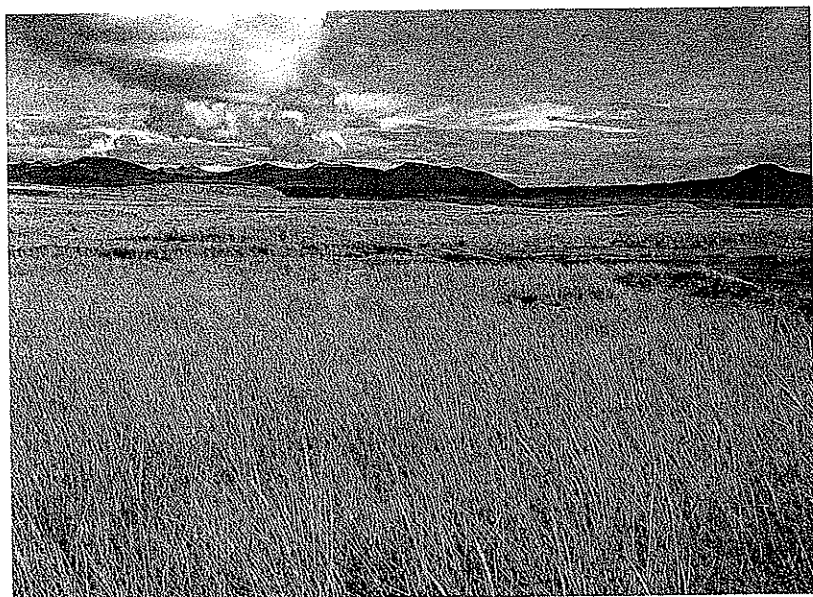
**Dwarf shrub heath.** Although intergrading considerably with the cushion heath, communities in which *Empetrum rubrum* and, to a lesser degree, *Pernettya pumila* and *Myrteola nummularia* dominate their structure develop along the margins of rock screes, on islands of more stable ground within the screes and on some other well-drained sites. Most of the associated species are also present in the cushion heath but differ in that species such as *Cystopteris fragilis* and *Senecio darwinii* have their principal alpine occurrences here. *Grammitis magellanica*, *Hymenophyllum falklandicum* and *Polystichum andinum*, which occur on rock faces and in crevices in the screes, may also enter the heath.



a. Coastal community, Seno Almirantazgo. *Senecio candidans*, with *Acaena magellanica*, *Apium australe* and *Poa patagonica* in foreground.



b. *Lepidophyllum* scrub, Bahía Inútil. (Photos: D. M. Moore).



a. *Festuca gracillima* grassland, Timaukel.

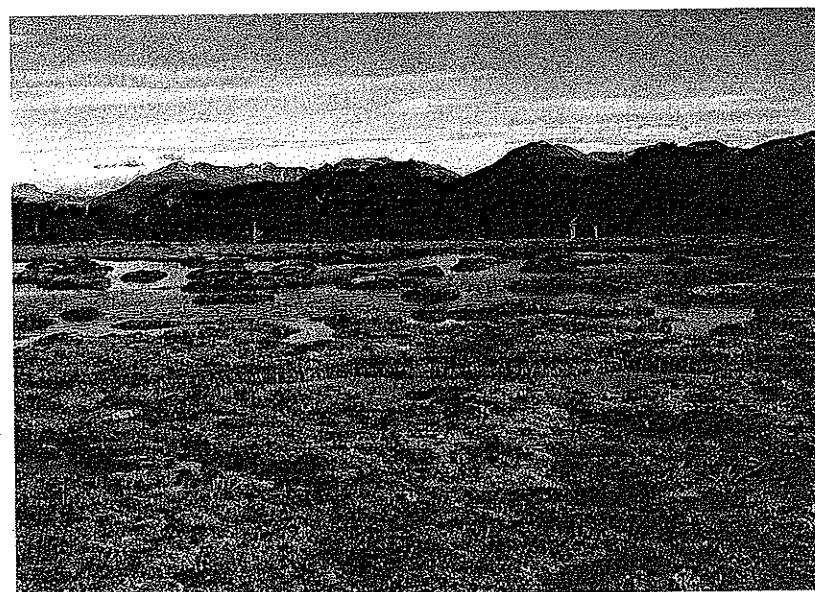


b. Deciduous forest (*Nothofagus pumilio*) in autumn, Rio Grande. (Photos: D. M. Moore).

PLATE 2.



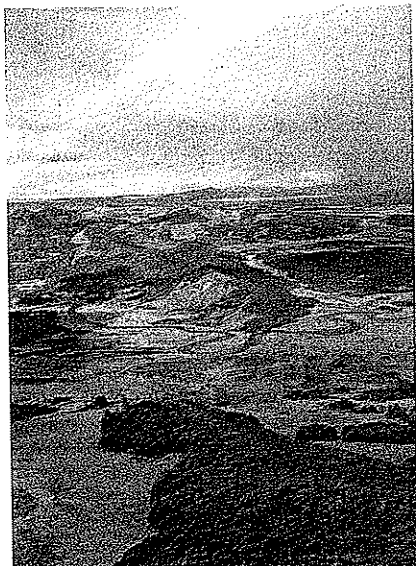
a. *Empetrum-Bolax* heath, Ea Cameron. *Nothofagus antarctica* at margin.



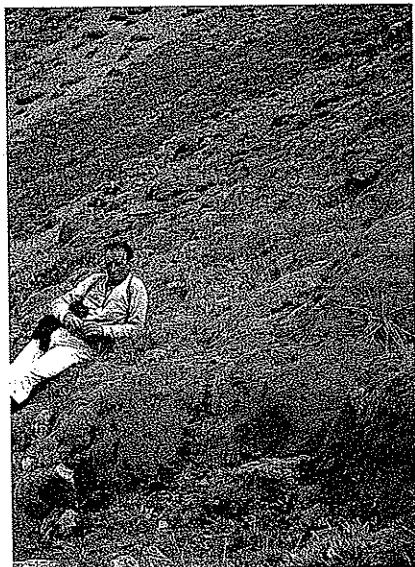
b. Magellanic moorland, dominated by *Donatia fascicularis*, Bahia Moat. (Photos: D. M. Moore).

PLATE 3.





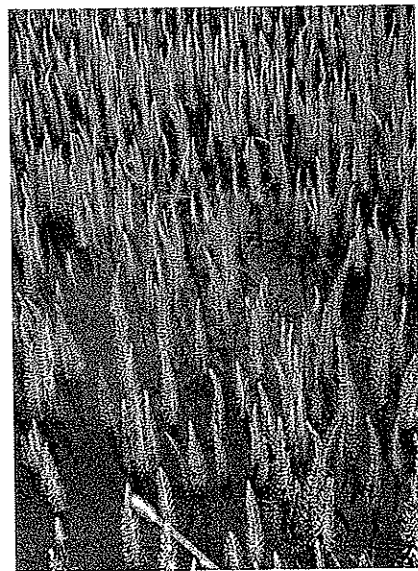
a. Ecotone between grass-steppe and deciduous forest, Ea Vicuña.



b. *Bolax gumifera* cushion-heath, above timberline on Cerro Atukoyak.



c. *Sphagnum* bog, Isla Navarino.



d. *Hippuris vulgaris* freshwater community, Lago Fagnano. (Photos: D. M. Moore).

PLATE 4.

#### b. Feldmark

At higher elevations on many Fuegian mountains there are extensive areas of undulating or gently sloping ground covered by talus deposits. These tend to be largely devoid of higher plants, hence the appropriate alternative term 'Desierto Andino' (Pisano 1974), but they provide the rather specialised habitat of *Moschopsis rosulata* and *Nassauvia lagascae*. Dense lichen communities, usually dominated by *Usnea*, are also common. The presence of large areas of open, exposed mineral soil allow the occurrence of such species as *Nassauvia latissima*, *N. pygmaea*, *Saxifraga magellanica* and *Senecio humifusus* and others which indicate a transition to the cushion heath, and the demarcation between it and true feldmark is often arbitrary.

#### c. Alpine "meadow"

Over much of the Fuegian high country south of the Azopardo-Fagnano depression there are frequent streams or seepage areas, derived in many cases from permanent glaciers or slow-melting snow patches, which often support a rather distinct and rich vegetation that has somewhat inappropriately been termed "meadow".

In relatively fine soil along stream-margins mats of *Abrotanella linearifolia*, *Caltha appendiculata* and *Plantago barbata* occur, amongst which grow such species as *Acaena antarctica*, *A. tenera*, *Caltha sagittata*, *Lagenifera nudicaulis*, *Ourisia fuegiana*, *Oxalis magellanica*, *Poa alopecurus* ssp. *fuegiana*, *Primula magellanica*, *Tapeinia obscura* and *Viola comersonii*. Where the substrate is rocky or composed of coarser soil, species such as *Cardamine glacialis*, *Epilobium australe*, *Hamadryas magellanica* and *Nassauvia magellanica* are also found.

The sheltered parts of many montane streams are flanked by a broad belt of marshy ground which, together with seepage areas having impeded drainage, can support communities in which grassy leaved plants are prominent. *Agrostis magellanica*, *Carex banksii*, *C. magellanica*, *Carpina alpina*, *Cortaderia pilosa*, *Deschampsia atropurpurea*, *Rostkovia magellanica*, *Schoenus antarcticus*, *Uncinia kingii* and *U. lehleri* can all be found in such areas, together with many of the streamside species noted above. Bryophyte communities, often grading into *Sphagnum* bogs, are also present.

#### F. LITTORAL VEGETATION

A number of communities at or just above highwater mark can be found around the coasts of Fuegia.

These are usually of small extent and are often absent, as on the steep shores frequent in south and west Fuegia where the dominant terrestrial vegetation reaches the sea-margin.

#### a. Sandy shores

In the northern half of Isla Grande communities dominated by *Salicornia ambigua* occur near or below highwater mark on sandy-silty shores. The dominant forms almost pure stands a few centimetres high, but where there is local drainage, as along the sides of small channels, species such as *Plantago barbata*, *P. maritima*, *Puccinellia magellanica* and *Suaeda argentinensis* may be associated.

Sandy beaches in the same area may support an almost pure community of *Senecio candidans*, although *Acaena magellanica*, *Adesmia pumila* and *Rumex magellanicus* can all be associated. Further south in Fuegia these communities can also include, for example, *Apium australe* and *Poa robusta*.

#### b. Rocky shores

In crevices of rock slabs and small areas of wet sand at or just above highwater mark it is usual to find an assemblage of maritime species various combined into several limited communities. The commonest species found in such sites include *Apium australe*, *Colobanthus quitensis*, *C. subulatus*, *Crassula moschata*, *Plantago barbata*, *P. maritima*, and *Polygoum maritimum*, while *Abrotanella submarginata* and the Fuegian endemic *Poa darwiniana* are restricted to such places in the southern parts of the archipelago.

#### G. FRESHWATER VEGETATION

Many species present in the various bogs of Tierra del Fuego may be found as local emergents in freshwater pools and along the margins of lakes. A relatively small number of species, however, are largely confined to freshwater habitats, though some of them are occasionally members of wetland, terrestrial communities.

In pools and at the margins of lakes and slow-moving streams the freshwater communities are dominated by such species as *Eleocharis melanostachys*, *Hippuris vulgaris*, *Myriophyllum quitense*, *Potamogeton linguatus* and *Ranunculus aquatilis*. All these species, with the exception of the *Eleocharis*, seem to be restricted to the Patagonian Steppe and Deciduous Forest zones, as are such associates as *Littorella australis*, *Potamogeton strictus*, *Ruppia filifolia*, *Scirpus californicus* and *Zannichellia palustris*. *Lilaeopsis hillii*

and *Moutia fortana* extend, like *Eleocharis melanostachys*, into the Evergreen Forest zone, while *Callitriche antarctica* and *Isoetes savatieri*, which probably grows

at greater depths (up to c. 5 m) than any of the other freshwater species, reach the Magellanic moorland zone.

## IV. Geographical affinities of the Flora

In this Flora 545 species are recognised as occurring in Tierra del Fuego. Of these, 417 species are considered to be native to the region, while 128 species are believed to be aliens. Since the alien species have been brought to the archipelago, either deliberately or accidentally, through the activities of the Europeans who inherited the area from the original Indian tribes, their occurrence has a significance different to that of the native species, whose distribution results from natural causes, and here they will be considered separately.

### I. NATIVE FLORA

It has long been recognised that the flora of Tierra del Fuego represents an extension of that of the temperate mainland of South America to the north (e.g. Hooker, 1847; Skottsberg, 1916; Cabrera, 1971; Hueck and Seibert, 1972). Thus, about 93% of Fuegian species occur on the mainland, as can be seen from the general geographical summaries given later (pp. 46-353) in the systematic account. This is not surprising since, after the Pleistocene ice began to retreat from southernmost South America (including Tierra del Fuego) about 16,000 years ago (p. 1), the colonising plants would be expected to come principally from the adjacent ice-free regions to the north. Nevertheless, other factors have been involved in producing the flora of Tierra del Fuego that we see today and it is interesting to look a little more closely at the distribution of the species occurring there.

The four principal climatic and vegetation zones described in passing from north and east to south and west Fuegia (pp. 24-30) parallel rather closely the sequence seen north of the Estrecho de Magallanes in traversing cool temperate Argentina and Chile from the Atlantic to the Pacific Oceans. Since all plant

species can only occupy areas with climatic and ecological conditions within their range of tolerance it is not surprising that some species restricted to the drier steppe areas of N.E. Tierra del Fuego extend northwards in the drier parts east of the Andes, while those in the wettest Magellanic moorland zone of Fuegia are found in similar areas of the western Chilean channels. Very many Fuegian species, however, have a rather wider ecological amplitude and extend northwards along the Andes, which provide a rather wide range of cool temperate conditions as a result of their altitude.

In addition to plant-distributions which can be related to the almost continuous climatic belts running northwards from Fuegia into southern South America, are those which appear to be related to the ability of some plants to disperse over rather large distances. Thus, a number of Fuegian species are found across the tropics in various parts of the Northern Hemisphere, while others have traversed the wide expanses of the Southern Ocean to show floristic affinities with the islands surrounding Antarctica and even with New Zealand and, to a lesser degree, Australia or further north.

Some species seem to be restricted to Tierra del Fuego. Such endemics are important because they give an indication of the extent of species-formation since Fuegia became available for colonisation by plants. However, it must be remembered that further exploration in other areas, principally north of the Estrecho de Magallanes, may change the status of some of these endemics.

On the basis of the information presented in this Flora the affinities of the Fuegian plants may be expressed approximately as follows:

- a. North along both flanks of the Andes in W. Argentina and E. Chile 64%
- b. North along the Andes in W. Argentina 2%

- c. North only or principally in C. and E. Argentina 4%
- d. North along west side of Andes, principally in W. Chile 8%
- e. Various distributions in South America but crossing tropics to north temperate areas 12%
- f. Various distributions in South America but extending to different degrees into the circum-Antarctic zone 7%
- g. Endemics, not known outside Tierra del Fuego 3%

a. The majority (c.75%) of Fuegian species occurring along both flanks of the Andes do not reach north of c.38°S. lat., indeed 11% of them, including e.g. *Acaena lucida*, *Agrostis fuegiana*, *Deschampsia kingii*, *Nassauvia magellanica*, *Perezia lactucoides*, *Ranunculus pseudotrullifolius* and *Viola tridentata*, scarcely occur north of 50°S. lat. This floristic affinity between the southern Andes and Tierra del Fuego is paralleled by the similarity of the vegetation, with deciduous forest and associated communities being prominent in both regions. However, the difference between the generally moister western and drier eastern slopes of the cordillera is reflected in the distribution of species having different environmental requirements. Thus, species such as *Adesmia lotoides*, *Arjona patagonica*, *Calceolaria biflora*, *Draba magellanica*, *Ephedra frustillata*, *Hamadryas delphinii* and *Sisyrinchium patagonicum*, which reach significantly further north on the east than the west side of the Andes, tolerate more arid conditions than, for example, *Azorella lycopodioides*, *Berberis ilicifolia*, *Carex vallis-pulchrae* and *Fuchsia magellanica*, for which the reverse situation seems to be true.

Of the species included in this section which occur north of c.38°S. lat., only a few, such as *Acaena ovalifolia*, *Anagallis alternifolia*, *Berberis empetrifolia*, *Carex fuscata*, *Perezia pilifera* and *Plantago barbata*, have been found at increasing altitudes in the Andes north of 30°S. lat. Indeed a few species, such as *Eleocharis albobracteata*, *Juncus chilensis*, *J. stipulatus* and *Saxifraga magellanica*, reach Colombia and Ecuador, while the extension of *Colobanthus quitensis* and *Daucus montanus* to the mountains of Mexico provides a link with the "bipolar" disjunct species included below in section c.

b. A number of species included in the preceding section, such as *Boopis australis*, *Gutierrezia baccaroides*, *Nardophyllum bryoides*, *Rumex magellanicus* and *Senecio anottii*, are quite widely distributed in W. Argentina, while their known occurrence in E.

Chile is restricted to the drier areas along the north shore of the Estrecho de Magallanes and, occasionally, Última Esperanza. They thus form a link with the species in this section which have so far only been found in W. Argentina, e.g. *Benthameiella nordenfjeldii*, *Botrychium dusenii*, *Bromus stamineus*, *Carex sorianoii* and *Tetrachondra patagonica*.

c. Species with their sole or principal extra-Fuegian distribution in W. Argentina, included in the previous section, probably indicate a preference for the drier conditions east of the mountains than those of section a, which also occur on the west side of the Andes. The species included in this section largely occur north of the Estrecho de Magallanes in the arid areas of central and eastern Argentina, e.g. *Androsace pusilla*, *Boopis patagonica*, *Draba australis*, *Frankenia chubutensis*, *Hypochaeris patagonica* and *Nassauvia fuegiana*. Others, such as *Chenopodium antarcticum*, *Puccinellia pusilla* and *Suaeda argentinensis*, clearly seem to have distributions governed by the occurrence of relatively low rainfall and the open saline habitats they prefer.

d. A significant proportion of Fuegian species (c.8%) occur north of the Estrecho de Magallanes only in the higher rainfall areas west of the Andes, principally in W. Chile. As might be expected most of them are principally or entirely restricted to the evergreen forest and magellanic moorland zones in Tierra del Fuego. Some, such as *Abrotanella linearifolia*, *A. submarginata*, *Agropyron elymoides*, *Caltha dioneifolia*, *Gnimeria lobata*, *Phyllachne uliginosa* and *Senecio darwini*, only just extend beyond Fuegia, while others, such as *Acaena pumila*, *Astelina pumila*, *Donatia fascicularis*, *Misodendrum brachystachyum*, *Pinguicula antarctica* and *Tapeinia pumila*, have been found as far north as c.40°S. lat. in W. Chile.

e. Just over 12% of the native species of Tierra del Fuego have disjunct distributions across the tropics to the cool temperate regions of the Northern Hemisphere. Some of these, such as *Carex curta*, *Cystopteris fragilis*, *Scirpus cernuus*, *Trisetum spicatum* and *Zannichellia palustris*, occur in suitable temperate areas throughout the world, and may be considered virtually cosmopolitan. However, most of these "bipolar" disjunct species reflect the geographical proximity of the Americas where they seem to have crossed the tropics, usually from north to south (e.g. Raven, 1963; Moore, 1972), by some form of long-distance dispersal. Species such as *Anemone multifida*, *Carex gayana*, *Chenopodium macrospermum*, *Osmorhiza chilensis*, *O. depauperata*, *Polemonium micranthum*,

*Salicornia ambigua* and *Triglochin concinna* have their only Northern Hemisphere occurrences in North America. A larger number, however, also occur in Europe – e.g. *Armeria maritima*, *Carex capitata*, *C. macloviana*, *C. magellanica*, *C. microglochin*, *Cerastium arvense*, *Deschampsia flexuosa*, *Gentiana prostrata*, *Hippuris vulgaris*, *Koenigia islandica*, *Plantago maritima*, *Ranunculus aquatilis* and *Triglochin palustris*. Of particular interest is a small number of species, including *Calamagrostis stricta*, *Galium aparine*, *Polygonum maritimum* and *Spergularia marina*, which occur in Europe and southern South America, apparently without areas in North America.

Many of these "bipolar" disjuncts have distributions which accord with the view that much of their journey between the Northern and Southern Hemispheres was achieved via the temperate mountain pathways provided by the Andes and Rocky Mountains. However, at least one species, *Koenigia islandica*, has its only South American occurrences in Tierra del Fuego so that the distance traversed from its source in temperate North America and Eurasia is considerable, although it may still be undiscovered along the Andes.

f. About 7% of Fuegian species show important affinities eastwards into the circum-Antarctic zone, occurring on various of the islands scattered across the Southern Ocean. The floristic relationships between the Australian-New Zealand region and South America have long been of interest because of the wide expanses of open ocean now separating these areas and the affinities have been explained in two ways (e.g. Moore, 1972). Since the southern continents were united into Gondwanaland until some 180 million years ago, genera and families shared by them may result from the fragmentation of that "supercontinent" by continental drift. Shared species, such as those considered here, indicate a much more recent situation when the land masses had attained more or less their present positions and the plants must have attained their disjunct distributions by long-distance dispersal over the intervening ocean.

The number of Fuegian species present on various areas in the circum-Antarctic can be summarised as follows:

Island (s)	Falkland Islands	South Georgia	Iles Crozet
Approx. longitude	59°W	37°W	50°E
No. of species	22	21	16
Island (s)	Iles de Kerguelen	Macquarie Island	New Zealand
Approx. longitude	70°E	159°E	170°E
No. of species	15	12	15

Most are present in the Falkland Islands (Islas Malvinas), while the number of species found in other areas generally decreases with distance from Tierra del Fuego, although the available land surface and diversity of habitats on some islands are certainly also important factors. It should also be noted that there is not a gradual "sieve" effect. Thus, whilst *Oreomyza hookeri* and *Valeriana sedifolia* only reach the Falkland Islands, and *Acaena tenera* only South Georgia, *Carpha alpina*, *Geum parviflorum* and *Oxalis magellanica* do not occur between Tierra del Fuego and New Zealand. On the other hand, species such as *Apium australe*, *Blechnum penna-marina*, *Callitriche antarctica*, *Festuca contracta*, *Juncus schenckerioides* and *Ranunculus bitematus* occur on most of the islands between those two areas and are truly circum-Antarctic.

g. On present information, not more than 3% of the native species of Tierra del Fuego are known only from the archipelago. This relatively low level of endemism is consistent with the youth of the flora, the area only having become available to plants during the past 16,000 years (p. 1). Of the presumed endemics, 11 seem to have their closest relatives in Fuegia north of the Estrecho de Magallanes: *Atriplex reichei*, *Chilophyllum fuegianum*, *Descurainia antarctica*, *Festuca cirrosa*, *Onuris alismatifolia*, *Oursia fuegiana*, *Poa darwini*, *P. yaganica*, *Senecio eightii*, *S. humifusus* and *S. websteri*. *Nassauvia latissima* seems to be most closely related to *N. magellanica*, of the southern Andes and Fuegia, and the Falkland Islands (Islas Malvinas) endemic, *N. serpens*, while *Epilobium conjungens* has its closest relatives in New Zealand.

## 2. ALIEN FLORA

About 128 species present in Tierra del Fuego are considered here to have been introduced into the archipelago by man (Moore and Goodall, 1977). They are probably all of European origin, although many certainly arrived via settlements in S. Chile, S. Argentina and the Falkland Islands (Islas Malvinas). The earliest certain records of alien species in Tierra del Fuego are in 1882 (Spegazzini, 1896), thirteen years after the first resident Europeans arrived, but there is evidence that some may have come with sealers and whalers much earlier.

A rather crude classification of the habitats occupied by the adventives suggests that only 9 species (about 7.2%) of the alien flora seem to have entered relatively unmodified natural communities. Interestingly, these species include those, such as *Cerastium fontanum*, *Poa annua*, *P. pratensis*, *Rumex*



*acetosella*, *Sagina procumbens* and *Veronica serpyllifolia*, which seem to have been amongst the earliest arrivals in Tierra del Fuego and which also figure prominently in the alien floras of other southern cool temperate regions. About 60% of the alien species are dependent upon habitats clearly disturbed by human activity, such as road-sides and tracks, a third of the species being restricted to highly modified sites such as gardens. The remaining species occur in naturally open habitats, such as beaches, river-banks etc., or in vegetation which has been modified by domestic animals, principally sheep.

The majority of the alien species seem to have been introduced accidentally by man, in the ballast of ships, among the packing of machinery or attached to animals brought from north of the Estrecho de Magallanes or the Falkland Islands (Islas Malvinas), for example. However, a number of species were certainly introduced deliberately. Seed mixtures containing such species as *Trifolium repens*, *Holcus lanatus* and *Anthoxanthum odoratum* have been used for many years to improve the natural pastures,

particularly where forests have been cleared for sheep-rearing. *Mentha x piperita* has long been cultivated in gardens along the Canal Beagle, escaping to semi-natural wet habitats, while even *Taraxacum officinale* seems to have been deliberately introduced to N.E. Isla Grande for use as a salad-vegetable (Moore and Goodall, 1977).

The increasing impact of man in parts of Tierra del Fuego is undoubtedly extending the area of many introduced species. *Cirsium vulgare*, for example, arrived in Isla Grande prior to 1917 but it was not common. During the 1960's, however, it became much more widespread, particularly along the roads. Being of earth, the roads are regularly levelled by big graders and the frequent disturbance of the verges, together with the greatly increased vehicular traffic, has undoubtedly been important in the recent spread of this species. As man's activities continue to expand in Tierra del Fuego the introduced species may be expected to become more prominent in the Fuegian flora and their occurrence should be monitored closely in the future.

## V. Systematic Account of the Flora

### A. INTRODUCTION

#### a. Format

The order of families in the systematic account follows that given by Stebbins (1974), incorporating as it does many modern views on their relations, while the sequence of genera within each family is largely based on the second edition of Engler's *Syllabus der Pflanzenfamilien* (Melchior and Werdermann, 1954; Melchior, 1964). Within a genus the order of the species follows recent revisions and other taxonomic works wherever possible. Descriptions are provided for all native and introduced species. The species' names accepted in this Flora are given in bold italic type and numbered, the number being prefixed by an asterisk (\*) when the species is considered to have been introduced into Fuegia (see Moore and Goodall, 1977), while synonyms are shown in smaller italics. Only the essential diagnostic characters are given for species that have been reported from Tierra del Fuego whose presence or status, for some reason, is regarded as doubtful and their names are not numbered.

Where appropriate, infraspecific categories within a species are mentioned, either formally or in notes following the geographical distribution, usually with some indication of their distinguishing characters and often, when data are available, with a comment on their validity. These categories are retained at the level recognised in the recent literature and there is therefore no uniformity in their circumscription. Thus, although the subspecies is generally a major morphologically and geographically definable node in the species' pattern of variation, the category of variety has been used much less consistently, in some instances being essentially synonymous with the subspecies and in

others referring to a much more restricted entity or even to a rather sporadic local variant or "form".

#### b. Nomenclature and literature citations

As far as possible all names appearing in the botanical literature of Tierra del Fuego are included in the Flora. A complete index to all names and synonyms is provided (pp. 383-396). The abbreviations of author names are listed and explained in the appendices, as are those for the titles of books and journals cited. References to citations of synonyms are given chronologically. Details of such references, as well as of those appearing elsewhere throughout the Flora, are given in the list of references (p. 373), which constitutes, therefore, a rather comprehensive guide to the botanical literature of Tierra del Fuego.

Common names, both English and Spanish, used in Tierra del Fuego are not included in the species' accounts but are listed separately (p. 360). A separate list of Indian names and uses is also provided (p. 367).

#### c. Descriptions

All descriptions apply to the species as they occur in Tierra del Fuego, as does the information on flowering period and altitudinal range. Characteristics of the family as represented in Tierra del Fuego are not repeated in the generic descriptions. Similarly, features of the genus common to all the Fuegian representatives are not repeated in the species' descriptions, which follow the general sequence: habit, stems, leaves, inflorescence, flowers, fruit and seed. Unqualified measurements refer to length; measurements connected by the multiplication sign refer to length by breadth; numbers enclosed in brackets indicate dimensions beyond the normal range. Explanations of the abbreviations used are incorporated in the glossary (p. 354), in