PROPOSAL FOR REFORESTATION ACTIVITIES IN THE XI th. REGION OF CHILE

(Visit of the "Instituto Forestal" in Chile 28.2 - 14.3 1993)

Dr. Jochen Kleinschmit

Lower Saxony Forest Research Institute, Dept. Forest Tree Breeding

Report

PROPOSALS FOR REFORESTATION ACTIVITIES IN THE XI$^{th.}$ REGION OF CHILE

Dr. Hans Grosse[1] and Dr. Jochen Kleinschmit[2]

1. Aim of the visit

One of the research programs of the "Instituto Forestal" will be developed in the XIth region of Chile, West Patagonien. In this region about 3 Million hectars of forests have been destroyed by fire 50 to 60 years ago which resultet partly in considerable erosion. This and the extensive utilization for cattle makes it difficult for indigenous species to get settled. First reforestation programs with Douglas fir, Scots pine and European larch have been conducted since 20 to 25 years on alltogether until today roughly 25.000 hectars, 15.000 thousand planted by the State, 10.000 by private owners.

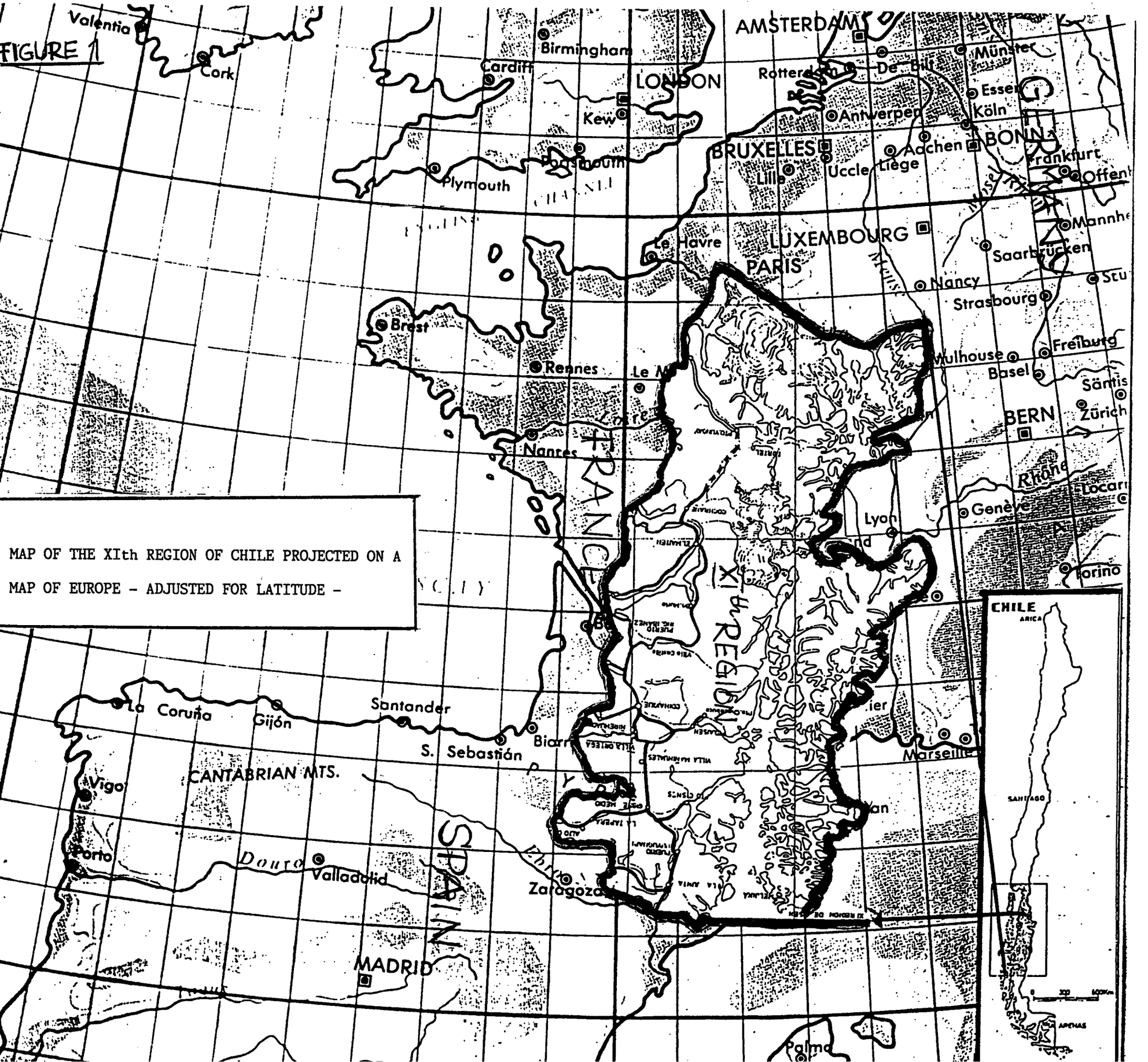
It is estimated, that roughly 1 Million hectars can be reforested as production forest.

There is still considerable lack in knowledge about the right species and the right provenances of the species to be used on these areas. Since the geographic conditions in this region are similar to parts of Europe and especially to the western part of Oregon and Washington in the United States (Figure 1 and 2) the aim of the visit was to propose additional species which could be used for testing and provenances of species which could be suitable for the respective tests. In addition some other questions in connection with testing, plant production and plantation forestry should be discussed.

The first part of the excellently organized visit (see ANNEX 1) had the aim to get acquainted with the conditions of plantation forestry in the VIII$^{th.}$, IX$^{th.}$ and X$^{th.}$ region of Chile, which include 930.000 hectares of *Pinus radiata* plantations accounting for more than 70 % of the total *Radiata* plantation area in Chile and a comparatively extended part of the *Eucalyptus* plantions (IGNACIO CERDA et al. 1992).

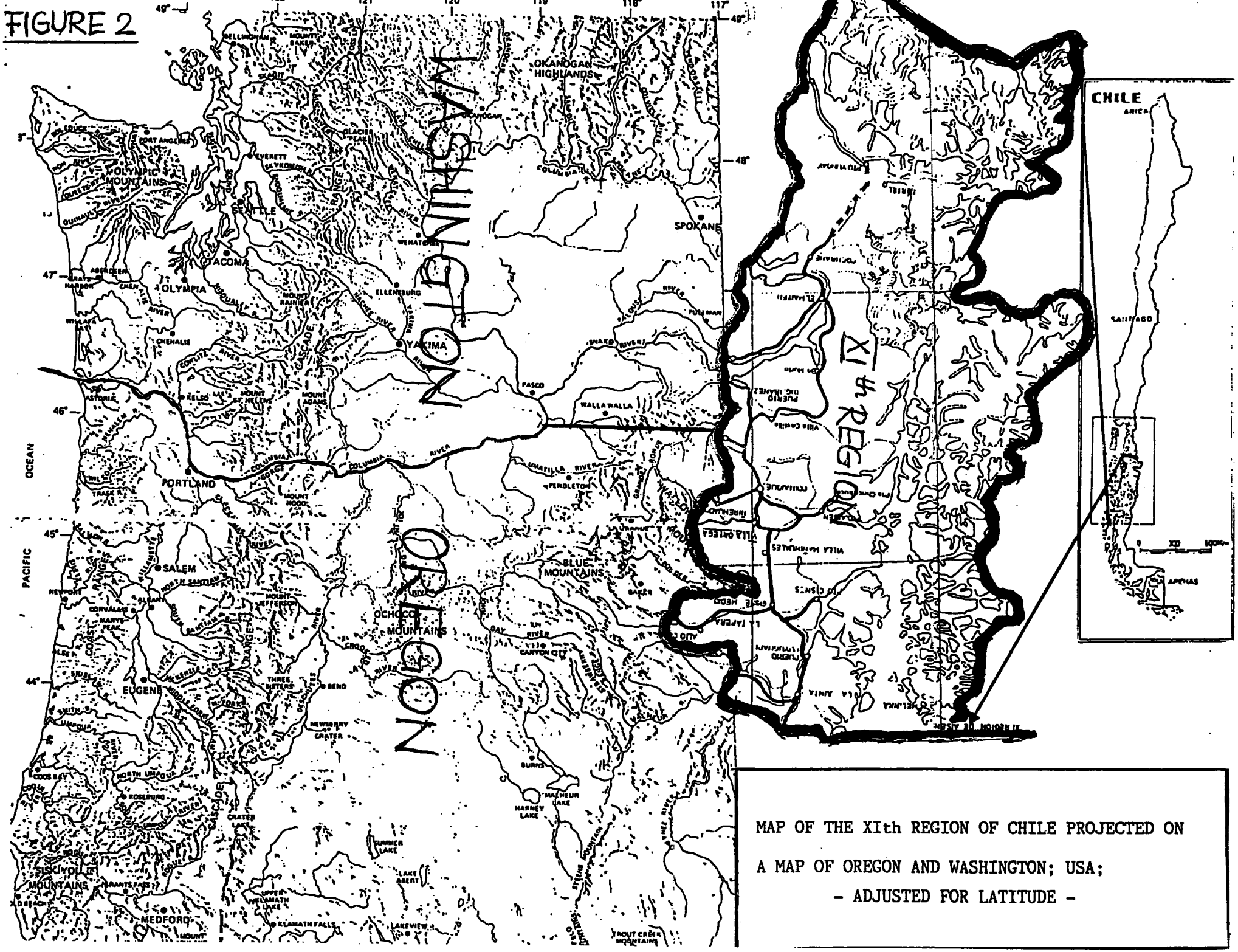
[1]Instituto Forestal, Regional Office Concepcion, Chile
[2]Lower Saxony Forest Research Institute, Dept. Forest Tree Breeding, Germany

FIGURE 1



MAP OF THE XIth REGION OF CHILE PROJECTED ON A MAP OF EUROPE - ADJUSTED FOR LATITUDE -

FIGURE 2



MAP OF THE XIth REGION OF CHILE PROJECTED ON

A MAP OF OREGON AND WASHINGTON; USA;

- ADJUSTED FOR LATITUDE -

2. Present situation of forestry in Chile

Chile with 13 Million inhabitants has a total surface of more than 75 Million hectars. From these roughly 7.62 Million hectars are native forests with production potential and 1.55 Million hectars plantation forests with *Pinus radiata* (1.3 Million hectar) and other species, before all *Eucalyptus* (0.13 Million hectars) (IGNACIO CERDA et al. 1992, Table 1).

Table 2

Exotic plantations in Chile until end of 1991

Species	Area (ha)	%
total	1.555,255	100,0
Pinus radiata	1.305,325	83,9
Eucalyptus	130,915	8,4
Atriplex spp.	40,663	2,6
Prosopis tamarago	20,600	1,3
Psuedotsuga menziesii	11,731	0,8
Populus spp.	3,660	0,2
Prosopis chilensis	3,201	0,2
others	39,160	2,5

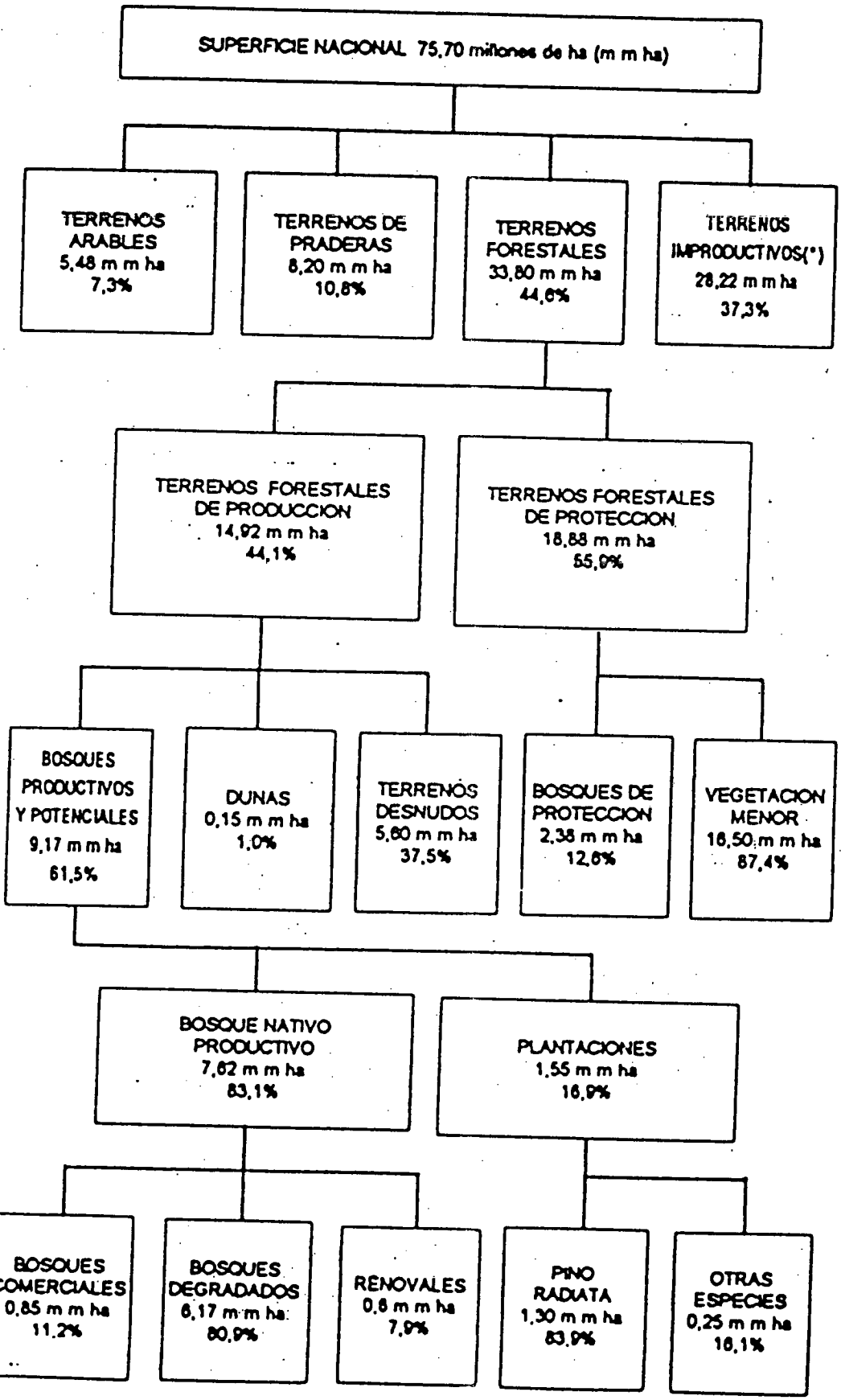
The political goal is to maintain the area of the natural forests and to initiate management for sustained yield on the one hand and to increase plantation forestry on the bare lands with productive tree species, mainly exotics, on the other hand. It is estimated that roughly 18 to 20 Million hectars can be reforested (CERDA et al. 1992; GROSSE 1992). This means, that up to now less than 10 % of the potential area has been planted. Roughly 85 % of the total wood used for industry and export originate from plantation forestry, only 15 % from native forests. Only 1 to 2 % of the native forests are managed silviculturally .

Most of the wood from native forests is locally used as fuel. The total standing volume of native productive forests is estimated with 940 Million m^3, which shows, that there is a high potential available.

The standing volume of the plantation forests is estimated with 204 Million m^3 for *Pinus radiata* and *Eucalyptus* and the wood disposable annually from these 2 species is estimated with more than 28 Million m^3 compared to 20 Million m^3 from the native forests. This is due to the high productivity of *Pinus radiata* and *Eucalyptus* expecially and the low productivity of non managed indigenous forest, which quite often are located in exposed sites on less fertile soils and in unaccessible places.

TABLE 1 : ACTUAL LAND - USE IN CHILE

(CERDA et al. 1992)



(*) Desiertos, altas cumbres, lagos, hielos patagónicos, etc
Fuente INFOR, INIA 1988

3. Situation in the XI$^{th.}$ region

The XI$^{th.}$ region of Chile includes 11 Million hectars with roughly 80.000 inhabitants which is less than 1 inhabitant per square kilometer. The capital Coyhaique has 40.000 inhabitants.

The XI$^{th.}$ region extends from 43° 50" southern latitude to 49° 18" southern latitude and from 71° 30" western longitude to 75° 39" western longitude. The region is mountainous with an extremely structured orography in the south and slightly more homogenous structures in the northern part (Foto 1).

Islands in the western part are the continuation of the coast range in the north. The continental mountain range of the Cordilliera de los Andes borders upon the sea and the interior part extends into the Pampa of Argentinia (Figure 3). Corresponding to these orographic changes the climatic conditions are extremely variable with high precipitation in the coastal range exceeding 4.000 millimeter in some locations and less than 600 millimeters in the steppe. The absolute minimum temperatures range from minus 7° in the coastal part to minus 24° in the steppe near Balmaceda (Figure 4). The elevations range from sealevel to 4085 m in Monte St. Valentin and St. Clemente. Many peaks surpass 2.000 meters. The local climate is influenced in addition by the water from the fjords partly reaching far into the country and by the lakes in the interior, especially Lago General Carrera and other bigger lakes which create an own microclimate. Proceeding from the coast to the interior a moderately cool and humid climate is followed by a transgression to continental climate and finally the continental steppe climate. In high elevation permanent glaciers are to be found. The climatic data for Rio Cisnes, Puerto Aisen, Coyhaique, Balmaceda, Chile Chico and Cochrane were compared to the respective situation in North America and Europe. The data for Chile were compiled by the chilean department for meteorology and arranged by VICTOR ARAVENA and UTE KANNEGIESSER (ANNEX 2 and 3).

The geographical range in the XI$^{th.}$ region is comparable to Oregon and Washington in the United States (Figure 2). The interior part comes climatically more close to the interior of British Columbia (Shuswap Lake Region). Oregon and Washington extend from 42°n to 39°n latitude with a precipitation very similar to the XI$^{th.}$ region. The distribution of the precipitation is more favourable in the XI$^{th.}$ region in Chile with more summer rainfall. The range of temperature is comparable too (Figure 5-7 from FRANKLIN and DYRNESS 1969). The mean minimum temperatures are somewhat lower in Oregon and Washington, the mean maximum temperatures significantly higher in Washington and Oregon. This is due to the dryer summers.

In Western-Europe we miss the high precipitation but we reach in the continental part lower temperatures as compared to most parts of the XI$^{th.}$ region (Figure 8; THRAN and BROEKHUIZEN 1965).

The high humidity we meet in the XI$^{th.}$ region indicates, that it may be important to select tree species and provenances adapted to humid conditions, since fungus diseases are more probable, if such an adaptation does not exist. This may be one of the reasons for the damages in Scots pine (*Pinus sylvestris*). It is therefore strongly recommended not to plant interior Dou-

FIGURE 3 :

SOUTHERN PART OF THE Xth AND XIth REGION OF CHILE

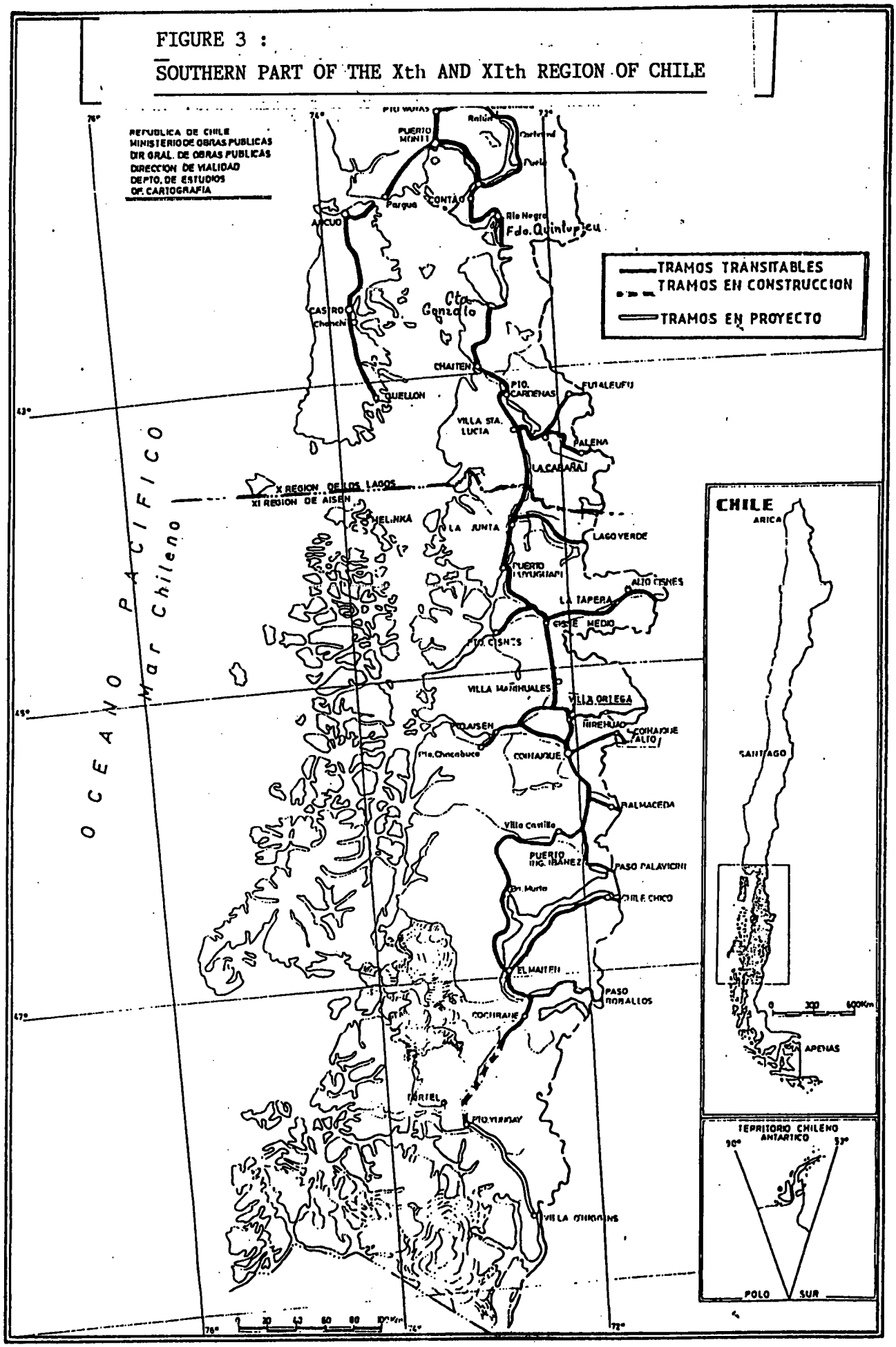
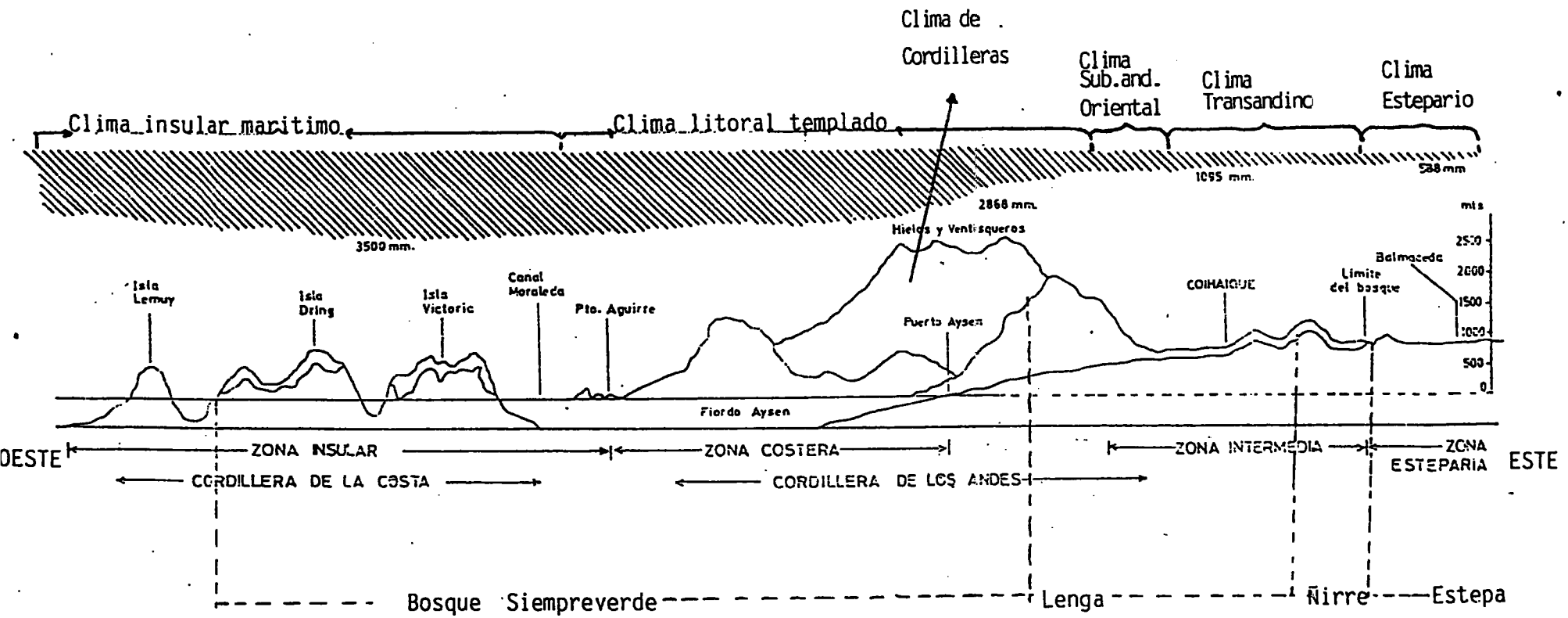


FIGURE 4 DIAGRAMA CLIMATICO TOPOGRAFICO Y PLUVIOMETRICO

(escala vertical aumentada 10 veces)



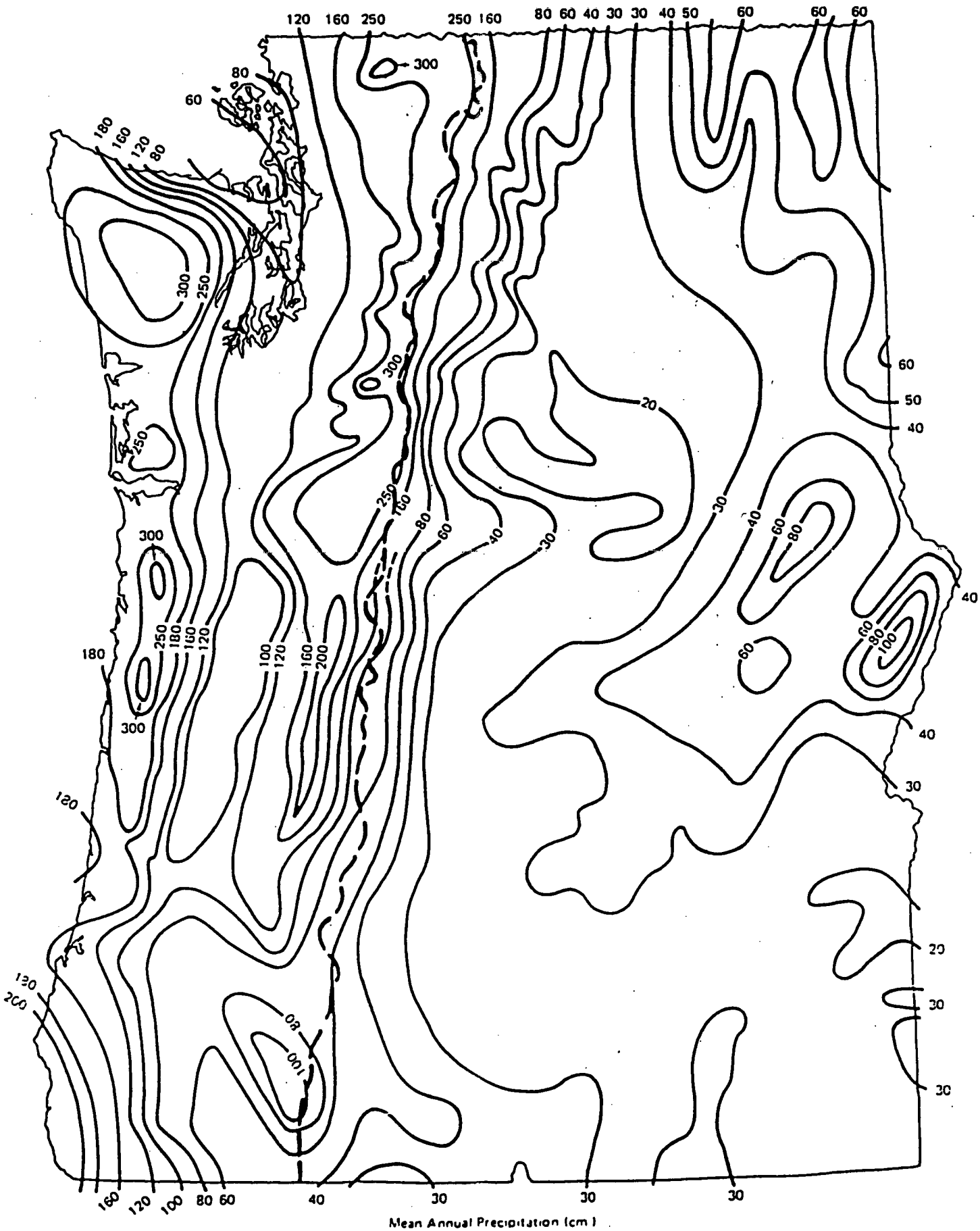


Figure 5 — Mean annual precipitation in Oregon and Washington (U.S. Weather Bureau 1960a, b).

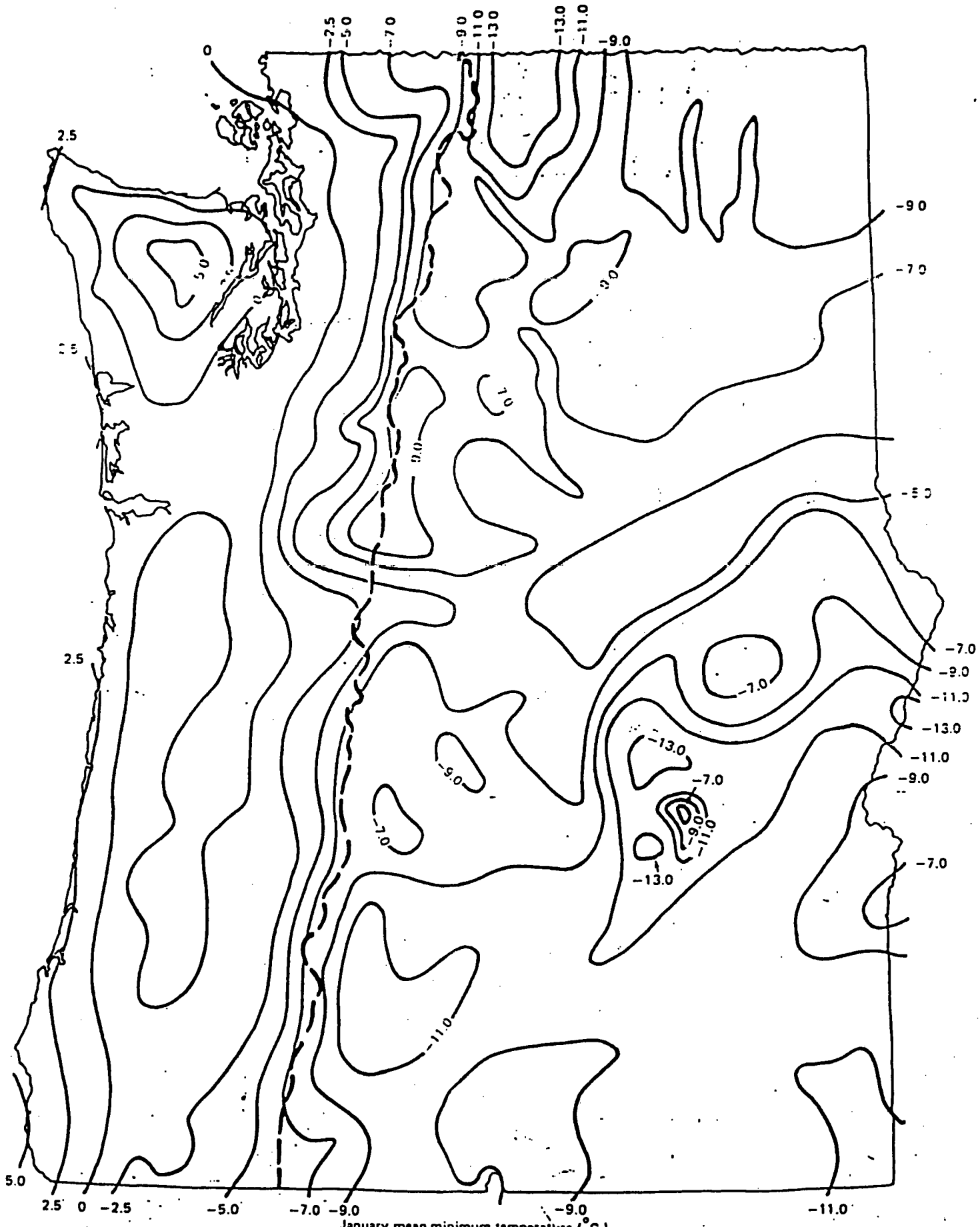


Figure 6 — January mean minimum temperatures in Oregon and Washington (U.S. Weather Bureau 1960a, b).

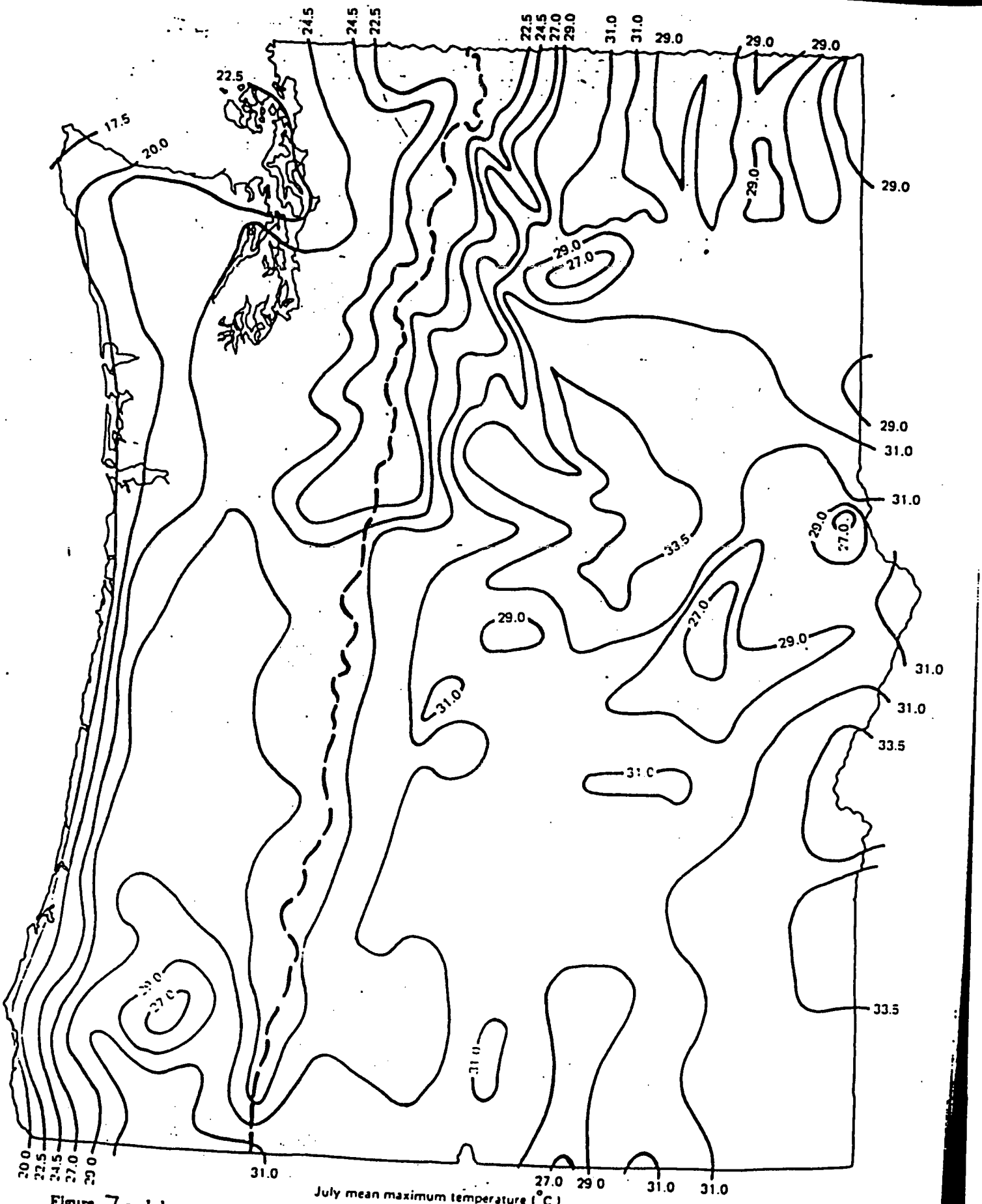
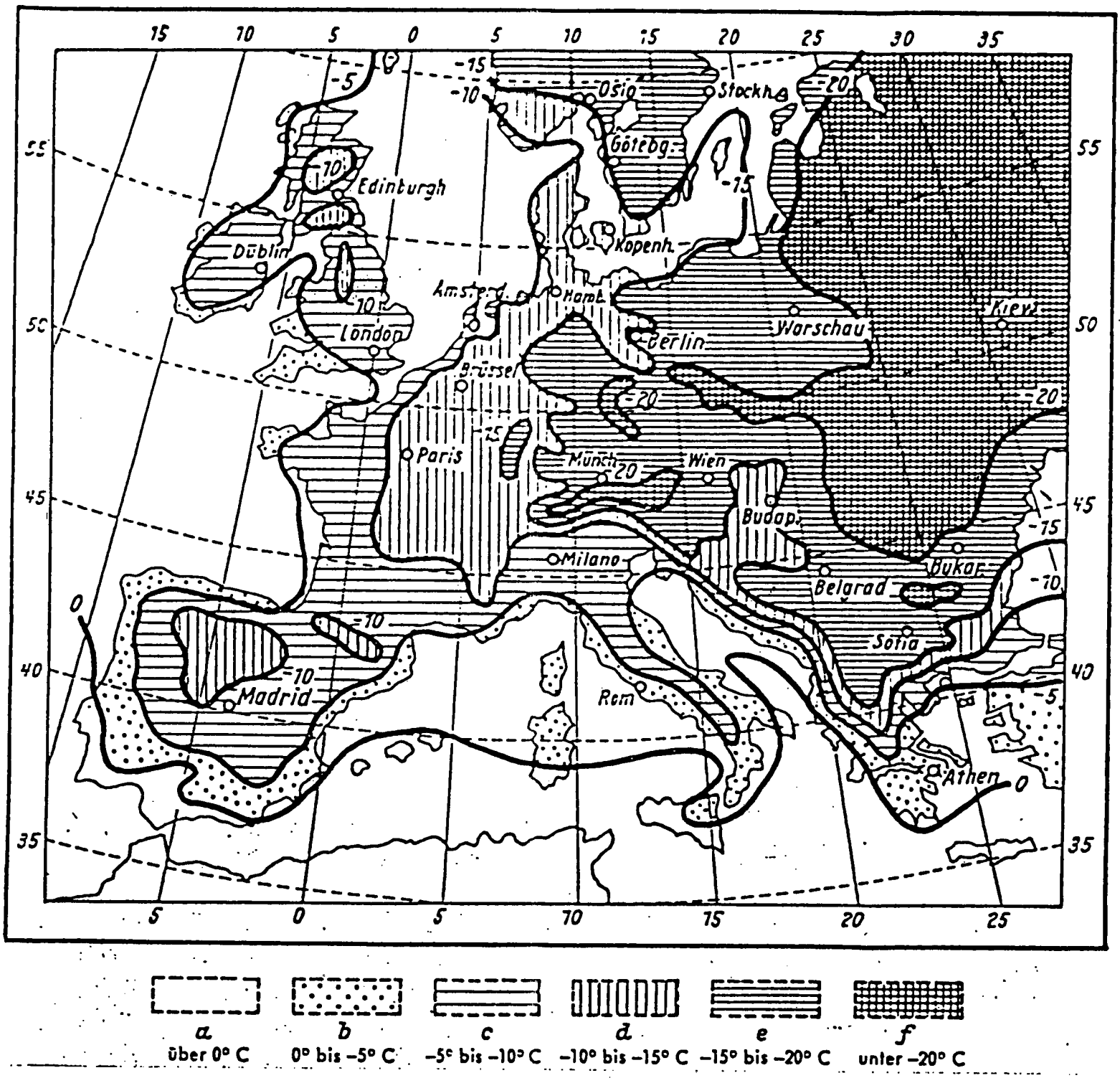


Figure 7 — July mean maximum temperatures in Oregon and Washington (U.S. Weather Bureau 1960a, b).



a über 0° C | b 0° bis -5° C | c -5° bis -10° C | d -10° bis -15° C | e -15° bis -20° C | f unter -20° C

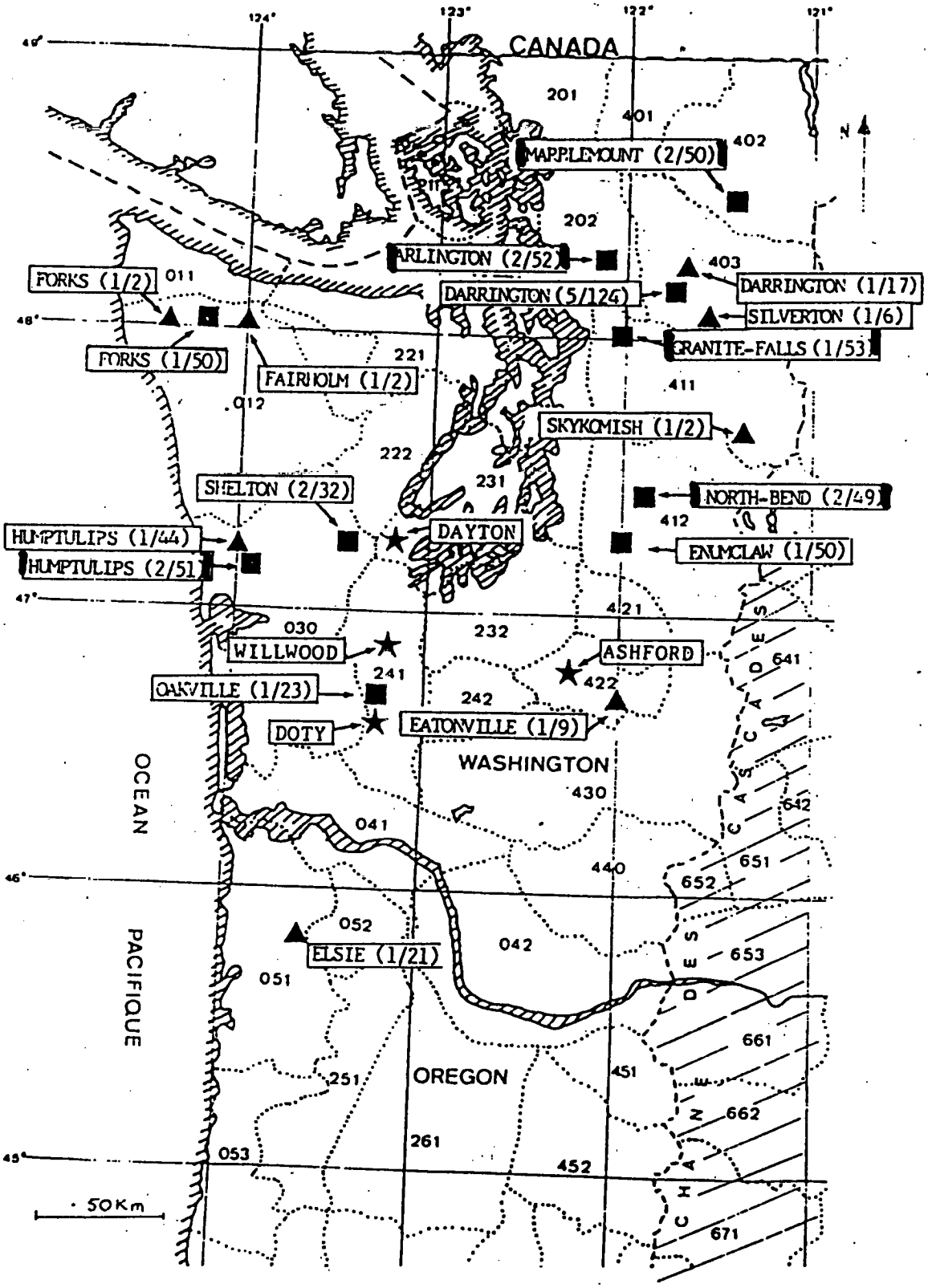
FIGURE 8:

ANNUAL MINIMUM TEMPERATURES IN EUROPE

(KÖPPEN-GEIGER;Handbuch der Klimatologie)

FIGURE 8a :

LOCATION OF THE 5 DOUGLAS FIR PROVENANCES PROPOSED FOR ADDITIONAL TESTING IN CHILE



glas fir provenances in the coastal and the intermediate zone.

The soils are considerably influenced by vulcanic deposites, very variable in depth due to exposition on rocks or in valleys, distance from vulcanos and erosion situation. Due to the high precipitation a lot of creeks, rivers, cascades interrupt the structure of the countryside. Therefore the ecological conditions in the XI$^{th.}$ region are much more heterogeneous than in the X$^{th.}$, IX$^{th.}$ and VIII$^{th.}$ region further in the north, where the climatic conditions, especially temperatures, are more favourable for tree growth. The availability of extended areas under more favourable conditions were one of the reasons that up to now only limited plantations (25.000 hectar) have been established in the XI$^{th.}$ region in spite of the fact, that compared to European conditions growth potential is good . However compared to the most favourable conditions in Chile volume production is lower however value may be higher. Douglas fir produces in the XI$^{th.}$ region 15-20 m^3 annually, in the north in Antiquina 18-25 m^3. Comparing the same species, the production may be 70-80 % at least in the XI$^{th.}$ region as compared to the main plantation areas in Chile.

The ecological conditions of the XI$^{th.}$ region are not as favourable for *Pinus radiata* and *Eucalyptus* as in the northern part of the country. The climatic conditions are comparable to parts of central and northern Europe and to the western part of northern United States (Washington) and Southwest British Columbia in Canada.

Up to now only 2.5 % of the potential lands for forestry have been planted. The species used were mainly *Pinus sylvestris, Pinus ponderosa, Pinus contorta, Pseudotsugae menziesii.* Other species have been used only in experimental plantations or just occasionally by private landowners. Some of the species show a good potential like *Larix decidua, Betula pendula* and *Acer pseudoplatanus* or just ocasionally by private landowners. Some interesting species for this climatic region have not yet been tested.

4. General recommendations

The high variability in site and climatic conditions needs on the one hand a thorough observation of the microsite for species allocation and on the other hand species and provenances with a broad adaptability which can cover a wide range of ecological differences. Since a fine grained site and climatic mapping is not available, it seems only possible at present, to select a broad adaptable material for plantation establishment and to differentiate from the coast to the interior and within the respective zone between west and east north and south exposition and between elevations.

5. Proposals resulting from the visit

The Instituto Forestal was founded in 1965 following the "Comité Técnico Forestal" founded 1961. It is a specialized technical organization for forestry matters with the aim to stimulate

activities in all areas. The institute has the headquarters in Santiago and regional divisions in Concepcion, Aldivia and Coyhaique (INFOR 1992). In agreement with the aim of the Institute the proposals will be mainly proposals for further investigations concerning species, provenances, development of seed stands for indigenous species, field experiment establishment and plant production. All the proposals only relate to region XI, even if some may have more general application.

5.1 Species to be tested additionally

Basically all species from regions of the world which have similar climatic conditions could be of interest for the XI$^{th.}$ region. Regions of similar climatic influence are to be found in the southern and in the northern hemisphere. However in the past a lot of species introduction trials have been made in different countries and continents, which showed that certain species are of special interest for plantation forestry. *Pinus radiata* and *Eucalypt* species are two outstanding examples for application in a worldwide view. The natural range of Pinus radiata is much more limited than the plantations established with this species in other countries.

The climatic conditions of the XIth. region exclude frost sensitive species from cultivation. Regions of origin for introduction, which are of interest, are especially the western part of Northamerica, Europe and East Asia. Some species of those regions proofed to be successful in the XI$^{th.}$ region:

Pseudotsuga menziesii
Pinus ponderosa
Pinus contorta
Larix decidua
Pinus sylvestris.

Especially *Pinus sylvestris* seems to run recently into difficulties with needle diseases and *Larix decidua* shows deformations due to wind exposition. *Pseudotsuga menziesii* and *Pinus ponderosa* show superior growth with more than 10 and in good sites even more than 20 m^3 annually. The provenance question has been touched for *Pinus ponderosa* in region XI near Coyhaique with best performance of north Oregon provenances.

Most of the *Pinus sylvestris* material was planted by Thomas Monfil who got the seed from Bavaria in Germany.

The only Company up to now engaged in the XI$^{th.}$ region is Forestal Mininco S.A., who established a Forest Office for the region Aisén in Coyhaique with the aim to plant 20.000 hectars of forest land. At the moment they own 15.000 hectars from which 12.000 can be planted. As a consequence of the existing knowledge they decided to plant *Douglas fir* in the coastal region, *Pinus ponderosa* in the intermediate zone and *Pinus contorta* under extreme site conditions.

40 species have been tested in the National Reserve Coyhaique since 1957 with good success of *Douglas fir, Ponderosa pine* and Pinus contorta and moderate success with *Pinus monticola*

and *Chamaecyparis lowsoniana. Sitka* spruce shows needle damages. *Pinus sylvestris* has losses as in most of the other plantations visited and *Picea abies* shows up slow growth and quite often yellow needle colour. In the National Reserve Manihuales european larch has excellent growth with about 10 m^3 annual increment. *Douglas fir* is growing well too. Eucalyptus globulus, planted 5 years ago, was partly frozen.

At the roadside, in some cities and around farms there were different other species like *Populus nigra italica var. pyramidalis, Populus trichocarpa, Betula pendula, Acer pseudoplatanus, Acer macrophyllum, Araucaria araucana* and others, which looked healthy and fast growing. A provenace experiment with *Eucalyptus nitens* 30 km distant from the coast between Manihuales and Pto. Cisnes is without frost damages at age 3 and vigorously growing. Lowest temperatures may reach there -6°C.

The following species are proposed for further testing:

a. Coastal region: *Picea sitchensis*
Abies grandis
Thuja plicata
Tsuga heterophylla
Larix leptolepis
Hybrid larch between *europea* and *leptolepis*

Populus trichocarpa
Populus tremuloides
Populus tremula and hybrids between both.

Especially *Picea sitchensis* has a high potential in the humid coastal region.

b. Intermediate Zone:
Abies grandis
Thuja plicata
Tsuga heterophylla
Larix leptolepis
Hybrid larch
Sequoiadendron
Populus trichocarpa
Populus tremula
Populus tremuloides and hybrids
Betula pendula

Betula platyphylla and hybrids between both

Alnus rubra
Alnus glutinuosa
Alnus incana
Acer pseudoplatanus
Fraxinus excelsior.

c. Interior Zone: *Pinus ponderosa*
Pinus contorta

Pseudotsuga menziesii (interior povenances)

Populus trichocarpa
Populus tremula
Populus tremuloides and hybrids
Betula pendula
Betula platyphylla and hybrids
Picea abies
Pinus sylvestris.

In addition it seems to be of interest also to test some of the indigenous species of the XI$^{th.}$ region which have a good growth potential in plantation forestry (DONOSO 1991):

Nothofagus pumilio (Lenga)
Nothofagus dombeyi (Coique)
Laurelia philippiana (Tepa)
Embotrium coccineum (Notro) and
Drimys winteri (Canelo).

For plantation establishment of shade demanding species especially damaged *Pinus sylvestris* stands could be used as nurse stands after cutting rows in east-west direction for planting of indigenous species. Enrichment planting of existing degraded stands is possible too.

For all species recommended for planting a thorough registration of place of origin should be followed and if possible 2 to 3 different provenances, representing ecological different parts of the natural range should be included.

The responsable researchers for region XI should visit the States Oregon and Washington to get acquainted with the local situation.

5.2 Provenances for testing

All material used for provenance testing should originate from sources which can later on serve for seed procurement. It seems so be worthwhile to include improved material from seed orchards, which can guarantee a continuous seed supply later on.

First inventory provenance tests should be designed for about 20 years observation time with small plots (36 plants per plot and 3 replications).

For species, where already some pre-knowledge is existing like *Douglas fir* and *Pinus ponderosa* it seems to be advisable at the same time to establish more extended plantations with wellknown provenances of good potential for certain regions which can be converted into local seed stands by intensive selection later on.

Generally speaking provenance collections as performed by the IUFRO with a good representation of the provenances can be recommended. In the specific case of Douglas fir an existing collection from Canada has been critically evaluated (ANNEX 4).

There is an extensive collection of Douglas fir provenances from British Columbia and some provenances from Washington and Oregon available for testing. The coastal Bristish Columbia provenances are over-represented and the most interesting part of the natural range, Washington West of the ridge of the Cascades, is under-represented. It is therefore recommend to include only 5 of the Coastal British Columbia provenances into all field experiments. These are Jeune Landing on North Vancouver Island, Forbidden Plateau Central Vancouver Island and San Juan River, southern Vancouver Island, and the provenances Chilliwack and Squamish from the mainland.

The othe provenances from coastal British Columbia need to be tested only in one coastal location. In addition to the proposed Washington provenances the following 5 provenances should be included in all testsites:

Marblemount	(50 trees included)
Arlington	(52 trees included)
Granite Falls	(52 trees included)
North Bend	(52 trees includes) and
Humptulips	(52 trees included).

The geographical coordinates are given in Table 3.

Table 3

Geographical location of the Douglas fir provenances

Herkunft	Reife	Höhenlage (m)	Breite	Länge
Arlington, IUFRO 1054	67	100	48°13'N	122°04'W
Granite Falls	76	150-300	48°03'N	121°58'W
Humptulips, IUFRO 1073	67	140	47°00'N	123°54'W
Marblemount, IUFRO 1050	67	130	48°35'N	121°24'W
North Bend	85	400	47°14'N	121°54'E

These provenances proof to be outstanding in tests in most european countries. They originate from a region of the natural range which seems to have the highest genetic potential and a broad adaptability.

Seed for testing can be procured by the Lower Saxony Forest Research Institute, which made together with France a controlled collection in the respective areas.

5 field tests should be established, one in the coastal zone, one in the intermediate zone and one in the continental climate zone in the northern part e.g. Puerto Aisén, Manihuales, Coyhaique, one near Lago General Carrera and one near Cochrane.

Picea sitchensis

For *Picea sitchensis* one provenance experiment with the maximum of 10 provenances is proposed in the coastal region.

A proposed list of provenances is given in Figure 9.

Abies grandis

The provenance tests for *Abies grandis* should be established in the coastal and in the intermediate zone. A list of provenances proposed for such a test is given in Figure 10 and Table 4.

Larix leptolepis

Since the genetic variation of *Larix leptolepis* is comparatively limited, seed of one or two good selected stands is proposed for testing.

Hybird larch (*Larix leptolepis x Larix decidua*)

Testing of hybrid larch of a seed orchard is proposed in the intermediate region and in the continental part.

Sequoiadendron giganteum

Testing of *Sequoiadendron* is proposed for the intermediate region. Seed of 2 to 3 stands from the central part or the central southern part of the natural range is proposed. Seed of 2 stands can be procured by the Lower Saxony Forest Research Institute - Dept. Forest Tree Breeding.

Populus trichocarpa, Populus tremula, Populus tremuloides

3 to 5 provenances of each of these species should be tested under the coastal, the intermediate and the continental conditions. Tested hybrids should be used in the intermediate and continental part.

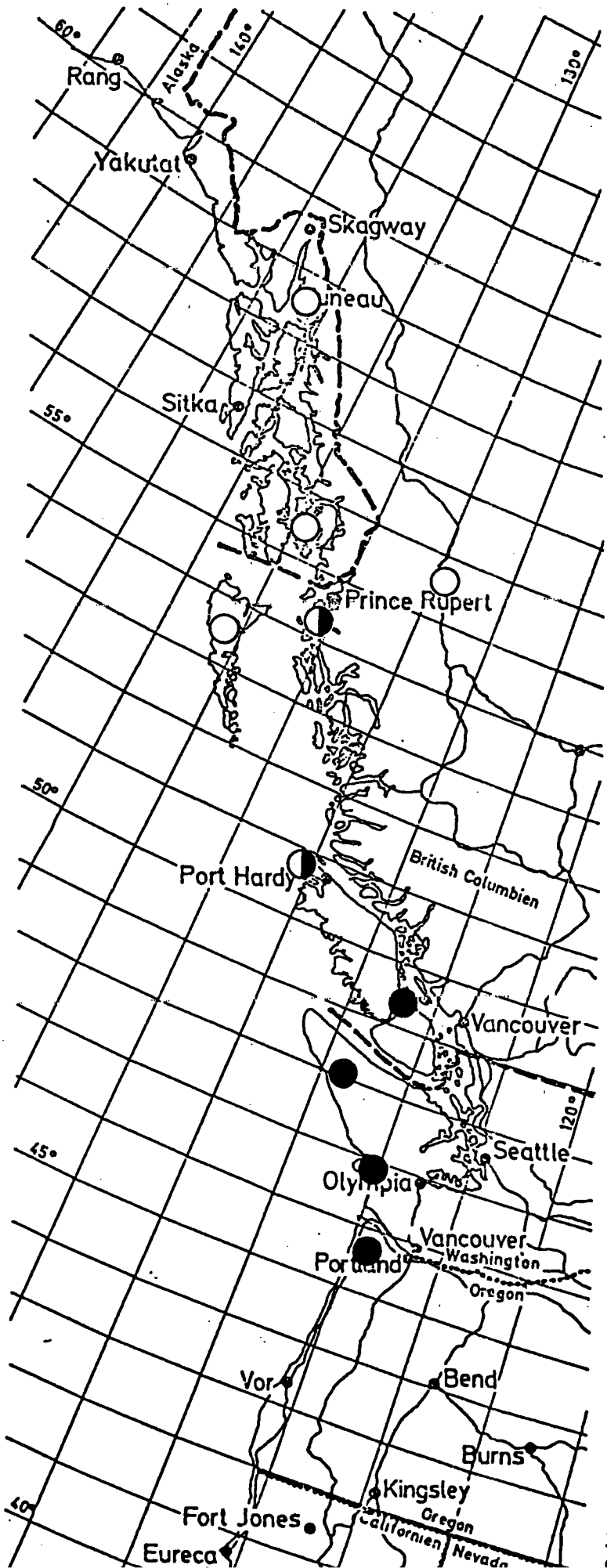
Alnus glutinosa, Alnus incana, Acer pseudoplatanus, Fraxinus excelsior

All these species are occuring in small stands or mixed populations with other hardwoods. Therefore seed orchard material from selected trees should be used for testing.

Betula hybrids with *Betula platyphylla x Betula pendula*

Those hybrids are only available from controlled crosses. Such material should be tested in

FIGURE 9 : SITKA SPRUCE PROVENANCES PROPOSED FOR TESTING IN THE XIth REGION

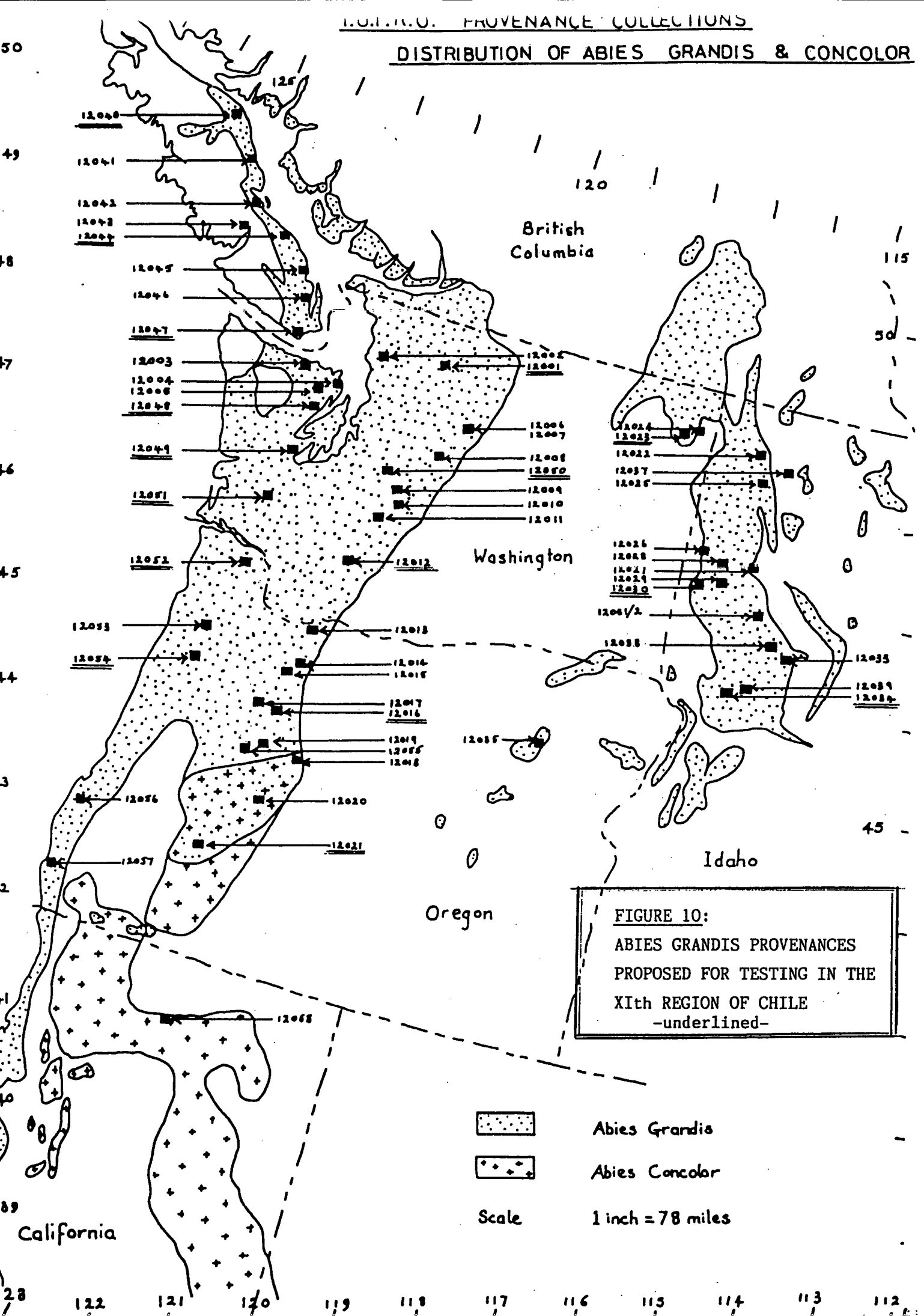


IUFRO SITKA SPRUCE PROVENANCES

Height 1977 (in cm)

- ○ 40 - 45
- ◔ 46 - 50
- ◑ 51 - 55
- ◕ 56 - 60
- ● 61 ≤ 65

Provenance	Elev. (m)	Geograph. lat.	Geograph. long.
3003 Forks, Wash.	137	4804	12418
3008 Hoquiam, Wash.	6	4705	12403
3012 Necanicum, Oreg.	46	4549	12346
3024 Duck Creek, Alaska	30	5822	13435
3030 Ward Lake, Alaska	15	5525	13142
3038 Pac. Skeena, B.C.	107	5446	12815
3044 Inverness, B.C.	15	5412	13015
3049 Link Road, QCI, B.C.	91	5330	13210
3056 Holberg, V.I., B.C.	30	5037	12807
3062 Qual. R., V.I., B.C.	1	4923	12437
Overall mean	47.8	5155	12803


I.U.F.R.O. PROVENANCE COLLECTIONS
DISTRIBUTION OF ABIES GRANDIS & CONCOLOR
British Columbia
Washington
Oregon
California
Idaho
12040
12041
12042
12043
12044
12045
12046
12047
12003
12004
12006
12048
12049
12051
12052
12053
12054
12001
12002
12007
12008
12050
12009
12010
12011
12012
12013
12014
12015
12017
12016
12019
12055
12018
12020
12021
12056
12057
12058
12022
12037
12025
12026
12028
12027
12029
12030
12031/2
12038
12035
12039
12034
12033
12024
12055
FIGURE 10:
ABIES GRANDIS PROVENANCES PROPOSED FOR TESTING IN THE XIth REGION OF CHILE
-underlined-
Abies Grandis
Abies Concolor
Scale 1 inch = 78 miles
50
49
48
47
46
45
44
43
42
41
40
39
38
125
120
115
50
45
122
121
120
119
118
117
116
115
114
113
112

ABIES GRANDIS PROV.

				N	W	(m)	1000 seeds (g)	percentage (prechill)
X	12001	Buck Creek, NE of Darrington	Washington	48°16′	121°21′	400	19.99	82
	12002	Tulalip Indian Reservation North of Everett	Washington	48°05′	122°16′	30	21.82	69
	12003	Indian Creek, 5 km W of Elwha	Washington	48°04′	123°38′	140	23.13	84
	12004	Gardiner, 15 km E of Sequim	Washington	48°04′	122°54′	30	20.53	51
	12005	Bear Mountain, Louella-Blyn	Washington	47°59′	123°02′	825	21.55	63
	12006	Eagle Creek, 12 km NE of Leavenworth	Washington	47°41′	120°34′	760	18.63	37
	12007	Eagle Creek, 13 km NE of Leavenworth	Washington	47°39′	120°30′	1200	23.57	39
	12008	Jack Creek, 18 km NE of Cle Elum	Washington	47°20′	120°50′	825	21.04	29
	12009	Cougar Flats, 15 km W of Cliffdell	Washington	46°55′	121°15′	945	23.50	27
	12010	Rattlesnake Creek, 30 km SW of Cliffdell	Washington	46°45′	121°06′	1300	—	—
	12011	Clear Lake, N fork of Tieton River	Washington	46°37′	121°20′	945	22.23	23
X	12012	Cascade Creek, 15 km NW of Trout Lake	Washington	46°07′	121°39′	945	24.62	55
	12013	Cooper Spur, 10 km S of Parkdale	Oregon	45°27′	121°39′	1040	23.71	56
	12014	Beaver Creek, 8 km W of Bear Springs Ranger Station	Oregon	45°07′	121°40′	1040	23.35	55
	12015	Sisi Butte, E of the Clackamas River	Oregon	44°52′	121°48′	975	26.15	66
X	12016	Santiam Summit, 31 km NW of Sisters	Oregon	44°26′	121°52′	1400	27.53	68
	12017	Tombstone Prairie, 14 km E of Soda	Oregon	44°24′	122°10′	1340	26.78	61
	12018	Big Spring, 18 km W of Bend	Oregon	43°59′	121°31′	1500	30.83	59
	12019	Roaring River Ridge, NE of Box Canyon G St	Oregon	43°53′	122°01′	1310	26.98	55
	12020	Crescent Creek, 16 km W of Crescent	Oregon	43°28′	121°57′	1375	33.48	39
X	12021	Whisky Creek, 7 km NE of Union Creek Resort	Oregon	42°56′	122°23′	1160	36.72	30
	12022	Kaniksu NF, Boulder Creek	Idaho	48°32′	116°13′	1320	—	—
X	12023	Corville NF, Chewelah	Washington	48°18′	117°38′	1280	26.34	52
	12024	Corville NF, USK	Washington	48°17′	117°16′	650	24.66	72
	12025	Coeur d'Alene NR, Buckskin Creek	Idaho	48°01′	116°13′	1220	19.47	64
	12026	St Joe Area, Plummer Hill	Idaho	47°17′	116°53′	850	19.14	39
	12027	St Joe NF, Avery-Kelly Creek	Idaho	47°13′	115°50′	1100	18.89	51
	12028	St Joe Area, Soldier Creek	Idaho	47°12′	116°28′	900	—	—
	12029	St Joe NF, Porcupine Creek	Idaho	46°56′	116°22′	900	23.99	70
X	12030	St Joe Area, Moscow Mtn	Idaho	46°50′	116°52′	1005	24.49	35
	12031	Clearwater Area, Bertha Hill	Idaho	46°46′	115°48′	1430	26.75	77
	12032	Clearwater Area, Alder Creek	Idaho	46°43′	115°48′	950	24.92	60
	12033	Nezperce Area, Green Flat	Idaho	46°24′	115°12′	730	—	—
X	12034	Nezperce NF, Dump Creek	Idaho	45°50′	116°01′	1190	—	—
	12035	Wallowa-Whitman NF, Baker Road	Oregon	44°47′	118°20′	1600	—	—
	12036	Frijsenborg, Hagsholm Cpt. 311, F No. 364 Pl. No. 150/74	Denmark	—	—	—	—	—
	12037	Lincoln, Stanley Creek, 28 km S W of Libby	Montana	48°17′	115°54′	800	22.98	58
	12038	Clearwater, Weitas Creek off the North Fork of the Clearwater River	Idaho	46°33′	115°26′	760	25.6	68
	12039	28 km to the SE of Grangeville, Nezperce National Forest	Idaho	45°53′	115°50′	1100	25.7	36
X	12040	Salmon River, Sayward	British Columbia	50°16′	125°50′	25	19.36	75
	12041	Oyster Bay, 23 km S of Campbell River	BC	49°56′	125°12′	5	20.66	79
	12042	Buckley Bay, 23 km S of Courtney	BC	49°31′	124°52′	45	20.77	73
	12043	Sproat Lake, 15 km W of Port Alberni	BC	49°18′	124°58′	25	20.87	82
X	12044	Kay Road, 5 km S of Parksville	BC	49°17′	124°16′	50	18.36	72
	12045	Yellow Point, 40 km SE of Nanaimo	BC	49°03′	123°46′	30	21.72	84
	12046	Mt Provost, 4 km NW of Duncan	BC	48°47′	123°46′	75	20.95	72
X	12047	Sooke, 4 km W of Sooke	BC	48°22′	123°47′	20	17.01	76
X	12048	Duckabush River, 10 km W of Brinnon	Washington	47°41′	123°01′	90	26.8	86
X	12049	Shelton, 4 km SW of Shelton	Washington	47°11′	123°07′	40	23.43	87
X	12050	West Fork White River, 35 km ESE of Enumclaw	Washington	47°07′	121°36′	655	23.68	19
X	12051	Rainbow Falls Park, 12 km NE of Pe Ell	Washington	46°38′	123°15′	125	21.11	85
X	12052	Pittsburg, 12 km N of Vernonia	Oregon	45°56′	123°10′	275	25.83	90
	12053	Armstrong Road, Bluell, 14 km NW of Dallas	Oregon	45°01′	123°23′	260	23.62	85
X	12054	Alsea Falls, Alsea, 30 km SW of Philomath	Oregon	44°20′	123°28′	275	21.35	61
	12055	Salt Creek, 10 km E of Oakridge	Oregon	43°43′	122°19′	685	27.83	74
	12056	Norway, 10 km SE of Coquille	Oregon	43°07′	124°09′	60	25.35	90
	12057	Otter Point, 8 km N of Gold Beach	Oregon	42°28′	124°24′	45	18.31	61
	12058	Snowmans Hill, 9 km SE of	California	41°15′	122°14′	1250	34.62	13

the intermediate and continental part.

5.3 Development of seed stands for indigenous species

Some of the indigenous species have a considerable growth potential in plantation forestry, as can be seen from second growth stands and from plantations existing. However the material used up to now was more or less randomly collected from trees with easy access. Therefore the distance between exotic species which usually are improved by tree breeding and the indigenous species not improved at all is increasing. To support plantation of indigenous species it is proposed to develop seed stands and to plant seed orchards for the most important indigenous hardwoods:

Nothofagus pumilio (Lenga)
Nothofagus dombeyi (Coique)
Laurelia philippiana (Tepa)
Embothryum coccineum (Notro)
Drimys winteri (Canelo).

Seed stand development

For this purpose extended second growth populations should be selected in climatically different regions of the natural range. Within these populations an intensive selection of good trees should be carried out and a silvicultural management favouring these good trees for a broad crown and seed production. At the same time methods of seed collection should be improved, e.g. with nets under the trees, shaking for seed harvest, improving climbing equipment and technology.

Seed orchards

The very best old growth trees of these species should be grafted and used for the establishment of seed orchards. Such seed orchards should be regionally structured. This activity seems especially urgent, since most of the good trees of the valuable species are extracted from the indigenous forests subsequently.

The seed material originating from these 2 types of seed producing areas can be used as well for enrichment plantings in existing degraded forests and unsuccessful exotic plantations like *Scots pine*, as for the establishment of plantation forestry with indigenous species.

Gene conservation

Furthermore it seems to be an important action to plan gene conservation measures for all the indigenous species. These activities had up to now minor consideration. The necessities for managing forest tree genetic resources have been stressed in different publications (National Research Council 1991) and Action Plans have been developed in some countries (MELCHIOR et al. 1989).

Even if the whole species is not endangered, quite often local populations are extinct or heavily reduced, due to land use for farming, selective logging and other human activities. This is especially true for some of the valuable timber species and in the intensively settled regions.

5.4 Considerations concerning field test establishment

The necessity to test a considerable number of species with a certain minimum number of provenances each makes it necessary to optimize testing procedures. For the first step of elimination trials a short term testing (up to 20 years) is absolutely sufficient. This means, that plot size and number of replications can be reduced to the necessary minimum. 36 Plants per plot and three replicats per provenance in one location is sufficient for this purpose. Number of test sites should be three at least. At the end of this testing time or even already earlier during observation it is possible to enter into a second step of testing, which includes a more limited number of species and provenances in more restricted regions with medium to long term observation time and more replications within the region (KLEINSCHMIT 1974). At this stage it is reccomended also to start to establish seed production areas or/and seed orchards of the most promising provenances of the interesting species. The establishment of seed production areas of certain provenances can be easily combined with research into volume production and silvicultural management.

For the conversion of certain provenance experiments into provenance seedling seedorchards it is necessary to change the experimental design into single tree plot designs with a sufficient number of replicates per provenance, which is estimated with at least 30 replicates. Thinning operations can exclude the worst provenances totally and the less promising trees within the better provenances and so develope a provenance hybridization seed orchard as proposed by NANSON (1972). With the time being a limiting factor such an option seems to be advisable at least for those species which have due to the present knowledge a high potential within the XI$^{th.}$ region

Pseudotsuga menziesii (N-Wash. provenances)
Pinus ponderosa (N-Oregon provenances)
Pinus contorta (Oregon and Wash. provenances).

5.5 Growing of planting stock

There is wide knowledge available in growing containerized and bare root plants, especially in the private companies. Arauco for example established recently one of the most modern container nurseries I have seen.

The species to be used in the XI$^{th.}$ region need however usually more than 1 year of growing for the planting stock. Therefore it seems to be advisable to test also bigger container types and combinations between small containers and transplanting into bigger containers or to bare root nurseries. Long experience with these species is available in the northwestern United States and in Canada.

6. Final remarks

Professional knowledge, enthusiasm and experience of all foresters I met had a high level compared to international standard. The structure of the ownership however concentrates most of the activities into plantation forestry. There are comparatively little activities going on in natural forests (1-2 % of the total area). Even these limited activities are very much depending on the interest of the local forester and the open mindedness of the respective companies or private forest land owners. There are political plans to support more activities in indigenous forests. I feel however, that the institute needs some own areas to create permanent examples regionally distributed with the management of indigenous species as well in plantation forestry as in long term silvicultural treatment of indigenous species. This was in Europe one of the most important tools for the development of a scientifically based forest management.

Therefore I propose to develop plans for the acquisition of a net of experimental areas - as available in Antiquina for exotics - also for management of indigenous species in old growth and in second growth stands.

Literature

BURSCHEL, P.; EDENS, J. and MORELLO, J. (1991): Informe Tecnico: Politica de Explotacion del Bosque nativo. FAO: FO:TCP/CHI/0052(A), 115 p.

CERDA, I.V.; OLAVARRIA, I.U. and ABALOS, M.I. (1992): El sector forestal en Chile: Logros y desaféos. Technical Information No. 129, Instituto Forestal, Santiago, Chile, 166 p.

DONOSO, C.Z. (1991): Arboles Nativos de Chile. Guia de Reconocimiento. Publ. Marisa Cúneo Ediciones. 116 p.

FRANKLIN, J.F. and DYRNESS, C.T. (1969): Vegetation of Oregon and Washington. USDA Forest Service Research Paper PNW-80, US Dept. of Agriculture PNW Forest and Range Exp. Sta. Portland, Oregon, 216 p.

GROSSE, H. (1992): Transformation of depleted natural forest in Chile. IUFRO Centennial Meeting Berlin, Div. 1.05, 26 p.

INFOR (1992): Memoria Tecnica 1991, Instituto Forestal, Santiago, Chile, 54 p.

KLEINSCHMIT, J. (1974): Geschichtliche Entwicklung, Stand und zukünftige Aufgaben forstlicher Herkunftsforschung. Allgem. Forst- und Jagdzeitung (145), p. 197-205

MELCHIOR, G.H.; BECKER, A.; BEHM, A.; DÖRFLINGER, H.; FRANKE, A.; KLEINSCHMIT, J.; MUHS, H.J.; SCHMITT, H.P.; STEPHAN, B.R.; TABEL, U.; WEISGERBER, H.; WIDMAIER, T. (1989): Konzept zur Erhaltung forstlicher Genressourcen in der Bundesrepublik Deutschland. Forst und Holz (15), p. 379-404

NANSON, A. (1972): The provenance seedling seed orchard. Silvae Genetica (21), p. 243-249

NATIONAL RESEARCH COUNCIL (1991): Managing global genetic resources - Forest trees. National Academy Press, Wash. D.C., 228 p.

THRAN, P. and BROEKHUIZEN, S. (1965): Agro-climatic atlas for Europe. Elsevier Publ. Co. Amsterdam, London, New York.

ANNEX 1

REPORT

Visit of the "Instituto Forestal" in Chile 28.2. - 14.3.1993

Dr. Jochen Kleinschmit
Lower Saxony Forest Research Institute, Dept. Forest Tree Breeding

1. Schedule

28.2. Arrival Santiago, meeting with Dr. Hans Grosse, Instituto Froestal

1.3. Meeting with Tomas Balaguer - Director Ejecutivo, Instituto Forestal
José Antonio Prado - Subdirector, Instituto Forestal
Dr. Hans Grosse - Director Regional Conncepcion
in the Head Office of the Institute in Santiago
Flight to Concepcion

2.3. Visit to Forestal Mininco (Victor Sierra) near Concepcion, Instituto Forestal, Concepcion with Dr. Hans Grosse und Mrs. Ute Kannegießer

3.3. Visit to Forestal Arauco with container nursery, Field experiments with *Eucalyptus, Pinus radiata, Antiquina* species trials with José Antonio Prado and Dr. Hans Grosse

4.3. Trip to Valdivia with José Antonio Prado
Instituto Forestal meeting with Jorge Cabrera
Roberto Ipinza
Rubens Peñaloza

5.3. Visit to indigenous Forests Llancahue,
Plantation with *Nothofagus* species "Fundo Las Palmas"
Neltume with thinning of natural second growth stands "Pidihuil" and "El Deposito" with Pablo Donoso and Ivan Quiroz

6.3. Visit to the species trial "Los Riscos" am Lago Llanquihue and trip to Puerto Montt with Pablo Donoso

7.3. Flight to Coyhaigue with Pablo Donoso, meeting with Raul Morales and Victor Sierra

8.3. Visit to field test with *Eucalyptus nitens* plantations with *Pinus ponderosa, Pinus silvestris*
National Reserve "Manihuales" with *Larix* and *Pseudotsuga*
Puerto Cisnes stand with *Nothofagus dombeyi* with Raul Morales, Pablo Donoso and Victor Sierra

9.3. Visit to Forestal Mininco Coyhaique and Instituto Forestal nursery with Raul Morales, Pablo Donoso and Victor Sierra. Trip to Cochrane with Dr. Hans Grosse and Raul Morales

10.3. Trip from Cochrane to Chile Chico. Vegetation aspects, extensive farming with Dr. Hans Grosse and Raul Morales

11.3. Trip from Chile Chico via Puerto Ingeniero Ibaiñez nach Coyhaigue and Puerto Aisén. Vegetation aspects, *Pinus silvestris* plantations, Douglas fir plantations with Dr. Hans Grosse and Raul Morales

12.3. Visit of National Reserve Coyhaique: Species trials and second growth indigenous species
Flight to Concepcion

13.- 14.3. Concepcion, Meeting with Victor Sierra, Dr. Hans Grosse. Discussion of results.

15.3. Flight to Germany via Santiago

Annex 2

NIEDERSCHLAG- UND TEMPERATURDATEN DER X UND XI REGION

t°med : Jahresmitteltempertur (°C)
t°max : Jahresmaximaltemperatur (°C)
t°min : Jahresminustemperatur (°C)
T°abs : Absolute Jahresmaximaltemperatur (°C)
t°abs : Absolute Jahresminustemperatur (°C)
HR : Relative Luftfeuchtigkeit (%)
pp : jährlicher Niederschlag (mm)
, : unvollständige Daten, daher ist es nicht möglich eine Durchschnittstemperatur zu berechnen.

ESTACION METEOROLOGICA "PUNAHUE" (39°51'S; 72°30'W; 230 m.s.n.m.) (Valdivia, X Región)

	1985	1986	1987	1988	1989
t°med	11,4	11,0	11,6	11,0	11,5
t°max	16,7	16,2	17,5	17,2	17,0
t°min	6,4	6,0	5,8	5,1	6,0
HR	85,4	86,8	83,8	84,8	85,8
pp	1935,9	2324,0	1936,2	1458,2	1735,2

ESTACION METEOROLOGICA "TEJA" (39°48'S; 73°14'W; 9 m.s.n.m.) (Valdivia, X Región)

	1985	1986	1987	1988	1989
t°med	12,6	12,1	12,8	12,2	12,4
t°max	17,5	17,0	18,0	17,5	17,6
t°min	8,1	7,7	8,0	7,5	8,0
HR	77,3	77,7	77,5	77,5	79,3
pp	1999,0	2450,9	2079,2	1438,8	1718,6

ESTACION METEOROLOGICA "PTO MONTT" (41°25'S; 73°05'W; 85 m.s.n.m.) (X Región)

	1983	1984	1988	1989	1990	1991
t°med	10,2	9,7	9,6	10,2	9,8	9,7
t°max	15,3	14,4	14,8	15,1	14,7	14,5
t°min	6,3	6,1	5,9	6,6	6,1	6,1
T°abs	31,8	30,4	27,8	28,0	25,9	26,8
t°abs	-4,2	-4,9	-7,1	-3,4	-4,2	-5,8
pp	1354,1	1566,7	1272,5	1491,5	1712,0	1745,0

ESTACION METEOROLOGICA "COYHAIQUE" (45°35'S; 72°07'W; 310 m.s.n.m.) (XI Región)

	1965	1967	1969	1970	1981	1983	1984
t°med	8,2	8,1	8,4	8,0	8,4	8,8	7,4
t°max	12,5	12,9	13,3	12,2	13,4	13,8	12,3
t°min	4,8	4,4	4,5	4,2	4,6	5,1	3,7
T°abs	30,8	29,6	30,5	29,7	26,7	33,0	30,8
t°abs	-15,0	-6,5	-9,4	-6,8	-7,4	-9,4	-10,3
pp	2396,1	1619,0	1311,4	1169,4	888,0	730,1	715,8

ESTACION METEOROLOGICA "COYHAIQUE" (45°35'S; 72°07'W; 310 m.s.n.m.) (XI Región)

	1985	1986	1987	1988	1989	1990	1991
t°med	8,6	7,7	8,7	8,2	8,2	8,3	7,4
t°max	13,7	12,6	13,8	12,8	12,9	13,0	12,8
t°min	4,7	3,9	4,5	4,5	4,6	4,5	3,8
T°abs	30,5	26,4	26,9	29,4	29,1	27,8	29,8
t°abs	-4,0	-7,4	-8,4	-10,2	-14,0	-6,5	-15,6
pp	915,3	1075,9	797,1	807,2	915,5	1156,8	1019,9

ESTACION METEOROLOGICA "BALMACEDA" (45°55'S; 71°41'W; 520 m.s.n.m.) (XI Región)

	1965	1967	1970	1980	1981	1983	1984
t°med	5,7	6,3	6,3	6,3	6,2	6,8	5,7
t°max	10,5	11,2	11,1	11,5	11,9	12,5	10,8
t°min	1,9	2,9	2,7	2,8	2,6	2,5	1,7
T°abs	29,3	28,0	27,8	24,3	26,9	32,0	28,8
t°abs	-23,8	-15,8	-13,4	-16,0	-15,3	-14,6	-21,4
pp	970,0	663,1	632,5	597,3	433,7	486,6	347,0

ESTACION METEOROLOGICA "BALMACEDA" (45°55'S; 71°41'W; 520 m.s.n.m.) (XI Región)

	1985	1986	1987	1988	1989	1990	1991
t°med	7,0	5,9	7,0	6,2	6,5	6,6	5,5
t°max	12,0	11,0	12,4	11,9	11,6	11,7	10,5
t°min	3,0	2,2	2,6	1,8	2,4	3,5	1,6
T°abs	30,5	25,0	25,8	27,6	28,0	26,9	28,0
t°abs	-9,0	-10,0	-14,0	-15,2	-21,2	-13,2	-23,6
pp	572,8	653,7	480,3	438,3	517,2	760,1	685,1

ESTACION METEOROLOGICA "CHILE CHICO" (46°23'S; 71°42'W; 328 m.s.n.m.) (XI Región)

	1965	1966	1967	1968	1969	1970	1984
t°med	8,4	10,3	9,8	10,3	10,1	9,8	8,5
t°max	15,6	16,4	16,1	16,4	16,2	15,8	14,6
t°min	3,5	5,3	5,4	5,4	5,5	4,8	3,5
T°abs	31,6	35,7	31,6	32,8	28,9	30,6	33,2
t°abs	-9,8	-8,2	-7,9	-4,9	-6,3	-5,2	-10,7
pp	370,6	422,5	279,9	136,1	293,5	192,9	164,5

ESTACION METEOROLOGICA "CHILE CHICO" (46°23'S; 71°42'W; 328 m.s.n.m.) (XI Región)

	1985	1986	1987	1988	1989	1990	1991
t°med	9,5	8,6	9,8	8,9	9,4	9,6	,
t°max	15,7	14,9	15,8	15,4	15,4	15,8	14,1
t°min	4,3	3,8	4,5	3,9	4,4	4,1	3,0
T°abs	32,3	29,4	29,2	30,3	31,4	30,2	31,2
t°abs	-5,4	-6,7	-6,1	-8,1	-10,0	-8,2	-11,2
pp	237,9	247,0	272,5	176,3	270,8	276,2	283,6

ESTACION METEOROLOGICA "PUERTO AYSEN" (45°24'S; 72°40'W; 11 m.s.n.m.) (XI Región)

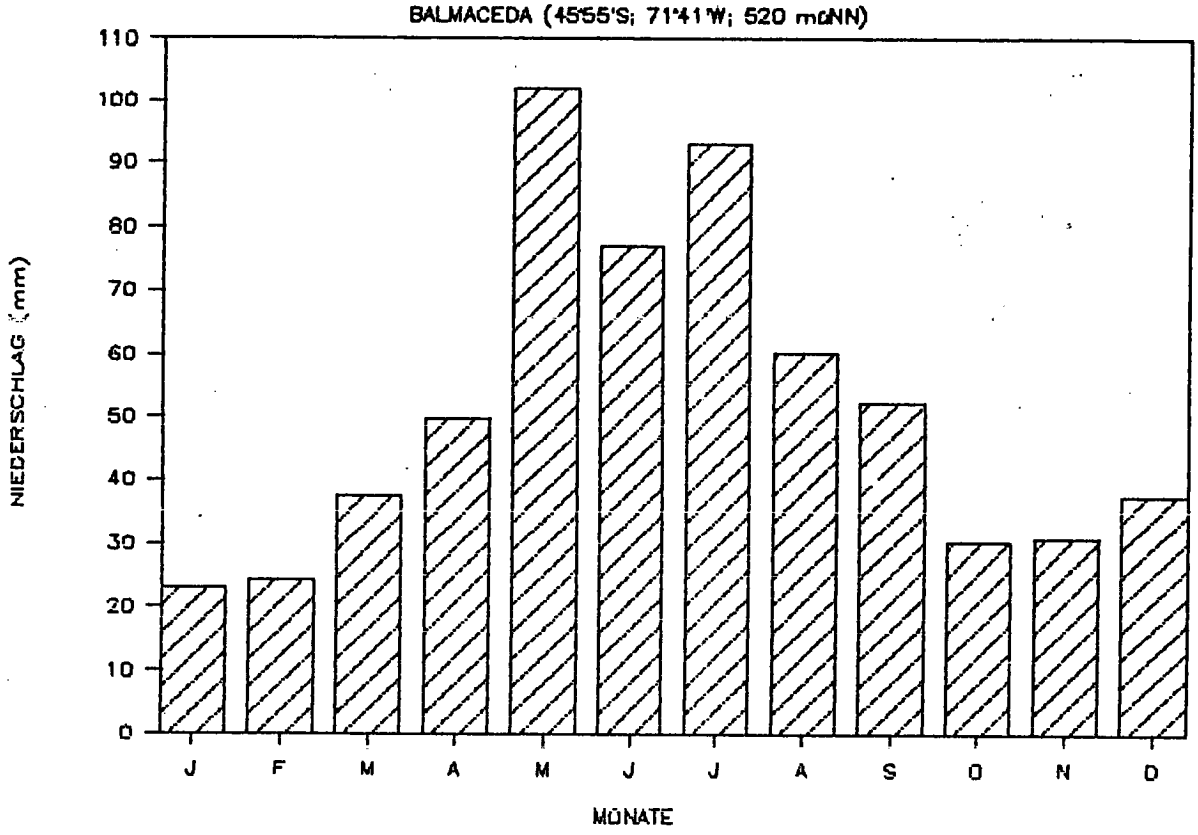
	1966	1967	1968	1969	1970	1983	1984
t°med	9,5	9,3	9,4	8,8	8,4	9,3	8,6
t°max	13,8	13,1	13,3	12,7	12,1	13,3	12,6
t°min	6,4	6,4	6,4	5,6	5,6	6,4	5,7
T°abs	30,1	25,1	30,2	26,0	28,1	30,0	30,5
t°abs	-5,3	-3,2	-4,8	-2,8	-2,7	-6,0	-8,6
pp	3037,0	3065,0	2589,5	2936,8	3158,5	2577,6	2170,0

ESTACION METEOROLOGICA "PUERTO AYSEN" (45°24'S; 72°40'W; 11 m.s.n.m.) (XI Región)

	1985	1986	1987	1988	1989	1990	1991
t°med	9,5	,	,	8,5	,	,	,
t°max	13,3	12,3	13,6	13,0	12,8	12,9	12,2
t°min	6,5	6,0	6,4	5,9	6,2	6,4	5,5
T°abs	32,1	22,8	26,5	27,5	25,4	28,6	24,8
t°abs	-4,6	-5,0	-4,0	-7,0	-4,1	-5,1	-5,6
pp	2543,4	2617,6	2081,3	2224,8	2446,6	2824,1	2619,2

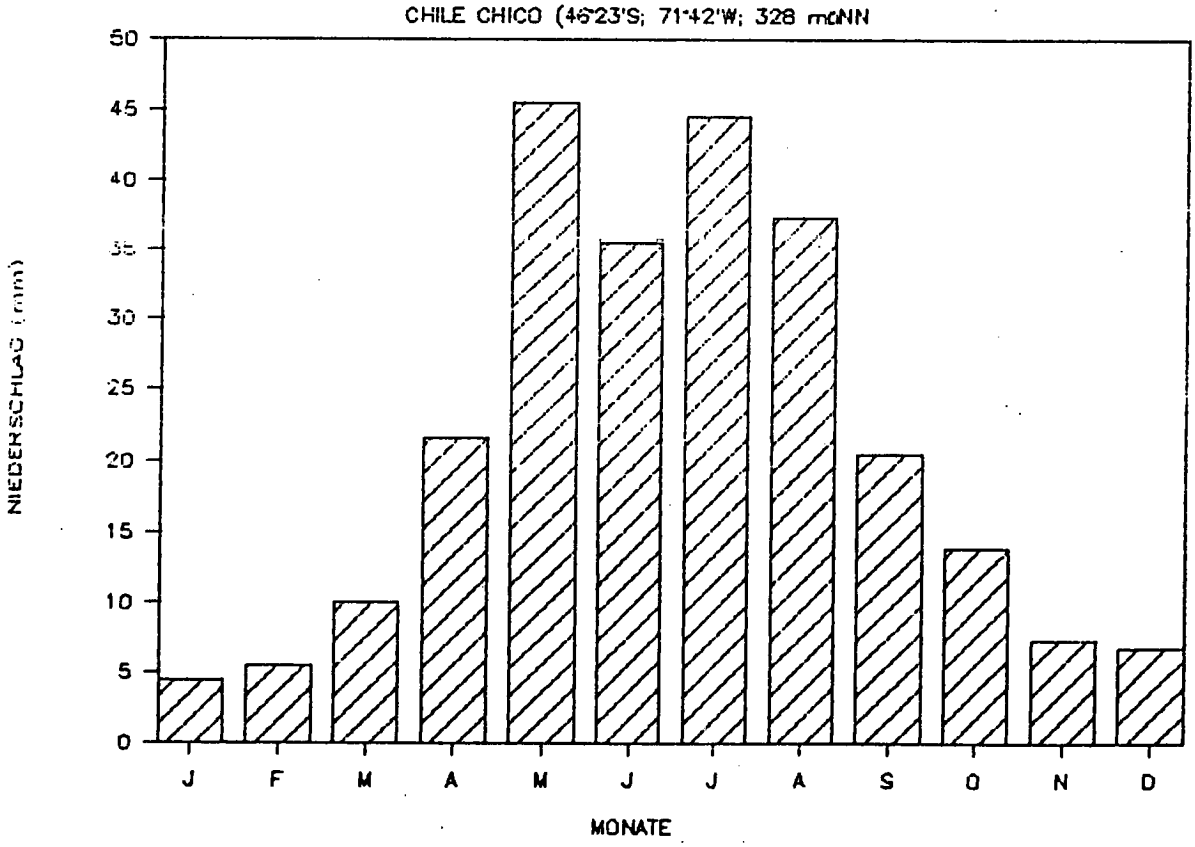
JÄHRLICHE NIEDERSCHLAGSVERTEILUNG

BALMACEDA (45°55'S; 71°41'W; 520 müNN)



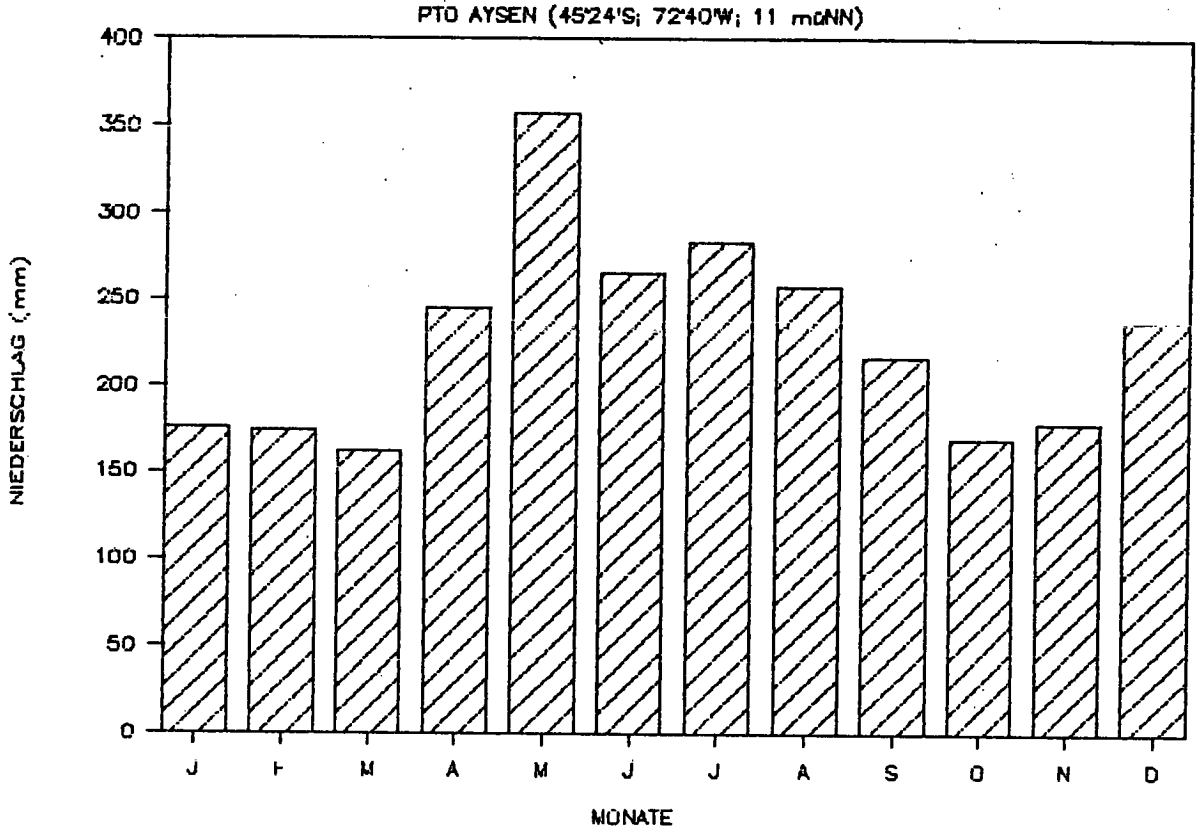
JÄHRLICHE NIEDERSCHLAGSVERTEILUNG

CHILE CHICO (46°23'S; 71°42'W; 328 müNN)



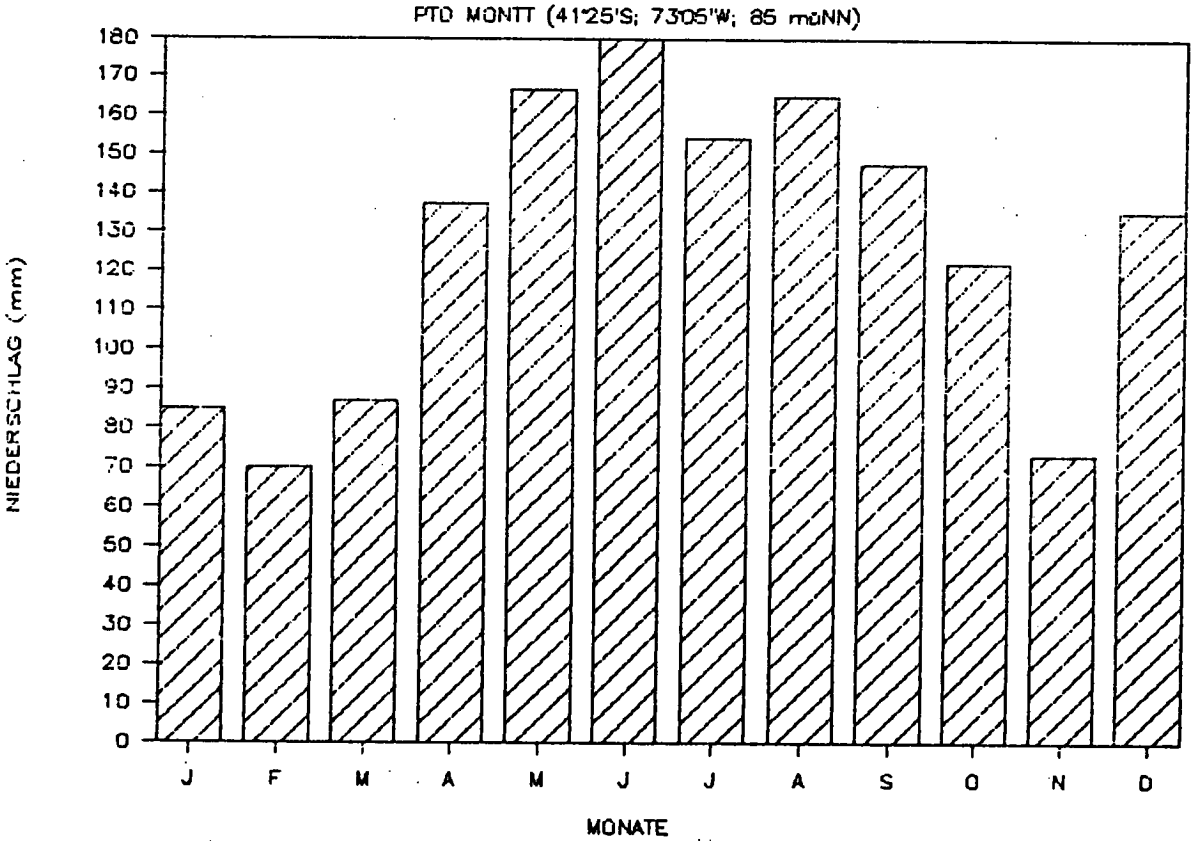
JÄHRLICHE NIEDERSCHLAGSVERTEILUNG

PTO AYSEN (45°24'S; 72°40'W; 11 müNN)



JÄHRLICHE NIEDERSCHLAGSVERTEILUNG

PTO MONTT (41°25'S; 73°05'W; 85 müNN)



Annex 3

instituto forestal
FILIAL CORFO

Nta. ref. Su ref: Fecha

SANTIAGO, Julio 1° de 1992

DE : JOSE ANTONIO PRADO D., INSTITUTO FORESTAL - CHILE
FAX - (56) (2) 381286

A : DR. RENE ALFARO C., PACIFIC FORESTRY CENTRE - CANADA
FAX - (1) (604) 3880775

REF. : INFORMACION CLIMATICA

Pag. 15 (incl. ésta)
****

Adjunto envío información climática del sur de Chile. Lamento el atraso, pero nos demoramos más de los presupuestado en su proceso.

En algunas estaciones es posible obtener información más detallada. Si es necesaria, por favor hazlo saber para enviarla.

Un afectuoso saludo de,

JOSE ANTONIO PRADO D.

HUERFANOS Nº 554 - TELEFONO (56) (2) 396189 - FAX (56) (2) 381286
SANTIAGO - CHILE

CUADRO No. 1

ESTACION :ANGOL

ALTITUD : 77.00 msnm
LATITUD : 37.00 ° 47.00 ' S
LONGITUD : 72.00 ° 42.00 ' W

MES	T°	PP	EVAP.
ENE	19.45	21.40	237.00
FEB	18.80	15.80	208.00
MAR	16.45	25.60	148.00
ABR	13.10	56.80	104.00
MAY	10.20	190.10	47.00
JUN	8.05	224.80	39.00
JUL	8.40	207.90	36.00
AGO	8.65	146.80	54.00
SEP	10.50	79.30	70.00
OCT	13.40	44.30	126.00
NOV	15.20	23.60	165.00
DIC	17.05	18.40	247.00
PROMI	13.27	87.90	123.42
TOT.	159.25	1054.80	1481.00

PARAMETROS MEDIOS.

M	a	D
28.00	4.00	7.29

I. MARTONNE :	45.33
I. WIERSMA :	288.32
I. EMBERGER :	137.34
I. ANGSTROM :	429.76
I. DANTIN-REVENGA :	1.26
I. MEYER :	144.69

CUADRO No. 2

ESTACION : CARILLANCA

ALTITUD :200.00 msnm
LATITUD : 38.00 ° 41.00 ' S
LONGITUD : 72.00 ° 25.00 ' W

MES	T°	PP	EVAP.
ENE	14.55	50.20	191.30
FEB	14.00	43.00	136.10
MAR	12.55	41.20	93.50
ABR	10.05	91.10	48.00
MAY	8.20	236.60	27.50
JUN	6.45	224.90	26.30
JUL	6.00	218.10	20.00
AGO	6.65	160.50	30.60
SEP	7.65	105.60	57.80
OCT	9.35	99.20	83.30
NOV	11.55	59.90	101.20
DIC	13.20	63.70	145.30
PROMI	10.02	116.17	76.74
TOT.	120.20	1394.00	920.90

PARAMETROS MEDIOS.

M	a	D
21.50	2.30	2.73

I. MARTONNE :	69.64
I. WIERSMA :	276.07
I. EMBERGER :	305.06
I. ANGSTROM :	707.84
I. DANTIN-REVENGA :	0.72
I. MEYER :	510.62

CUADRO No. 3

ESTACION : CHERQUENCO

ALTITUD :510.00 msnm
LATITUD : 38.00 ° 41.00 ' S
LONGITUD : 72.00 ° 1.00 ' W

MES	PARAMETROS MEDIOS. T°	PP	EVAP.
ENE	15.00	72.50	189.00
FEB	13.45	111.40	183.00
MAR	13.25	136.80	171.00
ABR	10.75	166.30	99.00
MAY	7.40	382.30	67.00
JUN	5.95	341.00	39.00
JUL	6.05	371.00	29.00
AGO	6.35	342.10	35.00
SEP	7.75	212.30	56.00
OCT	8.20	139.30	62.00
NOV	11.10	198.00	107.00
DIC	11.55	80.20	104.00
PROM	9.73	212.93	95.08
TOT.	116.80	2555.20	1141.00

M	a	D
23.00	1.20	NR

I. MARTONNE :	129.49
I. WIERSMA :	258.25
I. EMBERGER :	484.34
I. ANGSTROM :	1322.58
I. DANTIN-REVENGA :	0.38
I. MEYER :	NR

CUADRO No. 4

ESTACION : PUERTO SAAVEDRA

ALTITUD : 5.00 msnm
LATITUD : 38.00 ° 46.00 ' S
LONGITUD : 73.00 ° 24.00 ' W

MES	PARAMETROS MEDIOS. T°	PP	EVAP.
ENE	15.70	41.10	100.00
FEB	15.05	35.40	109.00
MAR	14.05	54.20	101.00
ABR	12.55	83.60	84.50
MAY	11.40	189.50	58.90
JUN	10.50	207.60	36.00
JUL	9.60	188.10	32.00
AGO	9.70	142.80	29.50
SEP	10.45	89.10	44.50
OCT	11.10	59.70	52.30
NOV	13.35	51.40	72.20
DIC	14.45	40.00	74.70
PROM	12.33	98.54	66.23
TOT.	147.90	1182.50	794.70

M	a	D
19.00	6.50	NR

I. MARTONNE :	52.97
I. WIERSMA :	286.89
I. EMBERGER :	370.98
I. ANGSTROM :	513.62
I. DANTIN-REVENGA :	1.04
I. MEYER :	NR

CUADRO No. 5

ESTACION :LONCOCHE

ALTITUD :115.00 msnm
LATITUD : 39.00 ° 33.00 ' S
LONGITUD : 72.00 ° 38.00 ' W

MES	PARAMETROS MEDIOS. T°	PP	EVAP.
ENE	18.40	52.30	185.00
FEB	16.35	85.50	162.00
MAR	15.55	67.40	131.00
ABR	12.45	167.30	79.00
MAY	10.05	301.20	40.00
JUN	7.55	309.70	21.00
JUL	7.65	274.00	18.00
AGO	8.85	328.00	37.00
SEP	10.25	189.00	64.00
OCT	12.40	135.80	88.00
NOV	15.00	123.30	119.00
DIC	15.70	105.10	121.00
PROM	12,52	176.22	88.75
TOT.	150.20	2139.60	1065.00

M	m	D
27.10	3.30	NR

I. MARTONNE :	94.98
I. WIERSMA :	275.98
I. EMBERGER :	295.58
I. ANGSTROM :	916.94
I. DANTIN-REVENGA :	0.59
I. MEYER :	NR

CUADRO No. 6

ESTACION :VALDIVIA

ALTITUD : 5.00 msnm
LATITUD : 39.00 ° 48.00 ' S
LONGITUD : 73.00 ° 14.00 ' W

MES	PARAMETROS MEDIOS. T°	PP	EVAP.
ENE	17.15	73.70	152.00
FEB	16.85	67.80	123.00
MAR	14.95	105.40	95.00
ABR	12.45	180.40	42.00
MAY	9.95	402.70	18.00
JUN	9.25	478.60	11.00
JUL	7.85	394.40	15.00
AGO	8.50	312.40	24.00
SEP	9.75	206.30	47.00
OCT	11.85	126.90	68.00
NOV	13.35	99.30	90.00
DIC	15.40	83.60	122.00
PROM	12.19	210.98	67.25
TOT.	146.30	2531.70	807.00

M	m	D
23.00	4.60	3.32

I. MARTONNE :	114.08
I. WIERSMA :	280.86
I. EMBERGER :	479.52
I. ANGSTROM :	1109.62
I. DANTIN-REVENGA :	0.48
I. MEYER :	762.56

CUADRO No. 7

ESTACION :PUNAHUE

ALTITUD :230.00 msnm
LATITUD : 39.00 ° 51.00 ' S
LONGITUD : 72.00 ° 3.00 ' W

MES	T°	PP	EVAP.
ENE	15.15	71.00	141.00
FEB	14.85	57.00	131.00
MAR	13.10	73.00	107.00
ABR	11.25	121.00	77.00
MAY	9.70	356.00	45.00
JUN	6.95	290.00	27.00
JUL	7.05	323.00	25.00
AGO	7.15	233.00	36.00
SEP	8.70	167.00	54.00
OCT	10.05	132.00	75.00
NOV	12.15	111.00	94.00
DIC	14.05	101.00	121.00
PROM	10.85	169.58	77.75
TOT.	130.15	2035.00	933.00

M	m	S
21.20	3.00	NR

I. MARTONNE :	97.62
I. WIERSMA :	267.64
I. EMBERGER :	436.47
I. ANGSTROM :	976.95
I. DANTIN-REVENGA :	0.53
I. MEYER :	NR

CUADRO No. 8

ESTACION :FUTRONO

ALTITUD :150.00 msnm
LATITUD : 40.00 ° 7.00 ' S
LONGITUD : 72.00 ° 23.00 ' W

MES	T°	PP	EVAP.
ENE	18.70	46.00	84.00
FEB	18.40	61.00	85.00
MAR	16.45	68.00	65.00
ABR	14.15	100.00	45.00
MAY	12.40	247.00	34.00
JUN	9.75	235.00	20.00
JUL	9.20	287.00	19.00
AGO	9.25	171.00	24.00
SEP	11.55	118.00	34.00
OCT	13.50	92.00	53.00
NOV	15.55	95.00	63.00
DIC	17.45	121.00	75.00
PROM	13.86	136.75	50.08
TOT.	166.35	1641.00	601.00

M	m	S
21.20	7.70	NR

I. MARTONNE :	55.77
I. WIERSMA :	270.70
I. EMBERGER :	420.61
I. ANGSTROM :	642.36
I. DANTIN-REVENGA :	0.84
I. MEYER :	NR

CUADRO No. 9

ESTACION :LA UNION

ALTITUD : 29.00 msnm
LATITUD : 40.00 ° 15.00 ' S
LONGITUD : 73.00 ° 2.00 ' W

MES	T°	PP	EVAP.
ENE	16.45	41.50	150.00
FEB	16.10	42.30	152.00
MAR	14.35	57.60	111.00
ABR	11.60	87.20	64.00
MAY	9.20	200.20	30.00
JUN	7.65	222.70	8.00
JUL	7.20	192.40	10.00
AGO	7.25	163.30	24.00
SEP	9.00	113.30	44.00
OCT	11.55	60.50	78.00
NOV	13.05	46.20	94.00
DIC	14.75	40.00	112.00
PROMI	11.51	105.60	73.08
TOT.	138.15	1267.20	877.00

M	a	D
23.70	3.40	NR

I. MARTONNE :	58.91
I. WIERSMA :	276.90
I. EMBERGER :	230.35
I. ANGSTROM :	581.52
I. DANTIN-REVENGA :	0.91
I. MEYER :	NR

CUADRO No. 10

ESTACION :REMEHUE

ALTITUD : 73.00 msnm
LATITUD : 40.00 ° 35.00 ' S
LONGITUD : 73.00 ° 9.00 ' W

MES	T°	PP	EVAP.
ENE	16.20	63.60	143.70
FEB	15.20	49.70	104.80
MAR	13.90	46.40	73.90
ABR	11.70	114.70	37.70
MAY	9.80	253.70	21.80
JUN	7.30	184.40	14.60
JUL	7.55	225.60	17.90
AGO	8.05	143.90	24.50
SEP	9.15	124.00	40.80
OCT	10.75	72.90	64.90
NOV	12.50	60.80	95.70
DIC	15.05	43.30	138.80
PROMI	11.43	115.25	64.93
TOT.	137.15	1383.00	779.10

M	a	D
23.80	3.20	3.12

I. MARTONNE :	64.54
I. WIERSMA :	272.45
I. EMBERGER :	248.65
I. ANGSTROM :	638.25
I. DANTIN-REVENGA :	0.83
I. MEYER :	443.27

CUADRO No. 11

ESTACION :PURRANQUE

ALTITUD : 58.00 msnm
LATITUD : 40.00 ° 55.00 ' S
LONGITUD : 73.00 ° 1.00 ' W

MES	T°	PP	EVAP.
ENE	15.60	89.00	129.00
FEB	15.30	75.00	118.00
MAR	13.50	52.00	107.00
ABR	11.00	77.00	70.00
MAY	9.10	276.00	34.00
JUN	6.50	196.00	25.00
JUL	7.40	258.00	23.00
AGO	7.60	152.00	28.00
SEP	8.65	124.00	48.00
OCT	10.10	96.00	61.00
NOV	11.65	92.00	73.00
DIC	14.65	55.00	116.00
PROM	10.92	128.50	69.33
TOT.	131.05	1542.00	832.00

M	a	D
21.40	3.00	NR

I. MARTONNE :	73.71
I. WIERSMA :	271.39
I. EMBERGER :	343.46
I. ANGSTROM :	736.53
I. DANTIN-REVENGA :	0.71
I. MEYER :	NR

CUADRO No. 12

ESTACION :EL TEPUAL

ALTITUD : 56.00 msnm
LATITUD : 41.00 ° 26.00 ' S
LONGITUD : 73.00 ° 7.00 ' W

MES	T°	PP	EVAP.
ENE	14.55	97.00	107.00
FEB	14.00	98.00	96.00
MAR	12.85	113.00	91.00
ABR	11.05	169.00	67.00
MAY	9.55	236.00	43.00
JUN	7.45	245.00	30.00
JUL	7.30	264.00	30.00
AGO	7.75	250.00	35.00
SEP	8.25	165.00	51.00
OCT	9.95	117.00	65.00
NOV	12.25	128.00	82.00
DIC	13.35	139.00	95.00
PROM	10.69	168.42	66.00
TOT.	128.30	2021.00	792.00

M	a	D
19.30	4.10	NR

I. MARTONNE :	97.57
I. WIERSMA :	266.70
I. EMBERGER :	566.21
I. ANGSTROM :	980.40
I. DANTIN-REVENGA :	0.53
I. MEYER :	NR

CUADRO No. 13

ESTACION :MAULLIN

ALTITUD : 47.00 msnm
LATITUD : 41.00 ° 37.00 ' S
LONGITUD : 73.00 ° 35.00 ' W

MES	T°	PP	EVAP.
ENE	14.75	79.00	107.00
FEB	14.55	93.00	110.00
MAR	13.25	132.00	90.00
ABR	10.95	155.00	68.00
MAY	9.35	229.00	40.00
JUN	7.65	277.00	28.00
JUL	7.55	237.00	29.00
AGO	8.10	202.00	32.00
SEP	9.25	167.00	41.00
OCT	10.20	106.00	52.00
NOV	11.80	106.00	71.00
DIC	13.60	108.00	85.00
PROM.	10.92	157.50	82.75
TOT.	131.00	1890.00	753.00

M	s	D
20.10	4.00	NR

I. MARTONNE :	90.36
I. WIERSMA :	268.00
I. EMBERGER :	467.10
I. ANGSTROM :	903.00
I. DANTIN-REVENGA :	0.58
I. MEYER :	NR

CUADRO No. 14

ESTACION :CASTRO

ALTITUD : 24.00 msnm
LATITUD : 42.00 ° 29.00 ' S
LONGITUD : 73.00 ° 48.00 ' W

MES	T°	PP	EVAP.
ENE	14.40	85.00	105.00
FEB	13.70	67.00	111.00
MAR	12.75	93.00	102.00
ABR	10.50	144.00	69.00
MAY	9.05	241.00	50.00
JUN	7.20	255.00	30.00
JUL	7.05	324.00	30.00
AGO	6.85	315.00	34.00
SEP	8.10	151.00	48.00
OCT	9.95	82.00	66.00
NOV	11.90	81.00	82.00
DIC	13.30	104.00	99.00
PROM.	10.40	161.83	83.83
TOT.	124.75	1942.00	825.00

M	s	D
19.40	3.20	NR

I. MARTONNE :	95.22
I. WIERSMA :	264.34
I. EMBERGER :	530.43
I. ANGSTROM :	961.13
I. DANTIN-REVENGA :	0.54
I. MEYER :	NR

CUADRO No. 15

ESTACION :PUERTO AYSEN

ALTITUD : 10.00 msnm
LATITUD : 45.00 ° 24.00 ' S
LONGITUD : 72.00 ° 42.00 ' W

MES	PARAMETROS MEDIOS. T°	PP	EVAP.
ENE	13.55	204.50	90.00
FEB	13.25	207.70	68.00
MAR	11.30	251.10	50.00
ABR	9.30	231.60	20.00
MAY	6.80	329.70	5.00
JUN	4.85	277.10	1.00
JUL	4.85	324.20	0.00
AGO	5.35	314.80	13.00
SEP	7.40	211.90	35.00
OCT	9.40	216.60	58.00
NOV	10.65	197.70	79.00
DIC	12.45	206.40	92.00
PROM	9.11	247.78	42.58
TOT.	109.35	2973.30	511.00

M	σ	D
17.20	2.10	2.02

I. MARTONNE :	155.57
I. WIERSMA :	248.38
I. EMBERGER :	1020.24
I. ANGSTROM :	1605.01
I. DANTIN-REVENGA :	0.31
I. MEYER :	1471.93

CUADRO No. 16

ESTACION :BALMACEDA

ALTITUD :520.00 msnm
LATITUD : 45.00 ° 54.00 ' S
LONGITUD : 71.00 ° 43.00 ' W

MES	PARAMETROS MEDIOS. T°	PP	EVAP.
ENE	11.25	26.00	111.00
FEB	11.50	26.00	107.00
MAR	10.00	39.00	95.00
ABR	6.45	69.00	69.00
MAY	3.75	124.00	40.00
JUN	-1.25	110.00	31.00
JUL	-0.20	107.00	29.00
AGO	1.05	68.00	35.00
SEP	3.65	58.00	54.00
OCT	5.85	39.00	71.00
NOV	8.75	25.00	90.00
DIC	10.95	32.00	112.00
PROM	5.98	60.25	70.33
TOT.	71.75	723.00	844.00

M	σ	D
18.10	-5.60	NR

I. MARTONNE :	45.25
I. WIERSMA :	216.18
I. EMBERGER :	244.05
I. ANGSTROM :	482.44
I. DANTIN-REVENGA :	0.83
I. MEYER :	NR

CUADRO No. 17

ESTACION :ESTACION
CHILE CHICO

ALTITUD :383.00 msnm
LATITUD : 46.00 ° 36.00 ' S
LONGITUD : 71.00 ° 43.00 ' W

II. MEI	PARAMETROS MEDIOS.		
MES	T°	PP	EVAP.
ENE	15.55	NR	89.00
FEB	15.35	NR	88.00
MAR	13.00	NR	59.00
ABR	9.45	NR	37.00
MAY	6.25	NR	18.00
JUN	3.05	NR	5.00
JUL	4.00	NR	8.00
AGO	5.40	NR	16.00
SEP	7.70	NR	33.00
OCT	10.30	NR	50.00
NOV	13.45	NR	66.00
DIC	16.55	NR	117.00
PROMI	10.00		40.83
TOT.	120.05	0.00	586.00

M	a	D
21.40	-1.50	NR

I. MARTONNE : NR
I. WIERSMA : 220.03
I. EMBERGER : NR
I. ANGSTROM : NR
I. DANTIN-REVENGA : NR
I. MEYER : NR

INDICES :

MARTONNE
I = P/(T + 10)

WIERSMA
N = 510 - 5.75 (L + 0.01 H)

EMBERGER
I = 100 P / (M^2 - m^2)

ANGSTROM
I = P / 1.07^T

DANTIN-REVENGA
I = 100 T / P

MEYER
I = P / D

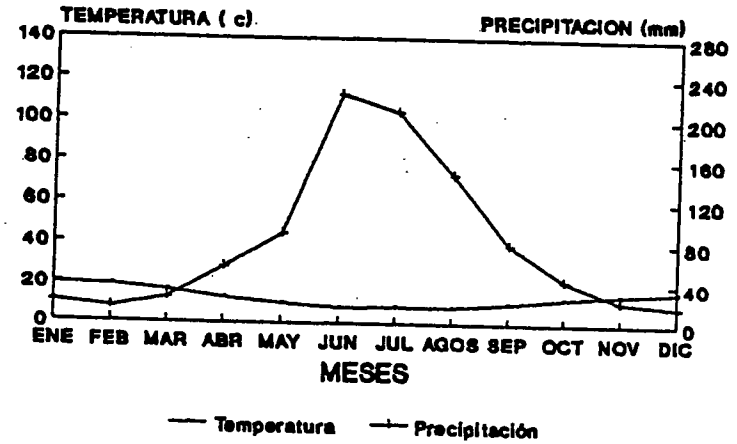
SIMBOLOGIA :

T°	Temperatura media mensual (°C).
PP	Precipitación media mensual (mm).
EVAP	Evaporación media mensual (mm).
M	Temperatura media de las máximas del mes más cálido (°C).
m	Temperatura media de las mínimas del mes más frío (°C).
D	Déficit medio de saturación (mm Hg).
PROM	Promedio.
TOT	Total.
NR	Valor no registrado.
T	Temperatura media anual (°C).
P	Precipitación media anual (mm).
N	Longitud del período vegetativo (No. de días con temperatura mayor de 6°C).
L	Latitud (grados y décimas de grado)
H	Altitud (msnm).

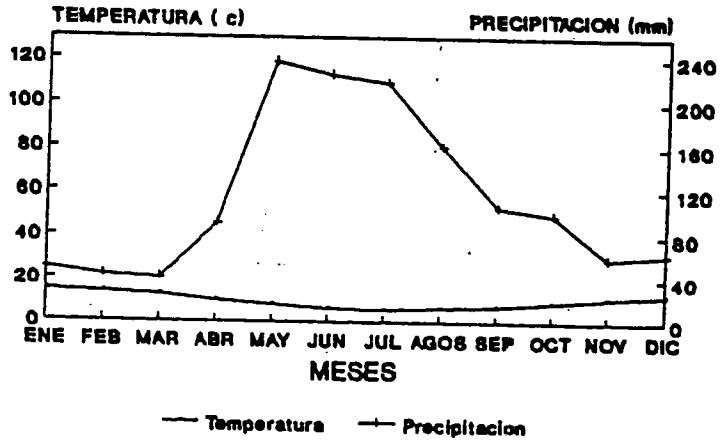
DIAGRAMAS OMBROTERMICOS

CUADRO 1

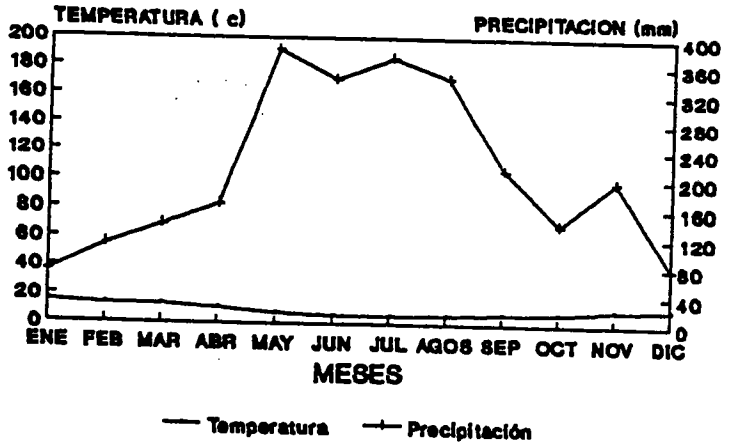
ESTACION ANGOL



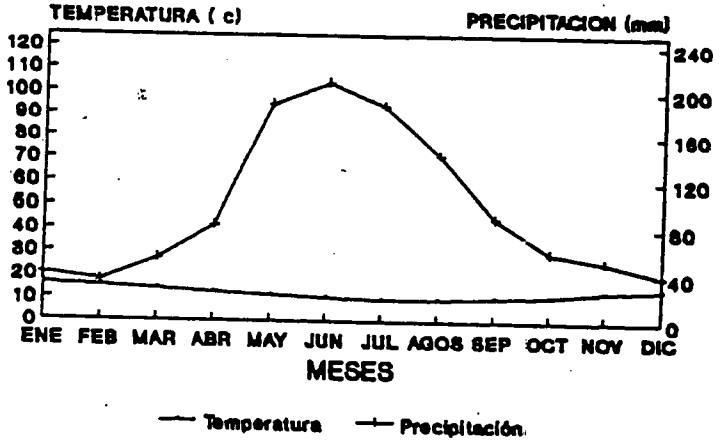
ESTACION CARILLANCA



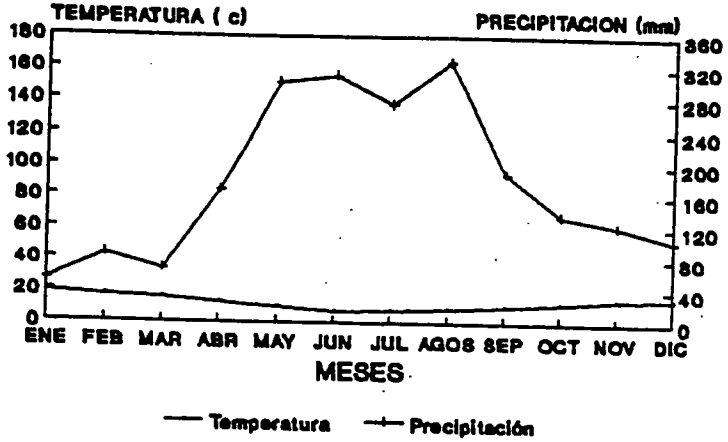
ESTACION CHERQUENCO



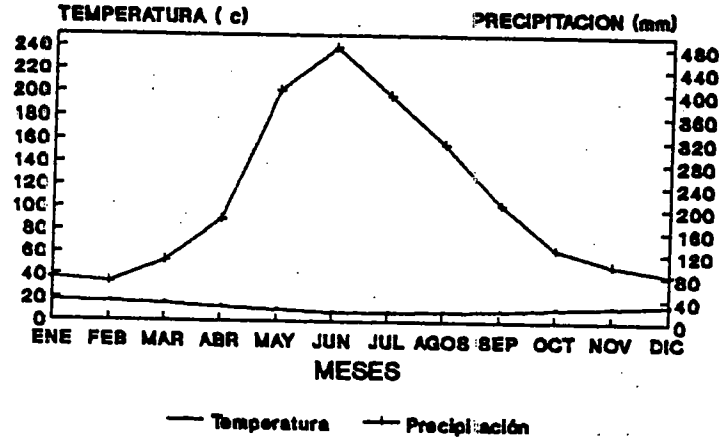
ESTACION PUERTO SAAVEDRA



ESTACION LONCOCHE



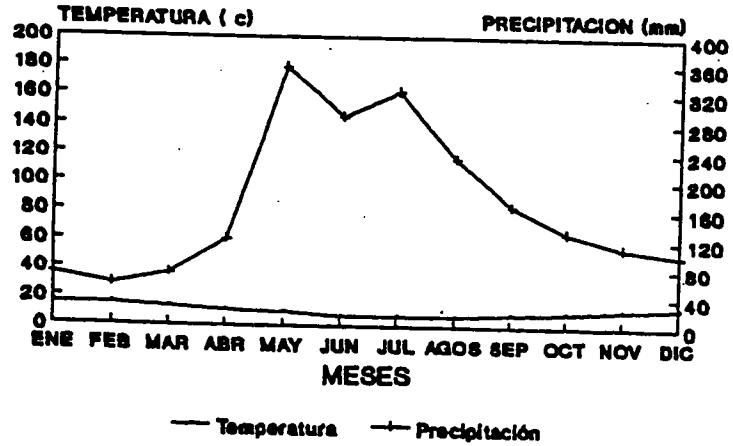
ESTACION VALDIVIA



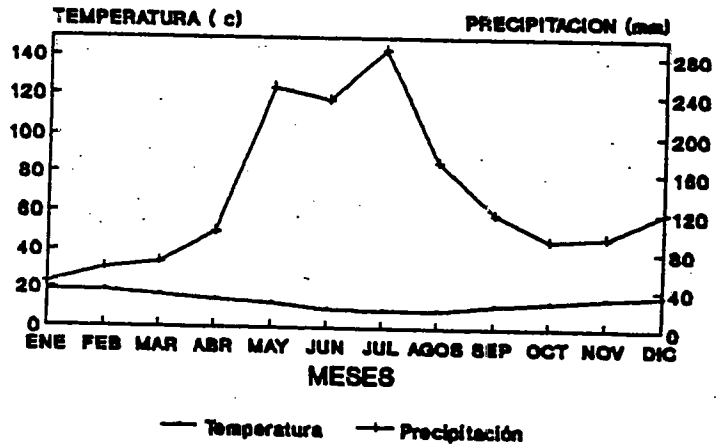
DIAGRAMAS OMBROTERMICOS

CUADRO 2

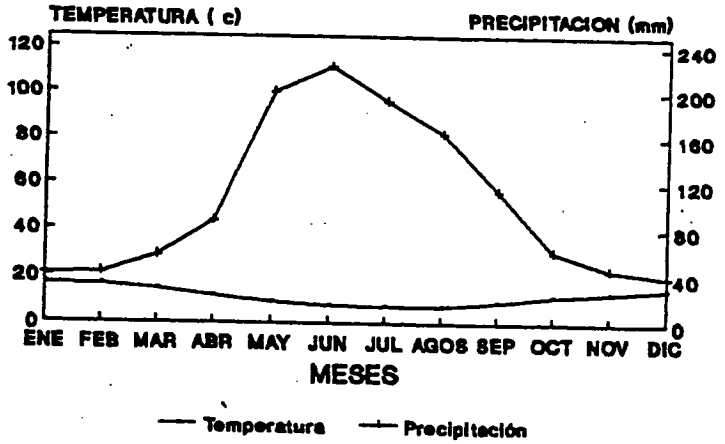
ESTACION PUNAHUE



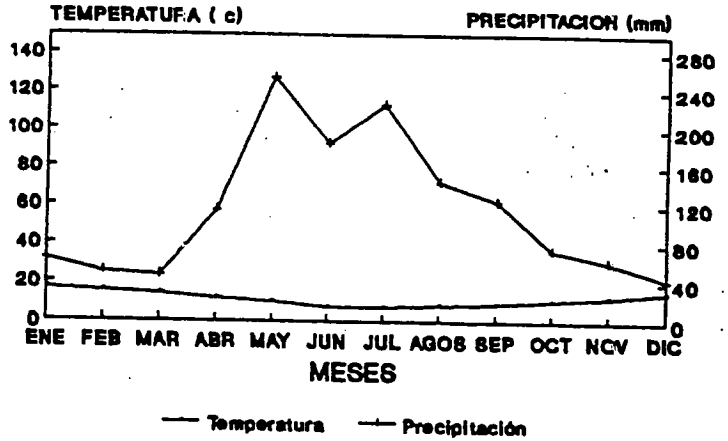
ESTACION FUTRONO



ESTACION LA UNION



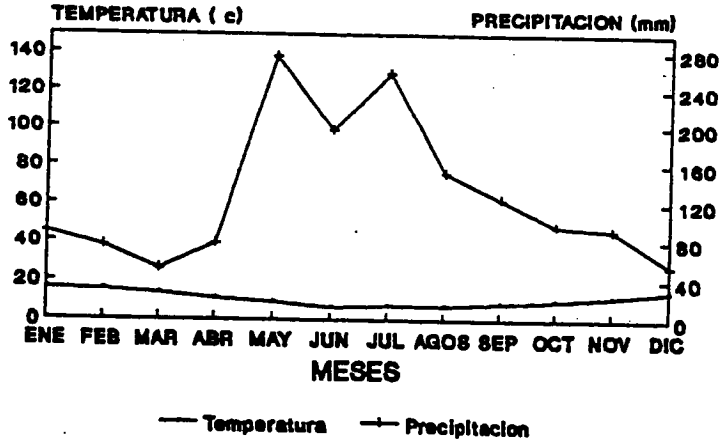
ESTACION REMEHUE



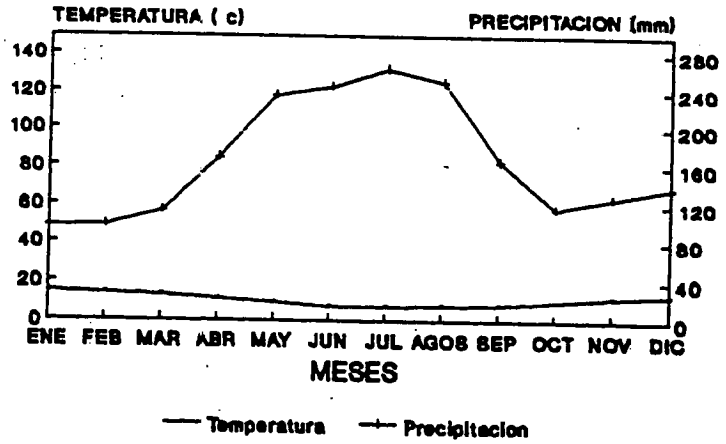
DIAGRAMAS OMBROTERMICOS

CUADRO 3

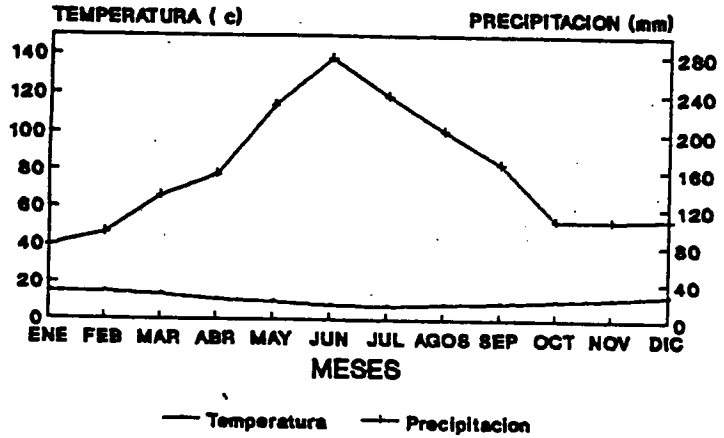
ESTACION PURRANQUE



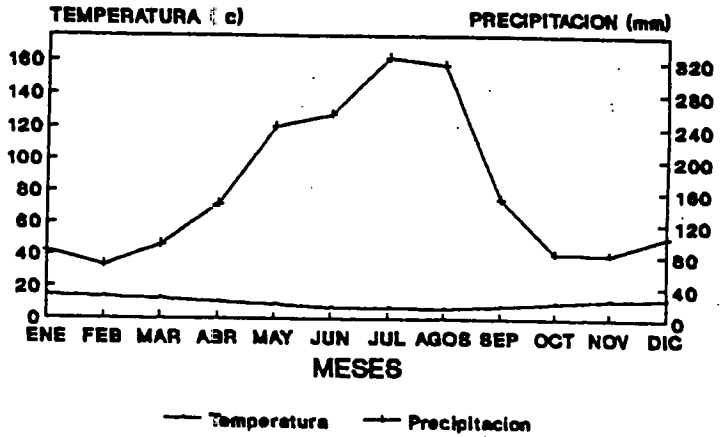
ESTACION EL TEPUAL



ESTACION MAULLIN



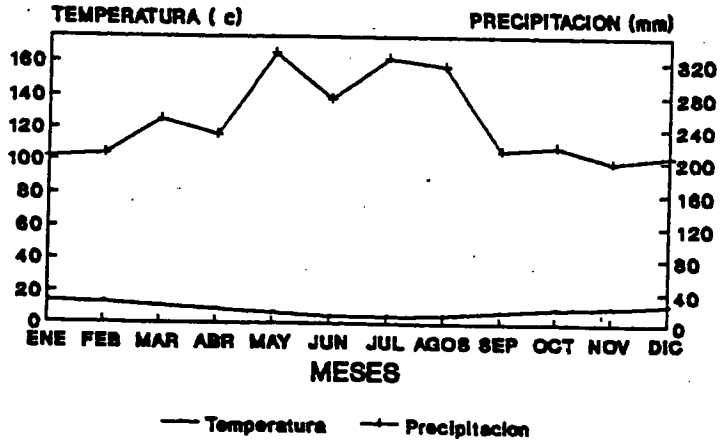
ESTACION CASTRO



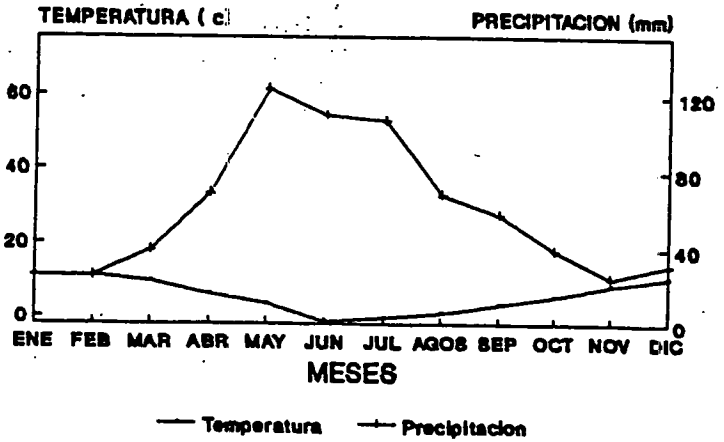
DIAGRAMAS OMBROTERMICOS

CUADRO 4

ESTACION PUERTO AYSEN



ESTACION BALMACEDA



SR:
HANS GROSSE -
ANNEX 4

File: 1145-60/C10

SELECTION OF DOUGLAS-FIR PROVENANCES FOR TESTING IN CHILE

M. D. Meagher, D. G. Edwards and R.I. Alfaro

Research Scientists, Forestry Canada

Pacific Forestry Centre, Victoria, B.C.

INTERIM REPORT

November 10, 1992

PROVENANCE SELECTION

Chilean results of Douglas-fir provenance tests (Aguirre and Wrann, Cienc.& Inves. For. 6, June 1989) showed that some coastal Pacific Northwest sources performed well at all sites, whereas Salmon Arm did well at Trafun, a high-elevation site. Alberni, the other B.C. source represented, did not rank high at any site.

Comparison of the mean annual temperature profile and total precipitation for the better provenances and test sites did not reveal close correspondence. However, on the advice of Dr. C. C. Ying, B.C. Ministry of Forests (BCFS), attempts were made to match the climates of the proposed test areas to those of the better provenances in the BCFS program of provenance tests. Where a reasonable match was found between temperature profile, including both winter and summer levels, and growing-season precipitation for a B.C. provenance and a Chilean test area, we used the nearest B.C. provenance test site as the "standard" site for the proposed Chilean test location. Then the better-performing provenances, based on both height and survival at that site, were listed.

Provenance tests appraised were established by the BCFS, Oregon State University (OSU) and the University of British Columbia (UBC). Test ages ranged from 10 to 25 years; the number of test sites per test series ranged from one (BCFS Interior and UBC) to 16 (OSU). Where our seedbank contained too few U.S. provenances to satisfy the request of Instituto Forestal (Dr. Hans Grosse), we substituted B.C. sources that had performed well at the "representative" test site.

RESULTS

1) Provenances Selected

Samples were extracted from 34 tested provenances in BCFS seed stores (Table 1). The Salmon Arm source is represented by seedlot 30460 (Mara Lake, Lat. 50° 48' N, Long. 119° 00' W, elevation 488 m) collected 1990, germination 99%. Further substitutions for Barriere, Clearwater and Revelstoke are being obtained and will be forwarded under separate cover.

All seeds are in plastic bags marked with source name and tree number in source (eg. "Caycuse 1"). All parents in a source are placed in one bag per provenance (eg. Caycuse, BC) on which the number of parents per provenance is marked. The accompanying list (Table 2) shows the minimal weight of seeds per parent in each provenance. Where possible, one gram of seeds was added to each bag to permit tests of germinative capacity prior to production sowing.

Parent-identified seedlots were supplied so that the option of establishing parental plots could be considered. Family-plot tests here have yielded greater genetic gain where further selections could be made from the best seedlings of the better parents, rather than only from a provenance plot. Normally, one family-plot plantation is established in a provenance test series, usually on fertile ground that can be protected well from fire, game, vandalism, etc. Not all families are planted in each replication; families usually are planted in small row plots (eg. 4 trees per plot). If this option is not followed, sowing seeds by parent still allows the researcher to compose the test of equal numbers of seedlings per parent, rather than incorporating bias into the test due to differences in germination, growth and nursery survival among seed parents in a provenance.

Also included is our proposed allocation of provenances to test sites (Table 2). It follows as closely as possible the allocation planned by Dr. Grosse in his message of 92-8-24 (CH133/92). It shows that we have selected 9 "standard" provenances from the B.C-Washington-Oregon coastal zone to appear in all sites. They are BC sources Chilliwack, Powell River and Squamish; Washington sources Alder, Darrington and Shelton; and Oregon sources Brookings, Coquille and Waldport. All inland provenances for the Coihaique, "Intermediate" and Punahue sites are from BC, since we had no access to tested provenances from inland U.S. areas.

2. Phytosanitary Inspection

A 10-percent sample from all provenances was X-rayed to screen for Megastigmus larvae. Where any was found, all seed from

that provenance were X-rayed so that infested seeds could be picked out from the X-ray photo. Further X-raying continued until no more infested seeds remained. The following provenances were found infested and cleaned from the X-ray photos: East Thurlow and Ymir, B.C.; Grande Ronde and Olalla, Oregon.

Canada Phytosanitary Certificate No. 386274 was issued 92-11-10 for this collection of seeds by Mr. Shane Sela, Agriculture Canada, in Victoria, B.C.

3. Co-operation by B. C. Forest Service

The following personnel of the B. C. Ministry of Forests, Forest Service, were fully supportive and co-operative in supplying provenance-test results and in releasing seeds for this project:

Forest Sciences Research Branch - Ms. Lesley McKnight, Messrs. Henry Benskin, Barry Jaquish and Dale Draper;
Silviculture Branch - Ms. Lesley McCauley, Victoria, and staff at the Surrey Seed Centre;
District Silviculturists in Clearwater, Kamloops and Revelstoke.

Table 1. Douglas-fir Provenance Source Data

British Columbia

Provenance Name	Prov. No. Local	Prov. No. IUFRO	Lat. ° ' (North)	Long. ° ' (West)	Elev'n m	Field Test Agency[1]	Field Test Yrs[2]
B.C. COASTAL							
Alexandra Bridge	1101		49 42	121 25	168	FS	20
						FS(I)	10
Caycuse	1041		48 55	124 26	213	FS	20
Chehalis River			49 19	121 55	30	FS	20
Chilliwack (low elevation)	1039		49 04	121 48	168	FS	20
D'Arcy	1021		50 33	122 30	268	FS(I)	10
Duncan	1042		48 45	123 45	61	FS	20
East Thurlow Island	1033		50 28	125 24	9	FS	20
Forbidden Plateau			49 40	125 09	609	FS	20
Haney			49 10	122 34	200	OSU	25
			49 18	122 33	366	FS	20
Jeune Landing	1023		50 27	127 27	168	FS	20
Kelsey Bay			50 18	125 53	30	FS	20
Nimpkish	1025		50 19	126 53	91	FS	20
Powell River			49 55	124 39	30	FS	20
San Juan River	1043		48 35	124 05	213	FS	20
Sechelt	1034		49 31	123 53	183	FS	20
Squamish	1030		49 47	123 09	15	FS	20
Stella Lake	1026		50 17	125 28	152	FS	20
Tahsis Inlet	1029		49 47	126 38	15	FS	20
Tinhat Mountain			49 59	124 23	914	FS	20

Douglas-fir Provenance Source Data

British Columbia

Provenance Name	Prov. No. Local	Prov. No. IUFRO	Lat. ° ' (North)	Long. ° ' (West)	Elev'n m	Field Test Agency[1]	Field Test Yrs[2]
B.C. INTERIOR							
Arrow Lake		1104	50 12	117 46	490	FS(I)	10
Barriere	159		51 00	120 10	430	"	10
Clearwater	172	1007	51 39	120 00	460	"	10
Otter Crk.		1151	51 40	119 22	334	"	10
Revelstoke (to come later)							
Salmon Arm (bulk seedlot)			50 44	119 13	470	"	10
White Lake		1177	50 53	119 14	870	"	10
Ymir		1178	49 17	117 12	640	"	10

Douglas-fir Provenance Source Data

Provenance Name	Prov. No. Local	Prov. No. IUFRO	Lat. ° ' (North)	Long. ° ' (West)	Elev'n m	Washington-Oregon Field Test Agency[1]	Yrs[2]
WASHINGTON							
Alder	1081		46 48	122 17	420	FS	20
Castle Rock	1088		46 19	122 52	150	FS	20
Darrington	1053		48 16	121 38	150	FS	20
Hoh	1064		47 48	123 58	240	FS	20
Shelton	1077		47 15	123 12	100	FS	20
Sequim	1060		48 02	123 02	90	FS	20
OREGON							
Brookings	1104		42 03	124 18	244	FS	20
Coquille	1103		43 10	124 11	91	FS	20
Grande Ronde	1100		45 06	123 36	305	UBC	15
Olalla			43 06	123 36	305	FS	20
Waldport	1101		44 24	123 56	61	FS	20

[1] FS = British Columbia Forest Service; coastal zone. EP 0599.
FS(I) = British Columbia Forest Service; interior zone; reference Jaquish, Joint Meeting of Western Forest Genetics Association and IUFRO Working Parties S2.02-05, 06, 12 and 14, Olympia, Wash., USA, 1990: 2.144.
OSU = Oregon State University reciprocal test; reference White and Ching, Silvae Genetica 34: 84-90, 1985.
UBC = University of British Columbia; reference Sziklai, Joint Meeting of Western Forest Genetics Association and IUFRO Working Parties S2.02-05, 06, 12 and 14, Olympia, Wash., USA, 1990: 2.313

[2] Years of testing in the forest

END

Table 2. DOUGLAS-FIR PROVENANCE SEED SOURCES

FOR CHILE

Province/State	Provenance	Proposed Test Site Allocation: Valdivia	Puerto Aysen	Intermediate	Punahue	Coihaique	No. of parent trees	grams/ tree
BRITISH COLUMBIA, coastal								
	Alexandra Bridge			X	X	X	10	4
	Caycuse	X	X				10	3
	Chehalis River	X	X			X	10	3
	Chilliwack	X	X	X	X	X	10	4
	D'Arcy			X	X	X	10	3
	Duncan	X	X	X	X		8	4
	East Thurlow Island	X	X				10	3
	Forbidden Plateau					X	8	3
	Haney					X	9	3
	Jeune Landing	X	X		X		10	3
	Kelsey Bay	X	X			X	9	3
	Nahatlatch			X	X	X	10	3
	Nimpkish	X	X	X		X	2	3
	Powell River	X	X	X	X	X	5	4
	San Juan River	X	X				10	4
	Sechelt	X	X				10	3
	Squamish	X	X	X	X	X	10	3
	Stella Lake	X	X				10	4
	Tahsis Inlet	X	X				10	3
	Tinhat Mountain	X	X			X	7	4

Approximativement 100 semilles/gr.

FROM INSTITUTO FORESTAL 05.03.93 10:25 P. 7
RECEIVED FROM 05.03.93 10:31 P. 7

Province/State	Provenance	Proposed Test Site Allocations: Valdivia	Puerto Aysen	Intermediate	Punahue	Coihaique	No. of parent trees	grams/ tree
WASHINGTON								
	Alder	X	X	X	X	X	10	4
	Castle Rock	X	X	X	X		9	4
	Darrington	X	X	X	X	X	10	4
	Hoh	X	X	X	X		9	4
	Shelton	X	X	X	X	X	10	4
	Sequim					X	10	3
OREGON								
	Brookings	X	X	X	X	X	10	4
	Coquille	X	X	X	X	X	10	4
	Grande Ronde	X	X	X	X		10	4
	Olalla	X	X	X	X		10	4
	Waldport	X	X	X	X	X	10	4

END
05.03.93 10:32 P. 2
05.03.93 10:26 P. 2
FROM INSTITUTO FORESTAL
RECEIVED FROM

Province/State	Provenance	Proposed Test Site Allocations: Valdivia	Puerto Aysen	Intermediate	Punahue	Coihaique	No. of parent trees	grams/ tree
BRITISH COLUMBIA, interior								
	Arrow Lake							
	Otter Creek	X		X	X	X	10	3
	Salmon Arm (bulk seedlot)	X		X	X	X	9	3
	White Lake	X		X	X	X		3
	Ymir	X		X	X	X	8	3
		X		X	X	X	10	4

FROM INSTITUTO FORESTAL 05.03.93 10:26 P. 8

END