

**TREE-RING CHRONOLOGIES  
OF THE  
SOUTHERN HEMISPHERE**

**1. ARGENTINA**

V. C. LaMarche, Jr., R. L. Holmes,  
P. W. Dunwiddie and L. G. Drew

**CHRONOLOGY SERIES V**  
LABORATORY OF TREE-RING RESEARCH  
UNIVERSITY OF ARIZONA  
TUCSON, ARIZONA 85721

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Volumes in Laboratory of Tree-Ring Research Chronology Series V:

1. Argentina
2. Chile
3. New Zealand
4. Australia
5. South Africa

## PREFACE

This report is one of a series documenting dendrochronological studies in the Southern Hemisphere carried out by the Laboratory of Tree-Ring Research from 1973 to 1979 with the support of the U. S. National Science Foundation. Initial studies in Chile and Argentina in 1973-1974 were part of the International Biological Program, Origin and Structure of Ecosystems project, administered by the San Diego State University Foundation. Subsequent work there, and in Australia, New Zealand and South Africa was supported directly by grant GV 41450, from the Office of Polar Programs, and by grants ATM 75-15495, ATM 76-24267, and ATM-7823008, all from the Climate Dynamics Program, Division of Atmospheric Sciences.

The purpose of these investigations was to develop long, accurately dated, and climatically sensitive tree-ring records and to use them as a basis for inference about past climatic fluctuations. We have collected several thousand tree-ring samples from some 200 sites in temperate latitudes in South America, New Zealand, Australia and southern Africa. We have developed 71 ring-width index chronologies, each incorporating the growth records of a large number of trees. The longest approaches 1000 years in length. In these reports, we present these time series of average annual ring-width indices together with information on the sample size, the location and nature of the sample site, and statistics describing both the site chronology and its component series. Information is also presented on other sample collections where no index chronology was developed.

In order to make our Southern Hemisphere tree-ring records as widely available and as useful as possible, the data have also been entered in the International Tree-Ring Data Bank. Two types of data are available in machine-readable (punched-card or magnetic tape) form. First, we have entered the basic data in the form of all the measured radial ring-width series that were used in development of each site chronology. Second, we have also entered the derived site chronologies themselves, as published in this volume. For information on current holdings, cost, and formats, contact:

Manager  
International Tree-Ring Data Bank  
Laboratory of Tree-Ring Research  
University of Arizona  
Tucson, Arizona 85721

Although we had overall responsibility for site selection, sample collection, preparation, dating, ring-width measurement, and for data processing, evaluation and analysis, we received a great deal of help in this effort. Information, logistic and other support, and field assistance were generously provided by individuals, academic institutions and government agencies in each of the countries that we visited. They are acknowledged in the introduction to each volume. Dating of the samples was carried out mainly by R. L. Holmes, P. W. Dunwiddie and B. J. Richards,

assisted at times by J. Ambrose, P. Brown, H. L. Fleischauer, V. C. LaMarche, and D. A. Campbell. T. P. Harlan and J. B. Harsha dated the initial Chilean collections. Ring-width measurements and measurement checks were made by those listed above, and by S. D. Morton, B. L. Fine, M. R. Henry, J. B. Heider, P. Houghton and K. A. Black. M. S. Crebbs, M. A. Kempinski and J. G. Miller aided in sample preparation. Computer operations were managed by L. G. Drew, with assistance from D. J. Buecher, R. B. Minton, C. S. Carlson, K. L. Kreutzer, S. L. Ward and others in the Data Processing Section of the Laboratory. M. K. Cleaveland developed some of the computer software that was used, and also helped with processing. Typing of the manuscripts was ably handled by A. K. Allen.



Plate 1. Wind-blown *Araucaria araucana*, Chenque Pehuén site, Neuquén Province.

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Plate 2. *Araucaria araucana* of various ages, Chenque Pehuén site, Neuquén Province.

## INTRODUCTION

### Background

The Andes extend in an unbroken chain from about 10° north to 55° south of the equator, some 8° and 900 km farther south than any other forested continent. It would be of great interest for Southern Hemisphere paleoclimatology if long and climatically sensitive tree-ring records could be developed throughout this entire latitude range. However, based on previous work and on some small reconnaissance collections, it appeared that trees in the tropical to subtropical forests of Ecuador, Peru and Brazil, and extending down the east side of the Andes through Bolivia into northern Argentina, would not be readily amenable to study by conventional dendrochronological techniques. Problems include poor definition of growth rings in many species, extreme circumferential irregularity in some cases, and surprisingly young ages of even very large forest trees. Southern South America thus seemed to offer the greatest immediate potential for application of tree-ring data to paleoclimatic reconstruction.

The areas with rainfall adequate to support temperate forests and woodland extend from central Chile to Tierra del Fuego on the wetter, western side of the Andes, and in a narrow belt east of the Andean crest in Patagonian Argentina (Figure 1). Edmund Schulman of this Laboratory had carried out reconnaissance sampling in Patagonia in 1949-1950 (Schulman, 1956), and had found trees of at least two coniferous genera to offer some dendrochronological potential. We accordingly concentrated our own sampling efforts in Argentina on Araucaria araucana and Austrocedrus chilensis in Neuquén, Río Negro, and northern Chubut provinces. Fitzroya cupressoides was sampled on a small scale, as were various angiosperm species, especially those in the genus Nothofagus (southern beech), which is the dominant forest tree south of 44°. We also examined a large collection of samples from small trees and shrubs from the Andean foothills near Mendoza, and have documented that collection here. Further details of the Argentine field work can be found in Boninsegna and Holmes (1977) and Holmes (1978).

### Sample Collection and Documentation

Most of the tree-ring samples described in this volume are housed at the Laboratory of Tree-Ring Research, and were collected during the period 1973-1978 by members of the Laboratory working in cooperation with Argentine scientists. The general procedure was to collect increment core samples from several radii of each of a number of trees on a geographically limited and ecologically homogeneous site. In a few cases it was also possible to collect discs (complete or partial transverse sections) from stumps or logs of recently felled trees. An embossed aluminum tag bearing an identification number was attached to each tree sampled. A brief site description accompanies each chronology; a description and

pertinent collection information are also presented for those sites from which no index chronology was developed. Site location maps (Figures 2a and 2b) are keyed to an Index to Localities (Table 1) by use of a 3-letter site code.

### Dating and Chronology Development

Each collection was evaluated both in the field and upon return to the Laboratory, in terms of its dendrochronological potential. Criteria included clarity of ring structure, circuit uniformity, sensitivity, and the feasibility of cross-dating patterns of wide and narrow rings and of other features between different radii and between different trees in the site. Development of the dating chronology followed standard cross-dating procedures (Stokes and Smiley, 1968). We adopted Schulman's convention of assigning the date of the annual ring to the year in which ring growth begins. The annual rings in all suitable samples from each site were dated; others were rejected because of complacency, short length, poor wood quality, an unusually high frequency of locally absent rings, the presence of pronounced growth surges or suppression, or for other reasons. One person normally had responsibility for evaluating and dating all the material from a particular site. The dating was then independently checked by another worker to ensure the accuracy of assignment of each annual ring in each sample to the correct calendar year.

After dating and checking were completed, the ring widths in each dated sample were measured to the nearest 0.01 mm using a Henson (Bannister model) measuring machine in conjunction with a Bausch and Lomb stereoscopic microscope with crosshairs, normally at 15X to 30X magnification. In the case of particularly difficult material, such as much of the Araucaria araucana, measurements were made by a senior research assistant. In all cases, spot checks were made of the accuracy of ring-width measurements using a test based on the Chi-square statistic. The printed tapes produced by the measuring machine were checked for errors, and the ring widths transferred to punched cards by keypunch operators.

A standard procedure was followed in the processing and evaluation of the data. First, descriptive statistics were calculated for each ring-width series and the series was listed and plotted for visual inspection and an error check, using the Laboratory's RWLST and TRPLT programs. Some series were deleted from the data set at this stage because of poor statistical quality, or because the plots showed evidence of gross non-climatic growth surges or periods of extreme growth suppression.

The remaining ring-width series were then transformed to dimensionless ring-width indices using the Laboratory's program INDXA. The purpose of this transformation is to remove effects of non-climatic growth trends or fluctuations, as well as the effect of differences in average growth rate between different trees (Fritts, 1976). The curve-fitting option for each ring-width series was carefully selected, based

on the general appearance of the plotted series, as well as our knowledge of the local site history and general environmental conditions. In a majority of cases, a negative exponential or straight-line curve was fit, although the orthogonal polynomial option was occasionally used with considerable discretion.

Finally, the individual radial ring-width index series were combined by averaging to produce the site chronology, either as part of the INDXA run, or in a subsequent step using the SMSR or SUMAC programs. In addition to the site chronology, which normally includes all the good quality ring-width index series available for a site, we also produced a so-called "statistical" chronology, incorporating a selected sub-set of the available index series.

### Descriptive Statistics

Two sets of statistics are presented for most of the sites for which a chronology was developed. These can be very useful in providing a quantitative basis for evaluating the dendroclimatic potential of a tree-ring chronology (Fritts, 1976).

The first set, designated "Sample Statistics", is based on analysis of the data ~~sub-set~~ incorporated in the statistical chronology. Most of the parameters provide measures of the relationships among the component radial ring-width index series, and are calculated for a period common to all the series, using a replicated sample in which, in most cases, at least two radii are available for each tree in the sub-set. The results of the analysis of variance show how the total variance in the chronology is partitioned among potential sources of variation. A high percentage of the variance retained by the mean chronology generally indicates that ring-width fluctuations are very similar in all the radii. However, differences between trees often account for a large percentage of the variance, particularly on more complacent sites or on those that have been disturbed. Other sources of variation may include differences between radius classifications, differences between groups of trees in different areas of the site, and other "unexplained" sources of variation that are not explicitly considered in the analysis. The estimated mean square of Y, as given here, is the estimated population value of the amount of variance in common among all series that is retained in the final chronology, and corresponds to the "Variance Component" used by Fritts in his Table 6.VII (1976, p. 288). The cross-correlation analysis duplicates the analysis of variance results to some extent, but also provides additional insights. The values given are the average linear cross-correlation coefficients between different sets of ring-width index series. The average correlation between radii within trees is always larger than the average correlation among radii from different trees, and reflects the tendency for growth records from individual radii of the same tree to be more similar than records from radii of different trees. Another measure of the similarities or differences between trees is provided by the

average correlation between the tree mean chronologies, obtained by averaging the replicated records from the different radii of the same trees, and calculating correlation coefficients.

The second set of data, labelled "Chronology Statistics", describes the properties of the site chronology presented on the facing page. Each chronology is identified by a 6-character code. The three letters correspond to the site code given in Table 1 and used in Figure 2. The first two numbers constitute a two-digit species code, explained in Table 3, and the "9" in the last position of the code for most chronologies follows a Laboratory convention indicating that it is a site chronology, incorporating all available good-quality radial index series. Three statistics are given that describe time-series properties of the chronology (Fritts, 1976). Autocorrelation is the first-order autocorrelation coefficient - a measure of the tendency for high or low index values to persist from one year to the next. The standard deviation of the series is calculated in the usual way, and measures the total amount of variation at all frequencies. The mean sensitivity is a statistic developed for the description of tree-ring series, but corresponds to the mean average first difference. High mean sensitivity indicates that there are large differences in index value from one year to the next. The standard error measures the amount of dispersion of the index values in the sample about the mean value in each year; they are averaged for the entire series to produce the mean standard error given here. In general, the closer the individual values are to the mean value, and the larger the sample size, the smaller the standard error. The chronology statistics are summarized in Table 2.

#### Acknowledgments

We are indebted to a large number of individuals and organizations for their help in our work in Argentina. We are particularly grateful to Dr. Arturo E. Corte, former Vice-Director of the Instituto Argentino de Nivología y Glaciología (IANIGLA) in Mendoza for his continued interest and for providing logistical support, laboratory space and clerical and field assistance. Ing. José Armando Boninsegna, present Vice-Director of IANIGLA, is a valuable co-worker and participated in many sampling trips in Mendoza province and in Patagonia along with Juan Carlos Quiroga, also of IANIGLA. Logistical support for some of our collecting was provided by Ing. Roig, Director of the Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA) in Mendoza. During reconnaissance sampling in northern Argentina in 1974, Federico Vervoort of the Instituto Miguel Lillo in Tucumán was very helpful in taking us to visit potential tree-ring sites in that area. Bariloche was the field headquarters for much of the Patagonian sampling, and we are grateful to the Director, Dr. Carlos Alberto Mallmann, for the cooperation of the Fundación Bariloche, both in Buenos Aires and in Bariloche. We are highly indebted to Dr. Arístides Romero of the Fundación's Departamento de Recursos Naturales y Energía for helping with transportation arrangements. Other personnel

of the Fundación, including Gilberto Gallopín, E. H. Rapoport and Isabel Gómez de Gallopín accompanied us on a local field trip. We also thank J. J. Olcese, former Director of the Centro Atómico Bariloche, for permission to obtain samples of wood specimens stored at the Centro. Juan Carlos Lerman participated in early discussion with some of our Argentine colleagues, and provided many valuable contacts.

Permission to take tree-ring samples in the National Parks was given by the Superintendents of the National Parks of Nahuel Huapi, Los Alerces, Los Glaciares, Tierra del Fuego and Lanín, and the Provincial Park of Copahue-Caviahue. Other National Park personnel gave us valuable assistance as well. The Gendarmería Nacional also assisted us in several locations.

Three sawmills, Alvarez Hermanos y Durán, Forestal Epuyén and Bronzovich Hermanos, cut cross-sections for us from logs in their lumber yards. Others who helped us in sample collection include Santiago Gentile and Daniel Cobos of IANIGLA, Sigfrido Rubulis, Ethel Breerton, J. Skamarauskas and Aldo Comastri of Fundación Bariloche, and Drs. José and María Saura of the Centro Atómico Bariloche.

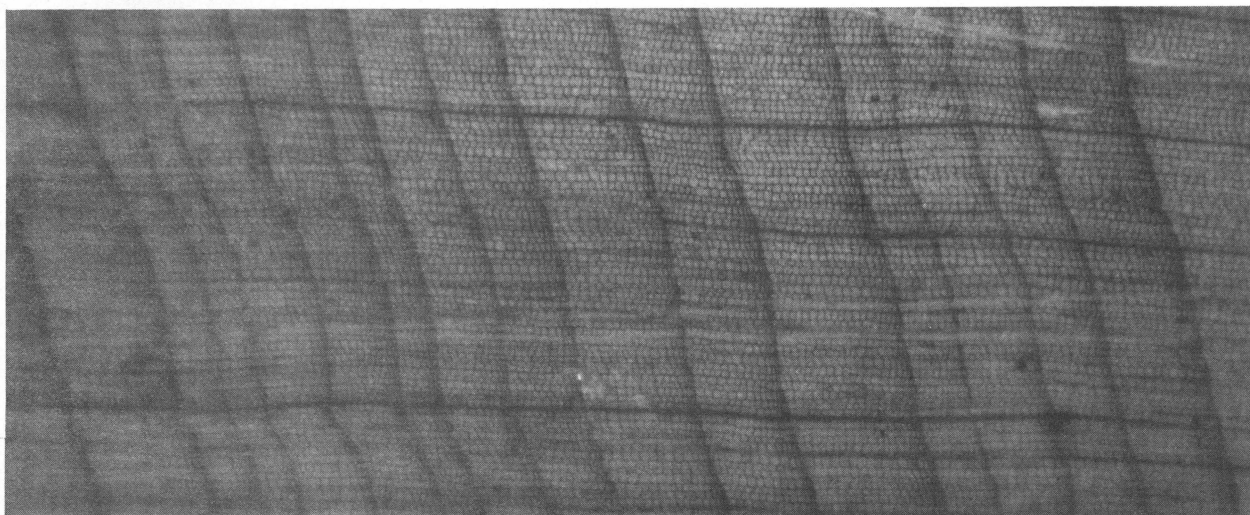


Plate 3. Enlarged core sample of *Austrocedrus chilensis*. Ring structure in this species is very clear.

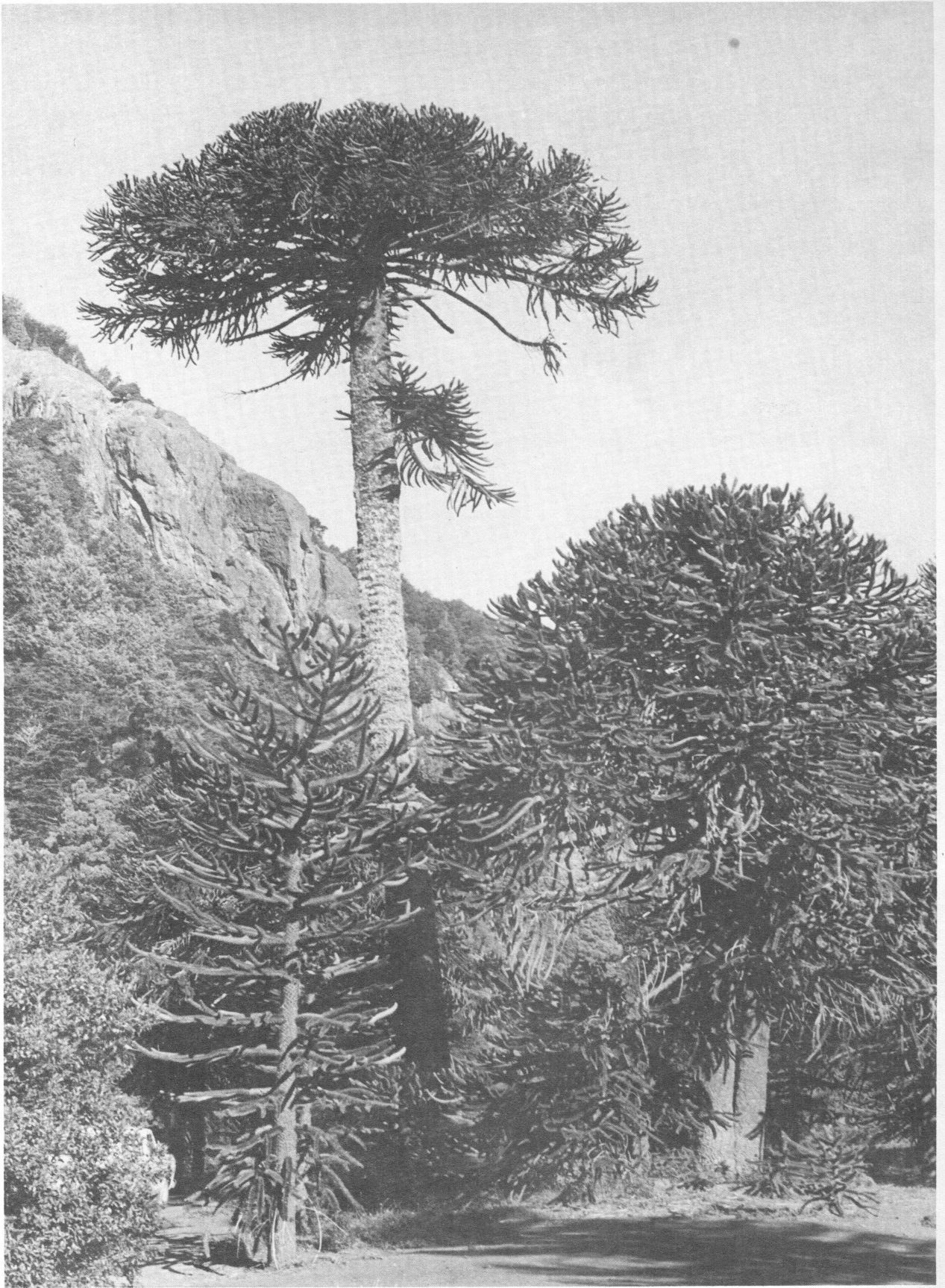


Plate 4. *Araucaria araucana*, Lago Tromen site, Neuquén Province. Trees of young, middle and advanced age appear in the foreground.

TABLE 1. INDEX TO LOCALITIES

Site Code	Site Name	Species Code	Lat.	Long.	Altitude, mts.	Site Chronology
ANG	Angostura Lago Aluminé	ARAR AUCH	38°53'S	71°10'W	1160	ANG799
BAR	Bariloche area	AUCH, MABO LOHI, NOAN NODO	41°46'S	71°38'W	800-850	
BRO	Brazo Rico	NOPU	50°27'S	72°49'W	300 to 340	
CAV	Caviahue	ARAR	37°52'S	71°01'W	1537 to 1550	CAV797
CBA	Cerro Buenos Aires	NOPU	50°22'S	72°47'W	490 to 870	
CHA	Estancia Chacabuco	AUCH	40°40'S	71°00'W	900	
CHP	Chenque Pehuén	ARAR	38°06'S	70°51'W	1500 to 1800	CHP799
CLL	Cerro los Leones	AUCH	41°05'S	71°09'W	1020	CLL479
COL	Estancia Collún-co	ARAR, AUCH	40°01'S	71°15'W	1060	
CON	Corcovado norte	NOAN	43°29'S	71°33'W	660	
COP	Copahue	ARAR NOPU	37°48'S	71°04'W	1670 to 1766	COP790
COW	Corcovado oeste	AUCH	43°36'S	71°42'W	470	
CUL	Arroyo Culebra	NOOB	40°14'S	71°22'W	1020	
CYM	Cuyín Manzano	AUCH	40°43'S	71°08'W	835 to 950	CYM479
ELM	El Maitén	AUCH	41°59'S	71°15'W	710	ELM477
EPU	Lago Epuyén	AUCH, NODO MABO, LOHI	42°09'S	71°33'W	500	
ESW	Esquel oeste	MABO	42°59'S	71°25'W	515	
ETA	Estancia Teresa	AUCH	42°57'S	71°26'W	820	ETA479
ETI	Estancia Tepí	NOAN	54°16'S	67°23'W	200	
GAR	Paso Garibaldi	NOBE	54°43'S	67°47'W	320	
HNG	Huinganco	AUCH	37°04'S	70°36'W	1300 to 1480	HNG477
ICA	Paso de Icalma	ARAR	38°56'S	71°25'W	1500	
KIL	Rfo Kilca	ARAR	38°55'S	70°46'W	1540	KIL799



TABLE 1. INDEX TO LOCALITIES (cont.)

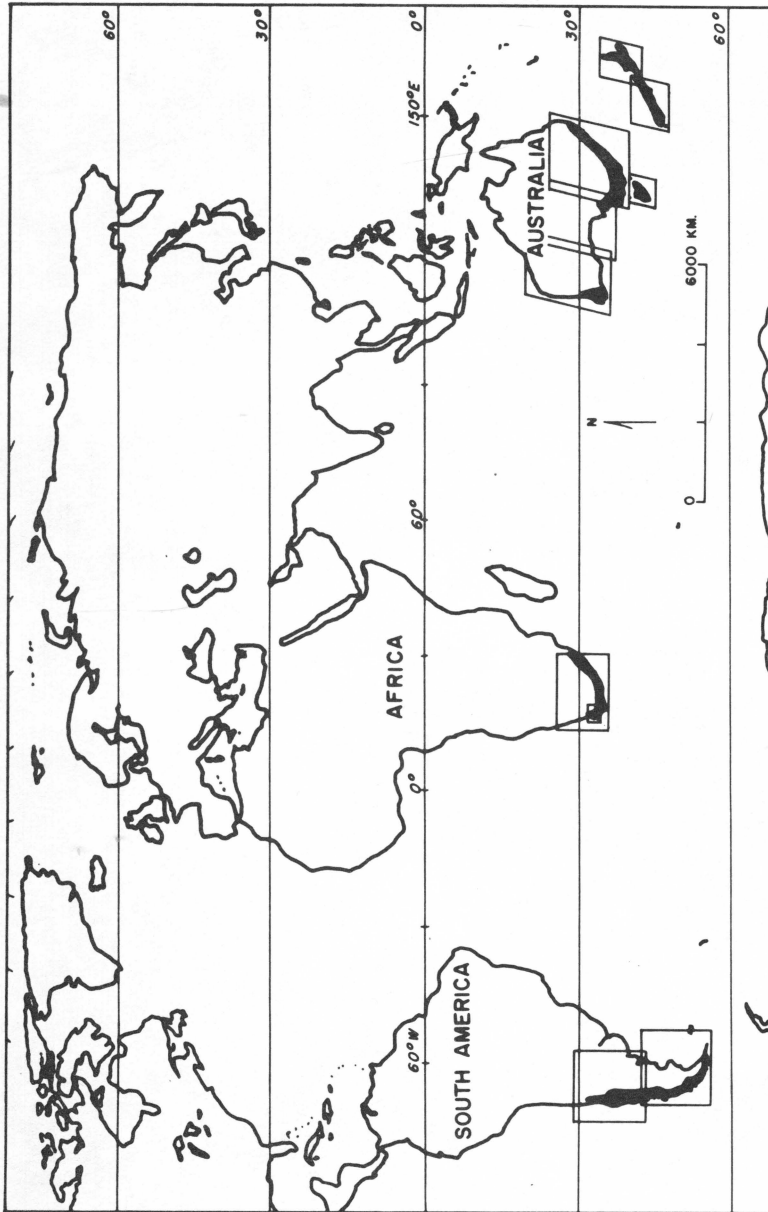
Site Code	Site Name	Species Code	Lat.	Long.	Altitude, mts.	Site Chronology
KOS	Kosobo	NOPU	54°37'S	67°26'W	200	
LAL	Lonco Luan	ARAR AUCH	38°59'S	71°03'W	1110	LAL799
LAP	Lapataia	NOPU	54°51'S	68°36'W	30	
LCS	Lago Cisne	FICU	42°36'S	71°58'W	560	
LRA	Lago Roca	NOPU, NOBE	54°49'S	68°34'W	15	
LTN	Laguna Terraplén	AUCH	43°01'S	71°34'W	650	LTN479
MEN	Mendoza	AZNU, BASA BEGR, BURE CEAU, COSN LADI, LANI MOAP, PRCU SCMO, SCPO	32°00'S to 32°45'S	69°00'W to 70°07'W	1300 to 3500	
MML	Estancia Mamuil-Malal	ARAR	39°41'S	71°13'W	890	MML799
MOQ	Lago Moquehue	ARAR	38°52'S	71°15'W	1250	MOQ799
PRA	Puente del Agrío	ARAR	37°49'S	70°57'W	1515	PRA799
PRI	Primeros Pinos de Aluminé	ARAR	38°53'S	70°37'W	1620	PRI799
PRP	Pino Hachado	ARAR	38°38'S	70°45'W	1400	PRP799
RAH	Rahue	ARAR	39°24'S	70°48'W	1360 to 1400	RAH799
RAW	Rahue oeste	AUCH	39°24'S	70°51'W	1200	
RCS	Río Cisne	FICU, NODO	42°37'S	71°54'W	524-600	
RFU	Río Futaleufú	AUCH	43°11'S	71°42'W	550	
RUC	Lago Rucachorói	ARAR	39°13'S	71°10'W	1252 to 1390	RUC799
RUC	Lago Rucachorói	AUCH	39°13'S	71°10'W	1252 to 1390	RUC479
RVU	Reñileuvú	ARAR	37°20'S	71°07'W	1470	
TRE	Trevelin	MABO	43°09'S	71°22'W	700	
TRO	Lago Tromen	ARAR	39°36'S	71°22'W	1010	TRO799

TABLE 2. CHRONOLOGY STATISTICS SUMMARY

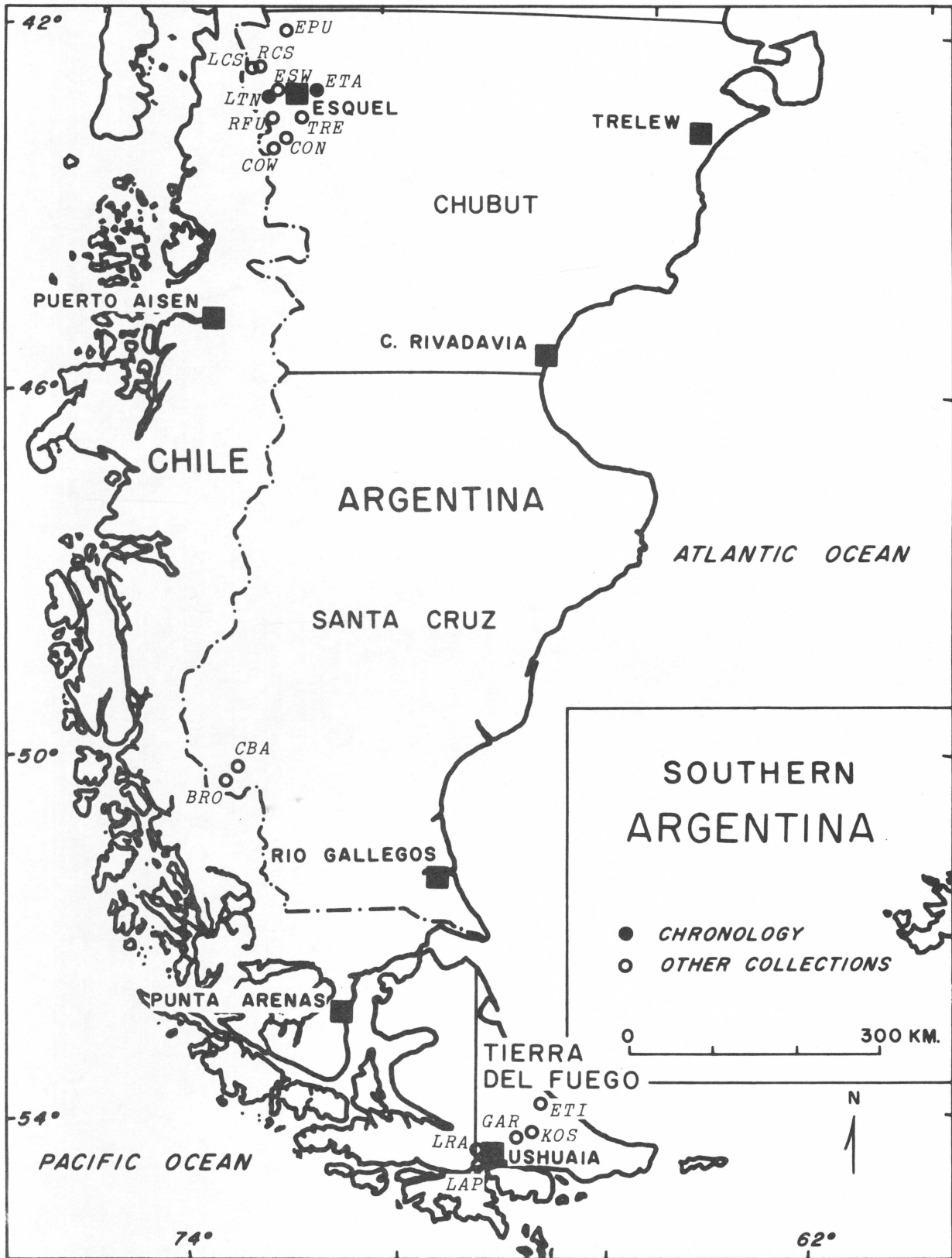
Chronology Identification Code	Mean Sensitivity	Standard Deviation	Auto- Correlation	Mean Standard Error	Time Span A. D.
ANG799	0.14	0.31	0.83	0.11	1717-1974
CAV797	0.13	0.23	0.70	0.07	1444-1974
CHP799	0.15	0.22	0.65	0.08	1246-1974
CLL479	0.17	0.26	0.62	0.11	1539-1974
COP790	0.13	0.18	0.63	0.11	1640-1974
CYM479	0.23	0.33	0.62	0.10	1543-1974
ELM477	0.20	0.30	0.62	0.11	1690-1974
ETA479	0.20	0.32	0.70	0.12	1540-1974
HNG477	0.17	0.25	0.60	0.08	1418-1975
KIL799	0.22	0.28	0.48	0.13	1700-1974
LAL799	0.15	0.24	0.65	0.08	1306-1974
LTN479	0.18	0.23	0.54	0.08	1700-1974
MML799	0.12	0.17	0.56	0.05	1690-1976
MOQ799	0.13	0.26	0.80	0.14	1601-1974
PRA799	0.13	0.18	0.62	0.14	1486-1974
PRI799	0.16	0.25	0.71	0.10	1140-1974
PRP799	0.14	0.24	0.77	0.07	1459-1974
RAH799	0.13	0.18	0.56	0.08	1483-1974
RUC799	0.14	0.18	0.55	0.05	1392-1976
RUC479	0.19	0.32	0.74	0.08	1572-1976
TRO799	0.12	0.17	0.62	0.05	1617-1976

TABLE 3. SPECIES COLLECTED

Species	Alphabetic Species Code	Numerical Species Code	Number of Sites Collected
<i>Araucaria araucana</i>	ARAR	79	17
<i>Austrocedrus chilensis</i>	AUCH	47	16
<i>Azorella nucamentacea</i>	AZNU		1
<i>Baccharis salicifolia</i>	BASA		1
<i>Berberis grevilleana</i>	BEGR		1
<i>Bulnesia retama</i>	BURE		1
<i>Cercidium australe</i>	CEAU		1
<i>Colletia spinossisima</i>	COSN		1
<i>Fitzroya cupressoides</i>	FICU	48	2
<i>Larrea divaricata</i>	LADI		1
<i>Larrea nitida</i>	LANI		1
<i>Lomatia hirsuta</i>	LOHI		2
<i>Maytenus boaria</i>	MABO		4
<i>Monttea aphylla</i>	MOAP		1
<i>Nothofagus antarctica</i>	MOAN		3
<i>Nothofagus betuloides</i>	NOBE		2
<i>Nothofagus dombeyi</i>	NODO		3
<i>Nothofagus obliqua</i>	NOOB		1
<i>Nothofagus pumilio</i>	NOPU		6
<i>Proustia cuneifolia</i>	PRCU		1
<i>Schinus molle</i>	SCMO		1
<i>Schinus polygamus</i>	SCPO		1







SITE CHRONOLOGIES

## SITE AND COLLECTION INFORMATION

Site name      ESTANCIA TERESA  
 Country        ARGENTINA                      State or Province   CHUBUT  
 Latitude       42° 57' S      Longitude       71° 26' W      Altitude       820 m  
 Species collected   *Austrocedrus chilensis*  
 Date of collection   16 December 1975  
 Collectors    R.L.Holmes, J.E.Ambrose  
 No. of trees sampled 8                      No. of cores   21                      No. of discs   0

### Site description:

*The site is ten kilometers east of the city of Esquel, about two kilometers to the southwest of the highway, on a steep northeast-facing slope above the Estancia Teresa which lies between the highway and the slope.*

*The stand of about 30 *Austrocedrus chilensis* with a drought-stricken appearance is just west of a stream cascading off the mountainside, near the top of a hill which appears to be the most barren in the vicinity.*

*Short grasses and low shrubs (*Berberis* sp. and *Mulinum spinosum*) are scattered through the area. The substratum is a steep (43°) granite-andesite talus slope with some outcropping rock and coarse sand on the surface.*

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1834 - 1943
No. of trees 5              No. of radii per tree 2	
Mean ring width (mm)	0.53
% locally absent rings	0.09
Analysis of variance:	
Estimated mean square of Y	0.059
Sources of variation, % variance	
Mean chronology	29
Differences between trees	37
Other	34
Cross-correlation analysis:	
Radii within trees	0.62
Radii among trees	0.03
Between tree means	0.10

## CHRONOLOGY STATISTICS

Identification	ETA479
Interval (A.D.)	1540 - 1974
No. of trees 7              Total no. of radii 16	
Autocorrelation	0.70
Standard deviation	0.32
Mean sensitivity	0.20
Mean standard error	0.12



FTA479  
 ESTANCIA TERESA  
 AUSTRORODRUS CHILENSIS

DATE	TREE RING INDICES									NUMBER OF SAMPLES										
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1540	22	23	25	30	30	32	85	59	74	127	1	1	1	1	1	1	2	2	2	2
1550	132	165	181	136	50	97	83	92	115	149	2	2	2	2	2	2	2	2	2	2
1560	134	156	131	177	145	70	150	172	175	175	2	2	2	2	2	2	2	2	2	2
1570	137	116	98	119	111	80	91	62	43	37	2	2	2	2	2	2	2	2	2	2
1580	55	66	54	60	50	61	75	71	89	162	2	2	2	2	2	2	2	2	2	2
1590	195	146	109	123	91	87	63	68	67	40	2	2	2	2	2	2	2	2	2	2
1600	78	54	51	55	68	90	99	89	87	115	2	2	2	2	2	2	2	2	2	2
1610	106	79	85	86	89	66	58	72	103	106	3	3	3	3	3	3	3	3	3	3
1620	70	62	65	59	51	52	62	74	68	65	3	3	3	3	3	3	3	3	3	3
1630	65	40	42	49	56	59	84	107	250	168	3	3	3	3	3	3	3	3	3	3
1640	117	114	140	115	84	101	96	84	101	121	4	4	4	4	4	4	4	4	4	4
1650	127	95	136	120	81	62	89	83	113	134	4	4	4	4	4	4	4	4	4	4
1660	94	87	122	90	46	46	66	72	71	66	4	4	4	4	4	4	4	4	4	4
1670	80	69	79	63	70	52	57	57	60	84	4	4	4	4	4	4	4	4	4	4
1680	84	67	34	61	70	56	62	71	106	126	4	4	4	4	4	4	4	4	5	5
1690	137	98	114	78	116	92	99	115	87	73	5	5	5	5	5	5	5	5	5	5
1700	73	67	74	118	148	90	83	112	117	124	5	5	5	5	5	5	5	5	5	5
1710	125	119	128	114	112	122	119	102	72	91	5	5	5	5	5	5	5	5	5	6
1720	109	109	108	108	125	107	101	121	118	83	6	7	7	7	7	7	7	7	7	7
1730	102	129	137	107	125	107	103	81	84	84	7	7	7	7	7	7	7	7	7	7
1740	87	111	120	128	105	75	90	83	72	104	7	7	7	7	7	7	7	7	7	8
1750	110	90	80	107	109	47	61	95	102	96	8	8	8	8	8	8	8	8	9	9
1760	121	122	82	98	83	75	106	101	108	112	9	9	11	11	11	11	11	12	12	12
1770	92	123	118	142	170	171	153	136	125	92	12	12	12	13	13	13	13	13	13	13
1780	90	114	97	78	86	94	79	95	116	111	13	13	13	13	13	13	13	13	13	13
1790	114	91	96	106	108	121	122	175	119	135	13	13	13	13	13	13	13	13	13	13
1800	140	77	44	101	93	91	105	85	134	116	13	13	13	13	14	14	14	14	14	14
1810	89	109	108	67	99	71	96	83	89	75	14	14	14	14	14	14	14	14	14	14
1820	52	35	55	92	121	92	88	60	50	70	14	14	14	14	14	14	14	14	14	14
1830	91	86	83	86	101	107	89	110	138	118	14	14	14	14	15	15	15	15	15	15
1840	114	91	103	136	133	90	100	91	94	109	15	15	15	15	15	15	15	15	15	15
1850	121	88	99	98	106	84	103	125	126	134	15	15	15	15	15	15	15	15	15	15
1860	138	117	145	130	123	107	120	110	156	150	15	15	15	15	15	15	15	15	15	15
1870	147	105	142	133	140	120	134	104	138	151	15	15	15	15	15	15	15	15	15	15
1880	150	114	131	118	116	89	103	108	128	156	16	16	16	16	16	16	16	16	16	16
1890	139	113	163	118	113	115	109	65	92	105	16	16	16	16	16	16	16	16	16	16
1900	115	88	81	91	91	133	91	74	50	35	16	16	16	16	16	16	16	16	12	12
1910	66	57	50	65	85	117	89	56	89	60	12	12	12	12	12	12	12	12	12	12
1920	91	93	79	65	81	105	142	117	143	134	12	12	12	12	12	12	12	12	12	12
1930	114	47	46	72	59	97	86	84	85	47	12	12	12	12	12	12	12	12	12	12
1940	83	114	89	42	22	61	85	44	56	55	12	12	12	12	11	11	11	11	11	11
1950	64	82	85	91	87	95	74	47	59	69	11	11	11	11	11	11	11	11	11	11
1960	59	77	56	83	93	119	115	135	95	108	11	11	11	11	11	11	9	9	9	9
1970	109	100	106	81	109						9	9	9	9	8					

## SITE AND COLLECTION INFORMATION

Site name *LAGUNA TERRAPLÉN*  
 Country *ARGENTINA* State or Province *CHUBUT*  
 Latitude *43° 01' S* Longitude *71° 34' W* Altitude *650 m*  
 Species collected *Austrocedrus chilensis*  
 Date of collection *3 February 1976*  
 Collectors *R.L.Holmes, J.E.Ambrose, J.A.Boninsegna, J.C.Quiroga*  
 No. of trees sampled *22* No. of cores *74* No. of discs *0*

### Site description:

The site is two parallel low steep ridges 31 kilometers southwest of Esquel on the road to Lago Futalaufquen, and 6.1 kilometers west of the road junction at Estancia Amancay. The ridges run northwest to southeast, and are to the south of the road just west of Arroyo Fontana. Laguna Terraplén can be seen from the site, three kilometers to the east.

The sampled stands of *Austrocedrus* are on mostly northeast facing slopes of 30° to 45°. Stand density is medium, with some isolated individuals. Relatively little rot for *Austrocedrus* was found in the trees at this site. Eight trees were sampled on the western of the two ridges, fourteen on the eastern ridge. Associated vegetation is sparse tall grass and shrubs to one meter tall. Small trees of *Lomatia hirsuta*, *Nothofagus antarctica* and other species are fairly common. Also *Alstroemeria aurantiaca*, *Fabiana imbricata*, *Mutisia decurrens* and *Fragaria chilensis*, and in the drainages, *Maytenus boaria* and *Gunnerachilensis*. This is the most mesic *Austrocedrus* from which a chronology was derived, as well as the farthest south.

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1879 - 1974
No. of trees 8      No. of radii per tree 2	
Mean ring width (mm)	1.37
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.039
Sources of variation, % variance	
Mean chronology	25
Differences between trees	45
Other	30
Cross-correlation analysis:	
Radii within trees	0.70
Radii among trees	0.27
Between tree means	0.30

## CHRONOLOGY STATISTICS

Identification	<i>LTN479</i>
Interval (A.D.)	1700 - 1974
No. of trees 12      Total no. of radii 21	
Autocorrelation	0.54
Standard deviation	0.23
Mean sensitivity	0.18
Mean standard error	0.08

LTN479  
LAGUNA TERRAPLEN  
AUSTROROCEDRUS CHILENSIS

DATE	TREE RING INDICES										NUMBER OF SAMPLES									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1700	110	99	76	103	120	88	74	95	92	95	1	1	1	1	1	1	1	1	1	1
1710	85	100	101	84	100	96	104	111	97	106	1	1	1	1	1	1	1	1	1	1
1720	123	112	120	131	109	152	121	114	127	137	1	1	1	1	1	1	1	1	1	1
1730	123	83	129	176	138	133	118	105	109	122	1	1	1	1	1	1	1	1	1	1
1740	113	119	122	167	120	81	60	95	82	101	1	1	1	1	2	2	2	3	3	3
1750	92	102	72	89	104	73	85	95	79	74	3	3	3	3	3	3	3	4	4	4
1760	104	97	70	114	104	73	122	109	108	130	4	4	4	4	4	4	4	4	4	4
1770	108	97	73	78	97	118	103	94	130	95	4	4	4	4	4	4	4	4	4	5
1780	94	109	92	63	83	83	69	77	84	77	5	5	5	5	5	5	5	5	5	5
1790	89	76	74	90	97	92	110	135	137	116	5	5	5	5	5	5	5	5	5	5
1800	133	101	101	120	108	111	149	142	148	142	5	5	5	5	5	5	5	5	5	5
1810	99	140	113	83	86	81	98	85	101	105	6	6	6	6	6	6	6	6	7	7
1820	77	59	66	82	89	124	128	74	102	111	7	7	7	7	7	7	8	8	8	8
1830	118	107	109	109	136	128	102	113	108	99	9	9	9	9	9	9	9	9	9	10
1840	105	84	117	126	116	64	77	63	65	83	10	10	10	10	10	10	11	11	11	11
1850	85	70	92	93	99	92	108	119	102	83	11	11	11	11	12	12	12	12	13	14
1860	73	68	88	75	57	73	88	91	137	119	15	15	15	16	16	17	17	17	18	19
1870	146	103	134	133	108	90	82	61	94	120	19	19	21	21	21	21	21	21	21	21
1880	129	110	92	92	73	72	82	109	98	117	21	21	21	21	21	21	21	21	21	21
1890	122	106	118	105	108	103	88	83	112	127	21	21	21	21	21	21	21	21	21	21
1900	106	80	95	98	63	98	73	97	86	97	21	21	21	21	21	21	21	21	21	21
1910	90	62	88	70	83	102	95	80	109	111	21	21	21	21	21	21	21	21	21	21
1920	167	167	78	92	89	118	153	122	148	146	21	21	21	21	21	21	21	21	21	21
1930	120	108	106	106	75	112	125	85	114	98	21	21	21	21	21	21	21	21	21	21
1940	75	87	67	44	73	94	134	107	106	107	21	21	21	21	21	21	21	21	21	21
1950	108	117	119	85	101	101	81	64	82	84	21	21	21	21	21	21	21	21	21	21
1960	103	113	69	102	128	142	122	117	105	97	20	20	20	20	20	20	20	20	20	20
1970	112	122	93	80	85						20	20	20	20	20					

### SITE AND COLLECTION INFORMATION

Site name *ANGOSTURA LAGO ALUMINÉ*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *38°53'S* Longitude *71°10'W* Altitude *1160 m*  
 Species collected *Araucaria araucana*  
 Date of collection *29 December 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose*  
 No. of trees sampled *6* No. of cores *11* No. of discs *0*

**Site description:**

*The sampled stand is on a rock outcrop six kilometers east of the settlement of Angostura, on the north side of Lago Aluminé toward its western end. It is opposite a small broad peninsula being developed for housing, to judge from the recently bulldozed streets. The stand is some 500 meters north of the road.*

*This is a small and scattered stand, but other stands in the vicinity are in apparently less xeric habitats at a higher altitude or near the lake.*

*Associated species are mainly Austrocedrus chilensis (two sampled), and grasses, with Lomatia hirsuta and Chusquea sp. just below the stand.*

### SAMPLE STATISTICS

Interval analyzed (A.D.)	1822 - 1974
No. of trees 4      No. of radii per tree 1	
Mean ring width (mm)	1.45
% locally absent rings	0.13
Analysis of variance:	
Estimated mean square of Y	0.031
Sources of variation, % variance	
Mean chronology	28
Differences between trees	72
Other	0
Cross-correlation analysis:	
Radii within trees	
Radii among trees	
Between tree means	0.27

### CHRONOLOGY STATISTICS

Identification	ANG799
Interval (A.D.)	1717 - 1974
No. of trees 4      Total no. of radii 6	
Autocorrelation	0.83
Standard deviation	0.31
Mean sensitivity	0.14
Mean standard error	0.11

ANG799  
 ANOSTURA LAGO ALUMTNE  
 ARAUCARIA ARAUCANA

DATE	TREE RING INDICES										NUMBER OF SAMPLES									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1717								98	94	17								1	1	1
1720	29	53	53	53	68	74	71	60	55	56	1	1	1	2	2	2	3	3	3	3
1730	48	40	38	38	43	39	54	54	53	64	3	3	3	3	3	3	3	3	3	3
1740	73	68	77	48	54	77	88	92	107	119	3	3	3	3	3	3	3	3	3	3
1750	108	87	79	70	80	78	83	70	84	82	3	3	3	3	3	3	3	3	3	3
1760	94	97	91	95	79	70	86	85	111	122	3	3	3	3	3	3	3	3	3	3
1770	115	146	134	126	135	138	126	103	113	103	3	3	3	4	4	4	4	4	4	4
1780	110	147	144	115	138	141	118	122	142	125	4	4	4	4	4	4	4	4	4	4
1790	167	124	144	177	183	157	126	145	176	168	4	4	4	4	4	4	4	4	4	4
1800	175	134	95	127	183	169	178	175	206	154	4	4	4	4	4	4	4	4	4	5
1810	126	139	140	94	94	89	84	81	85	74	5	5	5	5	5	5	5	5	5	5
1820	87	94	99	102	98	83	99	84	75	79	5	5	6	6	6	6	6	6	6	6
1830	103	106	74	84	104	108	87	105	134	104	6	6	6	6	6	6	6	6	6	6
1840	99	82	94	101	124	93	92	78	76	83	6	6	6	6	6	6	6	6	6	6
1850	76	66	76	68	67	71	76	72	66	53	6	6	6	6	6	6	6	6	6	6
1860	63	59	80	69	84	77	102	96	124	95	6	6	6	6	6	6	6	6	6	6
1870	97	96	105	103	80	55	99	89	78	69	6	6	6	6	6	6	6	6	6	6
1880	90	89	86	91	88	81	90	89	82	90	6	6	6	6	6	6	6	6	6	6
1890	93	107	113	92	124	104	110	90	133	155	6	6	6	6	6	6	6	6	6	6
1900	147	139	148	158	132	120	99	115	116	77	5	6	6	6	6	6	6	6	6	6
1910	94	106	94	77	80	81	103	103	106	94	6	6	6	6	6	6	6	6	6	6
1920	94	128	124	113	100	127	118	108	103	122	6	6	6	6	6	6	6	6	6	6
1930	115	97	95	113	107	101	92	84	100	85	6	6	6	6	6	6	6	6	6	6
1940	132	95	87	75	81	87	116	101	87	67	6	6	6	6	6	6	6	6	6	6
1950	94	114	87	81	87	86	94	74	68	96	6	6	6	6	6	6	6	6	6	6
1960	83	93	78	94	109	108	102	83	125	130	6	6	6	6	6	6	6	6	6	6
1970	127	138	133	126	134						6	6	6	6	6					

## SITE AND COLLECTION INFORMATION

Site name      CAVIAHUE  
 Country        ARGENTINA                      State or Province    NEUQUÉN  
 Latitude       37° 52' S      Longitude      71° 01' W      Altitude   1537 m - 1550 m  
 Species collected   Araucaria araucana  
 Date of collection  9 October 1975  
 Collectors      R.L. Holmes, J.E. Ambrose, J.A. Boninsegna, D. Cobos  
 No. of trees sampled   18      No. of cores   39      No. of discs   0

### Site description:

The site is on the north shore and near the western end of Laguna Caviahue (also called Lago Agrio), about 62 kilometers by road northwest of the town of Loncopué. As one goes toward the hot springs resort of Copahue, some three kilometers beyond the bridge over the Río Agrio, a sizable river, a road fork to the left leads to the resort hotel of Caviahue. The site is some six kilometers after the fork along this road. Subsite "A" at 1550 meters is some two kilometers north of the lake shore. An open stand of Araucaria araucana on a moderate southeast slope was sampled. Other species present include clump grass and some low forbs. There are no other trees. Basalt rocks cover about 30 % of the surface. Subsite "B" at 1537 meters is a rocky outcrop of vulcanite and basalt on the north shore of Laguna Caviahue, 55 meters above the lake level. An open stand of Araucaria araucana covers the outcrop, especially near the summit. The surface is mostly large rocks, some magnetite, with grasses and small Nothofagus pumilio.

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1864 - 1974
No. of trees 11      No. of radii per tree 2	
Mean ring width (mm)	0.74
% locally absent rings	0.08
Analysis of variance:	
Estimated mean square of Y	0.032
Sources of variation, % variance	
Mean chronology	22
Differences between trees	27
Other	51
Cross-correlation analysis:	
Radii within trees	0.53
Radii among trees	0.25
Between tree means	0.27

## CHRONOLOGY STATISTICS

Identification	CAV797
Interval (A.D.)	1444 - 1974
No. of trees 12      Total no. of radii 28	
Autocorrelation	0.70
Standard deviation	0.23
Mean sensitivity	0.13
Mean standard error	0.07



## SITE AND COLLECTION INFORMATION

Site name *CHENQUE PEHUÉN*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *38°06'S* Longitude *70°51'W* Altitude *1500 m - 1800 m*  
 Species collected *Araucaria araucana*  
 Date of collection *6, 8 November 1975*  
 Collectors *V.C. LaMarche, R.L. Holmes, J.E. Ambrose, J.A. Boninsegna*  
 No. of trees sampled *24* No. of cores *67* No. of discs *0*

### Site description:

The site is approximately 18 kilometers west of the town of Loncopué. The road runs west from a point just south of the town, past the airport, and 14 kilometers further west. An outpost of the Gendarmería Nacional (border police) is located in the stand of *Araucaria* near its western end.

The stand is in a broad valley about one kilometer wide. *Araucaria araucana* is distributed on the valley floor, gentle rocky knolls, and steep surrounding slopes. The site is in a zone of folded volcanic rocks with flat flows to the east. Soil is typically ashy and porous. The sampled stand of trees measures about three kilometers east to west by one kilometer north to south.

The first subsite (fifteen trees sampled) is near the crest of a northeast-facing slope about 250 meters south of the Gendarmería post on an andesite flow with some soil. The second subsite (five trees sampled) is on a north-facing slope east of the Gendarmería on an andesite flow with less ash and obsidian. The third subsite (four trees sampled) is a little over two kilometers to the east near the lower end of the stand.

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1794 - 1956
No. of trees 10      No. of radii per tree 2	
Mean ring width (mm)	0.51
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.030
Sources of variation, % variance	
Mean chronology	25
Differences between trees	38
Other	37
Cross-correlation analysis:	
Radii within trees	0.60
Radii among trees	0.26
Between tree means	0.28

## CHRONOLOGY STATISTICS

Identification	CHP799
Interval (A.D.)	1246 - 1974
No. of trees 14      Total no. of radii 32	
Autocorrelation	0.65
Standard deviation	0.22
Mean sensitivity	0.15
Mean standard error	0.08





## SITE AND COLLECTION INFORMATION

Site name *COPAHUE*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *37°48'S* Longitude *71°04'W* Altitude *1670 m - 1766 m*  
 Species collected *Araucaria araucana*  
 Date of collection *10 October 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose, J.A. Boninsegna, D. Cobos*  
 No. of trees sampled *9* No. of cores *18* No. of discs *0*

### Site description:

*The site consists of two subsites, one to three kilometers to the north of the road from the town of Loncopué north and west to the hot springs resort of Copahue, about 63 kilometers from Loncopué and about eight kilometers before reaching Copahue. Both subsites are south of and above Laguna Trolopes. They are fairly dense to open stands of Araucaria araucana, and a few scattered groups and individuals of Nothofagus pumilio (lenga). Large basalt rocks cover most of the ground.*

*At the time of sampling the ground was mostly covered with 50 to 100 cm of snow, with some bare patches. Nonetheless, around each Araucaria trunk there was always a snowless "well." Snow accumulation in one arroyo surpassed 14 meters.*

*Subsite "A" (1670 m) is on north- and northeast-facing slopes. Three Araucaria and two Nothofagus were sampled here. Subsite "B" (1766 m and lower) is farther southeast along the north-facing slopes above Laguna Trolopes, climbing upslope to near the upper border of the Araucaria stands. Six Araucaria were sampled here.*

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1810 - 1974
No. of trees 5      No. of radii per tree 2	
Mean ring width (mm)	1.12
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.012
Sources of variation, % variance	
Mean chronology	9
Differences between trees	25
Other	66
Cross-correlation analysis:	
Radii within trees	0.37
Radii among trees	0.11
Between tree means	0.14

## CHRONOLOGY STATISTICS

Identification	COP790
Interval (A.D.)	1640 - 1974
No. of trees 5      Total no. of radii 10	
Autocorrelation	0.63
Standard deviation	0.18
Mean sensitivity	0.13
Mean standard error	0.11

CJP790  
 COPAHUE  
 ARAUCARIA ARAUCANA

DATE	TREE RING INDICES										NUMBER OF SAMPLES									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1640	100	80	101	97	80	61	63	49	74	68	1	1	1	1	1	1	1	1	1	1
1650	72	66	111	93	92	81	67	48	113	105	1	1	2	2	2	2	2	2	2	2
1660	100	87	79	96	65	91	75	69	81	78	2	2	2	2	3	3	3	3	3	3
1670	93	92	96	114	111	66	99	97	108	88	3	3	3	3	3	3	3	3	3	3
1680	60	72	71	77	83	75	79	82	72	77	3	3	3	3	3	3	3	3	3	3
1690	100	102	78	85	107	84	69	80	77	67	3	3	4	4	4	4	4	4	4	4
1700	87	88	77	96	102	89	87	80	92	81	4	4	4	4	4	4	4	4	4	4
1710	97	89	95	73	77	95	72	80	75	62	5	5	5	5	5	5	5	5	6	6
1720	83	96	87	95	97	91	68	60	65	65	6	6	6	6	6	6	6	6	6	6
1730	71	71	83	83	79	90	107	72	99	96	6	6	6	6	6	6	6	6	7	7
1740	92	88	89	64	81	88	94	69	96	133	7	7	7	7	7	7	7	7	7	7
1750	116	94	83	83	90	81	97	98	104	93	7	7	7	7	7	7	7	7	7	7
1760	102	110	95	94	89	92	102	89	93	111	7	7	7	7	7	7	7	7	7	7
1770	107	97	78	88	90	88	94	88	95	80	7	7	7	7	7	7	7	7	7	7
1780	79	100	83	70	85	69	71	71	94	79	7	7	7	7	7	8	8	8	8	8
1790	101	104	81	98	104	115	125	122	111	103	8	8	8	8	8	8	8	8	8	8
1800	125	103	95	107	114	96	89	75	99	115	9	9	9	9	9	9	9	9	9	10
1810	117	103	112	94	112	115	115	110	95	79	10	10	10	10	10	10	10	10	10	10
1820	101	92	108	112	101	97	103	93	104	116	10	10	10	10	10	10	10	10	10	10
1830	107	124	116	109	118	110	94	125	116	84	10	10	10	10	10	10	10	10	10	10
1840	89	78	99	111	134	118	106	109	128	162	10	10	10	10	10	10	10	10	10	10
1850	149	120	126	97	92	93	101	128	128	120	10	10	10	10	10	10	10	10	10	10
1860	105	79	96	114	127	121	118	98	125	125	10	10	10	10	10	10	10	10	10	10
1870	116	104	115	101	96	85	122	94	95	95	10	10	10	10	10	10	10	10	10	10
1880	117	105	105	102	110	107	126	125	101	85	10	10	10	10	10	10	10	10	10	10
1890	92	96	95	73	78	79	76	76	113	111	10	10	10	10	10	10	10	10	10	10
1900	106	100	119	146	135	103	87	93	76	80	10	10	10	10	10	10	10	10	10	10
1910	111	110	107	97	90	88	86	94	92	86	10	10	10	10	10	10	10	10	10	10
1920	97	114	107	100	82	93	95	94	107	110	10	10	10	10	10	10	10	10	10	10
1930	100	107	105	123	107	91	78	73	113	125	10	10	10	10	10	10	10	10	10	10
1940	124	122	119	122	110	105	124	112	140	126	10	10	10	10	10	10	10	10	10	10
1950	128	138	101	107	101	112	100	97	91	97	10	10	10	10	10	10	10	10	10	10
1960	89	93	71	95	118	119	106	89	95	99	10	10	10	10	10	10	10	10	10	10
1970	86	121	102	92	112						10	10	10	10	10					

## SITE AND COLLECTION INFORMATION

Site name *CUYÍN MANZANO*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *40°43'S* Longitude *71°08'W* Altitude *835 - 950 m*  
 Species collected *Austrocedrus chilensis*  
 Date of collection *10 December 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose*  
 No. of trees sampled *9* No. of cores *16* No. of discs *0*

### Site description:

From the city of San Carlos de Bariloche 72 kilometers northeast on the highway to the city of Neuquen is Confluencia, the point at which the Río Traful flows into the Río Limay. Two roads lead west on opposite sides of the Río Traful; the road on the south side of the river leads to a bridge five kilometers west of Confluencia. The site is directly south of this bridge, on the first (three trees sampled) and second (six trees sampled) ridges encountered. The second ridge overlooks the Río Cuyín Manzano at the northwest foot of its precipitous slope.

This is an area of dramatic contours, spectacular volcanic outcrops alternating with steep slopes of weathered rock, with a fairly dense, albeit clumped, cover of *Austrocedrus chilensis*, mainly of medium size. These stands are interspersed with open areas having a moderately dense cover of bunch grasses, forbs and shrubs, including *Embothrium coccineum*, *Colletia spinosissima*, *Calceolaria* sp., *Lathyrus* sp., *Eryngium paniculatum* and *Berberis* sp.

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1765 - 1929
No. of trees 4      No. of radii per tree 2	
Mean ring width (mm)	3.33
% locally absent rings	
Analysis of variance:	
Estimated mean square of Y	0.063
Sources of variation, % variance	
Mean chronology	38
Differences between trees	25
Other	37
Cross-correlation analysis:	
Radii within trees	0.62
Radii among trees	0.39
Between tree means	0.43

## CHRONOLOGY STATISTICS

Identification	CYM479
Interval (A.D.)	1543 - 1974
No. of trees 6      Total no. of radii 12	
Autocorrelation	0.62
Standard deviation	0.33
Mean sensitivity	0.23
Mean standard error	0.10

CYM479  
 CUYIN MANZANO  
 AUSTRORCFORUS CHILENSIS

DATE	TREE RING INDICES										NUMBER OF SAMPLES									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1543				89	101	109	129	111	128	131				1	2	3	3	3	3	3
1550	143	122	132	134	105	101	87	79	66	40	3	3	3	3	3	3	3	3	3	3
1560	46	61	68	72	68	100	92	116	130	109	3	3	3	3	3	3	3	3	3	3
1570	112	140	119	125	113	84	43	58	68	47	3	3	3	3	3	3	3	3	3	3
1580	58	71	52	89	122	111	104	130	122	171	3	3	3	3	3	3	3	3	3	3
1590	167	150	75	59	86	61	77	107	97	50	3	3	3	3	3	3	3	3	3	3
1600	131	123	70	100	81	128	142	126	94	109	3	3	3	3	3	3	3	3	3	3
1610	114	64	60	84	82	78	83	96	113	160	3	3	3	3	3	3	3	3	4	4
1620	143	132	153	125	85	76	89	99	104	61	4	4	4	4	4	4	4	4	4	4
1630	72	93	86	69	103	150	146	137	151	163	4	4	4	4	4	4	4	4	4	4
1640	165	119	176	195	111	79	44	68	97	96	4	4	4	4	4	4	4	4	4	4
1650	140	116	218	176	167	43	38	42	48	53	4	4	4	4	4	4	4	4	4	4
1660	59	66	56	74	47	44	54	55	87	90	4	4	4	4	4	4	4	4	4	4
1670	75	103	109	92	99	116	152	159	122	132	4	4	4	5	5	6	6	6	6	6
1680	118	66	28	41	68	61	53	46	91	108	6	6	6	6	6	6	6	6	6	6
1690	140	133	140	106	131	123	133	152	118	126	7	7	8	8	8	8	8	8	8	8
1700	128	117	103	120	140	74	76	110	106	122	8	8	8	8	8	8	8	8	8	8
1710	89	85	100	97	79	118	72	73	60	59	8	8	8	8	8	8	8	8	8	8
1720	93	89	89	112	152	165	149	117	146	119	8	8	8	8	9	9	9	9	9	9
1730	101	127	126	99	101	105	96	87	102	113	9	9	9	9	9	9	9	10	10	10
1740	118	118	127	84	109	99	89	72	79	101	10	10	10	10	10	10	10	10	10	10
1750	102	81	79	101	96	63	113	117	89	83	10	10	10	10	10	10	10	10	10	10
1760	115	118	67	88	103	90	106	89	94	95	10	10	10	10	10	11	11	11	11	11
1770	67	73	87	78	73	95	104	110	98	90	11	11	11	11	11	11	11	11	11	11
1780	87	127	87	69	122	89	98	115	136	129	11	11	11	11	11	11	11	11	11	11
1790	155	97	108	98	97	93	112	136	121	78	11	11	11	12	12	12	12	12	12	12
1800	72	56	46	72	71	60	54	64	94	101	12	12	12	12	12	12	12	12	12	12
1810	90	105	120	35	61	89	117	110	123	90	12	12	12	12	12	12	12	12	12	12
1820	59	58	91	100	102	111	111	75	100	136	12	12	12	12	12	12	12	12	12	12
1830	165	134	119	99	161	143	100	127	124	100	12	12	12	12	12	12	12	12	12	12
1840	119	57	54	97	80	47	79	59	94	73	12	12	12	12	12	12	12	12	12	12
1850	92	60	86	86	85	117	122	112	101	71	12	12	12	12	12	12	12	12	12	12
1860	99	88	75	134	91	47	82	81	127	126	12	12	12	12	12	12	12	12	12	12
1870	142	101	136	130	111	72	106	70	133	149	12	12	12	12	12	12	12	12	12	12
1880	120	94	125	134	118	94	124	95	134	161	12	12	12	12	12	12	12	12	12	12
1890	137	120	133	89	107	124	83	47	37	70	12	12	12	12	12	12	12	12	12	12
1900	79	62	81	81	62	73	92	89	49	78	12	12	12	12	11	11	11	11	10	10
1910	98	48	57	45	65	101	84	53	92	88	10	10	10	10	10	10	10	10	10	10
1920	103	102	75	40	63	78	145	83	88	124	10	10	10	10	10	10	10	10	10	10
1930	101	63	84	118	111	140	106	137	130	157	9	9	9	9	9	9	9	9	9	9
1940	204	210	208	69	42	111	140	115	109	139	9	9	9	9	9	9	9	9	9	9
1950	96	156	125	118	118	139	101	70	119	131	9	9	9	9	9	9	9	9	9	9
1960	76	45	29	79	110	123	152	115	94	79	9	9	9	9	9	9	9	9	9	9
1970	90	104	96	138	196						9	9	9	9	9	9	9	9	9	9

## SITE AND COLLECTION INFORMATION

Site name ESTANCIA MAMUIL-MALAL  
 Country ARGENTINA State or Province NEUQUÉN  
 Latitude 39° 41' S Longitude 71° 13' W Altitude 890 m  
 Species collected *Araucaria araucana*  
 Date of collection 13, 14 January 1978  
 Collectors R.L. Holmes, J.A. Boninsegna, J.C. Quiroga  
 No. of trees sampled 11 No. of cores 35 No. of discs 0

### Site description:

The site is a small stand of *Araucaria araucana* 19 kilometers east of the entrance to Lanín National Park along the road from Junín de los Andes to Lago Tromen. It is well out into the Patagonian steppe at a point called Bajada de Primeros Pinos where the road ascends sharply some 50 meters (going westward) at a ford on the Estancia Mamuil-Malal.

*Araucaria araucana* dominates, but there is some young *Austrocedrus chilensis*. There are scattered xerophytic leguminous shrubs to one meter tall, grasses and *Stipa* sp. ("coirón"). There is also much bare dark sandy soil.

The site is disturbed by the presence of the road, but the sampled trees are far enough from it to have avoided major influence from this source. Trees were cored on both sides of the road, well away from it, mainly along the top of a ravine to the west of the road and at the edge of an 80 meter bluff to the east of the road overlooking the Río Malleo. This stand of *Araucaria* is the easternmost on this road.

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1849 - 1976
No. of trees 8      No. of radii per tree 2	
Mean ring width (mm)	0.95
% locally absent rings	0.05
Analysis of variance:	
Estimated mean square of Y	0.024
Sources of variation, % variance	
Mean chronology	22
Differences between trees	29
Other	49
Cross-correlation analysis:	
Radii within trees	0.54
Radii among trees	0.23
Between tree means	0.25

## CHRONOLOGY STATISTICS

Identification	MML799
Interval (A.D.)	1690 - 1976
No. of trees 9      Total no. of radii 28	
Autocorrelation	0.56
Standard deviation	0.17
Mean sensitivity	0.12
Mean standard error	0.05

MML799  
 ESTANCIA MAMUIL-MALAL  
 ARAUCARIA ARAUCANA

DATE	TREE RING INDICES									NUMBER OF SAMPLES										
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1690	115	162	102	108	132	156	149	108	85	88	1	1	1	1	1	1	1	1	1	1
1700	98	102	92	107	107	58	68	85	86	79	1	1	1	1	1	1	1	1	1	1
1710	95	84	67	62	69	81	61	77	98	87	1	1	1	1	1	1	1	1	1	1
1720	102	87	103	84	86	105	100	101	114	112	1	1	1	2	2	2	2	2	2	2
1730	115	104	101	98	109	99	107	80	92	86	2	2	2	2	3	3	3	4	4	5
1740	90	82	87	73	75	86	94	94	87	129	6	6	6	6	6	6	6	6	6	6
1750	120	107	108	101	93	69	112	93	104	98	6	7	8	8	8	8	9	11	11	11
1760	122	127	99	109	109	101	104	87	94	91	13	13	13	14	14	14	14	14	14	14
1770	91	89	107	114	99	112	121	113	105	99	14	14	14	14	14	14	14	15	15	15
1780	103	115	105	110	122	109	89	89	106	81	15	16	16	16	16	16	16	16	16	16
1790	88	88	92	117	118	135	129	110	87	94	16	16	16	16	17	17	17	17	17	17
1800	102	84	80	80	96	85	104	122	135	133	17	18	18	18	19	19	19	19	19	19
1810	101	109	109	78	98	106	102	93	85	80	19	19	20	20	20	20	21	21	21	21
1820	84	82	79	66	86	93	109	101	99	108	21	20	20	20	20	20	20	20	20	20
1830	86	69	105	113	110	118	110	123	102	78	20	20	20	20	20	21	21	21	21	21
1840	111	97	87	124	140	104	102	104	98	100	21	21	21	21	21	23	23	23	23	24
1850	103	94	118	86	103	95	98	103	106	98	24	27	27	27	27	27	27	27	27	27
1860	95	86	103	91	76	74	82	71	86	97	27	27	27	27	27	27	27	27	27	27
1870	73	82	93	78	93	92	125	117	114	103	27	27	27	27	27	27	27	27	27	27
1880	113	104	121	124	122	94	98	89	77	78	27	27	27	27	27	27	27	27	27	27
1890	92	104	108	94	102	105	82	65	82	78	27	27	27	27	27	27	27	27	27	27
1900	87	103	101	124	122	113	99	115	97	88	27	27	27	27	27	27	27	27	27	27
1910	106	95	82	75	99	107	84	84	87	94	27	27	27	27	27	27	27	27	27	27
1920	100	109	118	115	110	113	129	113	110	122	27	27	27	27	27	27	27	27	27	27
1930	105	103	113	130	119	99	85	69	98	92	27	27	27	27	27	27	27	27	27	27
1940	102	111	84	91	103	91	122	103	115	117	27	27	27	27	27	27	27	27	27	27
1950	138	144	84	105	120	110	107	95	109	136	27	27	27	27	27	27	27	27	27	27
1960	116	131	95	100	125	93	107	87	84	85	27	27	27	27	27	27	27	27	27	27
1970	72	100	76	79	97	80	88				24	24	24	24	24	24	24			

## SITE AND COLLECTION INFORMATION

Site name *HUINGANCO*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *37° 04' S* Longitude *70° 36' W* Altitude *1300 m - 1480 m*  
 Species collected *Austrocedrus chilensis*  
 Date of collection *15 February 1977*  
 Collectors *R.L. Holmes, J.A. Boninsegna, J.C. Quiroga*  
 No. of trees sampled *15* No. of cores *47* No. of discs *0*

### Site description:

*The site is ten kilometers northeast of the town of Andacollo, five kilometers north of the village of Huinganco, on the west slopes of the Cordillera del Viento, in a side canyon 350 meters above the Río Neuquén. The sampled stand is on a 34° south-facing slope. Drought-stunted Austrocedrus is scattered on a talus and outcrop slope with coarse sand, among "coiron" (*Stipa* sp.), with occasional Lomatia hirsuta in moister spots. Some trees have been disturbed by axe and saw cuts. Below the stand along the upper part of the arroyo is a gallery forest containing Nothofagus pumio, Nothofagus antarctica, Lomatia hirsuta and Drimys winteri.*

*This stand of Austrocedrus chilensis is 45 minutes of latitude north of any hitherto reported occurrence of the species in Argentina, and more than 120 years older than any other Argentine stand of the species we have sampled. It is described in detail by Boninsegna and Holmes (1978).*

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1826 - 1969
No. of trees 6      No. of radii per tree 2	
Mean ring width (mm)	0.38
% locally absent rings	0.06
Analysis of variance:	
Estimated mean square of Y	0.114
Sources of variation, % variance	
Mean chronology	29
Differences between trees	24
Other	47
Cross-correlation analysis:	
Radii within trees	0.60
Radii among trees	0.38
Between tree means	0.40

## CHRONOLOGY STATISTICS

Identification	HNG477
Interval (A.D.)	1418 - 1975
No. of trees 11      Total no. of radii 34	
Autocorrelation	0.60
Standard deviation	0.25
Mean sensitivity	0.17
Mean standard error	0.08





## SITE AND COLLECTION INFORMATION

Site name *LAGO MOQUEHUE*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *38° 52' S* Longitude *71° 15' W* Altitude *1250 m*  
 Species collected *Araucaria araucana*  
 Date of collection *28 December 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose*  
 No. of trees sampled *8* No. of cores *16* No. of discs *0*

### Site description:

*The sampled stand of trees is on a small north-facing knoll three kilometers west of the settlement of Angostura, just north of the eastern end of Lago Moquehue, 400 meters south of the road. The site is within about two kilometers in a straight line from the Chilean border at Paso de Icalma.*

*The stand is small (about 15 trees) and of moderate density, on a slope of about 35° to the north. Soil parent material is andesite.*

*Associated species include Nothofagus antarctica, Chusquea sp., Fragaria chilensis, Calceolaria sp., Lathyrus hookeri, and Berberis sp.*

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1839 - 1968
No. of trees 4      No. of radii per tree 2	
Mean ring width (mm)	0.89
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.076
Sources of variation, % variance	
Mean chronology	39
Differences between trees	24
Other	37
Cross-correlation analysis:	
Radii within trees	0.61
Radii among trees	0.42
Between tree means	0.45

## CHRONOLOGY STATISTICS

Identification	MOQ799
Interval (A.D.)	1601 - 1974
No. of trees 6      Total no. of radii 12	
Autocorrelation	0.80
Standard deviation	0.26
Mean sensitivity	0.13
Mean standard error	0.14

MJQ799  
LAGO MOJUFHU  
ARAUCARIA ARAUCANA

DATE	TREE RING INDICES									NUMBER OF SAMPLES										
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1601		56	62	89	81	89	99	103	84	80		1	1	1	1	1	1	1	1	1
1610	82	92	70	80	78	76	90	76	81	83		1	1	2	2	2	2	2	2	2
1620	91	88	81	77	67	83	88	90	104	98		2	2	2	2	2	2	2	2	2
1630	119	106	80	73	71	79	71	60	71	71		2	2	2	2	2	2	2	2	2
1640	72	76	79	64	70	79	82	86	99	101		2	2	2	2	2	2	2	2	2
1650	102	86	122	101	104	90	95	109	130	114		2	2	2	2	2	2	2	2	2
1660	90	64	71	76	61	53	60	60	60	61		2	2	2	2	2	2	2	2	2
1670	65	84	85	71	80	85	100	103	132	130		2	2	2	2	2	2	2	2	2
1680	117	102	70	120	119	126	115	122	123	126		2	2	2	2	3	3	3	3	3
1690	122	129	111	100	118	118	101	96	105	96		3	3	3	3	4	4	5	5	5
1700	125	128	125	114	115	101	106	108	135	120		5	5	5	5	5	5	5	5	5
1710	103	102	103	115	111	114	106	119	109	89		5	5	5	6	6	6	6	6	6
1720	115	98	93	93	91	103	72	67	81	91		6	6	6	6	6	6	6	6	6
1730	86	86	84	64	52	70	100	74	83	80		6	6	6	6	6	6	6	6	6
1740	94	77	77	66	68	82	96	105	129	158		6	6	6	6	7	7	7	7	7
1750	139	125	131	128	130	129	140	168	177	160		7	7	7	7	7	7	7	7	7
1760	169	149	129	135	132	123	123	99	114	131		7	7	7	7	8	8	8	8	8
1770	138	125	97	82	89	100	101	92	85	83		9	9	9	9	9	9	9	9	9
1780	93	124	133	99	91	95	89	71	92	83		10	10	10	10	10	10	10	10	10
1790	92	97	96	100	109	91	86	87	81	78		10	10	10	10	10	10	10	10	10
1800	109	73	64	75	93	79	66	57	89	94		10	10	10	10	10	10	10	10	10
1810	81	66	95	103	105	107	108	91	63	53		10	10	10	10	10	10	10	10	10
1820	84	83	113	116	99	86	83	109	124	144		10	10	10	10	10	10	10	10	10
1830	120	150	176	163	141	151	124	119	141	103		10	10	10	10	10	10	10	10	10
1840	101	67	77	90	112	99	108	108	112	126		12	12	12	12	12	12	12	12	12
1850	101	96	111	92	78	85	82	92	78	72		12	12	12	12	12	12	12	12	12
1860	69	63	67	61	68	52	76	65	88	62		12	12	12	12	12	12	12	12	12
1870	59	54	73	76	60	36	71	63	55	48		12	12	12	12	12	12	12	12	12
1880	77	79	82	81	87	81	98	95	74	77		12	12	12	12	12	12	12	12	12
1890	84	80	91	74	81	127	121	73	131	158		12	12	12	12	12	12	12	12	12
1900	163	150	136	165	141	178	156	161	160	105		12	12	12	12	12	12	12	12	12
1910	132	134	122	119	113	111	125	115	143	137		12	12	12	12	12	12	12	12	12
1920	106	121	118	119	106	136	139	114	92	121		12	12	12	12	12	12	12	12	12
1930	100	83	80	91	94	97	69	70	97	83		12	12	12	12	12	12	12	12	12
1940	105	96	95	75	84	83	129	110	99	66		12	12	12	12	11	11	11	11	11
1950	87	109	79	77	82	76	88	73	73	88		11	11	11	11	11	11	10	10	10
1960	76	79	72	82	96	79	77	77	121	123		10	10	10	10	10	10	10	10	8
1970	114	128	125	122	138							8	8	8	8	7				

SITE AND COLLECTION INFORMATION

Site name *LAGO RUCACHORÓI*  
 Country ARGENTINA State or Province NEUQUÉN  
 Latitude 39° 13' S Longitude 71° 10' W Altitude 1252 m - 1390 m  
 Species collected *Araucaria araucana*  
 Date of collection 14, 15, 16, 17 January 1978  
 Collectors R.L. Holmes, J.A. Boninsegna, J.C. Quiroga, M. Dedek  
 No. of trees sampled 35 No. of cores 137 No. of discs 0

Site description:

Four subsites were sampled on the south side of the eastern end of Lago RucachoróI in Lanín National Park, 23 kilometers west of the town of Aluminé. The entire south side of the lake is *Araucaria araucana* forest, becoming more dense and mesic at the western end of the lake. In the sampled area, density of *Araucaria* is medium, with scattered individuals of *Austrocedrus chilensis* (also sampled) and *Lomatia hirsuta*. Disturbance is notable in three of the subsites, from the use of the forest by a village of 400 Indians near the park entrance. *Austrocedrus* is severely disturbed--the branches are cut for firewood, making it difficult to find sound trees. *Araucaria* is much less disturbed since the Indians protect the trees for the nuts.

Three subsites are rocky north-facing slopes on a low range of hills some 250 meters higher than the lake and 200 to 500 meters from the shore. The fourth subsite is a steep rocky hill just at the eastern end of the lake, north of the river draining the lake. It appears to be undisturbed.

The area is unusual in that it contains old individuals of both *Araucaria araucana* and *Austrocedrus chilensis*. No other area was found which affords this opportunity for comparison of the two species.

SAMPLE STATISTICS

Interval analyzed (A.D.)	1860 - 1976
No. of trees 24	No. of radii per tree 2
Mean ring width (mm)	
% locally absent rings	
Analysis of variance:	
Estimated mean square of Y	0.019
Sources of variation, % variance	
Mean chronology	18
Differences between trees	36
Other	46
Cross-correlation analysis:	
Radii within trees	0.59
Radii among trees	0.21
Between tree means	0.21

CHRONOLOGY STATISTICS

Identification	RUC799
Interval (A.D.)	1392 - 1976
No. of trees 29	Total no. of radii 93
Autocorrelation	0.55
Standard deviation	0.18
Mean sensitivity	0.14
Mean standard error	0.05



## SITE AND COLLECTION INFORMATION

Site name *LAGO RUCACHORÓI*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *39°13'S* Longitude *71°10'W* Altitude *1252 - 1390 m*  
 Species collected *Austrocedrus chilensis*  
 Date of collection *14, 15, 16, 17 January 1978*  
 Collectors *R.L. Holmes, J.A. Boninsegna, J.C. Quiroga, M. Dedek*  
 No. of trees sampled *13* No. of cores *34* No. of discs *0*

### Site description:

*Four subsites were sampled on the south side of the eastern end of Lago Rucachorói in Lanín National Park, 23 kilometers west of the town of Aluminé. The entire south side of the lake is Araucaria araucana forest, becoming more dense and mesic at the western end of the lake. In the sampled area, density of Araucaria (also sampled) is medium, with scattered individuals of Austrocedrus chilensis and Lomatia hirsuta. Disturbance is notable in three of the subsites, from the use of the forest by a village of 400 Indians near the park entrance. Austrocedrus is severely disturbed; the branches are cut for firewood, making it difficult to find sound trees. Araucaria is much less disturbed since the Indians protect the trees as a source of nuts.*

*Three subsites are rocky north-facing slopes on a low range of hills some 250 meters higher than the lake and 200 to 500 meters from the shore. The fourth subsite is a steep rocky hill just at the eastern end of the lake, north of the river draining the lake. It appears to be undisturbed.*

*This area is unusual in that it contains old individuals of both Araucaria araucana and Austrocedrus chilensis. No other area was found which affords this opportunity for comparison of the two species.*

### SAMPLE STATISTICS

Interval analyzed (A.D.)	1871 - 1975
No. of trees 6      No. of radii per tree 2	
Mean ring width (mm)	0.52
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.019
Sources of variation, % variance	
Mean chronology	31
Differences between trees	23
Other	46
Cross-correlation analysis:	
Radii within trees	0.55
Radii among trees	0.32
Between tree means	0.34

### CHRONOLOGY STATISTICS

Identification	RUC479
Interval (A.D.)	1572 - 1976
No. of trees 11      Total no. of radii 25	
Autocorrelation	0.74
Standard deviation	0.32
Mean sensitivity	0.19
Mean standard error	0.08

RUC479  
LAGO RUCACHOROI  
AUSTROCEDRUS CHILENSIS

DATE	TREE RING INDICES									NUMBER OF SAMPLES										
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1572			207	231	248	174	104	75	89	42			1	1	1	1	1	1	1	1
1590	65	65	56	11	8	17	23	35	62	50	1	1	1	1	1	1	1	1	1	1
1590	71	65	38	15	58	80	124	149	129	61	1	1	1	1	1	1	1	1	1	1
1600	77	74	65	73	70	33	46	47	49	67	1	1	1	1	1	1	1	1	1	1
1610	56	52	49	64	71	64	55	109	105	96	1	1	1	1	1	1	1	1	1	1
1620	116	113	107	88	88	101	111	82	76	117	1	1	1	1	1	1	1	1	1	1
1630	88	73	75	82	90	99	111	123	142	141	1	1	1	1	1	1	1	2	2	2
1640	89	88	128	144	176	113	120	127	150	123	2	2	2	2	2	2	2	2	3	3
1650	96	67	105	141	194	89	35	24	62	88	3	3	3	3	3	3	3	3	3	3
1660	132	119	100	99	68	55	88	98	105	109	3	3	3	3	3	3	3	3	3	3
1670	137	127	128	128	124	113	82	109	150	155	3	4	4	4	4	4	4	4	4	4
1680	122	80	49	77	108	109	114	123	132	140	4	4	4	4	4	4	4	4	4	4
1690	96	64	60	62	67	95	94	169	101	58	4	5	5	5	5	5	6	6	6	6
1700	55	68	81	99	131	103	101	112	118	111	7	8	8	8	8	8	8	8	8	8
1710	75	71	83	88	101	107	97	77	63	63	8	8	8	8	8	8	8	8	8	8
1720	102	106	85	89	110	98	104	114	142	123	8	8	8	8	8	8	8	8	8	8
1730	124	149	160	158	140	135	124	115	101	117	8	8	8	8	9	9	9	9	9	9
1740	143	120	118	80	87	72	55	49	50	82	9	9	9	9	9	9	9	9	9	9
1750	86	84	76	92	91	133	161	159	190	186	9	9	9	9	10	10	10	10	10	10
1760	146	134	101	119	98	79	67	59	46	52	10	10	10	10	10	10	10	10	10	10
1770	51	52	65	69	77	92	95	121	132	147	10	10	10	10	10	10	10	10	10	10
1780	122	126	90	88	102	98	92	86	102	100	10	10	10	10	11	12	12	12	13	13
1790	122	73	45	58	58	42	45	75	85	81	15	15	15	15	15	16	17	17	17	17
1800	94	96	99	102	88	82	80	82	98	94	17	17	17	17	17	18	18	18	18	18
1810	85	100	104	67	86	99	96	101	87	63	19	19	19	19	19	19	19	19	19	19
1820	82	75	95	115	103	109	78	92	114	129	19	19	19	19	20	20	20	21	21	21
1830	142	123	115	110	134	117	92	122	136	99	23	23	23	23	23	23	23	23	24	24
1840	103	72	104	108	128	71	96	101	141	140	24	24	24	24	24	24	24	24	24	24
1850	136	111	129	101	94	131	135	136	133	84	24	24	24	24	24	24	24	24	24	24
1860	96	88	102	115	97	88	96	112	134	133	24	24	24	24	24	24	24	24	24	24
1870	144	111	129	138	124	103	90	69	92	117	24	25	25	25	25	25	25	25	25	25
1880	93	69	65	73	91	114	114	106	129	131	25	25	25	25	25	25	25	25	25	25
1890	121	109	122	71	104	115	97	117	125	81	25	25	25	25	25	25	25	25	25	25
1900	55	64	69	94	89	95	95	95	88	110	25	25	25	25	25	25	25	25	25	25
1910	119	77	116	65	74	106	82	78	100	92	25	25	25	25	25	25	25	24	24	23
1920	98	95	73	72	71	94	110	105	104	113	23	23	23	23	23	23	23	23	21	21
1930	123	125	61	92	93	93	104	95	105	79	21	21	21	21	21	21	21	21	21	21
1940	118	124	116	70	81	153	160	112	112	82	21	21	21	21	21	21	21	21	21	21
1950	92	122	94	82	94	84	57	66	64	65	21	21	21	21	21	21	21	21	21	21
1960	73	80	52	96	98	101	99	101	82	97	21	21	21	21	21	21	21	21	21	21
1970	121	118	118	128	113	125	111				21	21	21	21	21	21	19			

## SITE AND COLLECTION INFORMATION

Site name *LAGO TROMEN*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *39° 36' S* Longitude *71° 22' W* Altitude *1010 m*  
 Species collected *Araucaria araucana*  
 Date of collection *12, 13 January 1978*  
 Collectors *R.L. Holmes, J.A. Boninsegna, J.C. Quiroga*  
 No. of trees sampled *18* No. of cores *67* No. of discs *0*

### Site description:

*On the north of the road from Junín de los Andes to Lago Tromen, eight kilometers by road southeast of the lake and near the entrance to Lanín National Park are two large stands of Araucaria araucana, separated by about two kilometers. The western of the two was sampled because it contains more large trees.*

*The sampled stand is on a very gentle (2°) north-facing slope near the Río Malleo, with a low rocky knoll at the western end. Soil is of volcanic pumice origin. Pure Araucaria araucana of moderate density and much reproduction form the stand.*

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1819 - 1969
No. of trees 13      No. of radii per tree 2	
Mean ring width (mm)	
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.023
Sources of variation, % variance	25
Mean chronology	38
Differences between trees	37
Other	
Cross-correlation analysis:	
Radii within trees	0.65
Radii among trees	0.27
Between tree means	0.29

## CHRONOLOGY STATISTICS

Identification	TRO799
Interval (A.D.)	1617 - 1976
No. of trees 18      Total no. of radii 57	
Autocorrelation	0.62
Standard deviation	0.17
Mean sensitivity	0.12
Mean standard error	0.05



TR0799  
LAGO TOMEN  
ARAUCARIA ARAUCANA

DATE	TREE RING INDICES										NUMBER OF SAMPLES									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1617								74	71	71								2	2	2
1620	78	91	71	74	65	79	89	87	103	101	3	3	3	3	4	4	4	4	4	4
1630	114	99	102	108	100	121	105	83	99	133	4	4	4	4	4	4	5	5	5	5
1640	177	163	159	134	123	119	112	103	98	95	5	5	5	5	5	5	5	5	6	7
1650	113	105	119	96	100	94	85	88	108	97	7	8	8	8	8	8	8	8	8	8
1660	95	88	84	98	71	80	83	82	102	92	8	8	8	9	9	9	9	9	9	9
1670	82	87	78	92	89	45	92	113	113	113	9	9	9	9	9	9	9	9	9	10
1680	100	109	103	113	110	104	95	118	124	99	10	10	10	11	11	11	11	11	11	11
1690	119	111	110	104	121	101	92	107	100	102	12	12	12	13	14	14	14	14	15	15
1700	109	104	127	126	114	85	94	89	86	101	15	15	15	15	16	16	16	16	16	16
1710	89	104	90	104	109	99	83	91	103	89	16	16	16	16	16	16	16	16	16	16
1720	93	107	79	91	73	89	105	95	113	124	16	16	16	16	16	16	16	17	17	18
1730	123	107	107	93	90	93	94	94	91	106	18	18	18	18	18	18	18	18	18	18
1740	121	111	117	79	94	103	106	111	113	142	18	18	18	19	19	19	19	20	20	21
1750	131	95	110	116	107	94	130	125	105	104	22	22	23	23	25	25	25	25	25	25
1760	108	119	87	103	111	103	108	98	83	91	25	25	25	25	25	25	25	26	27	27
1770	77	84	62	75	60	64	85	78	93	80	27	28	28	28	28	28	29	30	32	33
1780	96	118	119	111	134	118	100	109	115	84	36	36	36	36	36	39	39	39	39	39
1790	89	90	77	105	119	117	125	128	118	112	40	41	46	46	46	46	46	46	47	47
1800	122	88	104	101	108	90	97	82	91	106	48	48	48	48	48	48	49	49	49	49
1810	87	81	88	50	61	70	96	97	96	101	49	49	49	49	49	49	49	49	49	50
1820	89	84	88	93	99	100	116	100	119	119	49	49	49	50	50	51	51	51	51	52
1830	92	95	101	115	118	132	122	132	134	92	52	52	52	52	53	53	53	53	52	52
1840	109	89	80	96	104	108	102	92	96	93	52	52	53	53	53	53	53	53	54	54
1850	94	87	106	86	94	96	101	111	105	107	54	54	54	54	54	54	55	55	55	55
1860	118	95	112	111	93	84	97	85	105	101	55	55	55	55	54	54	54	54	54	54
1870	96	91	107	92	90	79	107	94	93	79	54	54	54	54	54	54	54	54	54	54
1880	112	114	116	107	116	81	100	94	86	75	54	54	54	54	54	54	54	53	52	52
1890	81	82	95	87	87	94	78	72	112	109	52	52	52	52	52	52	52	52	51	51
1900	105	109	105	123	110	101	103	116	94	80	51	51	51	51	51	51	51	51	51	51
1910	100	91	86	75	90	101	91	75	93	94	51	51	51	51	51	51	51	51	50	50
1920	85	105	104	104	107	116	128	111	132	143	50	50	50	50	50	49	49	49	49	49
1930	120	131	150	171	143	114	96	73	108	99	49	49	48	48	48	48	48	48	48	48
1940	110	108	85	86	98	76	103	91	102	97	48	48	48	48	48	48	48	48	48	48
1950	111	130	95	100	118	101	107	98	99	115	48	48	48	48	48	48	48	48	48	48
1960	98	113	85	97	122	93	100	85	91	93	48	48	48	48	48	48	48	48	48	48
1970	76	114	86	79	94	79	86				47	46	46	45	45	45	44			

## SITE AND COLLECTION INFORMATION

Site name *LONCO LUAN*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *38° 59' S* Longitude *71° 03' W* Altitude *1110 m*  
 Species collected *Araucaria araucana*  
 Date of collection *29, 30 December 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose*  
 No. of trees sampled *19* No. of cores *53* No. of discs *0*

### Site description:

*The site is along the road from the town of Aluminé to Lago Aluminé, about two kilometers southeast of the eastern end of the lake where it empties into the Río Aluminé. The sampled stands of Araucaria araucana are on four steep rocky knolls adjacent to the road and the river. One is on the west side of the road, three on the east side; all four are east of the river. A high rocky ridge runs northeast from near the knolls.*

*The stands are of open to very open density, on mostly north-east-facing slopes from 15° to 40°, on andesite rocks.*

*Associated species include a few very young Austrocedrus chilensis (one sampled); very low shrubs up to 50 cm tall, including Berberis buxifolia; forbs, especially numerous composites, Rhodophiala elwessii and Viola maculata; and grasses.*

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1824 - 1974
No. of trees 12      No. of radii per tree 2	
Mean ring width (mm)	0.86
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.035
Sources of variation, % variance	
Mean chronology	27
Differences between trees	42
Other	31
Cross-correlation analysis:	
Radii within trees	0.67
Radii among trees	0.27
Between tree means	0.29

## CHRONOLOGY STATISTICS

Identification	LAL799
Interval (A.D.)	1306 - 1974
No. of trees 14      Total no. of radii 41	
Autocorrelation	0.65
Standard deviation	0.24
Mean sensitivity	0.15
Mean standard error	0.08



## SITE AND COLLECTION INFORMATION

Site name *PINO HACHADO*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *38° 38' S* Longitude *70° 45' W* Altitude *1400 m*  
 Species collected *Araucaria araucana*  
 Date of collection *3, 4 November 1975*  
 Collectors *V.C. LaMarche, R.L. Holmes, J.E. Ambrose, J.A. Boninsegna*  
 No. of trees sampled *15* No. of cores *44* No. of discs *0*

### Site description:

*The site is about 42 kilometers west of the town of Las Lajas, at a place called Primeros Pinos (a commonly seen name) on National Route 22 on the way to Paso Pino Hachado and Chile. It is near the easternmost point on the road passing close to Araucaria trees. There are many small and several larger stands in the vicinity. Four sampled subsites are within about one square kilometer, all on the south side of the road. Ground cover is mainly bunch grasses, with a few patches of cane (Chusquea coleu). The four subsites contain Araucaria of all ages. Trees were sampled on a rocky knoll underlaid by andesite with a deep layer of brown, sandy soil; on a west-facing rocky ridge of bedrock and boulders; and on two similar north-facing slopes. A cabin and an abandoned sawmill operation lie between two of the subsites.*

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1876 - 1974
No. of trees 7      No. of radii per tree 2	
Mean ring width (mm)	0.65
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.033
Sources of variation, % variance	
Mean chronology	21
Differences between trees	47
Other	32
Cross-correlation analysis:	
Radii within trees	0.72
Radii among trees	0.25
Between tree means	0.28

## CHRONOLOGY STATISTICS

Identification	PRP799
Interval (A.D.)	1459 - 1974
No. of trees 10      Total no. of radii 25	
Autocorrelation	0.77
Standard deviation	0.24
Mean sensitivity	0.14
Mean standard error	0.07

PRP 799  
 PINJ HACHADO  
 ARAUCARIA APAUCANA

DATE	TREE RING INDICES									NUMBER OF SAMPLES										
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1459										34										1
1460	42	78	84	88	86	81	86	81	78	84	1	1	1	1	1	1	1	1	1	1
1470	88	95	90	97	71	92	91	64	76	72	1	1	1	1	1	1	1	1	1	1
1480	85	71	44	56	46	39	43	47	57	71	1	1	1	1	1	1	1	1	1	1
1490	42	63	49	49	82	87	107	64	57	92	1	1	1	1	1	1	1	2	3	3
1500	97	84	80	112	95	80	73	74	102	92	3	3	3	3	3	3	3	3	3	3
1510	98	123	110	113	103	154	189	101	140	137	3	3	3	3	3	3	3	3	3	3
1520	123	157	137	138	138	128	107	101	111	97	3	3	3	3	3	3	3	3	3	2
1530	87	76	50	75	74	103	108	95	84	106	3	3	3	3	3	3	3	4	4	4
1540	120	123	104	93	87	74	72	65	79	104	4	4	4	4	4	4	4	4	4	4
1550	101	86	100	112	110	127	121	130	112	101	4	5	5	5	5	5	5	5	5	5
1560	90	84	67	52	32	33	32	32	48	59	5	5	5	5	5	5	5	5	5	5
1570	68	74	89	97	91	74	107	102	101	87	5	5	5	5	5	5	5	5	5	5
1580	124	115	108	132	137	129	145	142	132	154	5	5	5	5	5	5	5	5	5	5
1590	162	151	128	134	118	149	129	133	129	142	5	5	5	5	5	5	5	5	5	5
1600	136	95	112	107	116	103	75	102	133	138	5	5	5	5	5	5	5	5	5	5
1610	117	114	123	120	103	114	113	103	123	118	5	5	5	5	5	5	5	5	5	5
1620	109	115	103	111	107	109	85	88	71	67	5	5	5	5	5	5	5	5	5	5
1630	57	57	58	51	52	49	55	28	34	42	5	5	4	2	2	2	2	2	2	2
1640	51	63	69	77	72	68	82	88	100	86	2	6	6	6	6	6	6	6	6	6
1650	100	61	94	98	104	94	82	109	121	107	6	6	7	7	7	7	7	7	7	7
1660	93	94	90	129	111	114	100	109	121	114	7	7	7	7	7	7	8	8	8	8
1670	131	120	100	98	121	107	115	112	126	117	8	8	8	8	8	8	8	8	8	8
1680	102	96	93	99	104	101	97	91	94	86	8	8	8	8	8	10	10	10	10	10
1690	93	99	96	80	103	92	76	82	93	94	10	10	10	10	10	10	10	10	10	10
1700	105	113	103	110	120	90	83	91	106	106	10	11	11	11	11	12	12	12	12	12
1710	96	97	94	93	87	111	90	109	126	86	12	12	12	12	12	12	12	12	12	12
1720	128	118	109	118	111	115	111	102	106	100	12	12	12	12	12	12	12	12	13	13
1730	114	117	116	115	105	91	116	84	102	95	13	13	13	13	14	14	14	14	14	14
1740	106	107	107	80	82	82	91	91	103	143	14	14	14	14	14	14	15	15	15	15
1750	114	103	98	108	104	95	90	102	109	99	16	17	17	17	17	17	17	17	17	17
1760	94	99	91	98	91	100	95	85	84	98	17	17	17	17	17	17	17	17	17	17
1770	97	103	70	61	68	76	96	95	107	88	17	17	16	16	16	16	16	16	17	17
1780	86	114	112	86	106	97	89	90	115	89	17	17	17	17	17	17	17	17	17	17
1790	114	121	120	120	126	98	94	95	103	91	17	17	17	17	17	17	17	17	17	17
1800	93	72	87	86	79	72	68	59	61	74	17	17	17	17	17	17	16	15	14	14
1810	77	81	110	86	99	108	124	134	111	98	14	14	14	14	14	14	14	14	15	15
1820	111	95	111	115	126	103	127	127	127	117	15	15	15	15	15	15	15	15	15	15
1830	121	136	140	128	109	117	95	117	143	96	15	15	15	15	15	15	15	15	15	15
1840	110	92	108	125	141	118	125	132	132	150	15	15	15	15	15	15	15	15	15	15
1850	130	122	141	108	95	107	134	153	123	96	15	15	15	15	15	15	15	15	16	16
1860	95	63	43	40	50	53	44	65	90	76	14	14	14	14	14	14	14	14	14	14
1870	79	79	99	92	70	52	91	54	57	51	14	14	14	14	14	14	14	16	16	16
1880	76	85	91	101	98	81	100	107	84	80	16	16	16	16	16	16	16	16	16	16
1890	84	89	98	78	98	126	130	95	131	120	16	16	16	16	16	16	16	16	16	16
1900	106	112	98	116	111	95	85	97	86	70	16	16	16	16	16	16	16	16	15	15
1910	86	65	58	66	75	76	86	81	91	78	15	15	15	15	15	15	15	15	15	15
1920	75	96	91	101	89	109	113	98	104	129	15	15	15	15	15	15	15	15	15	15
1930	94	103	95	120	115	95	82	77	117	108	15	15	15	15	15	15	15	15	15	15
1940	121	104	94	96	103	84	106	92	113	113	15	15	15	15	15	15	15	15	15	15
1950	126	142	113	130	122	101	125	110	106	126	15	15	15	15	15	15	15	15	15	15
1960	88	111	87	110	126	121	128	92	103	120	15	15	15	15	15	15	15	15	15	15
1970	93	134	104	103	123						15	15	15	15	15					

## SITE AND COLLECTION INFORMATION

Site name *PRIMEROS PINOS DE ALUMINÉ*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *38° 53' S* Longitude *70° 37' W* Altitude *1620 m*  
 Species collected *Araucaria araucana*  
 Date of collection *31 December 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose*  
 No. of trees sampled *11* No. of cores *28* No. of discs *0*

### Site description:

The site is approximately 47 kilometers west of Zapala on the road to Lago Aluminé, at a point called Primeros Pinos (a commonly used name). This is the very easternmost group of stands of *Araucaria araucana* encountered along the road.

The eastern subsite is to the west of the road, across from a small house and construction site. An open stand of *Araucaria* grows on an igneous rocky ridge, level on top and sloping 30° to the north and east. Most of the ground is rock and bare sand, with sparse bunch grasses. Associated species include *Rhodophiala* sp. and *Poa* sp.

The western subsite is 1.9 kilometers to the west. The stand of *Araucaria* is about 700 meters south of the road, on a north- to east-sloping plateau and ravine, at an altitude 20 meters higher than the previous subsite. There is a considerably heavier cover of bunchgrasses here, mostly *Poa* sp.

During the sampling a constant gale force wind blew from the west, estimated at 80 kilometers per hour.

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1672 - 1859
No. of trees 6      No. of radii per tree 2	
Mean ring width (mm)	0.53
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.022
Sources of variation, % variance	
Mean chronology	16
Differences between trees	39
Other	45
Cross-correlation analysis:	
Radii within trees	0.57
Radii among trees	0.17
Between tree means	0.20

## CHRONOLOGY STATISTICS

Identification	PRI799
Interval (A.D.)	1140 - 1974
No. of trees 11      Total no. of radii 38	
Autocorrelation	0.71
Standard deviation	0.25
Mean sensitivity	0.16
Mean standard error	0.10



## SITE AND COLLECTION INFORMATION

Site name *PUENTE DEL AGRIO*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *37° 49' S* Longitude *70° 57' W* Altitude *1515 m*  
 Species collected *Araucaria araucana*  
 Date of collection *8, 10 October 1975*  
 Collectors *R.L. Holmes J.E. Ambrose, J.A. Boninsegna, D. Cobos*  
 No. of trees sampled *7* No. of cores *11* No. of discs *0*

### Site description:

*The site is 500 meters to the south of the road from the town of Loncopué north and west to the hot springs resort of Copahue. It is about 54 kilometers from Loncopue, and just over one kilometer west of the bridge over the Río Agrío, a fairly large river.*

*The sampled stand of Araucaria is on a rocky knoll which on the day of sampling was covered with some 20 cm of rapidly melting snow, with many patches of bare but soaked ground. At that time the west end of the above mentioned bridge was the lower limit of snow on the ground. Five trees were sampled here.*

*Two additional Araucaria were sampled on a low rocky knoll just south of the eastern end of the bridge.*

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1741 - 1959
No. of trees 4      No. of radii per tree 1	
Mean ring width (mm)	0.65
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.010
Sources of variation, % variance	
Mean chronology	8
Differences between trees	92
Other	0
Cross-correlation analysis:	
Radii within trees	
Radii among trees	
Between tree means	0.07

## CHRONOLOGY STATISTICS

Identification	PRA799
Interval (A.D.)	1486 - 1974
No. of trees 5      Total no. of radii 7	
Autocorrelation	0.62
Standard deviation	0.18
Mean sensitivity	0.13
Mean standard error	0.14



PRA799  
 PUFNTE DEL AGRIO  
 ARAUCARIA ARAUCANA

DATE	TREE RING INDICES									NUMBER OF SAMPLES										
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1486							100	86	111	134							1	1	2	2
1490	160	102	87	97	89	114	116	109	94	68	2	2	2	2	2	2	2	2	2	2
1500	63	88	80	73	96	158	122	125	105	101	2	2	2	2	2	2	2	2	2	2
1510	104	82	97	85	75	73	54	70	56	61	2	2	2	2	2	2	2	2	2	2
1520	79	71	99	87	84	92	88	53	71	91	2	2	2	2	2	2	2	2	2	2
1530	99	106	94	92	112	112	117	65	87	92	2	2	2	2	2	2	2	2	2	2
1540	105	114	123	115	125	105	99	105	100	103	2	2	2	2	2	2	2	2	2	2
1550	128	113	114	118	109	130	126	133	131	119	2	2	2	2	2	2	2	2	2	2
1560	132	124	111	133	120	94	120	129	114	110	2	2	2	2	2	2	2	2	2	2
1570	98	83	68	82	116	101	75	98	84	92	2	2	2	2	2	2	2	2	2	2
1580	94	112	119	102	109	105	98	83	116	99	2	2	2	2	2	2	2	2	2	2
1590	110	117	92	96	107	99	102	94	87	60	2	2	2	2	2	2	2	2	2	2
1600	88	93	112	81	83	102	111	93	75	80	2	2	2	2	2	2	2	2	2	2
1610	106	113	95	74	79	108	115	118	113	101	2	2	2	2	2	2	2	2	2	2
1620	109	104	94	95	82	82	95	83	95	78	3	3	3	3	3	3	3	3	3	3
1630	96	99	88	91	85	95	104	96	124	91	4	4	4	4	4	4	4	4	4	4
1640	75	90	113	114	100	111	134	113	120	110	4	4	4	4	4	4	4	4	4	4
1650	105	77	102	120	134	127	116	112	106	127	4	4	4	4	4	4	4	4	4	4
1660	133	120	96	117	109	92	78	86	99	79	4	4	4	4	4	4	4	4	4	4
1670	111	119	122	109	115	91	105	97	113	106	4	4	4	4	4	4	4	4	4	4
1680	81	76	72	84	111	107	95	90	96	89	5	5	5	5	5	5	5	5	5	5
1690	116	115	110	94	112	100	75	87	84	85	6	6	6	6	6	6	6	6	6	6
1700	108	110	126	138	128	118	115	131	154	140	6	6	6	6	6	6	6	6	6	6
1710	104	120	142	134	111	129	106	115	95	77	6	6	6	6	6	6	6	6	6	6
1720	106	102	100	93	98	86	71	63	91	92	6	6	6	6	6	6	6	6	6	6
1730	89	92	94	90	87	105	111	86	98	98	6	6	6	6	6	6	6	6	6	6
1740	109	99	104	73	73	77	81	86	77	105	6	7	7	7	7	7	7	7	7	7
1750	97	94	90	88	92	91	102	113	125	91	7	7	7	7	7	7	7	7	7	7
1760	89	88	80	84	88	113	91	86	79	88	7	7	7	7	7	7	7	7	7	7
1770	90	120	104	94	91	87	95	97	114	99	7	6	6	6	6	6	6	6	6	6
1780	106	108	107	100	121	101	98	81	107	90	6	6	6	6	6	6	6	6	6	6
1790	120	102	86	87	100	96	112	109	97	92	6	6	6	5	6	6	6	6	6	6
1800	86	76	82	92	98	93	95	84	93	101	6	6	6	6	6	6	6	6	6	6
1810	98	94	92	88	76	102	120	115	92	88	5	5	5	5	5	5	5	5	5	5
1820	104	106	111	118	114	102	127	112	131	120	5	5	5	5	5	5	5	5	5	5
1830	128	132	124	107	99	117	121	144	149	112	5	5	5	5	5	5	5	5	5	5
1840	120	94	111	111	99	80	93	82	84	93	5	5	5	5	5	5	5	5	5	5
1850	88	82	103	92	82	93	94	73	72	71	4	4	4	4	4	4	4	4	4	4
1860	75	76	74	91	104	101	102	82	121	104	4	4	4	4	4	4	4	4	4	4
1870	84	68	32	75	78	65	115	81	78	80	4	4	4	4	4	4	4	4	4	4
1880	112	92	99	90	97	71	87	102	80	85	4	4	4	4	4	4	4	4	4	4
1890	89	77	76	70	70	80	75	64	98	84	4	4	4	4	4	4	4	4	4	4
1900	85	88	103	120	111	96	85	97	111	80	4	4	4	4	4	4	4	4	4	4
1910	119	115	100	111	144	117	102	115	128	108	4	4	4	4	4	4	4	4	4	4
1920	98	106	104	105	99	131	119	117	136	149	4	4	4	4	4	4	4	4	4	4
1930	133	162	162	142	122	114	102	114	137	130	4	4	4	4	4	4	4	4	4	4
1940	114	116	102	103	120	93	111	102	125	99	4	4	4	4	4	4	4	4	4	4
1950	111	99	82	112	102	76	98	92	74	108	4	4	4	4	4	4	4	4	4	4
1960	67	88	68	102	113	92	80	67	86	95	3	3	3	3	3	3	3	3	3	3
1970	65	83	90	98	111						3	3	3	3	3					

## SITE AND COLLECTION INFORMATION

Site name RAHUE  
 Country ARGENTINA State or Province NEUQUÉN  
 Latitude 39° 24' S Longitude 70° 48' W Altitude 1360 m - 1400 m  
 Species collected *Araucaria araucana*  
 Date of collection 31 October, 1 November 1975  
 Collectors V.C. LaMarche, R.L. Holmes, J.E. Ambrose, J.A. Boninsegna  
 No. of trees sampled 14 No. of cores 46 No. of discs 0

### Site description:

The site is just east of the crest of the mountain range called Sierra de Catán Lil, on the north side of the road between Las Coloradas and Aluminé, some 15 kilometers east of the section of road with many steep hairpin turns known as the Bajada de Rahue.

The stand of *Araucaria* is in a rolling hilly area of sandy schist with a soil depth of about a meter. Vegetation is open forbs (*Oxalis enneaphylla* on ridge tops) and some low shrubs. Thickets of *Nothofagus pumilio* (lenga) grow in the swales, often still covered with snow, with *Araucaria* on the east- and south-facing slopes and especially on the edges of snow accumulation and along streams.

Two large pieces and many small fragments of black petrified wood were found lying adjacent to living *Araucaria* at this site. The largest piece is circular in cross section, about 45 cm in diameter by 15 cm thick.

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1799 - 1955
No. of trees 8      No. of radii per tree 2	
Mean ring width (mm)	0.77
% locally absent rings	0.00
Analysis of variance:	
Estimated mean square of Y	0.022
Sources of variation, % variance	
Mean chronology	16
Differences between trees	33
Other	51
Cross-correlation analysis:	
Radii within trees	0.52
Radii among trees	0.16
Between tree means	0.19

## CHRONOLOGY STATISTICS

Identification	RAH799
Interval (A.D.)	1483 - 1974
No. of trees 8      Total no. of radii 20	
Autocorrelation	0.56
Standard deviation	0.18
Mean sensitivity	0.13
Mean standard error	0.08

RAH799  
 RAHUE  
 ARAUCARIA ARAUCANA

DATE	TREE RING INDICES									NUMBER OF SAMPLES										
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1483				49	59	56	61	51	64	73				1	1	1	1	1	1	1
1490	68	79	68	75	87	130	136	113	98	86			1	1	2	2	2	2	3	3
1500	63	81	98	72	79	101	77	85	87	93			4	4	4	4	4	4	4	4
1510	101	89	94	91	93	92	65	83	81	76			5	5	5	5	5	5	5	5
1520	76	75	88	80	99	107	105	77	83	88			5	5	5	5	5	5	5	5
1530	88	97	88	79	87	85	82	78	92	111			5	5	6	6	6	6	6	6
1540	126	152	151	135	129	123	106	116	98	97			6	6	6	6	6	6	7	7
1550	122	109	100	102	105	96	105	116	142	125			8	8	8	8	8	8	8	8
1560	114	123	127	115	105	100	103	114	129	128			8	8	8	8	8	8	8	8
1570	102	103	105	95	110	105	69	120	99	115			9	10	10	10	10	10	10	10
1580	107	124	118	107	133	135	129	128	105	86			10	10	11	11	11	11	11	11
1590	118	122	108	102	120	112	128	99	103	105			11	12	12	12	12	12	12	12
1600	117	129	103	110	95	87	95	73	79	95			12	12	12	12	12	12	12	13
1610	114	93	91	89	88	92	101	97	73	98			13	13	13	13	13	13	13	13
1620	97	93	92	98	96	86	103	88	98	74			13	13	13	13	13	13	13	13
1630	97	118	90	122	113	110	121	92	106	92			13	13	13	13	13	13	13	13
1640	94	95	116	125	109	105	89	93	114	110			13	13	13	13	13	13	13	13
1650	106	75	95	91	118	104	102	98	122	101			13	13	13	13	13	13	13	13
1660	114	107	93	132	124	123	113	82	97	94			13	13	13	13	13	13	13	13
1670	121	118	102	104	111	75	78	85	103	94			13	13	13	13	13	13	13	14
1680	86	96	75	84	100	98	85	91	91	83			14	14	14	14	14	14	14	14
1690	85	84	91	85	108	100	85	89	101	99			14	14	15	15	15	15	15	16
1700	118	118	129	134	138	98	117	113	110	124			14	14	16	16	16	16	16	16
1710	99	108	95	86	91	110	89	91	92	71			16	16	16	16	16	16	16	16
1720	95	117	97	106	96	108	98	88	86	80			16	16	16	16	16	16	16	16
1730	97	100	113	88	85	95	108	86	103	177			16	16	16	16	18	18	18	18
1740	105	95	105	73	72	85	99	90	78	126			18	18	18	18	18	18	18	18
1750	119	98	91	92	99	103	108	122	127	119			17	17	17	17	17	17	17	17
1760	100	102	82	93	80	89	86	80	67	102			17	17	17	17	17	17	17	17
1770	101	105	70	76	87	84	86	77	89	70			18	18	18	18	18	18	18	18
1780	85	112	117	88	104	83	83	87	109	76			18	18	18	18	18	18	18	18
1790	94	96	92	97	120	91	111	124	122	105			18	18	18	18	18	18	18	18
1800	112	82	96	93	112	112	117	83	100	110			19	19	19	19	19	19	19	19
1810	114	84	98	63	85	88	89	97	87	76			19	19	19	18	18	18	18	18
1820	83	85	93	74	74	74	103	92	100	94			18	18	18	18	18	18	18	18
1830	82	93	106	84	83	89	76	93	105	78			18	18	18	18	18	18	18	18
1840	89	74	79	80	93	89	102	92	94	109			18	18	18	18	18	18	18	18
1850	100	87	96	65	70	79	83	106	107	88			18	18	18	18	18	18	18	18
1860	107	94	95	112	100	77	94	77	109	25			17	17	17	17	17	17	17	17
1870	90	87	109	93	80	61	112	83	93	87			17	17	17	17	17	17	17	17
1880	131	118	120	117	127	90	109	117	97	75			17	17	17	17	17	17	17	17
1890	79	85	98	85	95	99	106	77	96	98			17	17	16	16	16	16	16	16
1900	113	125	117	128	139	103	82	95	86	82			16	16	16	16	16	16	16	16
1910	119	98	108	97	110	110	121	99	125	103			16	16	16	16	16	16	16	16
1920	101	134	142	165	124	121	148	116	129	160			15	15	15	15	15	15	15	15
1930	108	120	102	143	117	118	88	74	114	118			14	14	14	14	14	14	14	14
1940	132	121	116	114	131	99	109	106	134	109			14	14	14	14	14	14	14	14
1950	100	120	75	116	108	103	120	108	102	97			14	14	14	14	14	13	13	13
1960	87	114	77	112	132	114	116	103	122	123			13	13	13	12	12	12	12	12
1970	88	119	87	83	112								12	12	12	12	12			

## SITE AND COLLECTION INFORMATION

Site name *RÍO KILCA*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *38° 55' S* Longitude *70° 46' W* Altitude *1540 m*  
 Species collected *Araucaria araucana*  
 Date of collection *30 December 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose*  
 No. of trees sampled *7* No. of cores *18* No. of discs *0*

### Site description:

The site is along the road between Zapala and Lago Aluminé, about three kilometers east of the bridge over the Río Kilca.

The sampled stand is on the steep north-facing slope of an andesitic plug south of the road, some 200 meters above it in altitude. Trees are scattered among clumped shrubs and grasses, including *Mulinum spinosum*, *Poa* sp. and *Calceolaria* sp. There is one very limited area of *Azorella* sp., a mat-forming umbellifer which grows in harsh xeric environments.

The site is very rocky, and most of the trees are growing among large boulders on a rock outcrop or adjacent to rock cliffs. The site appears to be a very harsh environment for tree growth.

A strong west wind of gale force, estimated at 80 kilometers per hour, blew constantly during sampling, yet the *Araucaria* did not exhibit a wind-blown appearance.

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1760 - 1974
No. of trees 3      No. of radii per tree 1	
Mean ring width (mm)	0.66
% locally absent rings	0.81
Analysis of variance:	
Estimated mean square of Y	0.035
Sources of variation, % variance	
Mean chronology	26
Differences between trees	74
Other	0
Cross-correlation analysis:	
Radii within trees	
Radii among trees	
Between tree means	0.29

## CHRONOLOGY STATISTICS

Identification	KIL799
Interval (A.D.)	1700 - 1974
No. of trees 3      Total no. of radii 4	
Autocorrelation	0.48
Standard deviation	0.28
Mean sensitivity	0.22
Mean standard error	0.13

KIL799  
 RIO KILCA  
 ARAUCARIA ARAUCANA

DATE	TREE RING INDICES										NUMBER OF SAMPLES									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1700	69	78	137	123	87	131	83	76	180	154	1	1	1	1	1	1	1	1	1	1
1710	122	134	130	117	147	213	145	136	168	93	1	1	1	1	1	1	1	1	1	1
1720	214	115	115	123	108	137	150	108	150	100	1	1	1	1	1	1	1	2	2	2
1730	108	72	89	73	91	103	93	90	123	108	2	2	2	2	2	2	3	3	3	3
1740	110	123	131	77	88	96	133	125	137	121	3	3	3	3	3	3	3	3	3	3
1750	117	126	117	118	96	88	106	107	129	139	3	3	3	3	3	3	3	3	3	3
1760	90	116	59	58	49	67	78	64	48	97	4	4	4	4	4	4	4	4	4	4
1770	100	102	32	84	92	79	96	82	109	75	4	4	4	4	4	4	4	4	4	4
1780	89	110	90	84	94	74	83	89	103	63	4	4	4	4	4	4	4	4	4	4
1790	72	99	83	71	97	54	93	85	96	91	4	4	4	4	4	4	4	4	4	4
1800	113	73	87	76	82	85	119	110	110	154	4	4	4	4	4	4	4	4	4	4
1810	115	115	145	72	131	115	113	140	136	108	4	4	4	4	4	4	4	4	4	4
1820	115	149	139	122	90	74	97	65	82	67	4	4	4	4	4	4	4	4	4	4
1830	97	113	118	112	122	100	69	99	107	77	4	4	4	4	4	4	4	4	4	4
1840	89	91	79	100	99	99	100	99	106	138	4	4	4	4	4	4	4	4	4	4
1850	106	108	121	77	88	112	112	156	154	135	4	4	4	4	4	4	4	4	4	4
1860	146	140	137	138	131	121	115	68	109	116	4	4	4	4	4	4	4	4	4	4
1870	136	87	124	106	89	42	100	83	84	91	4	4	4	4	4	4	4	4	4	4
1880	187	147	129	113	123	91	91	77	79	53	4	4	4	4	4	4	4	4	4	4
1890	70	69	56	27	51	69	66	35	80	48	4	4	4	4	4	4	4	4	4	4
1900	94	106	77	81	85	64	57	77	50	38	4	4	4	4	4	4	4	4	4	4
1910	86	81	78	75	99	85	92	86	98	88	4	4	4	4	4	4	4	4	4	4
1920	90	113	120	145	120	127	142	111	113	139	4	4	4	4	4	4	4	4	4	4
1930	100	112	110	145	123	94	93	77	105	116	4	4	4	4	4	4	4	4	4	4
1940	114	115	83	94	105	82	121	82	101	103	4	4	4	4	4	4	4	4	4	4
1950	96	106	108	115	93	101	114	96	106	117	4	4	4	4	4	4	4	4	4	4
1960	95	127	67	113	152	123	115	94	85	112	4	4	4	4	4	4	4	4	4	4
1970	66	154	92	106	124						4	4	4	4	4					

## SITE AND COLLECTION INFORMATION

Site name *CERRO LOS LEONES*  
 Country *ARGENTINA* State or Province *RÍO NEGRO*  
 Latitude *41°05'S* Longitude *71°09'W* Altitude *1020 m*  
 Species collected *Austrocedrus chilensis*  
 Date of collection *8 December 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose*  
 No. of trees sampled *9* No. of cores *21* No. of discs *0*

### Site description:

*The site is on a prominent low steep-sided, fairly flat-topped hill about 16 kilometers east of the city of San Carlos de Bariloche, one kilometer east of the bridge over the Río Nirihuau, on the south side of the road leading to the town of Pilcaniyéu. A jeep trail leads from the north side into a low saddle between this hill and a much smaller one to the west. A moderately open stand of *Austrocedrus chilensis* covers the top and the gentler eastern slope. The trees are mostly small, with multiple stems and branches to the ground. Many show flagging due to the nearly constant wind from the west.*

*The soil is sandy, with some rocks. The ground cover is of varying density, with shrubs, forbs and bunch grasses, including small *Embothrium coccineum*, *Colletia spinosissima*, *Ephedra* sp., *Mulinum spinosum*, *Viola* sp., *Calceolaria* sp., and *Eryngium paniculatum*. This site is at the western edge of the Patagonian steppe, with annual rainfall of about 200 mm. At the time of collection there were continuous cold west winds with gusts.*

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1881 - 1964
No. of trees 6      No. of radii per tree 2	
Mean ring width (mm)	0.56
% locally absent rings	0.30
Analysis of variance:	
Estimated mean square of Y	0.041
Sources of variation, % variance	
Mean chronology	28
Differences between trees	34
Other	38
Cross-correlation analysis:	
Radii within trees	0.66
Radii among trees	0.29
Between tree means	0.32

## CHRONOLOGY STATISTICS

Identification	CLL479
Interval (A.D.)	1539 - 1974
No. of trees 6      Total no. of radii 17	
Autocorrelation	0.62
Standard deviation	0.26
Mean sensitivity	0.17
Mean standard error	0.11

CLL479  
 CFRRD LJS LEONFS  
 AUSTRORCEDRUS CHILENSIS

DATE	TREE RING INDICES									NUMBER OF SAMPLES										
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1539										45										1
1540	40	45	55	58	61	69	71	73	82	85	2	2	2	2	2	2	2	2	2	2
1550	107	113	127	129	88	93	94	91	89	97	2	3	3	4	4	4	5	5	5	5
1560	81	100	108	113	113	93	120	137	135	119	5	5	6	6	6	6	6	6	6	6
1570	107	190	104	92	118	98	118	110	64	66	6	6	6	6	6	6	6	6	6	8
1580	72	69	76	77	123	99	112	115	93	138	8	8	8	8	8	9	9	9	9	9
1590	134	141	108	108	96	87	115	136	116	76	9	9	9	9	9	9	9	10	10	10
1600	112	96	96	90	102	124	122	123	87	109	10	10	10	10	10	10	10	10	10	10
1610	99	74	82	92	94	80	84	105	102	114	10	10	10	10	10	10	10	10	10	10
1620	93	104	91	98	96	86	96	98	103	73	10	10	10	10	10	10	10	10	10	10
1630	105	97	82	103	105	133	116	114	103	88	10	10	10	10	10	10	10	10	10	10
1640	94	121	117	119	85	75	63	73	99	84	10	10	10	10	10	10	10	10	10	10
1650	99	89	134	176	145	78	115	144	149	143	10	10	10	10	10	10	10	10	10	10
1660	126	115	117	105	83	73	88	79	100	101	10	10	10	10	10	10	10	10	10	10
1670	94	117	97	75	114	150	103	106	101	129	10	10	10	10	10	10	10	10	10	10
1680	102	69	37	48	78	96	74	75	94	97	10	10	10	10	10	10	10	10	10	10
1690	88	79	99	62	80	89	90	71	83	85	10	10	10	10	10	10	10	10	10	10
1700	79	74	80	84	96	71	60	84	99	87	10	10	10	11	11	11	11	11	11	11
1710	72	79	87	111	81	91	87	82	76	92	11	11	11	11	11	11	11	11	11	11
1720	117	101	95	114	131	114	124	100	133	114	11	11	11	11	11	11	11	11	11	12
1730	94	117	118	83	94	111	87	97	101	109	12	12	12	12	12	12	12	12	12	12
1740	112	122	127	96	109	84	78	91	101	107	12	12	12	12	12	12	12	12	12	12
1750	117	92	88	75	78	94	99	85	78	88	12	12	12	12	12	12	12	12	12	12
1760	119	116	69	75	89	76	86	60	85	89	12	12	12	12	12	12	12	12	12	12
1770	57	69	73	72	98	102	116	110	102	66	12	12	12	12	12	12	12	12	12	12
1780	71	112	86	63	92	71	77	75	94	96	12	12	12	12	12	12	12	12	12	12
1790	134	109	111	77	95	93	96	131	124	61	12	12	12	12	12	12	13	13	13	13
1800	63	67	83	103	25	101	77	74	113	120	13	14	14	14	14	14	14	15	15	15
1810	99	106	126	39	64	69	103	91	79	78	15	15	15	15	15	15	14	14	11	11
1820	74	55	45	72	81	79	83	67	82	105	11	11	11	11	11	12	12	12	12	12
1830	127	115	110	122	134	118	106	107	110	110	12	13	13	13	13	13	13	13	13	13
1840	126	111	114	145	150	80	106	105	110	98	13	13	13	13	13	13	13	13	13	13
1850	102	83	127	118	94	117	127	124	110	85	13	13	13	13	13	13	13	13	13	13
1860	99	93	101	146	115	61	76	93	142	150	13	13	13	13	13	13	13	13	13	13
1870	142	117	122	95	124	101	115	62	109	129	13	13	13	13	13	13	13	13	13	13
1880	105	94	100	98	109	87	102	103	118	141	13	13	13	13	13	13	13	13	13	13
1890	136	117	120	81	92	92	74	68	131	108	13	13	13	13	13	13	13	13	13	13
1900	101	84	96	97	89	95	92	101	74	70	13	13	13	13	13	12	12	12	12	12
1910	84	76	67	57	81	111	110	91	126	88	12	12	12	12	12	12	12	12	12	12
1920	114	105	95	76	69	102	158	112	146	126	12	12	12	12	12	12	12	12	12	12
1930	126	125	126	145	126	164	125	127	175	152	12	12	12	12	12	12	12	12	12	12
1940	193	197	170	81	101	194	203	146	158	125	12	12	12	12	12	12	12	12	12	12
1950	107	146	141	125	155	157	141	79	107	141	12	12	12	12	12	12	12	12	12	11
1960	127	102	82	125	135	152	167	134	126	129	11	11	11	11	11	10	9	9	9	9
1970	113	132	142	132	144						9	9	9	9	9					

## SITE AND COLLECTION INFORMATION

Site name *EL MAITÉN*  
 Country *ARGENTINA* State or Province *RÍO NEGRO*  
 Latitude *41° 59' S* Longitude *71° 15' W* Altitude *710 m*  
 Species collected *Austrocedrus chilensis*  
 Date of collection *22 December 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose*  
 No. of trees sampled *7* No. of cores *19* No. of discs *0*

### Site description:

The site is on the south side of the road between the towns of El Bolsón and El Maitén, six kilometers west of the point where the road crosses the provincial border and 14 kilometers west of El Maitén. The site is in Río Negro province, although it is named for the nearest town, El Maitén, in Chubut province.

The stand of *Austrocedrus chilensis* is on a low ridge about one kilometer south of the road, and contains about 30 trees. It is the easternmost stand of *Austrocedrus* seen along the road. The sampled trees are on an 18° northeast-facing slope whose parent material is granite. Several trees have no branches toward the west, showing evidence of the constant west winds.

Associated vegetation includes *Lomatia hirsuta*, *Berberis* sp., *Fabiana imbricata*, *Colletia spinosissima*, *Mutisia spinosa*, *Mulinum spinosum*, *Acaena* sp., and *Eryngium umbellatum*.

## SAMPLE STATISTICS

Interval analyzed (A.D.)	1873 - 1975
No. of trees 5      No. of radii per tree 2	
Mean ring width (mm)	1.24
% locally absent rings	0.35
Analysis of variance:	
Estimated mean square of Y	0.066
Sources of variation, % variance	
Mean chronology	22
Differences between trees	25
Other	53
Cross-correlation analysis:	
Radii within trees	
Radii among trees	
Between tree means	0.26

## CHRONOLOGY STATISTICS

Identification	ELM477
Interval (A.D.)	1690 - 1974
No. of trees 5      Total no. of radii 13	
Autocorrelation	0.62
Standard deviation	0.30
Mean sensitivity	0.20
Mean standard error	0.11



ELM477  
 EL MAITEN  
 AUSTRORCEDRUS CHILFNSIS

DATE	TREE RING INDICES										NUMBER OF SAMPLES									
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1690	179	148	139	109	115	96	94	56	64	80	1	1	1	1	1	1	1	1	1	1
1700	67	57	50	58	66	105	105	83	77	114	1	1	1	1	1	1	1	1	1	1
1710	99	85	70	64	76	78	84	105	120	116	1	1	1	1	1	1	1	1	1	1
1720	79	90	108	98	91	144	147	138	152	168	1	1	1	1	1	1	1	1	1	1
1730	148	145	135	124	221	120	129	91	103	80	1	1	1	1	1	1	1	1	1	1
1740	56	74	74	112	117	113	71	85	58	88	1	1	1	1	1	1	1	1	1	1
1750	61	70	97	92	109	124	146	136	128	166	1	1	1	1	1	1	1	1	1	1
1760	115	90	136	154	75	140	130	117	105	104	2	2	2	2	2	2	2	2	3	3
1770	113	122	83	129	152	126	155	125	60	56	3	3	3	3	3	3	3	4	4	4
1780	53	67	68	56	70	68	64	75	80	74	4	4	4	4	4	4	4	4	4	4
1790	105	89	73	65	83	83	79	107	92	90	4	4	5	5	5	5	6	6	6	6
1800	113	89	86	106	111	151	154	86	136	127	6	6	6	6	6	6	7	7	7	7
1810	100	113	103	22	38	38	81	85	90	83	7	7	8	8	8	8	8	8	8	8
1820	68	67	86	96	103	78	75	47	78	92	8	8	8	8	8	8	9	9	9	9
1830	117	111	98	98	110	109	97	126	126	103	9	9	9	9	9	9	9	9	9	9
1840	80	94	93	135	149	106	106	117	122	152	9	9	9	9	9	9	9	9	9	9
1850	132	65	93	100	103	80	100	117	115	108	9	9	10	10	10	11	11	11	11	11
1860	114	103	125	148	152	90	100	81	115	116	11	11	11	11	11	11	11	11	11	12
1870	120	94	106	108	123	115	143	74	84	89	12	12	12	13	13	13	13	13	13	13
1880	72	65	74	86	68	60	102	128	133	155	13	13	12	13	13	13	13	13	13	13
1890	154	142	192	123	130	145	89	63	124	142	13	13	13	13	13	13	13	13	13	13
1900	126	116	99	103	91	109	55	81	54	56	13	13	13	13	13	13	13	13	13	13
1910	75	69	77	52	83	120	116	106	118	85	13	13	13	13	13	13	13	13	13	13
1920	75	89	69	71	87	108	120	125	130	138	13	13	13	13	13	13	13	13	13	13
1930	98	61	35	46	56	72	77	68	98	89	13	13	13	13	13	13	13	13	13	13
1940	130	119	147	83	87	106	140	120	126	107	13	13	13	13	13	13	13	13	13	13
1950	106	110	126	111	124	90	87	73	88	97	13	13	13	13	13	13	13	13	12	12
1960	127	108	57	78	79	107	105	128	77	87	12	12	12	12	12	12	12	12	12	12
1970	79	86	100	95	124						12	12	12	12	12					

**OTHER COLLECTIONS**

#### SITE AND COLLECTION INFORMATION

Site name *CORCOVADO NORTE*  
 Country *ARGENTINA* State or Province *CHUBUT*  
 Latitude *43° 29' S* Longitude *71° 33' W* Altitude *660 m*  
 Species collected *Nothofagus antarctica*  
 Date of collection *17 January 1976*  
 Collectors *R.L.Holmes, J.A.Boninsegna*  
 No. of trees sampled *4* No. of cores *12* No. of discs *0*

#### Site description:

*The stand is on the west side of the road, six kilometers north of the town of Corcovado, in a semihumid area although less humid than most places that Nothofagus antarctica grows. It is an open stand, associated with short grasses to 8 cm tall, and some shrubs (Berberis sp.) and forbs (Acaena sp.). Most of the trees have dead tops and slanted or twisted trunks.*

#### SITE AND COLLECTION INFORMATION

Site name *CORCOVADO OESTE*  
 Country *ARGENTINA* State or Province *CHUBUT*  
 Latitude *43° 36' S* Longitude *71° 42' W* Altitude *470 m*  
 Species collected *Austrocedrus chilensis*  
 Date of collection *17 January 1976*  
 Collectors *R.L.Holmes, J.E.Ambrose, J.A.Boninsegna, J.C.Quiroga*  
 No. of trees sampled *2* No. of cores *4* No. of discs *0*

#### Site description:

*Exploratory samples were taken from trees along the road west of the town of Corcovado toward Carrenleufú. Trees in this area tend to have full crowns and grow in dense stands. This is the southernmost group of Austrocedrus we saw, and very near the reported southern limit of its occurrence.*

#### SITE AND COLLECTION INFORMATION

Site name *ESQUEL OESTE*  
 Country *ARGENTINA* State or Province *CHUBUT*  
 Latitude *42° 59' S* Longitude *71° 25' W* Altitude *515 m*  
 Species collected *Maytenus boaria*  
 Date of collection *3 February 1976*  
 Collectors *R.L. Holmes, J.A. Boninsegna*  
 No. of trees sampled *2* No. of cores *4* No. of discs *0*

#### Site description:

*The site is 12 kilometers southwest of Esquel on the road to Lago Futalaufquen, about 120 meters to the northwest of the road and above it. The Maytenus are scattered in a pasture with a 10° south-southeast slope along with low bushes up to one meter tall.*

#### SITE AND COLLECTION INFORMATION

Site name *LAGO CISNE*  
 Country *ARGENTINA* State or Province *CHUBUT*  
 Latitude *42° 36' S* Longitude *71° 58' W* Altitude *560 m*  
 Species collected *Fitzroya cupressoides*  
 Date of collection *cut in 1962*  
 Collectors *J.C. Lerman, et al.*  
 No. of trees sampled *1* No. of cores *0* No. of discs *6*

#### Site description:

*This tree was cut with the cooperation of Los Alerces National Park, 600 meters west of the west end of Lago Cisne up the Río Navarro in a dense, humid forest of Fitzroya cupressoides and Nothofagus dombeyi. Various sections were cut from the tree, and one was stored at the Centro Atómico Bariloche. Cuts were obtained from this section containing the most nearly complete radii (the least rot).*

#### SITE AND COLLECTION INFORMATION

Site name *LAGO EPUYÉN*  
 Country *ARGENTINA* State or Province *CHUBUT*  
 Latitude *42°09'S* Longitude *71°33'W* Altitude *500 m*  
 Species collected *(See list below)*  
 Date of collection *cut in 1973 and 1974*  
 Collectors *R.L.Holmes, J.E.Ambrose*  
 No. of trees sampled *6* No. of cores *0* No. of discs *12*

#### Site description:

Discs were obtained, two per tree, at a lumber mill in the village of Epuyén. They come from the trees growing at the northwest end of Lago Epuyén in a fairly dense forest on moderate south to east slopes.

Species collected are *Austrocedrus chilensis* (four discs), *Nothofagus dombeyi* (four discs), *Lomatia hirsuta* (two discs) and *Maytenus boaria* (two discs).

#### SITE AND COLLECTION INFORMATION

Site name *RÍO CISNE*  
 Country *ARGENTINA* State or Province *CHUBUT*  
 Latitude *42°37'S* Longitude *71°54'W* Altitude *524 m - 600 m*  
 Species collected *Fitzroya cupressoides, Nothofagus dombeyi*  
 Date of collection *19, 20 December 1975*  
 Collectors *R.L.Holmes, J.E.Ambrose*  
 No. of trees sampled *33* No. of cores *77* No. of discs *0*

#### Site description:

Río Cisne is a short river connecting Lago Cisne to Brazo Norte del Lago Menéndez in Los Alerces National Park, accessible only by boat. Two subsites were sampled here. One is a steep ridge south of Río Cisne, encircled by a path, covered with a dense mature forest of the two sampled species, with heavy underbrush largely of *Chusquea* sp. The other subsite is a level, very humid dense forest of the same species near a swampy forest and adjacent to the lake shore just south of the mouth of Río Cisne.

SITE AND COLLECTION INFORMATION

Site name *RÍO FUTALEUFÚ*  
 Country ARGENTINA State or Province CHUBUT  
 Latitude 43° 11' S Longitude 71° 42' W Altitude 550 m  
 Species collected *Austrocedrus chilensis*  
 Date of collection 16 January 1976  
 Collectors R.L.Holmes, J.E.Ambrose, J.A.Boninsegna, J.C.Quiroga  
 No. of trees sampled 7 No. of cores 21 No. of discs 0

Site description:

The site is 36 kilometers southwest of Trevelin, three kilometers east of the ferry across the Río Futaleufú and the Gendarmería Río Grande at Los Cipreses. The stand is on a steep (42°) north-facing talus slope 600 meters south of the road. The ground surface is mostly large rocks. The moderately open stand is associated with *Mulinum spinosum*, *Mutisia decurrens* and *Colletia spinosissima*.

SITE AND COLLECTION INFORMATION

Site name TREVELIN  
 Country ARGENTINA State or Province CHUBUT  
 Latitude 43° 09' S Longitude 71° 22' W Altitude 700 m  
 Species collected *Maytenus boaria*  
 Date of collection 17 January 1976  
 Collectors R.L.Holmes, J.A.Boninsegna  
 No. of trees sampled 2 No. of cores 4 No. of discs 0

Site description:

Scattered *Maytenus boaria* growing in a pasture of grasses 25 cm tall were sampled exploratorily at a point about 10 kilometers southeast of Trevelin along the road to Corcovado some 170 meters from it.

## SITE AND COLLECTION INFORMATION

Site name *MENDOZA*  
 Country *ARGENTINA* State or Province *MENDOZA*  
 Latitude *32°00'-32°45'* Longitude *69°00'-70°07'W* Altitude *1300 - 3500 m*  
 Species collected *(See list below)*  
 Date of collection *Cut in 1975*  
 Collectors *A.E. Corte, J.A. Boninsegna*  
 No. of trees sampled *16* No. of cores *0* No. of discs *16*

### Site description:

Sections were cut from thirteen species of trees and large shrubs growing in the arid foothills and high mountains of the Andean Cordillera to the north and west of the city of Mendoza. This was exploratory sampling. The following are the species collected and the altitude where each was found.

<u>Species</u>	<u>Family</u>	<u>Altitude</u>
<u><i>Azorella nucamentacea</i></u>	(Umbelliferae)	3500 m
<u><i>Baccharis salicifolia</i></u>	(Compositae)	1800 m
<u><i>Berberis grevilleana</i></u>	(Berberidaceae)	1800 m
<u><i>Bulnesia retama</i></u>	(Zygophyllaceae)	1900 m
<u><i>Cercidium australe</i></u>	(Leguminosae)	1800 and 2250 m
<u><i>Colletia spinosissima</i></u>	(Rhamnaceae)	1300 and 1800 m
<u><i>Larrea divaricata</i></u>	(Zygophyllaceae)	1800 m
<u><i>Larrea nitida</i></u>	(Zygophyllaceae)	1800 m
<u><i>Monttea aphylla</i></u>	(Scrophulariaceae)	1800 and 2250 m
<u><i>Proustia cuneifolia</i></u>	(Compositae)	1800 m
<u><i>Schinus molle</i></u>	(Anacardiaceae)	2250 m
<u><i>Schinus molle</i> var. <i>areira</i></u>	(Anacardiaceae)	1300 m
<u><i>Schinus polygamus</i></u>	(Anacardiaceae)	1800 m

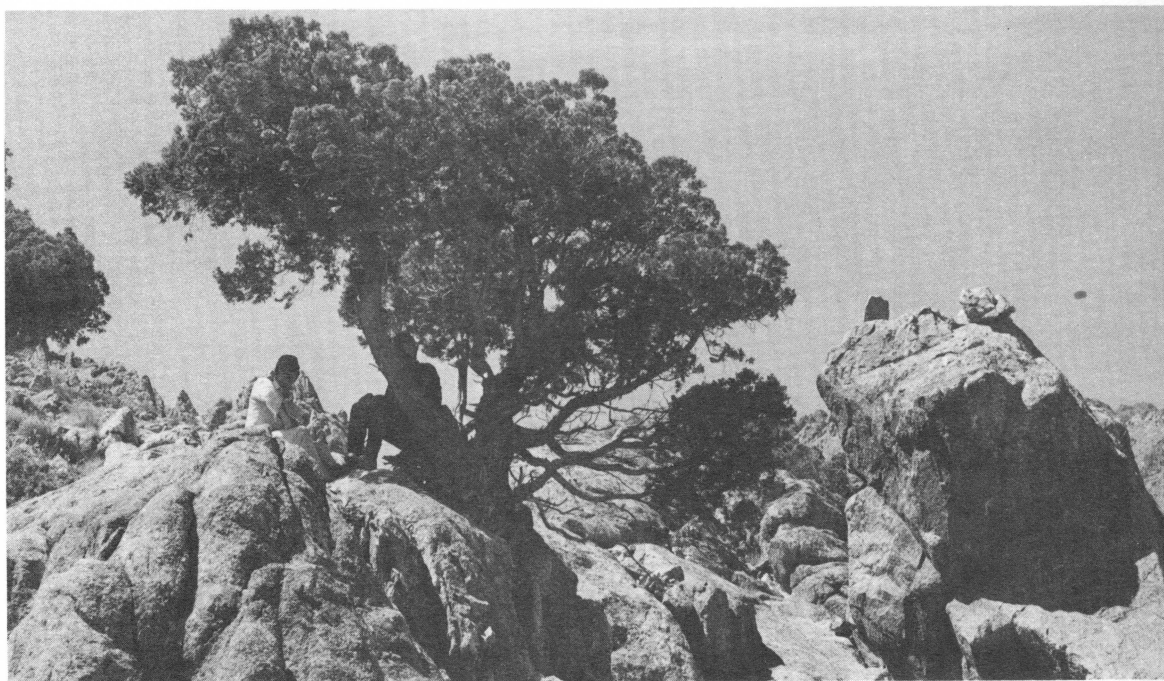


Plate 5. *Austrocedrus chilensis* growing among rocks, Huinganco site, Neuquén Province.

### SITE AND COLLECTION INFORMATION

Site name ARROYO CULEBRA  
 Country ARGENTINA State or Province NEUQUÉN  
 Latitude 40° 14' S Longitude 71° 22' W Altitude 1020 m  
 Species collected *Nothofagus obliqua*  
 Date of collection 10 January 1978  
 Collectors R.L.Holmes, J.A.Boninsegna  
 No. of trees sampled 2 No. of cores 7 No. of discs 0

#### Site description:

The site is ten kilometers along the road from San Martín de Los Andes south toward Paso Córdoba. A dense stand of *Nothofagus obliqua* with some *Nothofagus antarctica* grows on a 20° north-facing slope 400 meters east of the road and 300 meters south of and above Arroyo Culebra.

### SITE AND COLLECTION INFORMATION

Site name BARILOCHE Area  
 Country ARGENTINA State or Province NEUQUÉN and RÍO NEGRO  
 Latitude 41° 46' S Longitude 71° 38' W Altitude 800 m - 850 m  
 Species collected (See description below)  
 Date of collection 21, 23 October 1975  
 Collectors V.C.LaMarche, R.L.Holmes, J.E.Ambrose, G.Gallopin  
 No. of trees sampled 13 No. of cores 17 No. of discs 0

#### Site description:

Exploratory samples were taken from five species of trees (*Austrocedrus chilensis*, *Nothofagus dombeyi*, *Nothofagus antarctica*, *Maytenus boaria* and *Lomatia hirsuta*) on various locales on the north side of Lago Nahuel Huapi, to the northeast toward Confluencia, and to the east toward Pilcaniyéu. All samples are from trees growing near the road.



#### SITE AND COLLECTION INFORMATION

Site name *ESTANCIA CHACABUCO*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *40°40'S* Longitude *71°00'W* Altitude *900 m*  
 Species collected *Austrocedrus chilensis*  
 Date of collection *10 December 1975*  
 Collectors *R.L. Holmes, J.E. Ambrose*  
 No. of trees sampled *3* No. of cores *5* No. of discs *0*

#### Site description:

*The site is 16 kilometers northeast of Confluencia (Trafal), four kilometers west of Estancia Chacabuco, and two kilometers north of the road, near Arroyo Malalhuanca. The sampled stand of Austrocedrus is the easternmost seen from the Bariloche - Neuquén highway. The trees are on a rounded rocky hill with relatively dense ground cover of bunch grasses, Viola sp., Mulinum spinosum, Astragalus sp., and Verbascum thapsus. The stand contains some 60 trees, most with well developed crowns, some with a little flagging from the wind. Reproduction is in evidence.*

#### SITE AND COLLECTION INFORMATION

Site name *ESTANCIA COLLÚN-CO*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *40°01'S* Longitude *71°15'W* Altitude *1060 m*  
 Species collected *Araucaria araucana, Austrocedrus chilensis*  
 Date of collection *11 January 1978*  
 Collectors *R.L. Holmes, J.A. Boninsegna, J.C. Quiroga*  
 No. of trees sampled *11* No. of cores *27* No. of discs *0*

#### Site description:

*The site is some 10 kilometers northeast of Lago Lolog on the road to Junín de los Andes. The sampled stand is in a canyon 2.5 kilometers southeast of the road near Puesto Mallín Largo on the Estancia Collún-co. At the bottom of the canyon is a dense forest of Austrocedrus chilensis, the dominant species, with some Araucaria araucana interspersed throughout. Halfway up the canyon the dense forest ends abruptly with a well-defined edge. Widely scattered Austrocedrus chilensis grow farther up the slope. This is a mesic site; nearly all Austrocedrus chilensis here appear very young. Associated vegetation is Lomatia hirsuta, grasses, and low shrubs to 1.5 meters tall.*

#### SITE AND COLLECTION INFORMATION

Site name PASO DE ICALMA  
 Country ARGENTINA State or Province NEUQUÉN  
 Latitude 38° 56' S Longitude 71° 25' W Altitude 1500 m  
 Species collected Araucaria araucana  
 Date of collection cut in February 1975  
 Collectors R.L.Holmes, J.E.Ambrose  
 No. of trees sampled 5 No. of cores 0 No. of discs 5

#### Site description:

Discs were cut from the ends of logs in a plywood factory in the city of Neuquén. They come from a large dense stand of Araucaria araucana growing on the northwest side of Lago Moquehue near Paso de Icalma and very close to the Chilean border.

#### SITE AND COLLECTION INFORMATION

Site name RAHUE OESTE  
 Country ARGENTINA State or Province NEUQUÉN  
 Latitude 39° 24' S Longitude 70° 51' W Altitude 1050 m  
 Species collected Austrocedrus chilensis  
 Date of collection 2 November 1975  
 Collectors V.C.LaMarche, R.L.Holmes, J.E.Ambrose, J.A.Boninsegna  
 No. of trees sampled 3 No. of cores 3 No. of discs 0

#### Site description:

The site is a very steep and rocky volcanic plug about 10 kilometers east of the village of Rahue and four kilometers west of the steep slope called Bajada de Rahue. Exploratory sampling of the very few trees growing near the top of the plug showed them to be young and complacent.

#### SITE AND COLLECTION INFORMATION

Site name *REÑILEUVÚ*  
 Country *ARGENTINA* State or Province *NEUQUÉN*  
 Latitude *37° 20' S* Longitude *71° 07' W* Altitude *1470 m*  
 Species collected *Araucaria araucana*  
 Date of collection *13 February 1977*  
 Collectors *R.L. Holmes, J.A. Boninsegna, J.C. Quiroga, R. Fuentes*  
 No. of trees sampled *1* No. of cores *4* No. of discs *0*

#### Site description:

From the village of El Cholar, a road runs west through Chochoy Mallín, along the Río Reñileuvú to the Moncol post of the Gendarmería Nacional. From there it is some five kilometers northwest on horseback to the northernmost known occurrence of *Araucaria araucana*. There is only one tree at the site, on a  $8^{\circ}$  south-southeast slope adjacent to a thicket of *Nothofagus antarctica*. Bunch grasses (*Stipa* sp.) cover the ground away from the thicket. Another smaller tree can be seen some seven kilometers to the south of this one, but it was not visited.

#### SITE AND COLLECTION INFORMATION

Site name *BRAZO RICO*  
 Country *ARGENTINA* State or Province *SANTA CRUZ*  
 Latitude *50° 27' S* Longitude *72° 49' W* Altitude *300 m - 340 m*  
 Species collected *Nothofagus pumilio*  
 Date of collection *23 January 1976*  
 Collectors *R.L. Holmes, J.E. Ambrose, J.A. Boninsegna, J.C. Quiroga*  
 No. of trees sampled *7* No. of cores *27* No. of discs *0*

#### Site description:

The site is on the south edge of Península Magallanes which is surrounded on three sides by arms of Lago Argentino. Sampled trees are eight kilometers west of the bridge over the Río Mitre and one kilometer west of the National Park campsite. They are on a  $15^{\circ}$  southeast slope some 200 to 500 meters from the lake edge. Soil is deep, not rocky. The forest is dense *Nothofagus pumilio* with small plants and grasses 10 cm tall.

#### SITE AND COLLECTION INFORMATION

Site name CERRO BUENOS AIRES  
 Country ARGENTINA State or Province SANTA CRUZ  
 Latitude 50°22'S Longitude 72°47'W Altitude 490 m - 870 m  
 Species collected *Nothofagus pumilio*  
 Date of collection 22 January 1976  
 Collectors R.L.Holmes, J.E.Ambrose, J.A.Boninsegna  
 No. of trees sampled 15 No. of cores 52 No. of discs 0

#### Site description:

The site is a northeast-facing mountainside (Cerro Buenos Aires) about six kilometers south of the western end of Lago Argentino, 40 kilometers by road west of the town of Calafate. At a road intersection is the Estancia Cerro Buenos Aires; the mountain is just west of the estancia. It is very near the easternmost occurrence of *Nothofagus pumilio* at this latitude. This mountain was selected for sampling because it exhibits both lower and upper limits of the *Nothofagus pumilio* forest.

At the lower limit sampling was done in a dense forest of tall (8 meters to 15 meters) *Nothofagus pumilio* on a 27° northeast slope. Midway up a similar forest was sampled. Near the upper limit the trees become stunted; sampling was done where the trees are still of some size (three meters to five meters tall) on a 33° east-facing slope, but below the tree line.

#### SITE AND COLLECTION INFORMATION

Site name ESTANCIA TEPI  
 Country ARGENTINA State or Province TIERRA DEL FUEGO  
 Latitude 54°16'S Longitude 67°23'W Altitude 200 m  
 Species collected *Nothofagus antarctica*  
 Date of collection 29 January 1976  
 Collectors J.A.Boninsegna, J.C.Quiroga  
 No. of trees sampled 2 No. of cores 4 No. of discs 0

#### Site description:

The site is 50 to 100 meters southeast of the road, some 40 kilometers north of the east end of Lago Fagnano toward Río Grande. Exploratory sampling was done on a nearly level area with dense patches of *Nothofagus antarctica*.

In Tierra del Fuego *Nothofagus antarctica* usually displays more robust growth, less rot in the trunk and less dead tops than on the mainland.

#### SITE AND COLLECTION INFORMATION

Site name *KOSOBO*  
 Country *ARGENTINA* State or Province *TIERRA DEL FUEGO*  
 Latitude *54° 37' S* Longitude *67° 26' W* Altitude *200 m*  
 Species collected *Nothofagus pumilio*  
 Date of collection *cut in September 1974*  
 Collectors *R.L.Holmes, J.E.Ambrose, J.A.Boninsegna, J.C.Quiroga*  
 No. of trees sampled *2* No. of cores *0* No. of discs *2*

#### Site description:

*Cross sections were cut from the ends of logs in a lumber mill, which came from trees growing on the slopes above the south shore of Lago Fagnano near its eastern end about at Puerto Kosobo. Vegetation type there is dense sub-Antarctic forest.*

#### SITE AND COLLECTION INFORMATION

Site name *LAGO ROCA*  
 Country *ARGENTINA* State or Province *TIERRA DEL FUEGO*  
 Latitude *54° 49' S* Longitude *68° 34' W* Altitude *15 m*  
 Species collected *Nothofagus pumilio* and *Nothofagus betuloides*  
 Date of collection *28 January 1976*  
 Collectors *R.L.Holmes, J.E.Ambrose, J.A.Boninsegna*  
 No. of trees sampled *7* No. of cores *26* No. of discs *0*

#### Site description:

*The site is in Tierra del Fuego National Park on the northeast shore of Lago Roca near its eastern end, and also near the Chilean border which bisects the lake. A trail leads from the Hosteria Alakush (a hotel) at Lapataia along the lake shore. Samples were taken from a dense stand of trees on a 35° southwest slope some two kilometers along the trail. *Nothofagus pumilio* dominates the stand, with a few *Nothofagus betuloides* scattered throughout.*

#### SITE AND COLLECTION INFORMATION

Site name *LAPATAIA*  
 Country *ARGENTINA* State or Province *TIERRA DEL FUEGO*  
 Latitude *54°51'S* Longitude *68°36'W* Altitude *30 m*  
 Species collected *Nothofagus pumilio*  
 Date of collection *28 January 1976*  
 Collectors *R.L. Holmes, J.E. Ambrose, J.A. Boninsegna, J.C. Quiroga*  
 No. of trees sampled *8* No. of cores *28* No. of discs *0*

#### Site description:

*The site is in Tierra del Fuego National Park near the end of the road at Lapataia. On a low rocky ridge 600 meters south of the south-east end of Lago Roca, very near a place called "Archipiélago de los Cormoranes" is an open stand of *Nothofagus pumilio* with a moderate to dense underbrush. The slope angle is variable; trees were sampled on slopes facing southwest to east.*

#### SITE AND COLLECTION INFORMATION

Site name *PASO GARIBALDI*  
 Country *ARGENTINA* State or Province *TIERRA DEL FUEGO*  
 Latitude *54°43'S* Longitude *67°47'W* Altitude *320 m*  
 Species collected *Nothofagus betuloides*  
 Date of collection *29 January 1976*  
 Collectors *R.L. Holmes, J.A. Boninsegna*  
 No. of trees sampled *1* No. of cores *3* No. of discs *0*

#### Site description:

*Exploratory sampling was done at a point along the road between Ushuaia and Lago Fagnano, four kilometers north of Paso Garibaldi, in a dense forest of *Nothofagus betuloides* and *Nothofagus pumilio* on a 40° north-facing slope below the road (therefore a disturbed site).*



Plate 6. *Austrocedrus chilensis* above the Río Neuquén,  
Huinganco site, Neuquén Province.

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