Appendix. Model fitting

The study used two databases (SNFI2 and DGA) to develop auxiliary functions for estimating missing variables [Eqs. 1 to 5]. A linear regression of diameter over bark as a function of diameter under bark [Eq. 1] was fitted with a subsample of 379 trees from 104 SNFI2 plots, which was crucial for the model's usability. Crown width [Eq. 3] was developed by modifying the model proposed by Condés & Sterba (2005) using data from the same dataset (SNFI2). Other crown metrics such as crown length and height to crown base [Eq. 4] were characterized using the DGA dataset (515 trees from 58 plots) and established models (Maguire & Hann, 1989; Hann et al., 2003; Ritchie & Hamann, 2008) with drivers *RS*, *IS*, and *balmod*. A generalized height-diameter function [Eq. 2] estimated the relationship between individual tree heights and diameters through stand variables (Temesgen & Gadow, 2004) using pre-selected models, with the Schnute (1981)´s model modification proposed by Castedo Dorado et al. (2005) being the most appropriate.

The height to crown base model [Eq. 4] was developed using the same dataset as model [Eq. 2], consisting of 515 trees from 58 permanent plots established by the DGA. A logistic regression model with asymptote on total tree height was used for this purpose. The stem taper function [Eq. 5] was constructed using a sample of 48 trees and 718 diameters measured at various heights from the DGA dataset. After comparing different taper equations, we selected the model described by Leban et al. (1999) and used by Cabanillas-Saldaña (2010) due to its robustness against heteroscedasticity and flexibility in capturing variations in stem form, as previously reported by Fonweban et al. (2011) and Rodríguez et al. (2013, 2053).

For increment, growth, and yield models [Eqs. 6 and 7], we initially used the SNFI database to fit a diameter increment model, but it produced unrealistic predictions in simulations. Therefore, according to Hann (2001) and Bravo et al. (2008) we adopted a backdating procedure on the DGA database, which was detailed in the methodology section. To backdate the data to 10 years ago [Eq. 6], we used wood cores extracted from 348 trees in the DGA's permanent plots to calculate current diameter under bark (*dub2*) and estimate the diameter under bark 10 years ago (*dub1*). We then fitted a model [Eq. 6] that related *dub1* to *dub2* and current stand and tree variables. The backdating process was applied to 1684 trees from 58 permanent plots, and the resulting data were used to fit the individual-tree diameter growth model [Eq. 7]. The model's second-degree polynomial of *dbh* ensures that the diameter increment rises to a given value of *dbh* and then decreases for larger trees, assuming constant competition variables. The dominant height of the stand 10 years ago was estimated from the site index curves developed by Rojo-Alboreca et al. (2017) using stand age and dominant height data. We then used the generalized height-diameter relationship [Eq. 2] to backdate the total height of each tree 10 years ago.

The regeneration models [Eq. 8] initially developed by Ferguson et al. (1986) did not predict the likelihood of natural regeneration, but rather the likelihood of regeneration exceeding a certain height or diameter. Other alternatives considered the probability of a specific seedling density emerging under particular conditions. However, traditional discrete probability distributions cannot be used to model recruitment events due to the excess of null counts. To address this issue, recruitment is often modeled as the outcome of two distinct processes: the occurrence of recruitment and the number of recruits conditional on its occurrence. In our study, we chose to model the occurrence of regeneration using a boolean variable (presence vs. absence of regeneration) and the decision tree technique (CART) based on the main stand variables.

The mortality model [Eq. 9] was constructed using the DGA permanent plot database, where the backdating procedure [Eq. 6] was applied to backdate the data of each plot 10 years ago. A total of 1720 trees, including 36 dead trees (2.09% mortality over the 10-year period), were used to fit a logistic regression model. The best set of denominator exponent variables was obtained through linear fitting with the stepwise selection procedure. The model predicts the probability of survival for each tree, and we used a stochastic method to apply this submodel in simulations. Specifically, the submodel calculates the ratio of stems ha^{-1} with the same attributes (e.g., *dbh*, competition) that will survive in a given time period, which represents the probability of survival. The mortality model was thus able to provide reliable predictions of tree survival in simulations.

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