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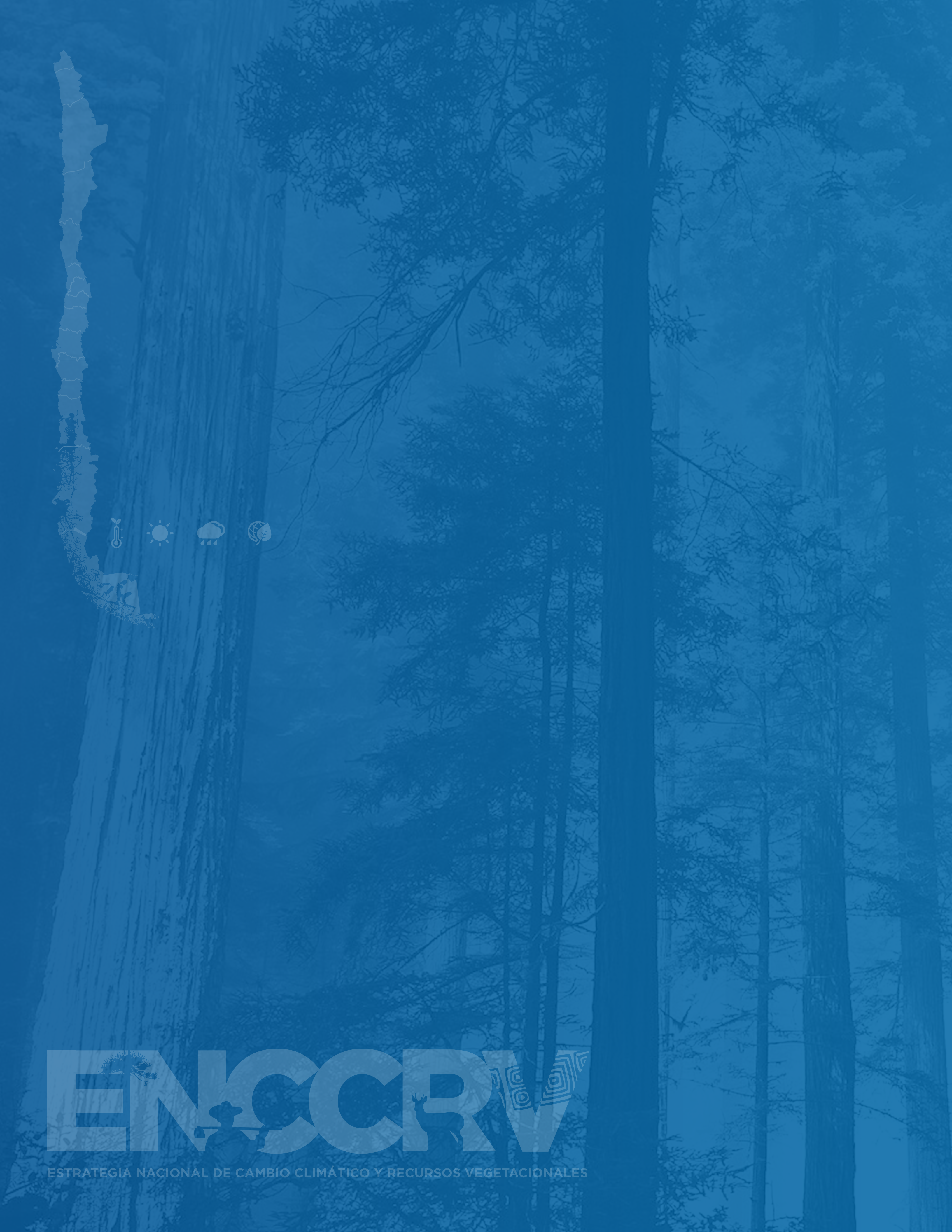
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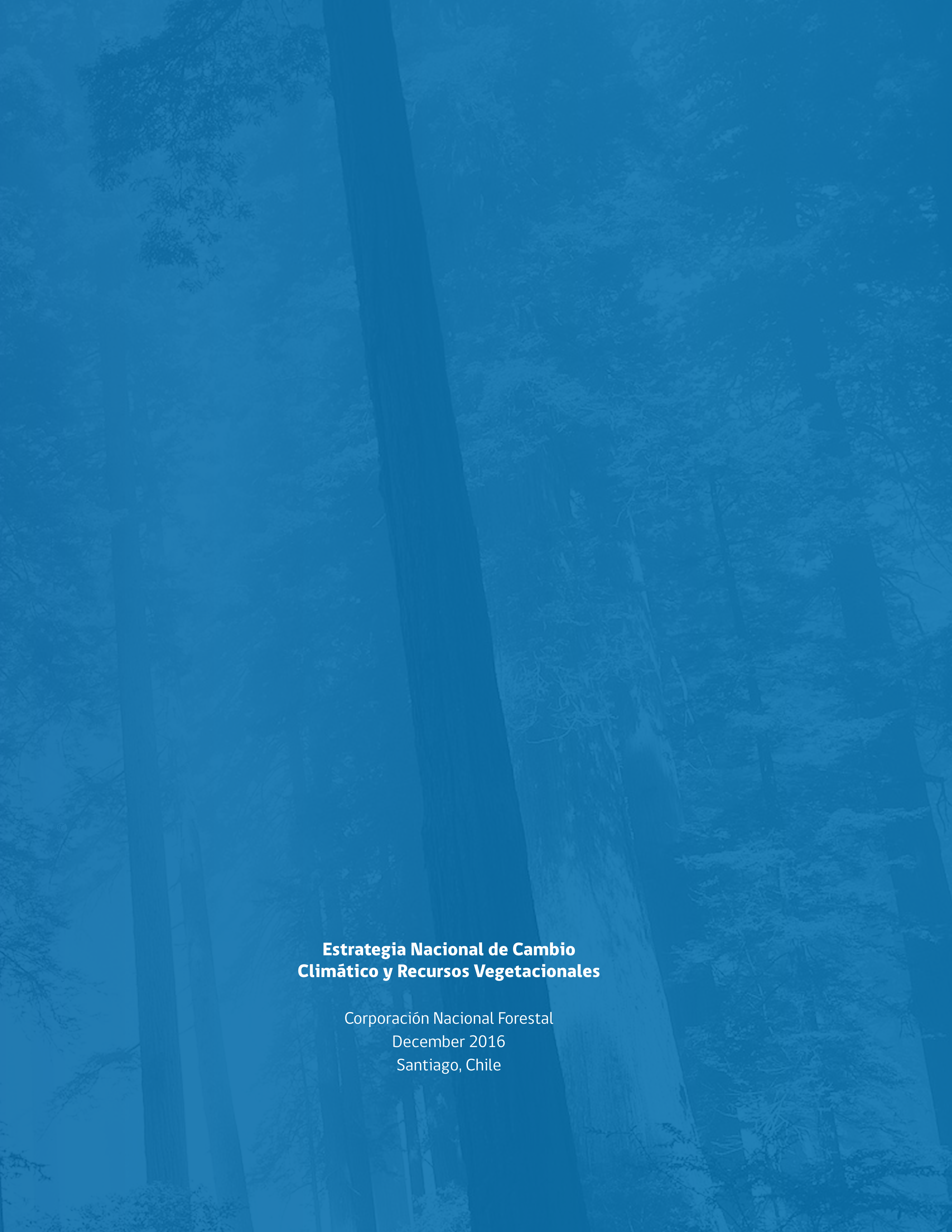

Estrategia Nacional de Cambio Climático y Recursos Vegetacionales

Corporación Nacional Forestal
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Santiago, Chile

Annex: Selection of Regional EFS

Javier Cano[1], Felipe Casarim[2], Gabriel Sidman[2], Anna McMurray[2], Tim Pearson[2], Carlos Bahamondez[3], Yasna Rojas[3].

The purpose of this document is to justify the selection of regional emission factors (EFs) used to estimate emissions from deforestation in the Reference Level (RL) included in Chile's Emissions Reduction Program Document (ERPD). This justification was developed in response to a request coming from the Technical Advisory Panel's (TAP) evaluation process for more background on the topic.

Although the practice in most countries is to use EFs based on a stratification related to forest types and/or structures, in the case of the Emissions Reduction (ER) Program Area, Chile has estimated that the use of regional EFs represents national reality better and maintains consistency with other official country documents, such as the Forest Emission Reference Level/Forest Reference Level (FREL/FRL) submitted to the UN Framework Convention on Climate Change (UNFCCC) or the National Greenhouse Gas Inventory (INGEI for its initials in Spanish), an aspect which fulfills Criterion 10 of the Methodological Framework of the Forest Carbon Partnership Facility (FCPF).

In the first place, it is important to note that for the estimations of emissions from land use changes, made in the INGEI, as well as for the estimation of deforestation emissions established in the FREL/FRL, regional EFs were used. These regional EFs were generated based on stocks in terms of cubic meters of solid volume without bark (m3 under bark), coming from the National Forest Institute's (INFOR) Continuous Forest Inventory. The details on these data used for the generation of the regional EFs can be found in the Inventory's 2011 report. Through expert analysis, the National System of Inventories of Chile (SNIChile) established as an assumption that deforested forests contain 50% of the average biomass stock.

The estimation of volume at a regional scale is generated by weighting volume estimations by cluster based on the area of each forest type in each region.

On the other hand, in accordance the suggestions made by TAP, with the objective of strengthening this selection, a series of circumstances have been analyzed based on Chile's geo/climatic characteristics with a large latitudinal range, the subnational character of ER Program Area, the size and variability of the distribution of Forest Types and the statistical error produced from aggregating clusters.

[1] Corporación Nacional Forestal de Chile (CONAF)
[2] Winrock International
[3] Instituto Forestal de Chile (INFOR)

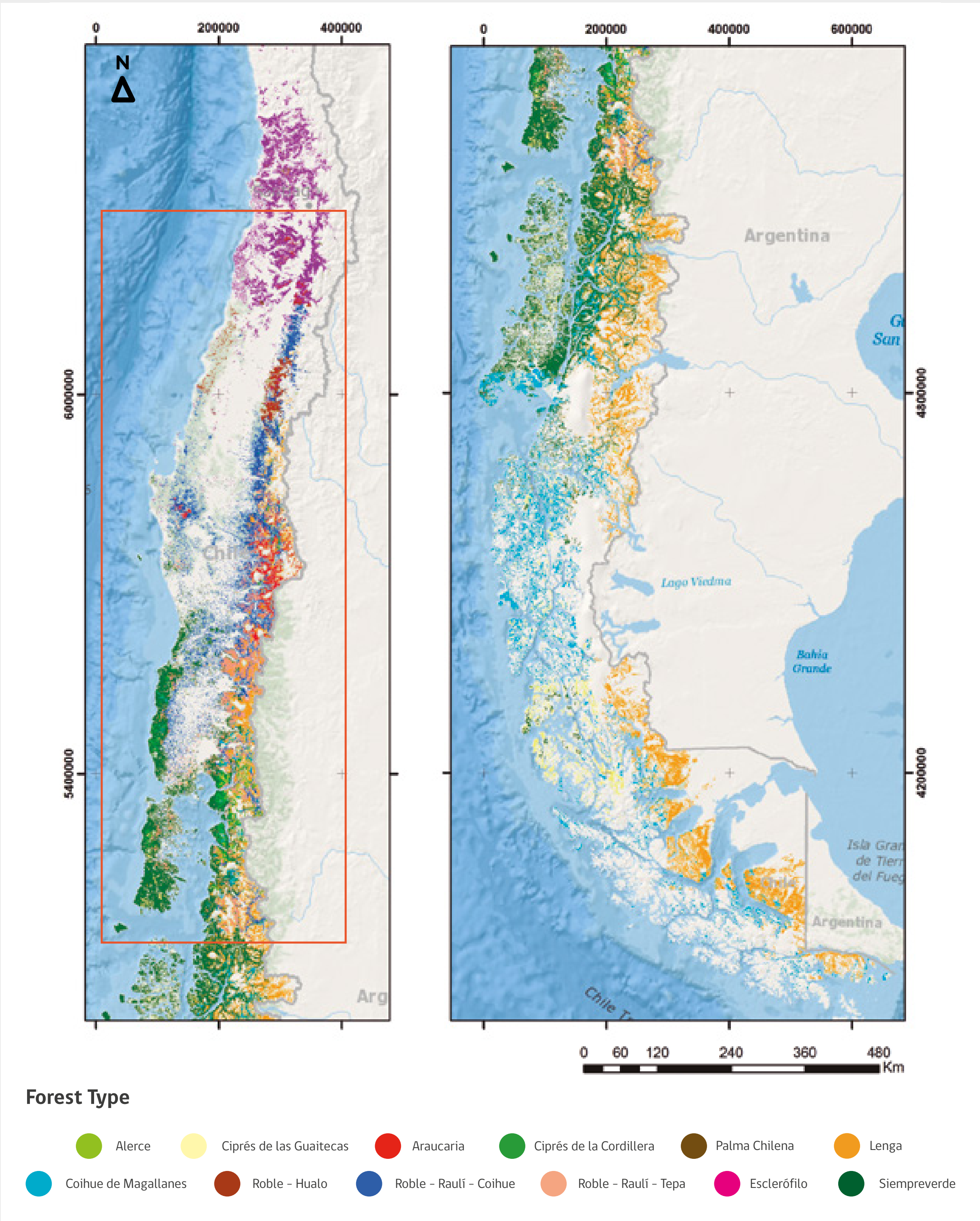
Distribution and Representation of Forest Types

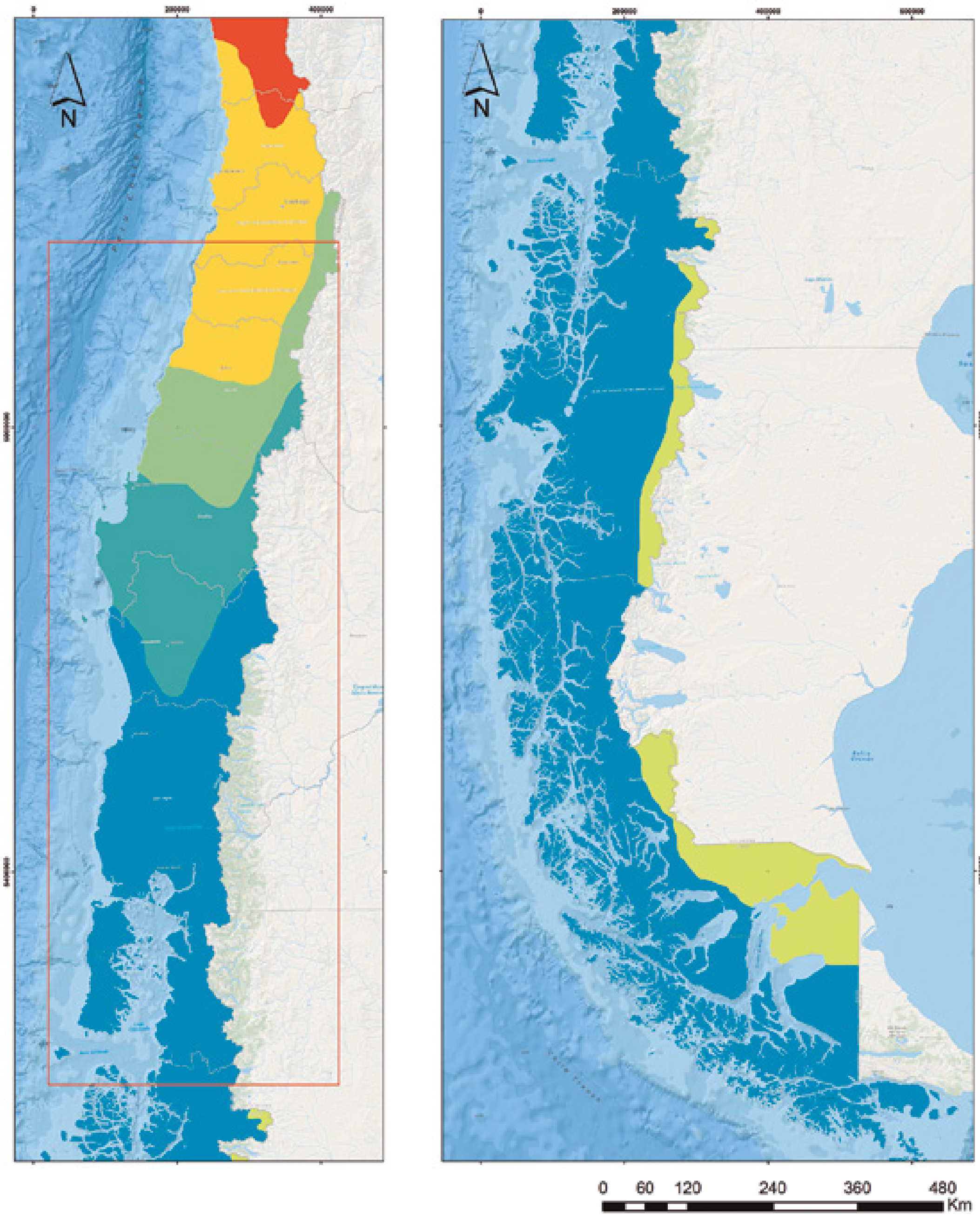
It is important to highlight the distribution and representation of forest types in the ER Program Area, as can be seen in Table 1. Of the 11 present forest types in the ER Program Area, only 4 are exclusively found in these 5 regions (Alerce, Araucaria, Roble-Raulí-Coihue y Coihue-Raulí-Tepa). Highlighting two particular case, Lenga makes up almost 1 million hectares and has a representation of 25%, and Siempreverde makes up 1.5 million hectares and has a representation of 44%.

Table 1. Distribution of forest types within and outside of the Emissions Reduction Program Area.

	Forest Type (ha)										
Región	**Alerce**	**Ciprés de las Guaitecas**	**Araucaria**	**Ciprés de la Cordillera**	**Lenga**	**Coihue de Magallanes**	**Roble-Hualo**	**Roble-Raulí-Coihue**	**Coihue-Raulí-Tepa**	**Esclerófilo**	**Siempre verde**
ER Program Area	216.130	43.171	253.339	59.849	906.740	130.839	175.697	1.602.588	841.701	71.520	1.551.814
Rest of Country	-	536.796	-	3.026	2.714.465	1.868.512	44.759	-	-	1.282.905	1.950.736
ER Program Area	100%	7%	100%	95%	25%	7%	80%	100%	100%	5%	44%
Rest of Country	0%	93%	0%	5%	75%	93%	20%	0%	0%	95%	56%

As can be seen in the Forest Type distribution map and the Aridity Index (Figure 1), the climatic distribution of Chile has a latitudinal characterization that fits, to a large extent, the regional administrative divisions. The distribution of Forest Types is very heterogeneous in the ER Program Area, with certain predominant Forest Types in the Mediterranean and Southern Macro zones.


0
200000
400000
600000
6000000
5400000
4800000
4200000
N
Argentina
Lago Viedma
Bahía Grande
0 60 120 240 360 480
Km
Forest Type
Alerce
Ciprés de las Guaitecas
Araucaria
Ciprés de la Cordillera
Palma Chilena
Lenga
Coihue de Magallanes
Roble - Hualo
Roble - Raulí - Coihue
Roble - Raulí - Tepa
Esclerófilo
Siempreverde



Index of aridity of the Ministry of the Environment

- Hiperhúmeda
- Subhúmeda
- Semiárida
- Árida
- Húmeda
- Semiárida Estepárica Fría
- Árida Estepárica de Altura
- Hiperárida

Statistical error of the continous forest inventory estimations

With respect to the statistical error of the estimations of the Continuous Forest Inventory, the aggregation at the regional level leads to errors of between 17.03% and 19.34%, significantly lower than the statistical errors resulting from aggregation by forest type and region, as can be seen in Table 2, a determining factor being the sampling "n" of each category[1].

Table 2. Errors in the estimation of volume by Region and by Forest Type and Region.

Region	Vol Error (m3/ha)	Forest Type	Vol Error (m3/ha)
Maule	19.14%	Esclerófilo	28.28%
		Roble-Raulí-Coihue	34.13%
		Roble-Hualo	26.11%
BioBĪo	17.02%	Siempreverde	133.00%
		Esclerófilo	S/I
		Roble-Hualo	70.65%
		Roble-Raulí-Coihue	17.06%
Araucanía	19.33%	Roble-Raulí-Coihue	14.31
		Siempreverde	113.26
		Coihue-Raulí-Tepa	52.05%
Los RĪos	18,00%	Roble-Raulí-Coihue	23.93%
		Siempreverde	28.75%
		Coihue-Raulí-Tepa	33.35%
Los Lagos	17.60%	Alerce	60.91%
		Roble-Raulí-Coihue	33.44%
		Siempreverde	23.43%
		Coihue-Raulí-Tepa	59.54%

The methodology for estimating the error, extracted from Forest Resources in Chile, INFOR, 2011, is described below, as explained in the chapter "Estimation from sample units to the total population".

Starting from the sample units defined in the sample design y from the average final number in the field data collection, statistics are calculated that reflect the quality of the estimation by way of describing the statistical uncertainty associated with the estimates.

[1] The original data from the ground measurements of the clusters used in the estimations can be reviewed in the Annex Continuous Inventory Data http://www.enccrv-chile.cl/index.php/descargas/nivel-de-referencia/52-anexo-datos-inventario-continuo/file

Thus, the estimates of volumetric stocks in m^3 under bark of the population are:

Calculation of the total mean and total stocks

$$\mu = \Sigma_{mn} V_{ij} / MN$$

Where,

μ = Total estimated mean in m^3 under bark by hectare
V_{ij} = Solid cubic volume in feet on plot *i(i=1,N)* of the cluster *j(j=1,M)*

Calculation of the variance of the total mean

The total sample mean variance is estimated as a classic two-stage sample for an infinite population according to:

$$Var(\mu) = \frac{\sum_j^M n_j (v_i - \mu)^2}{(\sum_j^M n_j)(m - 1)}$$

Where,

v_i = Mean volume per hectare of cluster *j* in m^3 under bark
μ = Total mean volume of the study area
n_j = Number of secondary plots of cluster *j*
m = Total number of primary units

With,

$$\sum_j^M n_j = mn_j$$

Calculation of the variance of the total mean:

The calculation of the error of the total average and therefore of the estimated stocks is calculated as:

$$Error(\mu) = t_g \hat{S}$$

With,

$Error(\mu)$ = Absolute error of the total mean in m^3 under bark
$\hat{S}$ = Standard deviation of the mean in m^3 under bark

Similarly, the above expressions are applied to the degraded estimation schemes, such as calculations of stocks at the regional and provincial levels and by forest type and their respective sampling errors.

Analysis of statistical significance

To identify statistically significant forest strata, data were analyzed on aboveground biomass per hectare for different forest types, as well as for different forest structures and canopy coverage, as these classes are all mapped by the Cadaster. The analyzed forest types included Alerce (AL), Araucaria (AR), Ciprés de la Cordillera (CC), Coihue de Magallanes (CM), Coihue-Raulí-Tepa (CRT), Esclerófilo (ES), Lenga (LE), Roble-Haulo (RH), Roble-Raulí-Coihue (RRC), and Siempreverde (SV). The forest structures included achaparrado (stunted) forests, secondary (renoval) forests, adult-secondary (adulto-renoval), and adult forests. The coverage levels included open, semi-dense, and dense forests.

Information on biomass for the different forest types was included from 2002 in the regions Biobío, Maule, la Araucanía, Los Ríos y Los Lagos, and information on biomass for different forest structures and coverage levels was also included from 2002 in the same regions. In each of these categories, biomass values for certain classes were not normally distributed, as illustrated by the histograms for forest structure in Figure 2. Therefore, non-parametric statistical tests were used to identify significantly different strata.

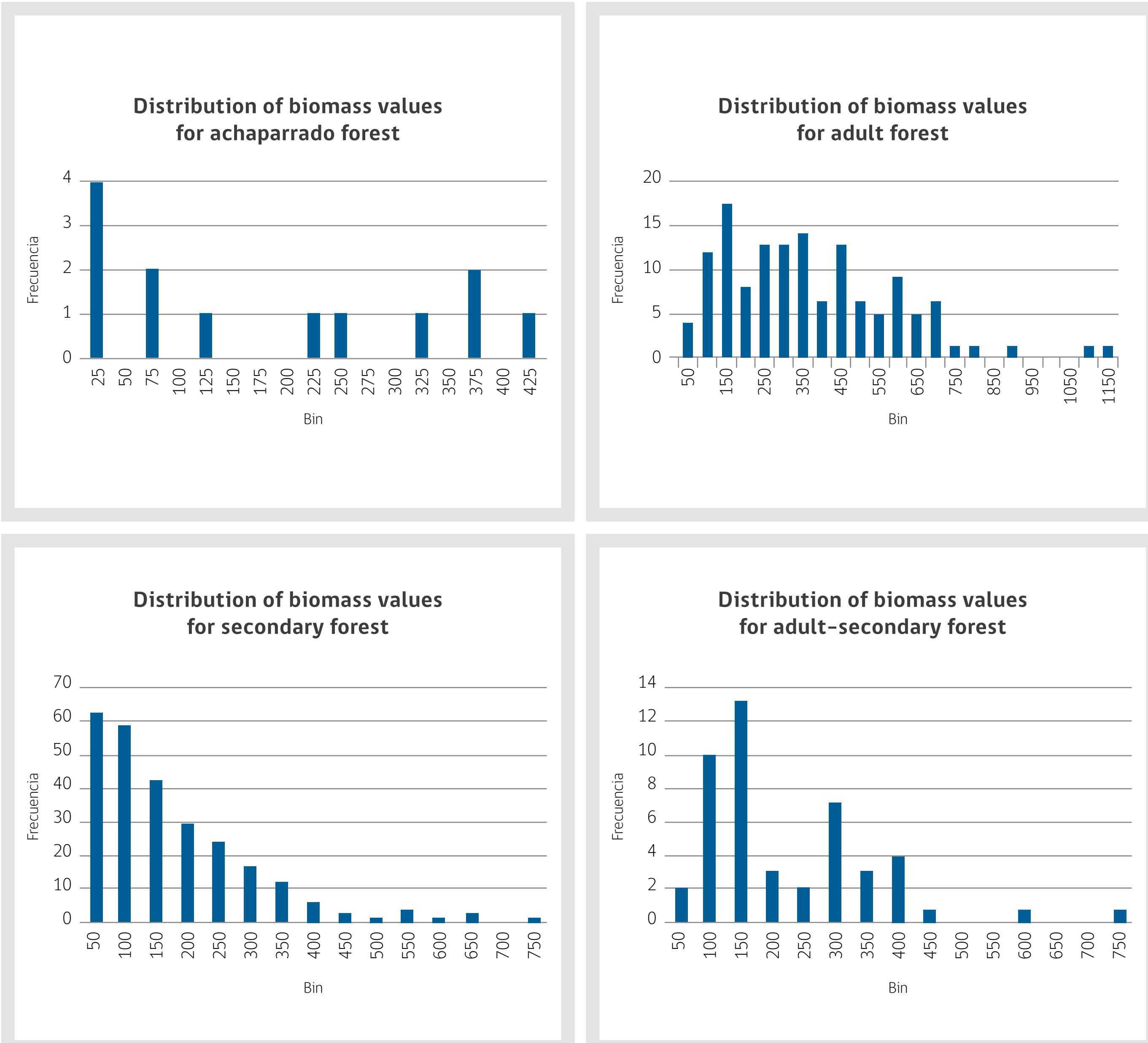


Figure 2. Distribution of different forest structure classes.

Before running the analyses, any observations with a biomass value of 0 were removed, since colleagues at INFOR reported these were likely errors in the database.

Box plots were created to visualize the distributions of biomass in the different categories (Figures 1-3). The bands in the box represent the median biomass values, the top of the boxes represent the third quartile of the data, the bottom of the boxes represents the first quartile, the top of the lines (frequently referred to as whiskers) represent the 95% percent confidence interval of the median. The points outside the whiskers are outlier values.

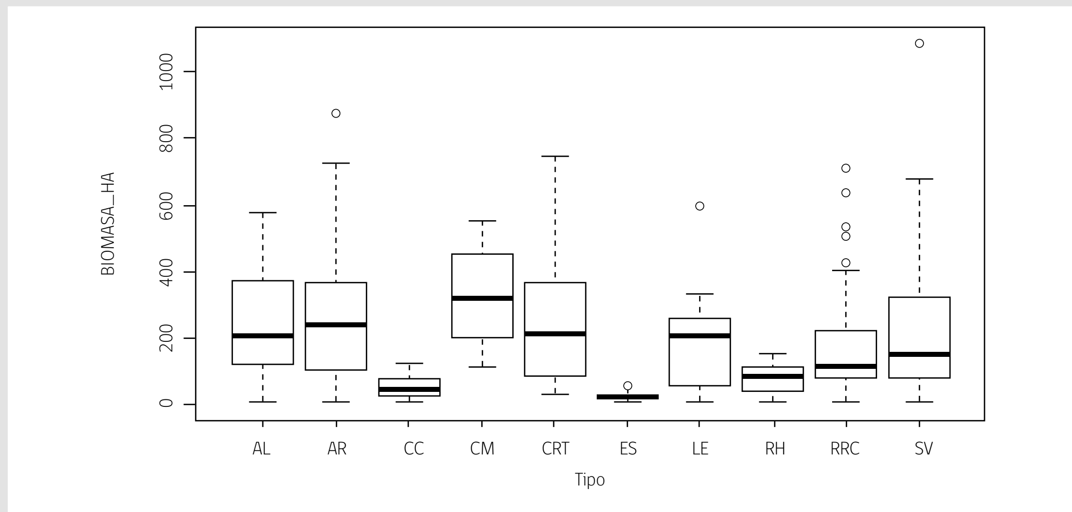


Figure 3. Box plot of biomass per hectare values for different forest types.

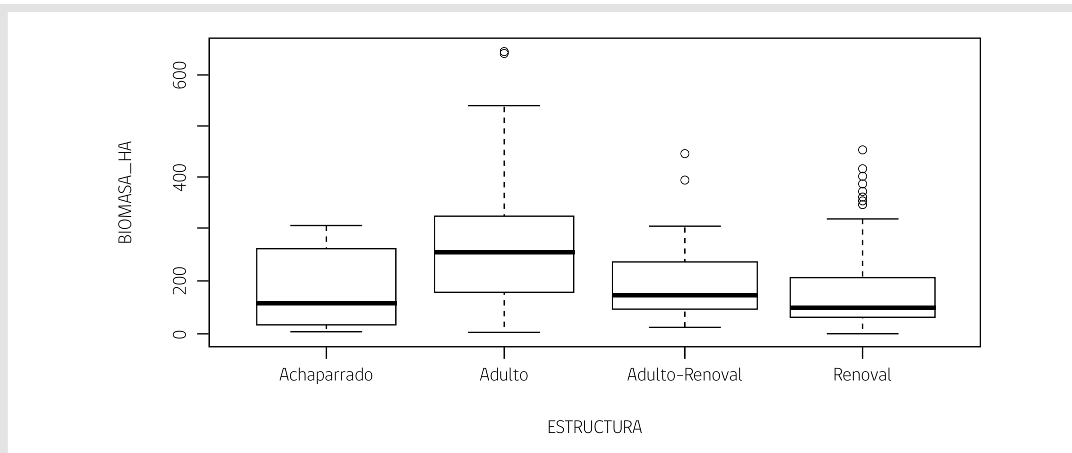


Figura 4. Box plot of biomass per hectare values for different forest structures.

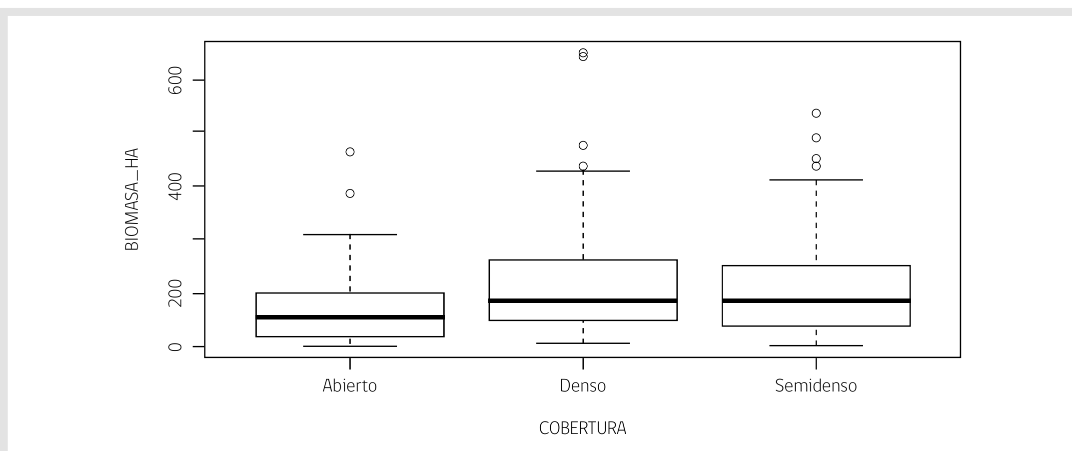


Figure 5. Box plot of biomass per hectare values for different forest covers.

A Kruskal-Wallis Rank Sum test was performed to identify the existence of significant differences among the different groups, and if there were differences, different post-hoc tests, Dunn, Nemenyi, and Conover, for pairwise multiple comparisons were performed to identify where the differences were. The Kruskal-Wallis Rank Sum was performed using the kruskal.test function in the R Base Package v 3.2.2 and the post-hoc tests Pairwise Multiple Comparison of Mean (PMCMR) package for R (functions posthoc.kruskal.dunn.test, posthoc.kruskal.nemenyi.test, posthoc.kruskal.conover.test).

For forest types, the Kruskal-Wallis Rank Sum test showed statistical evidence of differences (p-value = 0.0001025). However, the post-hoc tests showed that these differences were not relevant. For instance, it showed a significant difference between Roble-Raulí-Coihue and Coihue-Raulí-Tepa, however, the difference only existed between these two classes, and the biomass of both these forest types did not differ from the biomass of any of the other forest types. Therefore, it is assumed here there was only one forest type stratum.

For both forest structure and cover, the Kruskal-Wallis test also showed differences (for structure, p-value < 2.2e-16; for cover, p-value = 0.001314). The post-hoc tests, as illustrated in the results of the Dunn's multiple comparison test show differences between adult and the other forest structure classes at a significance level of 0.01 (Table 1). For cover classes, the tests showed a difference between open and the other two classes at a significance level of 0.01 (Table 4).

The results obtained through the analyses do not show sufficiently strong statistical difference between the different groups to allow a sufficiently robust forest stratification.

Table 3. Adjusted p values of Dunn post-hoc test for structure class

	Achaparrado	Adult	Adult-Secondary
Adult	0.00547*	-	-
Adult-Secondary	0.67881	0.00096*	-
Secondary	0.72140	< 2e-16*	0.03427

* Statistically significant at a p-value of 0.01

Table 4. Adjusted p values results of Dunn post-hoc test for coverage classes.

	Open	Dense
Dense	0.00081*	-
Semi-dense	0.00857*	0.27166

* Statistically significant (p-value < 0.01)

Subsequently, the Kruskal-Wallis test was performed again to evaluate the difference in biomass between different regions.

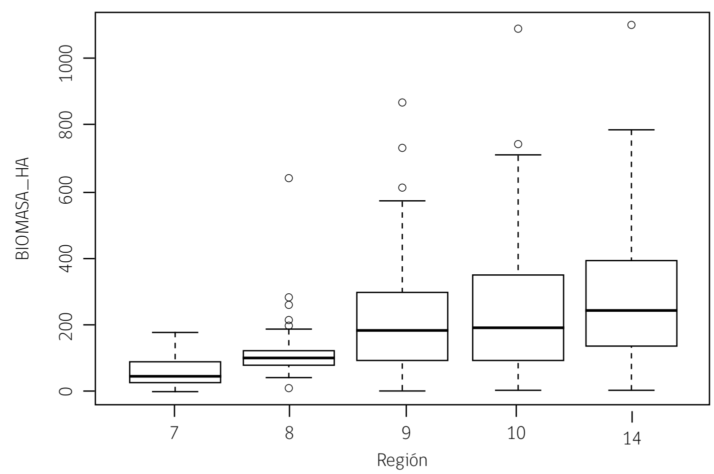


Figure 6. Box plot of biomass per hectare values for different regions.

The kruskal.test function in the R Base Package v 3.3.1 of the R Base Package was used. The results showed statistical differences between regions (P value <2.2e-16). To indicate where these difference occurred, a post-hoc Dunn test was done using the Pairwise Multiple Comparison of Mean (PMCMR) package for R (function posthoc.kruskal.dunn.test). The results in Table 5 show that the biomass values of Maule and Bío Bío are statistically different from the values of all the other region including between each other. However, using a significance level of P=0.01, there are no significant differences between la Araucanía, Los Lagos and Los Ríos.

Table 5. Results of adjusted p values of the Dunn test for regions.

	Maule (7)	Bío Bío (8)	Araucanía (9)	Los Lagos (10)
Bío Bío (8)	0.00636*	–	–	–
Araucanía (9)	5.8e-11*	0.00878*	–	–
Los Lagos (10)	2.9e-14*	0.00047*	0.32494	–
Los Ríos (14)	< 2e-16*	3.3e-07*	0.01380	0.10686

* Statistically significant (p-value < 0.01)

Comparative analysis

In accordance with TAP suggestions, a comparative analysis was done to estimate in a preliminary way the potential differences between the estimation of deforestation emissions based on Regional EFs and Forest Type EFs.

For this, based on the average biomass content by Forest Type extracted from the raw data of the Continuous Forest Inventory plots, EF simulations were estimated by Forest Type, as shown in Table 7. These values were weighted by the area deforested by period and by region, generating an emission factor weighted by deforested area by Forest Type.

$$EF_{SIM} = \left(\sum_{i=1} Def_{i,j}\ CB_{i=1}\right) + \left(\sum_{i=n} Def_{i,j}\ CB_{i=n}\right) \Big/ \sum Def_j$$

Where,

EF_{SIM} = Simulated weighted emission factor

$Def_{i,j}$ = Deforested area by Forest Type (i) and Region (j)

CB_i = Biomass content by Forest Type (i) and Region (j)

The results were compared with the emission factors used, demonstrating that there is a significant variation, with biomass content values significantly lower in the Regional EFs than in the Forest Type EFs (Table 6).

Table 6. Comparison between Regional EFs and simulated EFs.

	Regional emission factors (t biomass/ha)			
	INGEI		Calculated	
	Commercial biomass	Total biomass	Commercial biomass	Total biomass
Maule	45,9	80,4	60,2	105,4
Biobío	85,7	149,9	169,2	296,1
La Araucanía	148,7	260,2	219,7	384,4
Los Ríos	187,7	328,4	200,5	350,8
Los Lagos	154,6	270,5	210,6	368,6

Tabla 7. Deforested Area by Forest Type, Region, and period and mean biomass content by Forest Type.

	Deforestation (ha)					
	Maule		Bio-Bio		La Araucanía	
Forest Type	P1	P2	P1	P2	P1	P2
Alerce	–	–	–	–	–	–
Ciprés de las Guaitecas	–	–	–	–	–	–
Araucaria	–	–	1.053	–	3.547	117
Ciprés de la Cordillera	21	47	509	3	144	69
Palma Chilena	–	–	–	–	–	–
Lenga	14	34	6.461	6	3.018	59
Coihue de Magallanes	–	–	–	–	–	–
Roble – Hualo	347	470	366	6	–	–
Roble – Raulí – Coihue	242	81	6.626	1.069	4.933	1.006
Coihue – Raulí – Tepa	–	–	326	10	1.626	57
Esclerófilo	464	705	281	311	–	–
Siempreverde	23	–	227	70	15.003	226
Total	**1.112**	**1.337**	**15.849**	**1.475**	**28.272**	**1.533**

Conclusions

Based on the analyses carried out, it was considered that:

1.

Given the distribution of forests in Chile, a large percentage of the data used to generate Forest Type EFs comes from plots outside of the ER Program Area.

2.

The statistical quality of the information is significantly better when aggregating by region in comparison to aggregating by region and forest type.

3.

The results of the analyses of statistical significance do not provide enough statistical differentiation to allow for a sufficiently robust forest stratification.

4.

The result of the comparative analysis between Regional EFs and Simulated EFs indicate that there is a variation between both calculations and that the Regional EFs are conservative since they give estimates of biomass content lower than the Simulated EFs.

Deforestation (ha)						Biomass content (t biomass/ha)	
Los Ríos		Los Lagos N		Los Lagos S		Commercial Biomass	Biomass total
P1	P2	P1	P2	P1	Total		
0	–	62	21	75	158	261	457
1	–	–	–	5	6		–
35	–	–	–	–	4.752	282	493
2	2	–	–	13	811	56	98
–	–	–	–	–	–		–
530	1.946	1.749	263	5.490	19.571	189	332
–	3	22	–	172	198	327	572
–	–	–	–	–	1.189	79	138
2.136	907	3.602	769	384	21.754	154	270
764	89	636	318	108	3.934	255	447
25	–	31	1	–	1.819	13	22
2.244	1.357	1.819	523	12.520	34.014	235	411
5.738	**4.305**	**7.923**	**1.894**	**18.767**	**88.205**		

5.

The nature of the simulations of the estimated EFs implies that they cannot be used to estimate accuracy.

This leads to the conclusion to use EFs constructed on the basis of data coming from measurements in clusters located in regions corresponding to the ER Program Area versus using data from measurements from other regions outside the accounting area, with aggregation by region being statistically superior to the aggregation by forest type and region, by forest type in the ER Program area and by other attributes analyzed. In addition, it is concluded that currently it is not possible to estimate uncertainty associated with the accuracy of the Regional EFs since there are no official or precise data to carry out this analysis.

In the future, meetings are planned of the expert group involved in the national communications related to Climate Change and Land Use Change and Forestry (INFOR/CONAF/MINAGRI) in which the suitability of Regional EFs/Forest Type EFs will be analyzed. The results of the meetings, in the event that modifications are recommended, will be considered as part of an update of the Reference Level that integrates information improvements based on the *step-wise* approach.

Chile proposes to include an uncertainty value based on the difference between the EF-Regional and the EF-Simulated, emphasizing that it does not consider this the statistically adequate option

Annex: Analysis of use of Stocking Chart

Javier Cano[1], Felipe Casarim[2], Gabriel Sidman[2], Anna McMurray[2], Tim Pearson[2], Carlos Bahamondez[3], Yasna Rojas[3].

Description of the Stocking Chart

To estimate the area affected by degradation in permanent forests, recovery of degraded forest, and conservation, methodology defined in detail in Bahamóndez *et al*. (2009) was used, which is based on data on number of trees per hectare and basal area collected in plots of the Continuous Forest Inventory, to estimate in a spatially explicit way carbon stocks at different times, coinciding with the Inventory's measurement dates.

The plots of the Continuous Forest Inventory are located on a density graph, or stocking chart, based on data on the number of trees and basal area per hectare. The stocking chart includes various thresholds, or lines, that determine for different forest types, their status at the moment of measurement, distinguishing between degraded and non-degraded plots (Bahamondez, 2009).

Line B represents the limit where the trees can develop large crowns and a full occupation of site capacity without excessive competition (Gingrich, 1967). The delimitation of these thresholds was established through field work by experts and is specific to each forest type (INFOR, 2012). Line B is considered to be the threshold of a forest's natural resiliency. In those plots located below the threshold or Line B, it is not recommended to manage forests for production (Figure 1).

In the presented Reference Level, the stocking chart designed for the Forest Type Siempreverde (Evergreen) has been applied to the entire accounting area, that includes 11 Forest Types due to the fact that stocking charts for the other Forest Types have not been developed, validated, or published.

This process is currently being developed, but since it is a scientific research process, implementation times are far from the Carbon Fund's requirements of immediacy.

In parallel, analyses have been carried out to explore the influence that the use of a stocking chart of one specific forest type can have on other forest types.

[1] Corporación Nacional Forestal de Chile (CONAF)
[2] Winrock International
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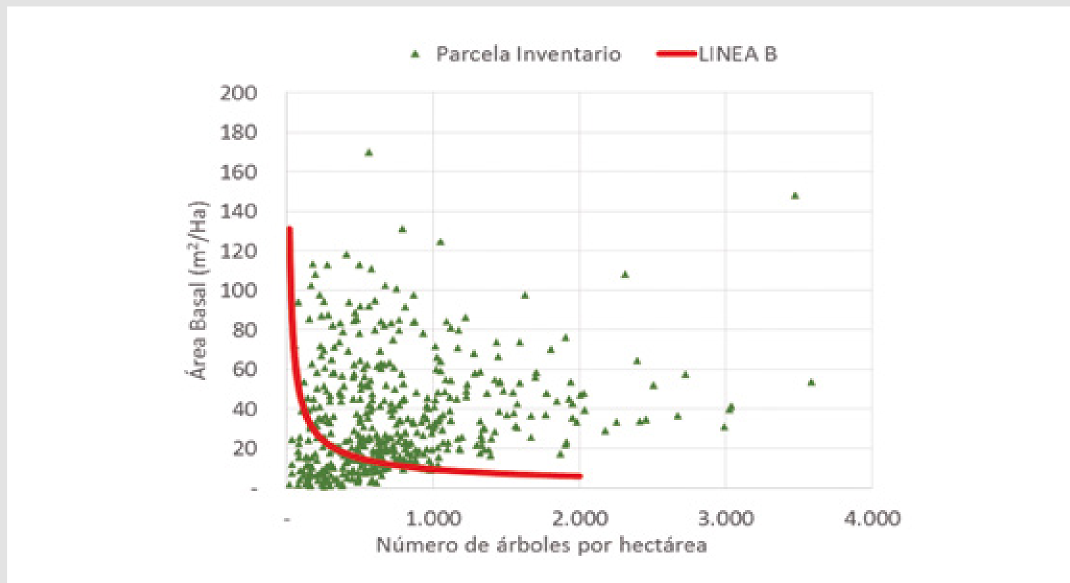


Figure 1. Stocking Chart and line B. Based on data generated from the field measurements of the Continuous Forest Inventory (INFOR) used in the RL.

Comparison of the relationship between crown diameter and diameter at breast height in Roble-Raulí-Coihue and Siempreverde Forests

The creation of the stocking chart depends directly on the relationship between Crown Diameter (CD) and Diameter at Breast Height (DBH), all the resulting ratios come from this ratio, in other words, the maximum crown area (MCA) and the crown competition factor (CCF).

In this context, the difference or similarity between charting stocks is compared based on ratio CD-DBH through two statistical methods, the conditional variable method and the covariance method. For this case, there are 9115 pieces of data of the variables of interest.

Metodology

Hypothesis (Ho)

The CD-DBH regression models for Roble-Raulí-Coihue y Siempreverde forests are combinable.

Conditional variable method

This method uses conditional variables that only have values 0 or 1 depending on the characteristics of the observation to be represented in the regression model.

It consists of generating a combined model of the two populations of interest for comparison, performing the combined regression and inferring whether to accept or reject the null hypothesis.

Basically, it is applied as follows:

1. Consider a regression model, such as a linear model of type y = ax + b
2. Assume a variable z such that it takes value 0 for one population and 1 for the other population.
3. Form the combined model $y=a_1 (1+a_2 z)+b_1 (1+b_2 z)x$.
4. Run the regression.
5. Analyze the value ‘t’ associated with the combined regression.
6. Reject or fail to reject the null hypothesis.

Covariance method

The method is based on the analysis of the sums of squares of the regression so as to explain the sums of squares accumulated for the parameters of regression of the two populations, the assumption is that the comparison of slopes and intercepts allows one to infer if both regressions are similar at 5% and 1%.

The analysis is based on the following expressions.

$\sum y$ = Summation of CD
$\sum y^2$ = Summation of CD^2
$\sum x$ = Summation of DBH
$\sum x^2$ = Summation of DBH^2
$\sum xy$ = Summation of CD*DBH
n = Number of cases

With,

$$SCy = \sum y^2 - (\sum y)^2 / n$$
$$SCx = \sum x^2 - (\sum x)^2 / n$$
$$SPxy = \sum xy - \sum x \sum y / n$$

And coefficients,

$$b = SPxy / SCx$$
$$a = (\sum y - b \sum x) / n$$
$$SCR = bSPxy$$

With sum of squares between coefficients b:

$$SCb = \sum SCR - (\sum SPxy)^2 / \sum SCx$$
$$SCa = \sum SCy - \sum SCR$$
$$SCE = SCy_c - (SCa + SCb + SCR_c)$$

Where ‘c’ stands for combined regression

The analysis considering the previous parameterization is based on the following table:

Source of variation	Sum of Squares (I)	Degrees of freedom (II)	Mean squares (III)	Ratio of variance	Significance ** 1% * 5%
Combined regression	SCRc	1	(I)/(II) = A	A/D	
Between slopes	SCb	1	(I)/(II) = B	B/D	
Between intercepts	SCa	1	(I)/(II) = C	C/D	
Residuals	SCE	n_1+n_2-2r	(I)/(II) = D		
Total	**SCy_c**	**n_c-1**			

n_c : Total data quantity

r : Number of regressions

n_i : Regression i data quantity

Results

The results are explained in the tables associated with each method.

Conditional variable method

Table of parameters resulting from the combined regression

Regression statistics				
Multiple correlation coefficient	0,81474631			
Coefficient of determination R^2	0,66381154			
Adjusted R^2	0,66370085			
Standard error	1,65391739			
Observations	9115			

Analysis of Variance				
	Degrees of freedom	Sum of squares	Mean of the squares	F
Regression	3	49210,2621	16403,4207	5996,62368
Residuals	9111	24922,6188	2,73544274	
Total	9114	74132,8809		
	Coefficients	Standard error	T statistic	Probability
Interception	1,2446758	0,0405027	30,7306876	2,056E-194
Z	0,04671023	0,05884753	0,79375001	0,42736165
BNARBVI_DAP	0,13965055	0,00142719	97,850283	0
ZD	-0,00318722	0,00206234	-1,54544044	0,1222745

Student's T Analysis			
	Calculated t	Tabulated t	Degrees of freedom
Z	0,7937	1,96	9115
ZD	-1,5454	1,96	

Given the parameters obtained for t, one fails to reject the null hypothesis.

Covariance Method

Table of parameters resulting from the combined regression

Source of variation	Sum of Squares (I)	Degrees of freedom (II)	Mean squares (III)	Ratio of variances	Significance ** 1% * 5%
Combined regression	49220,3379	1	49220,3379	68898644,3	**
Between slopes	6,7553	1	6,7553	9456,0158	**
Between intercepts	24919,0613	1	24919,0613	34881709,7	**
Residuals	6,5116	9115	0,0007		
Total	74152,6661	9114			

Given the resulting parameters, one fails to reject the null hypothesis.

Conclusion

Both methods result in the failure to reject the null hypothesis reinforcing the decision to consider only one model for the application of a single curve in the stocking chart for the issue of detecting degraded forests.

Representation of Forest Types

Recognizing that the use of specific stocking charts for each forest type can increase the precision and accuracy of the results, a preliminary analysis was done on the representation of the different forest types.

To carry out this analysis, the approximate area was estimated of permanent forest subject to degradation processes and degraded forests in the process of recovery for the reference period by Forest Type (Tables 8 and 9). For both cases, the forest types Siempreverde, Roble-Raulí-Coihue, Lenga and Coihue-Raulí-Tepa were identified as having the greatest representation (77% in both cases).

As a final step, the relative area by Forest Type and the relative area of degradation and stock enhancement by Forest Type were compared (Table 10). The results show that there is a very close direct relationship with ratios close to 0 in most of the cases. The greatest variations are registered in Siempreverde (0.11/0.01) and Roble-Raulí-Coihue (0.06/0.08).

Table 8. Area in the process of degradation by Forest Type and Region.

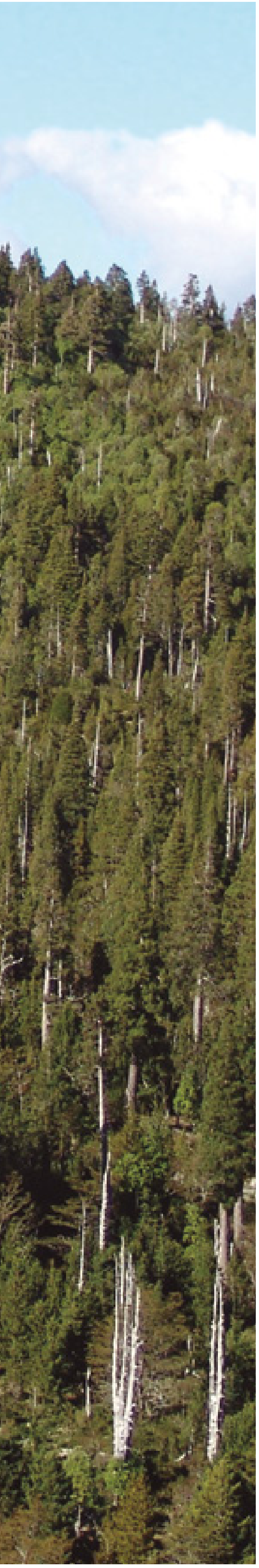
Degraded Area (ha)							
Forest Type	**VII Región**	**VIII Región**	**IX Región**	**XIV Región**	**X Región**	**Total**	**%**
Arborescent Shrubland (Matorral Arborescente)	6.380	16.138	3.306	1.793	617	28.234	6%
Alerce				797	20.125	20.922	4%
Ciprés de las Guaitecas				14	8.509	8.523	2%
Araucaria		1.896	7.357	144		9.397	2%
Ciprés de la Cordillera	654	1.095	867		3.190	5.806	1%
Palma Chilena						–	0%
Lenga	806	6.233	6.823	5.907	53.463	73.232	14%
Coihue de Magallanes	5.430			290	11.913	17.633	3%
Roble - Hualo	5.994	199				6.193	1%
Roble - Raulé - Coihue		17.136	18.037	14.305	22.441	71.919	14%
Coihue - Raulé - Tepa		905	2.042	14.294	46.158	63.399	12%
Esclerofilo	7.234	1.459	32	8	30	8.763	2%
Siempreverde	13	291	1.127	19.380	177.135	197.946	39%
	26.511	45.352	39.591	56.932	343.581	511.967	

Table 9. Degraded areas in the process of recovery by Forest Type and Region.

Area of Stock Enhancements (ha)							
Forest Type	**VII Región**	**VIII Región**	**IX Región**	**XIV Región**	**X Región**	**Total**	**%**
Arborescent Shrubland (Matorral Arborescente)	12.569	31.433	5.026	1.992	1.251	52.271	7%
Alerce				1.425	24.746	26.171	4%
Ciprés de las Guaitecas				10	8.071	8.081	1%
Araucaria		4.748	17.723	1.156		23.627	3%
Ciprés de la Cordillera	1.813	3.535	2.103		3.143	10.594	1%
Palma Chilena						-	0%
Lenga	1.257	14.329	13.329	15.838	73.522	118.275	16%
Coihue de Magallanes				551	16.447	16.998	2%
Roble - Hualo	19.780	720				20.500	3%
Roble - Raulí - Coihue	15.818	56.842	32.493	20.362	20.782	146.297	20%
Coihue - Raulí - Tepa		3.508	6.314	41.724	49.850	101.396	14%
Esclerófilo	12.549	2.592	40	6	30	15.217	2%
Siempreverde	34	845	2.937	28.992	169.536	202.344	27%
	63.820	118.552	79.965	112.056	367.378	741.771	

Tabla 10. Relationship between total forest area by forest type and area of degradation/enhancements.

Forest Type	Degradation	Enhancements	Total area	Ratio Deg/Area	Ratio Enhance/Area
Alerce	4%	4%	4%	1%	0%
Ciprés de las Guaitecas	2%	1%	1%	1%	0%
Araucaria	2%	4%	3%	-1%	1%
Ciprés de la Cordillera	1%	1%	1%	0%	0%
Lenga	14%	15%	16%	-2%	0%
Coihue de Magallanes	3%	2%	2%	1%	0%
Roble - Hualo	1%	3%	3%	-2%	0%
Roble - Raulí - Coihue	14%	27%	20%	-6%	8%
Coihue - Raulí - Tepa	12%	14%	14%	-1%	1%
Esclerófilo	2%	1%	2%	0%	-1%
Siempreverde	39%	27%	27%	11%	-1%



Conclusions

It is recognized that using stocking charts specific to each Forest Type would improve the uncertainty, precision and accuracy of the data.

The uncertainty linked to the above cannot be calculated as there are no stocking charts for the other Forest Types.

It is argued here that the best information should be used, based on a scientific approach and methodologies validated internationally and with the backing of scientific publications.

The similarity between the Forest Types Siempreverde and Roble-Raulí-Coihue was analyzed through two statistical analyses to determine the feasibility of using only one stocking chart for both Forest Types with a positive result.

Despite not being able to quantify the uncertainty due to the absence of stocking charts that can be used for comparison, the analysis of representation indicates that the variations are not likely to be significant.

Work is currently underway to design and validate lines B and C for the Forest Type Lenga. In 2017 and 2016, new lines B and C will be generated for other forest types, based on their national territorial representation. For the forest types with smaller distributions, similarity analyses will be done with the objective of establishing.

We defend maintaining the current methodology, considering the step-wise approach of the Reference Level to include improvements in the future and update the Reference Level once validated and published information becomes available.

Chile proposes to include a 100% uncertainty value for activity data in permanent forests, different from the Evergreen and Roble-Raulí-Coihue Forest Types.

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