© Prof. Dr. Jürgen Nagel
Northwest German Forest Research Station
Department of Growth and Yield
Grätzelstr. 2
37079 Göttingen
Germany
Juergen.Nagel@nw-fva.de

Table of Content

The ForestSimulator based on the software package TreeGrOSS

1 Overview

The *ForestSimulator* was developed to analyze and evaluate forest stands and their development. The program focuses on the handling of single stands. It offers various methods to create virtual forest stands either without data or by reading existing stand data. Stand treatment and the assortment of harvested tree can be defined by user dialogs. These definitions are used in combination with the defined forest growth model to model the forest stand development. Reports about the growth, the treatment, the harvested volume and the assortment can be generated after each simulated 5 year period. Furthermore it is possible to visualize the stand 2 and 3 D. Both illustrations are interactive. The user can mark trees for thinning and harvesting, as well as for protection (habitat trees). The manipulated and simulated stands can be saved and used at a later point time. This way it is possible to analyse different development strategies of one forest stand.

The program offers interesting functions for different users. The foresters from the field can simulate different silvicultural options, analyze the consequences and use the information for his decision. For teaching and education the program can be used for example to explain thinning and harvesting concepts. In strategic planning it can be used to find a reasonable treatment solution.

2 Installation

In this manual the installation of the ForestSimulator will be described only for Microsoft Windows and the Linux operating system Ubuntu. The ForestSimulator can be also used on all other operating system with an available Java Runtime Engine. The program has been tested on MS Windows and Ubuntu operating systems.

2.1 Requirements

The program is written in Java and it ca therefore be used on nearly every operating system. All you will need is:

- The Java Runtime Engine (JRE) 1.6.0 or higher Version. To install the JRE you might need administration rights for your computer.
- Java 3D if you want to use the 3D-graphics.

You need to install the JRE before Java3D. If the JRE on your computer gets updated it might be necessary to reinstall java 3D.

The installation on Windows is simple if you use the Setup-programs. For Linux operating systems you will find a detailed description in the next paragraphs.

2.2 Directories and Files

The program *ForestSimulator* does not need an installation routine. You can copy the ForestSimulator folder to a directory of your choice. Just unpack the file *ForestSimulator7.zip*. In this example the program es unzipped to the directory `\Eigene Dateien\ForestSimulator75` . If you do not have a program for unpacking just download the free version of 7-Zip from the internet. [1].

After unpacking you will find the following subdirectories and files (Fig. 1).

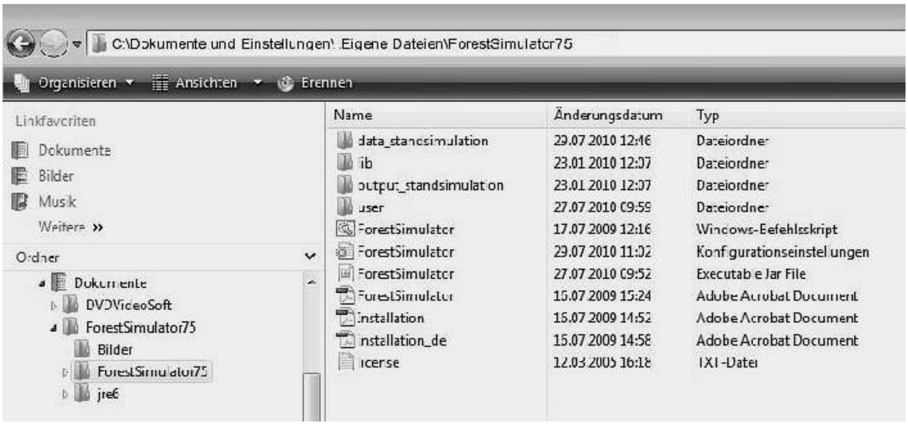


Figure 1: Directories and files of the program ForestSimulator in Windows Explorer

Table 1 explains the meaning of the files and subdirectories. If you are a new to this program, you might not want to chance the names and location of the subdirectories.

[1] http://www.7-zip.org

Table 1: Meaning of directories and files of the program ForestSimulator

\data_standsimualtion	Your stand data and some data of examples
\output_standsimulation	results
\user	Program settings and other important program information
\lib	Java libraries
ForestSimulator.jar	Startfile of ForestSimulator, also doppel click under Windows
ForestSimulator.cmd	Startfile for Windows for large stands with numerous trees, which need more memory
ForestSimulator.ini	Program settings
License.txt	GPL- Licence
Installation.pdf	File with installtion tips

2.3 Installation of the ForestSimulator under Ubuntu

Running the ForestSimulators under Ubuntu is very similar to Microsoft Windows. Most complicated is the installation of Java3D. This is described in detail. Please be sure that you have the administration password.

Install the Java Runtime Engine (JRE) by the Synaptic package management of Ubuntu: *System* → *Systemverwaltung* → *Synaptic Paketverwaltung*.

Install Java 3D, if you want to use the 3D-graphics of the simulator. First download the file *j3d-1_5_2-linux-i586.zip*[2] and copy it to a new directory. (in this example: `/juergen/temp`). You can use the file browser to do so. Unpack the file by highlighting it and choose *Datei* → *Mit Archivmanager öffnen* of the file browser menu. Press the button [unpack] and *entpacken* in the next dialog again. You should now find in directory (example: `/jurgen/temp`) a sub directory named *j3d-1_5_2-linux-i586.zip*. This sub directory contains the zipped file *j3d-jre.zip*, with the sub directories `/ext` and `/i386` in which you will find the files: j3dcore.jar, j3dutils.jar, vecmath.jar, libj3dcore-ogl.so and libj3dcore-ogl-cg. The first tree files with the ending *.jar need to copied to the directory `jre/lib/ext` and the last tw0 with the ending *.so* into the directory `jre/lib/i386` of the valid JRE. This action can not be execute by the file manager because you need administration rights (Root). But you should use the file browser to localize the sub directories. This makes the copying easier and better understandable. In this example the complete subdirectory name is: `/usr/lib/jvm/java-6-sun-1.6.0.10/jre/lib/ext`. Please notice that you have to use the right Java version number. Open a terminal window *Anwendungen* → *Zubehör* → *Terminal* and

[2] https://java3d.dev.java.net/binary-builds.html

change the directory of the terminal window to that one, where you unpacked the Java3D files:

```
cd home/juergen/temp/j3d-1_5_2-linux-i586
```

Unzip the the file *j3d-jre.zip* in the terminal window:

```
unzip j3d-jre.zip
```

Copy all files as „root“ (sudo) to the corresponding directories of your JRE (see above). Use the commands:

```
sudo cp lib/ext/* /usr/lib/jvm/java-6-sun-
1.6.0.10/jre/lib/ext/
```

```
sudo cp lib/i386/* /usr/lib/jvm/java-6-sun-
1.6.0.10/jre/lib/i386/
```

After the first **sudo** you will be asked for the administration password. If you do not know it, you can not perform this task.

Unpack the file *ForestSimulator7.zip* into directory of your choice and start the using the ForestSimulator7 by double click of file *ForestSimulator.jar* .

2.4 First use

Start the program by double click of file *ForestSimulator.jar* in Windows Explorer or by opening the file with Java under Ubuntu. You can change the program settings by choosing *Einstellungen -> Programm Einstellungen* from the menu. You will see the following dialog. (Figure 2):

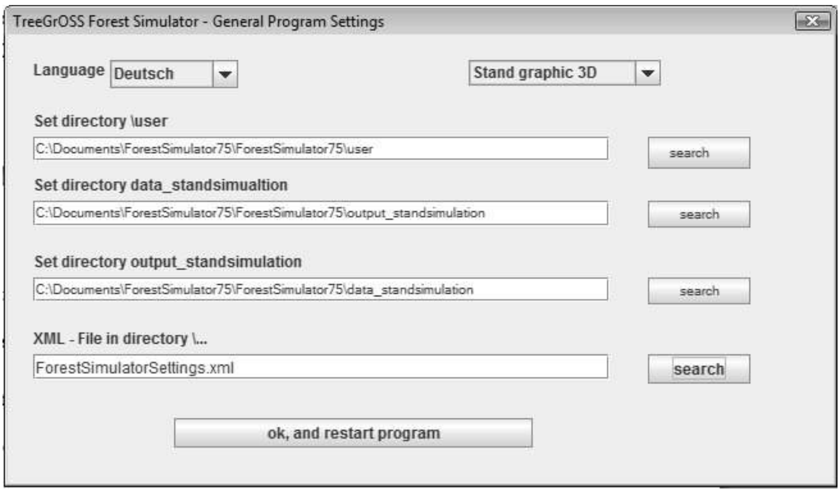


Figure 2: Dialog of program settings

a) Choose your language.

b) Select if you want to use the 3D or the 2D Graphic. For 3D you will Java3D. It requires more memory

c) Select the user directory. It will contain all important information about the species and program settings. You can open a directory selecting dialog by pressing the search button.

d) Select the data directory. This directory contains all example stands and all your own stand data.

e) Select the output directory. All output and reports are written to this directory.

f) Choose and XML-File with the simulator settings. The default `ForestSimulatorSettings.xml` is for the growth model of north west Germany.

After you finished **a** to **f**, click the button [ok]. The program will end and you will have to start the ForestSimulator again.

Hint: You have to delete the file *ForestSimulator.ini*, if you can not open the program and want to start it with it's default settings.

2.5 Starting ForestSimulators

Start the program by double click of file *ForestSimulator.jar* in Windows Explorer or by opening the file with Java under Ubuntu. In the menu under *Help* you will find a detailed manual to the program.

If the program does not start, delete the file *ForestSimulator.ini* and check if the Java3D is installed correctly. You can do so by starting the program in the *2D* mode.

If you want to start the ForestSimulator from the desktop, you have create a link. Make sure the working directory is set correctly.

If there problems if you want to simulate stands with numerous trees, because the memory of the java virtual machine is not sufficient, you need to start the program by executing the file *ForestSimulator.cmd* instead of *ForestSimulator.jar*. This will execute the following command:

java -Xmx256m -jar ForestSimulator.jar

which increases the memory of the virtual machine.

2.6 Update

Unfortunately a good program is never finished. The ForestSimulator7 gets improved from time to time. The program checks at every start if there is an internet connection if a new simulator version is available. Before you update, make sure you save all your data and changes to the default settings.

2.7 Deinstallation

Just delete the complete directory `\ForestSimulator`. Do not forget to save your data if necessary.

3 Using the ForestSimulator

3.1 User Interface

The program ForestSimulator is written in Java and it has a graphical interface which is shown in figure 3. Using the interface is intuitive and similiar to the standard you already know from other programs.

The user interface consists of a main window, in which several other sub windows are integrated. All windows can be modified by the window controls and the cursor. You can also move the windows on your screen. If the main window is closed all other windows will be closed and the program stops. The main menu and the action buttons are display in the heading of the main menu. Choosing *View* in the main menu you can open other program windows and also reopen closed ones. The top bar of the window which is active is shown in light blue color. You can switch from window to window by mouse click. That is also the reason, why the menus of the sub-windows do not react immediately. If you load a stand, all information about it is displayed as shown in figure 3. If you perform an action (e. E. *grow* or *treatment*), all windows will be updated.

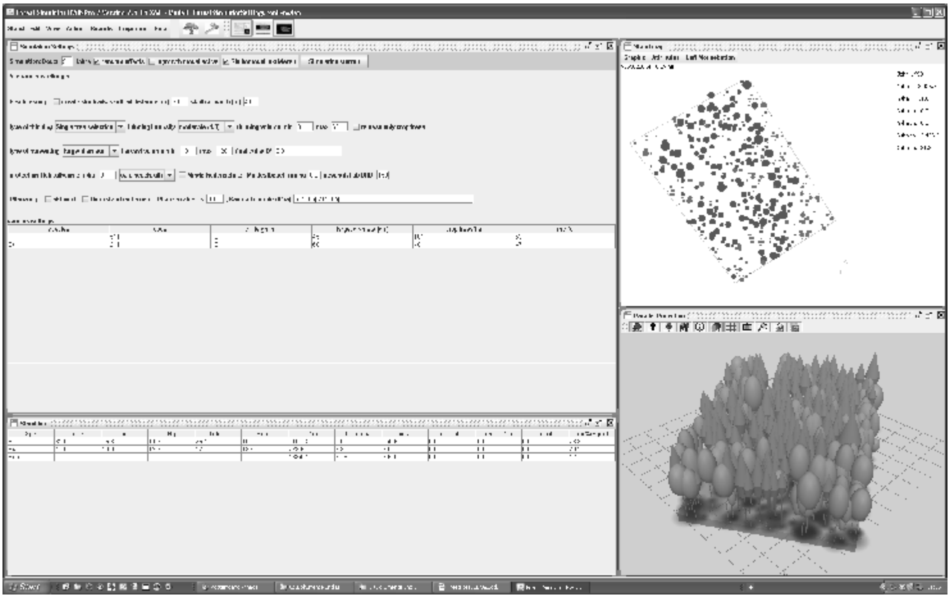


Figure 3: Benutzeroberfläche des ForestSimulators (beispielhaft wurde hier der Bestand fibugen2.xml eingeladen)

3.2 stand analysis

This chapter demonstrated the possibilities to use the ForestSimulator to analyze and visualize forest stand..

Start the ForestSimulator and click in menu *Stand* → *Open* → *TreeGrOSS.xml-File*. Choose the file *fibugen2.xml* in the following dialog. After the program has read the data, you will find different information in the sub windows.

.3.2.1 Bestandesinformationen

The window *Stand Info* shows a table with the main growth and yield information. This table is divided by species and also shows the sum of values. You will always find the current status of the stand in this table. If there is a thinning the numbers will change as soon as the thinning is performed. The meanings and the units of the columns are described in Table 2.

Table 2: Stand Information

Abbreviation	**Description**
Spe.	Species
Age	Age

Dgv	Mean quadratic diameter [cm]
Hg	Height of mean quadratic diameter [m]
Ddom	Mean quadratic diameter of 100 thickest trees/ha of one species [cm]
Hdom	Height of Ddom [m]
n/ha	Number of trees per hectare [n/ha]
b.area/ha	Basal area per hectare [m^2/ha]
v/ha	Volume (> 7 cm) per hectare [m^3/ha]
rem. n/ha	Removed number of trees per hectare [St/ha]
Rem. b./ha	Removed basal area per hectare [m^2/ha]
Rem. v/ha	Removed volume (> 7cm) per hectare [m^3/ha]
mix. %/ Bgrad	Percentage of mixture [%] or degree of stocking in summation (s. calculation of area and degree of stocking.)

You can use Strg + c and Strg + v to copy and paste the content of the table which es highlighted.

If you close the window, you can open it by *View → Stand Info*.

.3.2.2 Stand map

The stand map shows the distribution of the tree of the ground. The species are shown in those RGB-colors which are defined in the *XML-file* with the species settings. You can change the settings with the TreeGrOSS species manager (see chapter *changing the program*). If crop tree are selected, they marked by a red circle. The green circle is for temporary crop tree and the yellow color for habitat trees. (Figure 4).

If you click at certain trees using the left mouse button, the tree will be thinned and shown as open squares. You can redo the thinning by clicking on the square again.

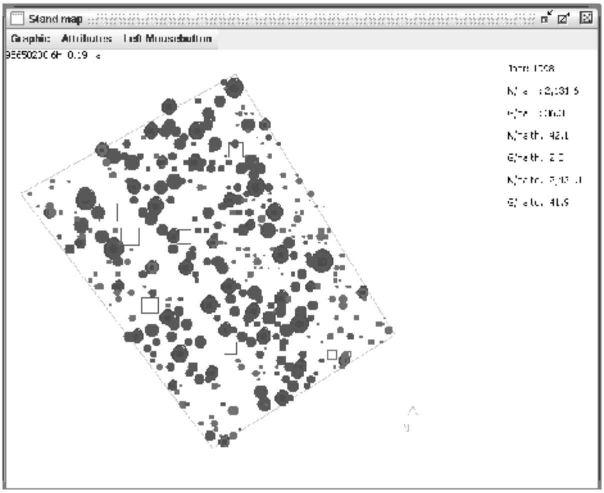


Figure 4: *Window of stand map*

Using the menu *Attributes* of the stand map, you choose if stand information, crown size and tree numbers are displayed. At a DBH-Factor of 1 the dbh of the tree will be shown true to scale of with at least 1 pixel.

The *Graphic* sub menu is for redrawing, saving as jpg and for zooming. If you start saving the stand map a file saving dialog will open and the stand map will be saved with a higher resolution. Please do not forget to add the ending .jpg to the file name. If you zoom, you have to mark the lower left and the upper right corner of the area.

The menu left mouse button sets the type of selection: Thinning and crop trees.

.3.2.3 Parallel Projection

The simulator can display the stand in 2D and 3D mode. The visualization mode is set in the main menu by *Properties → Program settings*. If you want to simulate large stands with lots of trees, it might be necessary that you switch from 3D to 2D visualization because 2D uses less computer resources.

The 3D mode let's you see the stand from every direction even from above. You can also walk virtually through the stand. To change the view press the left mouse button and move the mouse until the stand is in the desired position. You move the stand on the screen by pressing the right mouse button and moving the mouse at the time in the four directions. You can zoom by using the mouse wheel. Walking through the stand works by the arrow buttons. Please watch out that you do not crash into a tree. You will have to walk around. PgUp and PgDown control the angle of your view. So you look up using PgUp.

If you click with the left mouse button on a tree, the attributes of the tree will be shown in a little red window. Please notice: This window is modal, which means that you will have to close the window before you can do any other action. If you click on a tree using the right mouse button, you can mark and unmark the tree. A red marker is for thinning or harvest, the blue for crop trees, the green for temporary crop trees, and the yellow for habitat trees.

The windows *Parallel Projection* has 11 symbol buttons. The first is to active the markers. The second button allows to show the dead trees. The third changes the texture of the tree. The fourth changes the color from green to RGB color. The six button add fog and the seventh a grid. The eighth button (camera) allows to make picture of the window which is stored in a jpg file. The ax lets you fell the trees to the ground. These will stay in the stand. Button ten is to switch to the standard view position. This is important, if you get „lost“ walking through the stand. The last button changes the symbols position.

For orientation there is a red and white marker stick in the stand, which is located in the south west corner. The grid is always orientated in north – south and east to west direction.

The 2D mode of the window *Parallel Projection* should also give an impression of the stand. The tree crowns are displayed in the preset RGB-colors. The attributes menu allows to set if the living, the dead and the thinned trees will be displayed. You can also change the colors of the sky, the ground and the stand floor. The menu Graphic let's you save the stand to a jpg file and allows zooming. The jpg file will be saved in the output directory by a standard file name like sv2011.jpg. Sv stand for stand view and 2011 for the simulated year. If you zoom you have to mark the lower left and the upper right corner.

3.3 Reports

You can create several standard reports from the menu Reports. All reports are saved to the output directory in form of HTML and XML files. The reports are normally displayed automatically by your browser after you create one. In case the browser does not open the reports due to certain settings of your operating system, you can open the reports manually in the browser (File ...). If a report is called for the second time the old report will be overwritten. In case you want to store the reports you need to save these before the next call.

.3.3.1 *Tree values*

You can create a list with all tree values by clicking on *Reports* → *Tree values*. The list is saved in the file *treelist.html*. It will be shown in the browser. You can find the in the output directory (default: `output_standsimulation/treel-ist.html`).

You can also open the file *treelist.html* with other programs such as Excel, Word or OpenOffice. Or you can use the cut and paste functions of your browser. The meanings and the units of the abbreviations are described in Table 3.

Table 3: Fields of singel tree list

Abbreviation	Meaning
No	Tree number
Sp.	Species code
Age	Age
DBH	dbh [cm]
Height	Height [m]
c.base	Crown base [m]
c.wdith	Crown width [m]
cr%	Crown percent [%]
h/d	h/d-ratio
Vol.	Volume inside Bark [m³] (up to 7 cm diameter)
aus	-1 = tree is alive, year of mortality or removal
x	relative coordinate x [m]
y	relative coordinate y [m]
z	relative coordinate z [m]
c66	Position independent competition index c66
c66c	Change of position independent competition index c66c
c66xy	Position dependent competition index c66
c66cxy	Change of position independent competition index c66c
si	Site index height at age 100 [m]

.3.3.2 Stand table

The stand values are calculated by *Reports* → *Stand values*. There will be two table in the report one for all trees and one for crop trees only. The values are given by species. The report gives the numbers from the first to the current simulation step. The tables have the character of a yield table. The column abbreviations are described in table 4.

Table 4: Stand values

Abbreviation	Meaning
Year	Year of simulation
Species	Species code
Age	Age
Dg	Quadratic mean diameter [cm]
Hg	Height of Dg [m]
Ddom	Diameter of 100 largest trees per hectare [cm]

Hdom	Height of Ddom [m]
N/ha	Number of stems per hectare (>=7cm) [n/ha]
Ba/ha	Basal area [m²/ha]
V/ha	Volume inside Bark [m³/ha]
rem. N/ha	Number of stems of removal per hectare (>=7cm) [n/ha]
rem. Ba/ha	Basal area of removal [m²/ha]
rem. V/ha	Volume inside Bark of removal [m³/ha]

.3.3.3 *Stand structure*

You can generate some information about the stand structure by *Reports →Structure table*. The stand structure is characterized by the vertical and horizontal orgganization of the trees (see Kimmins 1987, S.340). The stand structure by means of silviculture consists of the spatial arrangement of the trees, the scrubs and ground plants (Dengler 1992). This structure can be characterized by the tree positions (coordinates), the species diversity, the diameter distribution and the vertical structure in Form of stand layers. The stand structure is influenced by silviculture. It is correlated to the stand stability and gives information about the ecological diversity (Altenkirch 1977).

The ForestSimulator provides the following indicators:

- number of species
- Shannon-Index (Pielou 1966)
- Species profile index (Artenprofil-Index) by Pretzsch (Pretzsch 1995)
- percentage of height mingling (Albert 1999)
- percentage of diameter mingling (Albert 1999)
- percentage of species mingling (Albert 1999)

.3.3.4 *Assortment*

The menu *Reports →Sorting* opens a dialog to evaluate different assortment options by reporting the volume of assortments, the biomass and nutrient export, as well as the remaining debris wood. You can include into the evaluation:

- the current stand and the removal of the same year
- the removal of a elapsed year
- the removal of the entire simulation time

You will find a detailed description in the chapter Assortment of this manual.

.3.3.5 *Species settings*

You can document and review the species settings for the species which are used in the simulation by *Reports →List species definition.*

.3.3.6 *Species code*

The menu *Reports →Species code* shows all species, which are defined for your ForestSimulator set up. This may be helpful, if you want to see which species are defined for your region and how are the species coded. In the list you will also find a link to Wikipedia. You should use *Properties →Species manager* to define new species or changes to existing ones (see separate chapter).

.3.3.7 *Additional graphics*

If you press *View →Graphics* an additional window will open, which allows to create the following graphs:

- Species percentage by crown surface area
- Diameter distribution
- Diameter distribution of crop trees
- Height – diameter relation.

You can not change those graphs. You can only save them as JPEG files.

3.4 Stand treatment and prognosis

This chapter explains the options to manipulate the stand and to mark trees for special functionality. Both you can do either interactively or by a rule based dialog. The chapter also explains how you can perform a stand prognosis and what you have to keep in mind.

.3.4.1 *Interactive thinning*

You can interactively mark and thin trees in the windows *Stand map.*

In the *Stand map* window you just point at the tree with the mouse and press the *left mouse button*. You can switch in the menu of this window whether you want to thin or to mark trees. You just point at the trees with your mouse an press the left mouse button. The thinned trees will be shown as open squares. Crop trees are marked by a red ring. If the function *Stand information* is activated you can see for instance how much trees you have thinned. It is also possible to reselect trees thinned trees.

You can do interactive stand treatment and marking of trees in addition and in combination with the automatic rule based stand treatment.

.3.4.2 Automatic rule based stand treatment

You can set you stand treatment scenario in the window *Simulation Settings*.

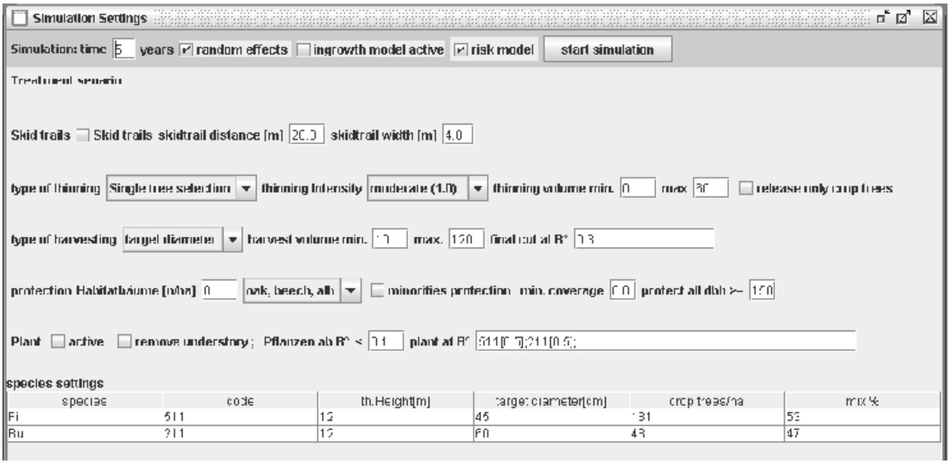


Figure 5: Dialog to set treatment scenarios

In the first dark grey line of the dialog you can make some basic settings for the simulation. The *time* set the duration of the simulation. If the value is greater than 5 years automatically so many 5-year simulations steps will be executed until the wanted time is reached or exceeded. Remaining years or times below 5 years are simulated by one 5-year time step which is linear interpolated to the given time length (see chapter prognosis). The check boxes *random effects*, *ingrowth model,* and *risk model* determine if these are included in the simulation. By pressing the *start button* you execute the simulation with the set stand treatment.

In the next row you can define if the simulator should establish *skid traids* and you can set the *width* and the *distance* of skid trails. The skid trail function is only execute once, when stand height exceeds the height for the first thinning.

The options for thinnings are set in the next row. There three *thinning types*: single tree selection, thinning from above, and thinning from below. The *thinning intensity* can be set by the next check box. The moderate thinning is oriented on the recommendations given by the Northwest German Forest Research Station. The actual basal to which a stand will be thinned, is determined by the maximum *density* *function* and the given *moderate thinning factor*. Both can be altered in the *species manager dialog*. You can fix the minimum and maximum thinning volume in order to limit thinnings. By checking the box *release crop trees only* you will just thin trees, which are in competition to crop trees.

The harvesting method is given in the line. You can select the *harvesting methods*: *target diameter*, *shelter wood*, and *clear cut*. The last two methods are only executed if 50% of the basal of the trees have reached the target diameter. You can also limit the *minimum* and *maximum harvesting volume*. If you have chosen *target diameter* harvesting you can set the criterion for a final removal of all remaining over story trees in the field *final cut at B°* a degree of stocking. If you selected shelterwood the stand will be cut by a given *regeneration process* sequence. The sequence "*0.7; 0.5; 0.3; 0.0;*" means, that the degree of stocking will be lowered to 0.7 in the first time step, 0.5 in the second, 0.3 in the third, and all remaining over story will be out in the fourth time step. Each degree of stocking in that sequence should be separated by a semicolon (";"). There should be also a semicolon at the end. If you chose *clear cut* all trees will be removed.

In the line *protection* you can set the *number of habitat trees* per hectare and the group of trees where the habitat trees will be selected from. Habitat trees are selected from the pool of trees which have exceeded the target diameter limit by 80%. If you check the box minorities at least one crop tree per species will be selected to ensure that rare species get priority. Additionally you can set a *minimum coverage* and protect all tress with *dbh greater or equal* a certain value. Notice that the protection settings are given a higher priority than the thinning and harvesting rules. So for instance a clear cut might be not possible because of the protection settings.

The last line are the rules for planting. First decide if you want to activate planting. Define if the under story should be removed before planting. The planting is executed when the degree of coverage of the over story trees is below the level you set at planting at B°. In the last text field of that row you tell the system hat to plant. The text "511[0.5];211[0.5];" means that species 511 and 211 will be planted, each with a coverage of 50%. The ForestSimulator does not have a real regeneration routine, therefore the trees planted are only placeholders. Each placeholder covers an area of 5 m² ground which is about the size of the trees when ingrowth occurs (7cm). The height growth of the placeholders is oriented on the site index. The placeholders die in the simulation of the competition index get to high. By a given h/d ratio the diameter of the placeholders is calculated from the height. If it exceeds 7 cm in dbh a new tree of the placeholder's species is established.

In the table *species settings* you can adjust the settings for the treat of each species. The column *th.height[m]* determines at what height the first thinning is executed. If the average height of a species is below that given height, there will be no thinning. The column *target diameter [cm]* determines the size of crop trees for harvesting. The number of *crop trees [ha]* is important for the thinning and the future species composition of the stand. The default values of that column are calculated by the number of crop trees which will fit on the site without crown contact at given target diameter. You can of course change the default settings. The column *mix%* determines how much of the stand should be covered by one species. These numbers are used to calculate the default number of crop trees. You can best change the species composition by altering the number of crop trees.

The simulation process is started when you hit the button start simulation. If you press the ax symbol in the top menu or choose *Action → treatment* the settings of the window simulation settings will be read and a single treatment will be conducted.

.3.4.3 Prognosis

The major function of the ForestSimulator is to stand prognosis. Each time setp is a five year period. You can start a prognosis by the menu *action → grow* or by by pressing the tree symbol. Please notice, that the longer you grow a stand the less precise the prediction will be. Generally, the length of the simulation should not exceed 30 to 40 years. The errors will be also higher if you simulate very extrem stand situations.

For the 5-year growing period you can set if random effects, ingrowth, and a risk model should be active. The random effects will add a random error component to the diameter and height growth. That way trees with the same attributes will grow differently. The ingrowth model will predict ingrowing trees. The risk model add another component of random mortality. The probabilities are set to the average drop out values from the survey of the states Hessen, Lower Saxony and Sachsen-Anhalt.

- The growth action will call the following procedures:
- check for age dependent mortality
- check for risk mortality (if activated)
- check for density dependent mortality
- calculate diameter and height growth
- adjust the crown width and crown base
- establish ingrowth (if activated)
- increase the age
- update all windows in the simulator

Every time you start the single growing step a copy of the stand data will be saved in the treegross xml format to the directory data-simulation. The copy's file name consists of the name and the year (example: Stand_2020.xml). You can use the copies (*Stand → open → TreeGrOSS.xml-File*) if you want to go back in simulation or branch off a different treatment scenario.

The stand development is also saved by the simulated and can be displayed by *Reports → Stand table* .

3.5 Assortment

.3.5.1 Introduction

The menu allows *Reports → Sorting* to analyze different utilization strategies with respect to the volume of assortment, remaining debris wood and nutrient balance. The report can focuse on the harvested trees of a year, the remaining and the removed trees of the current year, and remaining stand and all removed trees in the simulation. The calculation of the assortments is based on the taper functions of SCHMIDT (2001). With the help of these functions it is possible to estimate the diameter of a tree at a given height. The functions for hardwoods should be only used up to crown base. The taper functions by SCHMIDT (2001) are also dependent of the h/d-ratio. The bark thickness is calculated by the functions of ALTHERR et al. (1978).

In the program it is possible to define assortments very flexible for one or several species. In the context of the program an assortment can be understood as pieces of the tree trunc with certain attributes. Therefore pieces which should remain in the forest because of decay or by other reasons need also to be defined like an assortment. The definition is given by the following parameters:

- name of assortment
- Species code (or species code from to)
- minimum and maximum middle diameter [cm]
- minimum and maximum top diameter [cm]
- minimum and maximum length [m]
- assortment is removed or stays in the forest
- tolerance for sale
- assortment can occur only below crown base
- assortment can occur in all trees or only in crop trees

- priority
- value
- amount of trees the assortment will occur in
- assortment can occur multiple or only one time in a tree trunc

The sorting is done in a simple way. The program tries to cut the assortment with the highest priority as long as possible starting at the base of the tree. If that assortment does not occur in that tree anymore or the other restrictions prevent the program from doing so the assortment with the next higher priority will come into consideration. This process is continued until all defined assortments are evaluated.

.3.5.2 *Calculate assortments*

Choosing *Reports →Sorting* in the main menu opens the Assortment Dialog (fig. 6).

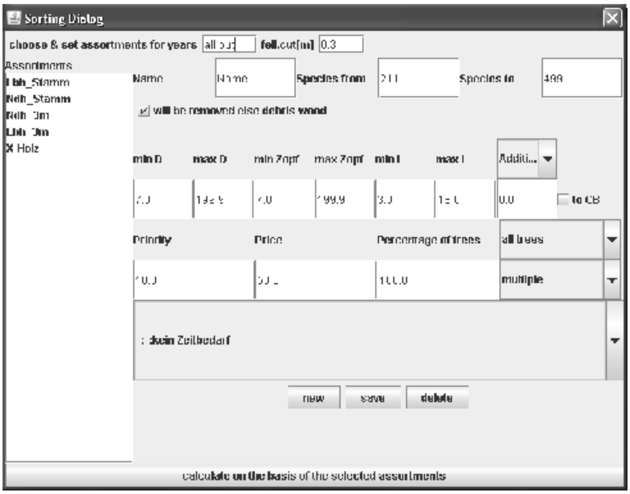


Figure 6: Assortment Dialog

In the top row of the *Sorting Dialog* you can set in the text field behind *choose & set assortments for years* the time frame for the calculation. The default is *all*, which means all cut and remaining trees will be evaluated. If you enter a year (example: *2010*) only the trees harvested in the year 2010 are part of the calculation. In the next text field after *fell.cut [m]* you can define the height at which the trees are usually felled. All volume below that height will be accounted to the debris wood.

The sorting dialog can be also used to estimate the volume, the biomass and the nutrient elements of x-wood and debris wood. To do so you have to define a special assortment with a high priority.

You can alter, define new and delete assortments using this dialog. The defined and useable assortments are shown in left box. If you click on a name in that box the attributes of the assortments will be displayed. To alter you can change the text fields and press the button *save* or add the settings as a *new* assortment. Do not forget to change the name. A marked assortment can be delete using the *delete* button. **Hint: if you make changes you should better close the dialog each time**.

In order to calculate the assortments of a stand, you first choose the assortments you want to consider. Mark the assortments in the box with the left mouse button and choose additional ones by holding down the Strg or Ctr button. After you have marked the assortments just press the lower button for calculation. Please be patient if you choose several assortments and if you have a stand with numerous trees. The sortet trees will be saved to the file *sortierung.xml* into the *output_standsimulation* directory. The file will be automatically displayed by your browser with the help of a style sheet *treegrosslogging.xsl*. In case the browser does not show the file you will have to open it manually. The file contains a report with several tables:

Table 1: List of the used assortments

Table 2: Volume by species

Table 3: Biomass by species

Table 4: Calcium by species

Table 5: Magnesium by species

Table 6: Potassium by species

Table 7: List of all stem pieces

3.6 Using of own stand data

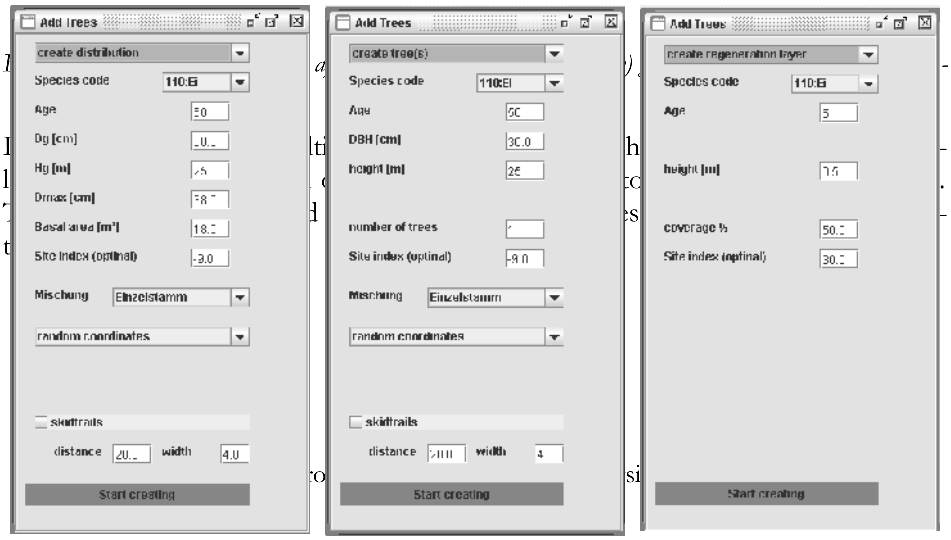
In this chapter you will learn how to generate stands and how you can use your own data

.3.6.1 Generating new stands

If you have a special question to forest growth and you do not have any data, you can generate a stand, which should fit to your question. This might help to get a better understand the problem.

You can generate a stand using the main menu *Stand → new* . Add a name, the size [ha] and choose the form (square or circle) of your model stand. If you press the button create. An empty stand with no trees will appear. The size of the simulation plot should fit your question. If you want to analyze a very young stand with lots of trees you should choose a size 0.1 to 0.2 ha so that you can save computing time and memory. Is your question geared towards older stands, then it might be better if you chose a size of 0.5 to 1 ha. If you need to simulate large stands with many trees you can switch the visualization to 2D that also saves memory and computing time.

You can trees to the stand in three different ways. The first option is to generate a distribution, which is created by some average plot information like species, age, mean basal area diameter (dg), the height of dg, maximum diameter and the wanted basal area (7a). The information for site index (height at age 100) is optional and if you do not know it add -9. When you press start creating the trees will be places on *random coordinates*, which are chosen in a way that the crowns will not overlap if possible. *Raster coordinates* plat the trees in rows and columns. If you choose under *Mischung* Trupp or Horst the trees will be clustered. You can also activate the option *skid trails* so that those trails will be without trees. - The second options is to generate n trees with same attributes like species, age, diameter, height and site index (optional)(7b). The coordinates are assigned as described before. - And in the third option you can create a regeneration layer. Just chose the species and add the age the height and the degree of coverage(7c). The site index is optional. Since there is only an ingrowth model the regeneration layer consists of 5m² regeneration placeholders.



.3.6.2 *Edit stand data*

You can edit the stand data directly in the ForestSimulator using *Edit → Stand data*. The dialog shows the data of the current stand (fig. 8). If you want to change your changes you have to press the button *accept changes* before you close the window. You copy and paste from the dialog window using Strg + c and Strg + v the commands. You can also use the dialog to create stands with the editor dialog. For this task first generate a new stand with the correct size and form. Next add only one tree to that stand, so that you have an example how your data should look. Save that stand and open it with *Edit → Stand*. The buttons *add cornerpoint* and *add lines* let you add empty rows to the tables. Next add the data with paste and copy to the tables. If you accept the changes empty rows of the tables will be ignored.

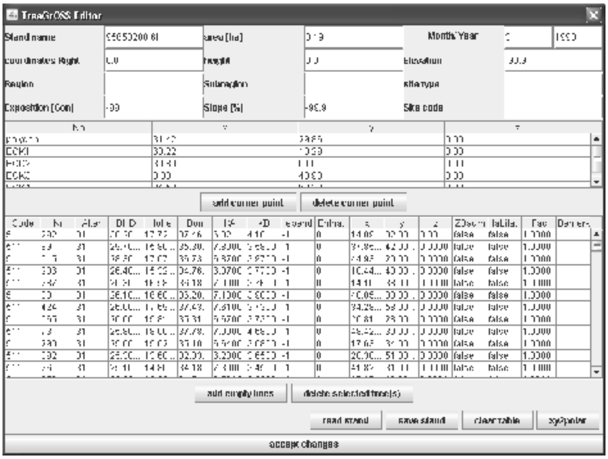


Figure 8: *TreeGrOSS editor*

If you have polar coordinates, you can convert them to xy coordinates (button *xy2polar* resp. *polar2xy*. All coordinates are converted based on the corner point polygon. The coordinates are shifted so that all of them have positive values. **If you save the data all coordinates need to be xy-coordinates**.

Some times the 3D graph will not show up after using the TreeGrOSS Editor. In this case just move the window with the graph a little and it gets refreshed.

.3.6.3 *TreeGrOSS – data format*

For data in- and output all stand data needs to be in the TreeGrOSS Format, which is defined as an xml data file. XML (Extensible Markup Language) is a format which allows to describe the data by tags. The tags are similar to HTML tags and are marked by <>. The names of the tags can be freely chosen. Table 5 shows the structure and the tags of a treegross.xml file. An xml file can hold also structured data. You can print and display xml-data with the help of style sheets in different ways. For the display of data in the TreeGrOSS Format there is an tree-gross.xsl style sheet.

Table5: Structure and tags of a treegross.xml File

<Tag>	<Tag>	Discription (*data type*)
Stand		Stand information
	ID	Stand ID *(character)*
	Kennung	Any other name *(character)*
	Allgemeines	Any text *(character)*
	Flaechengroesse_m2	Stand size [m²] *(decimal)*
	HauptbaumArtCodeStd	Standard code of main species *(integer)*
	HauptbaumArtCodeLokal	lokale code of main species *(integer)*
	AufnahmeJahr	Year of survey *(integer)*
	AufnahmeMonat	Month of survey *(integer)*
	DatenHerkunft	Data origin *(character)*
	Standort	Site name *(character)*
	Hochwert_m	Gauss-Krüger northing of stand *(decimal)*
	Rechtswert_m	Gauss-Krüger easting of stand *(decimal)*
	Hoehe_uNN_m	Height above sea level [m] *(decimal)*
	Exposition_Gon	Exposition of stand [Gon] *(integer)*
	Hangneigung_Prozent	Gradient [%] *(integer)*
	Wuchsgebiet	Name of growth region *(character)*
	Wuchsbezirk	Name of growth district *(character)*
	Standortskennziffer	Site code *(character)*

Baumar-tencode		**Species information**
	Code	Code number *(integer)*
	deutscherName	German species name *(character)*
	lateinischerName	Latin species name *(character)*

Eckpunkt		
	Nr	Number of corner point *(character)*
	RelativeXKoordinate_m	relative x-coordinate of corner point [m] *(decimal)*
	RelativeYKoordinate_m	relative a-coordinate of corner point [m] *(decimal)*
	RelativeBodenhoehe_m	relative z-coordinate (height) of corner point [m] *(decimal)*

Baum		**Tree information**

	Nr	number *(character)*
	Kennung	Height of diameter measurement *(integer)*
	BaumartcodeStd	Species code *(integer)*
	BaumartcodeLokal	Local species code *(integer)*
	Alter_Jahr	Age [years] *(integer)*
	BHD_mR_cm	Dbh inside bark [cm] *(decimal)*
	Hoehe_m	height [m] *(decimal)*
	Kronenansatz_m	Crown base [m] *(decimal)*
	MittlererKronenDurchmes-ser_m	Mean crown diameter [m] *(decimal)*
	SiteIndex_m	Height at age 100 [m] *(decimal)*
	RelativeXKoordinate_m	Relative x-coordinate of tree [m] *(decimal)*
	RelativeYKoordinate_m	Relative y-coordinate of tree [m] *(decimal)*
	RelativeBodenhoehe_m	Relative z-coordinate of tree [m] *(decimal)*
	Lebend	Tree alive *(true/false)*
	Entnommen	Tree removed *(true/false)*
	AusscheideMonat	Month of removeal *(integer)*
	AusscheideJahr	Year of removal , lebend = -1 *(integer)*
	AusscheideGrund	Reason for removal *(integer)*
	ZBaum	Crop tree *(true/false)*
	Zbaumtemporaer	Temporary crop tree *(true/false)*
	HabitatBaum	Habitat tree *(true/false)*
	KraftscheKlasse	Kraft'sche tree class *(integer)*
	Schicht	Stand layer *(integer)*
	Flächenfaktor	Size factor normal 1.0 *(decimal)*
	Volumen_cbm	Volume inside bark m³ *(decimal)*
	VolumenTotholz_cbm	Volume, if debris wood m³ *(decimal)*
	Bemerkung	Remarks *(character)*

3.7 Add additional trees to stand

This was already explained in the Chapter „Generating new stands“.

3.8 Special functions

.3.8.1 Using the results in other programs

This should give you just some ideas, how you can integrate the results from the simulator into other programs.

XML- und HTML- files

All results are displayed and stored as xml or hmtl files. You can view both type in your browser, however the xml-files might need a style sheet. You can copy and paste the information from the browser into other programs like spreadsheets (MS

Excel or OpenOffice Calc). It is also possible to read in the HMTL files into those programs directly. The xml-files you might need to save to HTML before doing so.

Using the graphical information

Most graphical information is stored in jpg files. You can open these with any graphical program. In addition you can save a screen shot and paste that into a graphical software.

3.9 Adjust the simulator

There are two important program controlling files. The first file *ForestSimulator.ini* controls the general setup and was already explained in the chapter installation. The second file *ForestSimulatorSettings.xml* (default name) controls the ForestSimulator and holds most of the equations. You can best edit this file *Properties → Species Manager* choosing in the menu. The dialog is displayed for the species oak of the model region Northwest Germany (fig. 9).

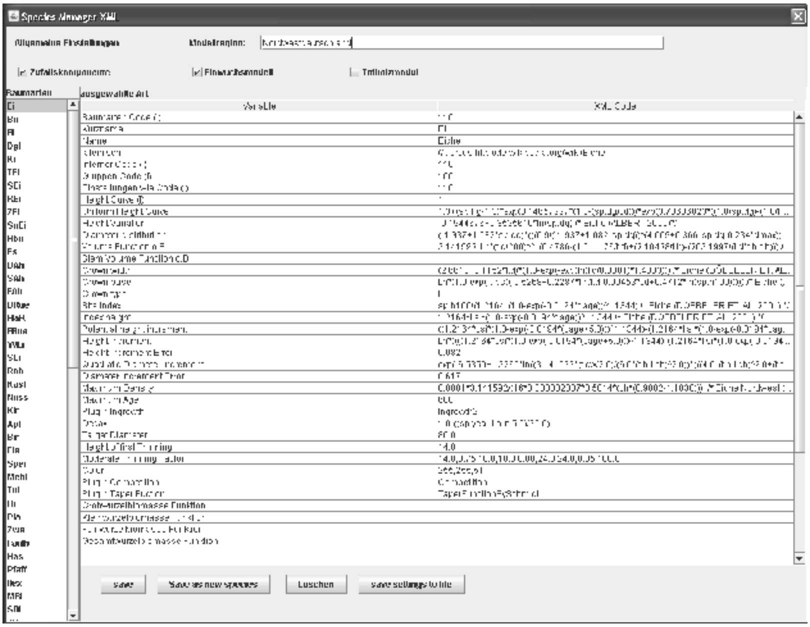


Figure 9: Dialog of Species Managers

In this dialog you will find on the left the species with their abbreviation. The default setting is the model for Northwest Germany. If you click on one of the short species names, you can see all the properties of that species in the main table. You can of course change the text in the table. If you that your changes shall be come permanent, you first leave the table cell you changes by clicking into another one, then hit the button *save* and finally *press save settings to file*. You can add new and also delete species. In table

In table 6 you find an example of the settings for the species Fagus silvatica.

Table 6: XML-file , species settings for Fagus silvatica

Tag <SpeciesDefinition>	**Type**	**Pack-age**	**Setting for beech (Northwest Germany)**
Baumarten Code	I	B	211
Kurzname	A	B	Bu
Name	A	B	Buche
lateinisch	A	B	Fagus silvatica http://de.wikipedia.org/wiki/Rotbuche
Interner Code	I		211
Gruppen Code	I		200
Einstellungen wie Code	I	B	211
Height Curve	I	B	1
Uniform Height Curve	AF	B	1.3+(sp.hg-1.3)*exp(0.20213328*(1.0-(sp.dg/t.d)))*exp(5.64023296*((1.0/sp.dg)-(1.0/t.d)))
Height Variation	AF	S	1.1217150+0.2203473*ln(sp.BHD_STD)
Diameter Distribution	AF	b	(-4.282+1.132*sp.dg)*(((6.9/(-4.282+1.132*sp.dg))^(4.518+0.317*sp.dg-0.200*dmax))-ln(1.0-random))^(1.0/(4.518+0.317*sp.dg-0.200*dmax))
Volume Function o.B.	AF	B	3.141592*t.h*(t.d/200)^2*(0.4039+0.0017335*t.h+1.1267/t.h-118.188/(t.d*t.d*t.d)+0.0000042*t.d*t.d)
Stem Volume Function	af	s	
Crown width	AF	B	(2.0837+0.15*t.d)*(1.0-exp(-exp(ln(t.d/5.7292)*1.3341)))
Crown base	AF	B	t.h*(1.0-exp(-abs((0.25704+0.11819*t.h/t.d-0.002065*t.d+0.13831*ln(sp.h100)))))
Crown type	I	S	0
Site index	AF	B	(sp.h100+75.65900-23.19200*ln(t.age)+1.46800*((ln(t.age))^2.0))/

			(0.00000+0.21520*ln(t.age))
Site index height	AF	B	-75.65900+23.19200*ln(25.0)-1.46800*(ln(25.0)^2)+0.0*t.si+0.21520*t.si*ln(25.0)
Potential height increment	AF	B	((-75.65900+23.19200*ln(t.age+5)-1.46800*((ln(t.age+5))^2.0)+0.21520*t.si*(ln(t.age+5))) -(-75.65900+23.19200*ln(t.age)-1.46800*((ln(t.age))^2.0)+0.21520*t.si*(ln(t.age))))
Height increment	AF	B	0.00159*(t.hinc^1.9086)
Height increment error	D	B	0.082
Quadratic diameter increment	AF	B	exp(-7.393+1.375*ln(3.14159265359*(t.cw/2.0)/(6.0*(t.h-t.cb)^2)*((4.0*(t.h-t.cb)^2 +(t.cw/2)^2)^1.5 -(t.cw/2)^3))-0.791*ln(t.age)-0.793*t.c66xy+0.809*t.c66cxy-0.0*ln(5.0))
Diameter Increment Error	D	B	0.762
Maximum density	AF	B	0.0001*3.141592/(16*0.00000010829*8.3652*(t.h^(1.5374-1.7365)))
Maximum age	I	B	300
Plugin Ingrowth	a	b	Ingrowth2
Decay	af	b	1.0-((sp.year-t.out-5.0)/30.0)
Target diameter	D	T	65.0
Height of first thinning	D	T	12.0
Moderate Thinning Factor	A(D)	T	12.0;0.7;22.0;22.0;0.65;28.0;28.0;0.75;100.0
Color	A(I)	S	199;83;28
Plugin Competition	A	B	Competition
Plugin TaperFunction	a	b	TaperFunctionBySchmidt
Grobwurzelbiomasse Funktion	af	s	0
Kleinwurzelbiomasse Funktion	af	s	0
Feinwurzelbiomasse Funktion	af	s	0
Gesamtwurzelbiomasee Funktion	af	s	0

Type: I = integer; D = double, A = character, AF = function as string

TreeGrOSS Package: B = treegross.base, T = treegross.treatment, S = treegross.standsimulation;
Capital letter = required input, small letter = optional

All information in Table 6 that is marked by „AF" resp. „af" contains equations. These character strings are evaluated by a Java Equation Parser[3] (JEP). The JEP requires some declaration for the variables used. In Table 7 the main functions and variables are listed.

Table 7: Declaration and Variables for the Java Equation Parser

declaration	Variable	declaraction	Variable
t.d	Tree diameter [cm]	sp.dg	Mean Quadratdiameter (dg) of species [cm]
t.h	Tree height [m]	sp.hg	Height of dg of species [m]
t.age	Tree age [years]	sp.h100	Top height of species [m]
t.c66xy	Tree competition	sp.year	Year of simulation
t.c66cyx	Tree competition change	sp.BHD_STD	Standarddeviation of diameter of species [cm]
t.out	Tree removal year	abs()	Absolut
t.si	Tree site index	exp()	Exponent
t.ihpot	Tree potential height increment [m]	ln()	Natural log.
t.hinc	Tree height increment [m]	random	Random number 0 -1

If there is no information for a specific species and you want that species treated like another species, you only have to complete the first 6 lines. The species in the field will refer to that species and it's information is copied for all other fields where there is no input or the field is blank.

Attention: Chan

ges to the species settings may have significant impact on the simulation.

3.10 Convert BWINPro6.2 files to XML

In the help menu you find a procedure which may help to convert data from the old BWINPro 6.2 version to the new TreeGrOSS format (*BWIN62 → XML*). It is important that all species which are in the old format are already defined in the simulator.

[3] Thanks to the open source code and version of JEP (http://www.singularsys.com/jep/)

4 Literatur

ALBERT, M. (1999): Analyse der eingriffsbedingten Strukturveränderung und Durchforstungsmodellierung in Mischbeständen, Dissertation, Universität Göttingen, Hainholz-Verlag, Band 6: 201 S.

ALBERT, M. (2000): Ein funktionalisierter Höhenergänzungsalgorithmus für Einzelbaumwachstumsmodelle. Jahrestagung des DVFFA -Sektion Ertragskunde- in Kaiserslautern

ALBERT, M. (2007): Waldwachstumssimulatoren zur mehrkriteriellen Szenariobewertung: ein Ansatz für eine benutzerfreundliche und flexible Bewertung. Tagungsband der Jahrestagung der Sektion Ertragskunde im DVFFA vom 21.-23.05.2007 in Alsfeld-Eudorf, 43-56

ALBERT, M. (2007): Waldwachstumssimulatoren zur mehrkriteriellen Szenariobewertung: ein Ansatz für eine benutzerfreundliche und flexible Bewertung. Tagungsband der Jahrestagung der Sektion Ertragskunde im DVFFA vom 21.-23.05.2007 in Alsfeld-Eudorf, 43-56

ALBERT, M. UND SCHMIDT, M. (2010): Climate-sensitive modelling of site-productivity relationships for Norway spruce (Picea abies (L.) Karst.) and common beech (Fagus sylvatica L.). Forest Ecology and Management, Vol. 259, Issue 4, 739-749

ALTENKIRCH, W. (1977): Ökologie, Studienbücher Bilogie, Verlag Diesterweg/Salle, Frankfurt, Main, Verlag Sauerländer, Aarau, 234 S.

ALTER, S.L. (1980): Decision Support Systems: Current Practice and Continuing Challenges, Reading, MA: Addison-Wesley

ALTHERR, E., UNFRIED, P. HRADETZKY, J. U. HRADETZKY, V. (1978): Statistische Rindenbeziehungen als Hilfsmittel zur Ausformung und Aufmessung unentrindeten Stammholzes. Teil IV: Fichte, Tanne, Douglasie und Sitka-Fichte. Mitteilungen der Forstlichen Versuchs- und Forschungsanstalt Baden-Württemberg Heft 90, S. 294

BAILEY, T.C. u. GATRELL, A.C. (1995): Interactive Spatial Data Analysis. Addison-Wesley Longman, Harlow, Great Britain

BAUER (1955): Die Roteiche, J.D.Sauerländer, Frankfurt a.M

BERGEL, D. (1974): Massentafeln II Eiche Roteiche Kiefer. Niedersächsische Forstliche Versuchsanstalt, Göttingen

BERGEL, D. (1985): Douglasienertragstafel für Nordwestdeutschland. Niedersächsische Forstliche Versuchsanstalt

BERGEL, D. (1987): Derbholz-Massentafeln III (Nordwestdeutschland). Niedersächsische Forstliche Versuchsanstalt

BERGEL, D. .(1973): Formzahluntersuchungen an Buche, Fichte, europäischer Lärche und japanischer Lärche zur Aufstellung neuer Massentafeln. Allg. Forst- u. J. Ztg. 144 (5/6): 117-124

BÖCKMANN, T. (1990): Wachstum und Ertrag der Winterlinde (Tilia cordata Mill) in Nordwestdeutschland. Dissertation Univ. Göttingen

BÖCKMANN, T. (2004): Möglichkeiten und Grenzen von Waldwachstumsmodellen aus Sicht der forstlichen Praxis. In Hanewinkel u. v. Teufel (Hrsg.) Waldwachstumsmodelle für Prognosen in der Forsteinrichtung. Freiburger Forstliche Forschung, FVA Baden-Württemberg, 50, S. 95-102

BONCZEK, R. H., HOLSAPPLE, C.W. u. WHINSTON, A.B. (1981): Foundations of Decision Support Systems, Academic Press, New York

BRENNAN, J. J. u. ELAM, J. (1986): Enhanced Capabilities for Model-Based Decision Support Systems. In: Sprague, R.H.W. und Watson,H.J. (Ed.): Decision Support Systems. Putting Theory into Practice, Prentice-Hall, London, 130-137

CHEN, B.W. U. GADOW, K. V. (2008): Combining spatial and other objectives in forest design. Metsanduslikud Uurimused (Forestry Studies) 48, 30-40

CZERANKA, M. u. EHLERS, M. (1997): GIS als Instrument zur Entscheidungsunterstützung. Geo-Informations-Systeme, Vol. 10, No. 2, 9-17

DEGENHARDT, A. (2006): Der Waldwachstumssimulator „BWINPro Brandenburg“ für die Kiefer in Brandenburg. Landesforstanstalt Eberswalde, Abschlussbericht

DENGLER, A. (1992): Waldbau. Erster Band. 6. neu bearbeitete Auflage. Verlag Paul Parey, Hamburg und Berlin. 350 S.

DIJKSTRA, E.W. (1959): A note on two problems in connection with graphs, Numerische Mathematik, 1:269-271

DÖBBELER, H. (2004): Simulation und Bewertung von Nutzungsstrategien unter heutigen und veränderten Klimabedingungen mit dem Wuchsmodell SILVA 2.2. Dissertation Univ. Göttingen. S. 231

DÖBBELER, H., ALBERT, M., SCHMIDT, M., NAGEL, J. (2002): BWINPro – Programm zur Bestandesanalyse und Prognose. Handbuch zur Version 6.1. Niedersächsische Forstliche Versuchsanstalt Abteilung Waldwachstum, Göttingen, S. 121

DUDA, H. (2006): Vergleich forstlicher Managementstrategien. Dissertation Universität Göttingen, S. 180 (http://webdoc.sub.gwdg.de/diss/2006/duda/)

ECKMÜLLNER, O. (2006): Allometric relations to estimate needle and branch mass of Norway spruce and Scots Pine on Austria. Austrian Journal of Forest Science, 123. Jahrgang, Heft 1/2, S.7-16.

FÜLDNER, K. (1995): Strukturbeschreibung von Buchen-Edellaubholz-Mischwäldern. Dissertation, Fakultät für Forstwissenschaften und Waldökologie, Georg-August-University Göttingen. Cuvillier, Göttingen. 146 S.

GADOW, K. V.(2003): Waldstruktur und Wachstum. Universitätsverlag Göttingen, 241 S.

GAFFREY, D. (1988): Forstamts- und bestandesindividuelles Sortimentierungsprogramm als Mittel zur Planung, Aushaltung und Simulation. Diplomarbeit Univ. Göttingen

GEOFFRION, A.M. (1983): Can MS/OR Evolve Fast Enough? Interfaces, 13:1, 10-25.

GOSAVI, A. (2003): Simulation-based optimization: parametric optimization techniques and reinforcement learning. Kluwer Academic Publishers, Boston, 554 S.

GSCHWANTNER, T.u. SCHADAUER, K. (2006): Biomass branch functions for broadleaved tree species in Austria. Austrian Journal of Forest Science, 123. Jahrgang, Heft 1/2, S.17-34

GUERICKE, MARTIN (2001): Versuchsflächenanalyse, Modellparametrisierung und waldbauliche Konsequenzen für die Behandlung von Buchen-Lärchen-Mischbeständen im Südniedersächsischen Bergland. Dissertation Universität Göttingen (http://webdoc.sub.gwdg.de/diss/2001/guericke/index.html)

HANSEN, J. (2006): Der WaldPlaner - Ein System zur Entscheidungsunterstützung in einer nachhaltigen Forstwirtschaft. Deutscher Verband Forstlicher Forschungsanstalten - Sektion Forstliche Biometrie und Informatik. Trippstadt 2006, S. 112-119

HANSEN, J., NAGEL, J., SCHMIDT, M.u. SPELLMANN, H. (2008): Das mittelfristige Buchenholzaufkommen in Niedersachsen und Deutschland. In: Ergebnisse angewandter Forschung zur Buche. Beiträge aus der NW-FVA, Band 3, 291-310

HAUSENAUER, H. (2006): Sustainable Forest Management: Growth models for Europe. Springer, Berlin Heidelberg, 398

HEINEN, E. (1976): Grundfragen der entscheidungsorientierten Betriebswirtschaftslehre. Goldmann, München.

HEINEN, E. (1991): Industriebetriebslehre als entscheidungsorientierte Unternehmensführung. In Heinen, E. (Hrsg.): Industriebetriebslehre. 9. Auflage. Gabler, Wiesbaden, 3-69.

HINRICHS, L. (2006): Untersuchungen zur Simulation von Behandlungspfaden für Buchen-Fichten-Mischbestände. Diss., Universität Göttingen. 123 S.

HOLTEN, R. u. KNACKSTEDT, R. (1997): Führungsinformationssysteme. Historische Entwicklung und Konzeption. Arbeitsberichte des Instituts für Wirtschaftsinformatik der Westfälischen Wilhelms-Universität Münster, Nr. 55, Münster

HURME, E., KURTTILA, M., MÖNKKÖNEN, M., HEINONEN, T. u. PUKKALA, T. (2007): Maintenance of flying squirrel habitat and timber harvest: a site-specific spatial model in forest planning calculations. Landscape Ecology, 22, 243–256

JACOBSEN, C., RADEMACHER, P., MEESENBURG, H. u. MEIWES, K.-J. (2003): Gehalte chemischer Elemente in Baumkompartimenten Literaturstudie und Datensammlung. Berichte des Forschungszentrums Waldökosysteme, Reihe B, Bd. 69, S. 81

KAHLE, MIKE (2004): Elsbeere. Untersuchungen zum Wachstum am Beispiel einiger Mischbestände in Nordrhein-Westfalen. Schriftenreihe der Landesanstalt für Ökologie, Bodenordnung und Forsten Nordrhein-Westfalen, Band 21. ISSN: 3-89174-033-6. S. 155

KEEN, P.G.W. u. SCOTT-MORTON, M.S. (1978): Decision Support Systems: An Organizational Perspective, Reading, MA: Addison-Wesley

KIMMINS, J.P. (1987): Forset Ecology, Macmillan Publiching Company, New York, 531 S.

KNIGGE, W. u. SCHULZ, H. (1966): Grundriss der Forstbenutzung: Entstehung, Eigenschaften, Verwertung und Verwendung des Holzes und anderer Forstprodukte, Paul Parey, Berlin

KRAMER, H. (1982): Nutzungsplanung in der Forsteinrichtung, J.D. Sauerländer's Verlag, Frankfurt a. M., S. 128

KRAMER, H.u. AKÇA, A., (1982): Leitfaden für Dendrometrie und Bestandesinventur, J.D. Sauerländer's Verlag, Frankfurt a. M.

KURTTILA, M., PUKKALA, T.u. LOIKKANEN, J. (2002): The performance of alternative spatial objective types in forest planning calculations: a case for flying squirrel and moose. Forest Ecology and Management 166, 245-260

LEDERMANN, T. u. NEUMANN, M. (2009): Prognose des Waldwachstums und des Nutzungspotenzials. BFW-Praxisinformation 18, 5 – 7

LEITÃO, A. B., MILLER, J., AHERN, J.u. MCGARIGAL, K. (2006): Measuring Landscapes: A Planners Handbook. Island Press, Washington, D.C.

LOCKOW, K.W. (1994): Aufstellung einer neuen Ertragstafel für im Hochwaldbetrieb bewirtschaftete Roterlenbestände (Alnus glutinosa [L.] Gaertn.). Abschlußbericht Forstliche Forschungsanstalt Eberswalde e.V.

MEESENBURG, H., HENTSCHEL, S., SUTMÖLLER, J., JANSEN, M., AHRENDS, B., DÖRING, C., RÜPING, U. (2009): SILVAQUA & SILVAQUAplus, Abschlussbericht, Pilotprojket zur Umsetzung der EG-WRRL in Niedersachsen

MEESENBURG, H., SUTMÖLLER, J., HENTSCHEL, S. (2010): Retrospective and prospective evaluation of water budgets at Lange Bramke, Harz Moutains, Germany: effects of plant cover and climate change. In: Status and Perspectives of Hydrology in Small Basins (Proceedings of the Workshop held at Goslar-Hahnenklee, Germany, 30 March-2 April 2009), IAHS Publ. 336, 239-244

MERKER, K.. (2006): Bewirtschaftung des Staatswaldes in einer globalen Wirtschaft. Forst u. Holz 61 (7): 250 - 252

MEYER, P., MENKE, N., NAGEL, J., HANSEN, J., KAWALETZ, H., PAAR, U.u. EVERS, J. (2009): Entwicklung eines Managementmoduls für Totholz im Forstbetrieb. Abschlussbericht DBU, 106 S.

MÖHRING, B., RÜPING, U., LEEFKEN, G.u. ZIEGLER, M. (2006): Die Annuität – ein „missing link“ der Forstökonomie, Allgemeine Forst- und Jagdzeitung, 177/2, 21-29

MÜLLER-USING, B. (2005): Totholzdynamik eines Buchenbestandes im Solling, Berichte des Forschungszentrums Waldökosysteme, Reihe A, Bd. 193. Göttingen

NAGEL, J. (1985): Wachstumsmodell für Bergahorn in Schleswig-Holstein. Dissertation Univ. Göttingen

NAGEL, J. (1994): Ein Einzelbaumwachstumsmodell für Roteichenbestände. Forst u. Holz 49 (3): 69-75

NAGEL, J. (1996): Anwendungsprogramm zur Bestandesbewertung und zur Prognose der Bestandesentwicklung. Forst u. Holz, 51 (3): 76-78

NAGEL, J. (1999): Konzeptionelle Überlegungen zum schrittweisen Aufbau eines waldwachstumskundlichen Simulationssystems für Nordwestdeutschland. Schriften aus der Forstlichen Fakultät der Universität Göttingen und der Nieders. Forstl. Versuchsanstalt, Band 128, J.D. Sauerländer's Verlag, Frankfurt a.M., S. 122

NAGEL, J. (2002): Das Open Source Entwicklungsmodell - eine Chance für Waldwachstumssimulatoren. Deutscher Verband Forstlicher Forschungsanstalten - Sektion Ertragskunde, Jahrestagung Schwarzburg 13-15. Mai 2002, S. 1-6

NAGEL, J. (2008): Schätzung der Holznutzung und der Totholzmengen im Hinblick auf Quantifizierung der korrespondierenden Nährstoffmengen. Themenschwerpunkt Energieholz und standörtliche Nachhaltigkeit Teil 1. Forst und Holz, 63. Jg., 23-25

NAGEL, J. (2009): Waldwachstumssimulation mit dem Softwarepaket TreeGrOSS – Neuerungen, Erweiterungsmöglichkeiten und Qualitätsmanagement. In: Römisch, K., Nothdurft, A., Wunn, U. (Hrsg.): Tagungsband der gemeinsamen Jahrestagung der Sektion Forstliche Biometrie und Informatik im DVFFA (20. Tagung) und der AG Ökologie u. Umwelt in der Intern. Biometr. Gesell., 22.-24.09.2008 in Freiburg. Die Grüne Reihe, 174-178

NAGEL, J., ALBERT, M. u. SCHMIDT, M. (2002): Das waldbauliche Prognose- und Entscheidungsmodell BWINPro 6.1. Forst u. Holz 57, (15/16) 486-493

NAGEL, J., DUDA, H. u. HANSEN, J. (2006): Forest Simulator BWINPro7. Forst und Holz 61, Heft 10, S.427-429

NAGEL, J.u. BIGING, G.S. (1995): Schätzung der Parameter der Weibullfunktion zur Generierung von Durchmesserverteilungen. Allg. Forst- u. J. Ztg. 166 (9/10): 185-189

NAGEL, J.u. SCHÖDER, J. (2005): Modellfunktionen und Koeffizienten des Forest Simulators BWINPro Version 7.0 - Version Alnus – . Beschreibung zum ForestSimulator BWINPro 7.0 Programmbeschreibung http://www.nw-fva.de

OESTEN, G. u. ROEDER, A. (2002): Management von Forstbetrieben I. Kessel: Remagen-Oberwinter., 363 S.

PICOT, A. u. M. MAIER (1993): Information als Wettbewerbsfaktor. In: Preßmar, D. (Hrsg.): Informationsmanagement. Schriften zur Unternehmensführung, Band 49, Gabler, Wiesbaden.

PIELOU, E.C. (1966). The measurement of diversity in different types of biological collections. Journal of Theoretical Biology, Volume 13, 131-144

PRETZSCH, H. (1992): Konzeption und Konstruktion von Wuchsmodellen für Rein- und Mischbestände. Forstliche Forschungsberichte München, Band 115

PRETZSCH, H. (1995): Analyse and Reproduktion räumlicher Bestandesstrukturen. Methodische Überlegungen am Beispiel niedersächsischer Buchen-Lärchen-Mischbestände. Centralblatt für das gesamte Forstwesen, 112 (2), 91-117

PRETZSCH, H. (1995): Zum Einfluss des Baumverteilungsmusters auf den Bestandeswzuwachs. Allg. Forst- u. J. Ztg. 166. (9/10), S.190-201.

PUKKALA, T. (2006): The Use of Multi-Criteria Decision Analysis and Multi-Objective Optimisation in Forest Planning. Sustainable Forest Management, Springer Berlin/Heidleberg, 263-284.

RÖÖS, M. (1990): Zum Wachstum der Vogelkirsche (Prunus avium L.) in Nordrhein-Westfalen und angrenzenden Gebieten. Dissertation Univ. Göttingen

RÜTHER, B., HANSEN, J., LUDWIG, A., SPELLMANN, H., NAGEL, J., MÖHRING, B., DIETER, M. (2007): Clusterstudie Forst und Holz Niedersachsen. Beiträge aus der Nordwestdeutschen Forstlichen Versuchsanstalt, Band 1.

RÜTHER, B., HANSEN, J., LUDWIG, A., SPELLMANN, H., NAGEL, J., MÖHRING, B., LÜPKE, N. V., SCHMIDT-WALTER, P., DIETER, M. (2008a): Clusterstudie Forst und Holz Schleswig-Holstein. Eigendruck, Göttingen, 78 S.

RÜTHER, B., HANSEN, J., LUDWIG, A., SPELLMANN, H., NAGEL, J., MÖHRING, B., LÜPKE, N. V., SCHMIDT-WALTER, P.u. DIETER, M. (2008): Clusterstudie Forst und Holz Schleswig-Holstein. Eigendruck, Göttingen, 78 S.

RÜTHER, B., HANSEN, J., LUDWIG, A., SPELLMANN, H., NAGEL, J., MÖHRING, B.u. DIETER, M (2007): Clusterstudie Forst und Holz Niedersachsen. Beiträge aus der Nordwestdeutschen Forstlichen Versuchsanstalt, Band 1

RÜTHER, B., HANSEN, J., SPELLMANN, H., NAGEL, J., MÖHRING, B., SCHMIDT-WALTER, P., DIETER, M. (2008b): Clusterstudie Forst und Holz Sachsen-Anhalt, Nordwestdeutsche Forstliche Versuchsanstalt (Hrsg.), 60 S.

RÜTHER, B., HANSEN, J., SPELLMANN, H., NAGEL, J., MÖHRING, B., SCHMIDT-WALTER, P.u. DIETER, M. (2008): Clusterstudie Forst und Holz Sachsen-Anhalt, Nordwestdeutsche Forstliche Versuchsanstalt (Hrsg.), 60 S.

SCHMIDT, A. (1968): Der rechnerische Ausgleich der Bestandeshöhenkurven. Forstwissenschaftl. Centralblatt, 370-382

SCHMIDT, M. (2001): Prognosemodelle für ausgewählte Holzqualitätsmerkmale wichtiger Baumarten. Dissertation Univ. Göttingen. S.302 (http://webdoc.sub.gwdg.de/diss/2002/schmidt/index.html)

SCHMIDT, M., BÖCKMANN, TH.U. NAGEL, J. (2006):The Use of Tree Models for Silvicultural Decision Making. In Hasenauer, H. (Ed.) Sustainable Forest Management, Growth Models For Europe, Springer, Berlin, Heidelberg. 237-261. ,ISBN-10 3-540-26098-6

SCHMIDT, M., NAGEL, J.u. SKOVSGAARD, J.-P. (2006):Evaluating Individual Tree Models. In Hasenauer, H. (Ed.) Sustainable Forest Management, Growth Models For Europe, Springer, Berlin, Heidelberg. 151-163. ,ISBN-10 3-540-26098-6

SCHOBER, R. (1949): Die Lärche. Schaper, Hannover

SCHOBER, R. (1962) Die Sitka-Fichte. J.D. Sauerländer's Verlag. Frankfurt a.M.

SCHOBER, R. (1971): Die Rotbuche. J.D.Sauerländer Frankfurt a.M.

SCHOBER, R. (1987): Ertragstafeln wichtiger Baumarten. J.D. Sauerländer's Verlag, Frankfurt a.M.

SCHÖLLER, W. u. SPORS, H.-J. (2001): Einführung von Steuerungselementen in der Landesforstverwaltung NRW. Allgemeine Forstzeitschrift 56 (14). 740–742

SCHRÖDER, J., RÖHLE, H., GEROLD, D.u. MÜNDER, K. (2007): Bewertung waldbaulicher Maßnahmen mit BWINPro-S. AFZ-DerWald, pages 656 - 659

SCHRÖDER, J., RÖHLE, H., GEROLD, D.u. MÜNDER, K.. (2007): Modeling individual-tree growth in stands under forest conversion in East Germany, European Journal of Forest Research, Springer Berlin/ Heidelberg, Vol. 126, No. 3, 459-472

SIMPSON, E. H. (1949): Measurement of diversity. Nature, 163, 688 S.

SODTKE, R., SCHMIDT, M., FABRIKA, M., NAGEL, J., DURSKY, J.u. PRETZSCH, H. (2004): Anwendung und Einsatz von Einzelbaummodellen als Komponenten von entscheidungsunterstützenden Systemen für die strategische Forstbetriebsplanung. Forstarchiv 75, 51-64

SPELLMANN, H., NAGEL, J., DUDA, H.u. HENTSCHEL, S. (2006): Szenarien der Waldentwicklung. In: Meyerhoff, J., Hartje, V., Zerbe, S. (Hrg.) 2006: Biologische Vielfalt und deren Bewertung am Beispiel des ökologischen Waldumbaus in den Regionen Solling und Lüneburger Heide. Berichte des Forschungszentrums Waldökosysteme

SPRAGUE, R. H., JR. u. CARLSON, E. D. (1982) Building Effective Decision Support Systems, Englewood Cliffs, NJ: Prentice Hall

STERBA, H. (1981): Natürlicher Bestockungsgrad und Reinekes SDI, Centralblat für das ges. Forstwesen 98 (2), S. 101-116

SUN (2009: http://www.sun.com/software/products/appsrvr/index.jsp, 15.05.2009.

SUTMÖLLER, J., HENTSCHEL, S., HANSEN, J., MEESENBURG, H. (2010): Coupled forest growth-hydrology modeling as an instrument for the assessment of effects of forest management on hydrology in forest catchments. ADGEO, Copernicus Publications, in press.

TEUFEL, K., V., HEIN, S., KOTAR, M., PREUHSLER, E. P., PUUMALAINEN, J.u. WEINFURTER, P. (2006): End User Needs and Requirements. Sustainable Forest Management, Springer Berlin/Heidelberg, 19-38

THE APACHE SOFTWARE FOUNDATION (2009): http://tomcat.apache.org/index.html, 15.05.2009.

ULLENBOOM, C. (2007): Java ist auch eine Insel. 7., aktualisierte Auflage Galileo Computing, 1492 S.,ISBN 978-3-8362-1146-8

VARGAS, B. (2006): Analyse und Prognose des Einzelbaumwachstums in strukturreichen Mischbeständen in Durango, Mexiko. Dissertation Universität Göttingen, Cuvillier Verlag Göttingen, S. 149

VOLQUARDTS, G. (1958): Die Esche in Schleswig-Holstein. Dissertation Univ. Göttingen

WENSEL, L., MEERSCHAERT, W. u. BIGING, G.S. (1987): Tree Height and Diameter Growth Models for Northern California Conifers. Hilgardia, University of California, Volume 55, No. 8

WESTPHAL, B. (1998): Beschreibung und Modellierung des Wachstums von Japan-Lärchen (Larix kaempferi) im Reinbestand. Dissertation Universität Göttingen

WIEDEMANN, E. (1942): Eine Korrektur an der Fichtenertragstafel von 1936. Mitt.aus Forstwirt. u. Forstwiss. 287-294

WIEDEMANN, E. (1948): Die Kiefer. Schaper Hannover

WITTMANN, W. (1959): Unternehmung und unvollkommene Information: Unternehmerische Voraussicht – Ungewissheit und Planung. Westdeutscher Verlag, Köln

5 Appendix

5.1 Equations and Settings for Northwest Germany

Tabelle 8: Species code

Code	Kurz	Name	lat. Name	Einstellung wie
110	Ei	Eiche	Quercus	110
111	SEi	Stieleiche	Quercus robur	110
112	TEi	Traubeneiche	Quercus petraea	110
113	REi	Roteiche	Quercus rubra	113
114	ZEi	Zerreiche	Quercus cerris	110
115	SuEi	Sumpfeiche	Quercus cerris	110
211	Bu	Buche	Fagus silvatica	211
221	Hbu	Hainbuche	Carpinus betulus	211
311	Es	Esche	Fraxinus excelsior	311
321	BAh	Bergahorn	Acer pseudoplatanus	321
322	SAh	Spitzahorn	Acer platanoides	321
323	FAh	Feldahorn	Acer campestre	321
331	BRue	Bergulme	Ulmus glabra	211
332	FlaR	Flatterulme	Ulmus laevis	211
333	FRue	Feldulme	Ulmus minor	211
341	SLi	Sommerlinde	Tilia platyphyllos	342
342	WLi	Winterlinde	Tilia cordata	211
351	Rob	Robinie	Robinia pseudoacacia	211
352	Kast	Kastanie	Castanea sativa	211
353	Nuss	Nussbaum	Juglans regia	211
354	Kir	Kirsche	Prunus avium	211
355	Apf	Wildapfel	Malus silvestris	211
356	Bir	Wildbirne	Pyrus pyraster	211
357	Els	Elsbeere	Sorbus torminalis	357
358	Spei	Speierling	Sorbus domestica	357
359	Mehl	Mehlbeere	Sorbus intermedia	357
361	Tul	Tulpenbaum	Liriodendron tulipifera	321
362	Hi	Hickory	Carya alba	321
363	Pla	Platane	Platanus acerifolia	321
365	Zwe	Wildzwetschge	Prunus domestica	357
372	Faulb	Faulbaum	Faulbaum	357

Code	Kurz	Name	lat. Name	Einstellung wie
375	Has	Hasel	Corylus avellana	357
380	Pfaff	Pfaffenhütchen	Euonymus europaeus	357
386	Ilex	Stechpalme	Ilex aquifolium	357
410	Bi	Birke	Betula	412
411	SBi	Sandbirke	Betula pendula	412
412	MBi	Moorbirke	Betula pubescens	412
413	JBi	Japanische Birke	Betula	412
414	HyBi	Hybrid Birke	Betula	412
421	REr	Roterle (Schwarzerle)	Alnus glutinosa	421
422	WEr	Weißerle (Grauerle)	Alnus incana	421
423	GEr	Grünerle	Alnus incana	421
430	Pa	Pappel	Populus	211
431	As	Espe o. Zitterpappel	Populus tremula	110
432	SPa	Schwarzpappel	Populus nigra	110
433	GPa	Graupappel	Populus canescens	110
434	BPa	Balsampappel	Populus balsamifera	110
441	Wei	Weide	Salix	110
442	RKast	Rosskastanie	Aesculus hippocastanum	321
451	Ebs	Eberesche	Sorbus aucuparia	211
452	TKir	amerik. Traubenkirsche	Prunus serotina	221
511	Fi	Fichte	Picea abies	511
512	SFi	Sitkafichte	Picea sitchensis	511
513	OFi	Omorikafichte	Picea omorika	511
514	SteFi	Stechfichte	Picea pungens	511
515	SwFi	Schwarzfichte	Picea mariana	511
516	SaFi	Sachalinfichte	Picea glehni	511
517	YeFi	Ajanfichte	Picea jezoensis	511
521	Ta	Weisstanne	Abies alba	511
522	NTa	Nordmannstanne	Abies nordmanniana	511
523	KTa	Küstentanne	Abies grandis	511
524	KolTa	Koloradotanne	Abies concolor	511
525	ETa	Edeltanne	Abies procera	511
527	LTa	Sierra-Tanne	Abies concolor var.lowiana	511
528	VTa	Veitchs-Tanne	Abies veitchii	511
529	PTa	Purpurtanne	Abies amabilis	511
541	Ts	Hemlock	Picea abies	541
542	Th	Lebensbaum	Thuja plicata	711
611	Dgl	Douglasie	Pseudosuga menziezii	611

Code	Kurz	Name	lat. Name	Einstellung wie
711	Ki	Kiefer	Pinus Silvestris	711
712	SKi	Schwarzkiefer	Pinus nigra	711
731	Stro	Strobus	Pinus strobus	711
811	ELae	Europäische Lärche	Larix deciduas	811
812	JLae	Japanische Lärche	Larix kaempferi	811
999	Grass	Grass	Grassverdämmung	999

Voll parametri-siert	Weitgehend parametrisiert	Teilweise parametrisiert	Nicht parametrisiert

Tabelle 9: Baumart 110 – Eiche (Quercus)

Durchmessergenerierung [cm]	t.d = (-1.937+1.082*sp.dg)*(((6.9/(-1.937+1.082*sp.dg))^(4.669+0.366*sp.dg-0.234*dmax))-ln(1.0-random))^(1.0/(4.669+0.366*sp.dg-0.234*dmax)) /* Eiche (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.14657227*(1.0-(sp.dg/t.d)))*exp(3.78686023*((1.0/sp.dg)-(1.0/t.d))) /* Eiche (NAGEL 1999)*/
Höhenvariabilität [m]	t.hv = -0.1944676+0.3535610*ln(sp.dg) /* Eiche (ALBERT 2000)*/
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.4786-(1.011176/t.d) +(2.10428/t.h)-(203.1997/(t.d*t.h*t.h))) /*Eiche Derbholz (BERGEL 1974) */
Kronenbreite [m]	t.cw = (2.6618+0.1152*t.d)*(1.0-exp(-exp(ln(t.d/8.3381)*1.4083))) /* Eiche (DÖBBELER ET. AL. 2001) */
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((-0.5268+0.2287*t.h/t.d-0.00453*t.d+0.4712*ln(sp.h100))))) /* Eiche (DÖBBELER ET. AL. 2001) */
Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = sp.h100/(1.2164*(1.0-exp(-0.0194*t.age))^1.1344) /* Eiche (DÖBBELER ET. AL. 2001) */
Höhe entsprechend der Bonität [m]	Höhe = 1.2164*t.si*(1.0-exp(-0.0194*t.age))^1.1344 /* Eiche (DÖBBELER ET. AL. 2001) */
Potentieller Höhenzuwachs [m]	ihpot = ((1.2164*t.si*(1.0-exp(-0.0194*(t.age+5.0)))^1.1344)-(1.2164*t.si*(1.0-exp(-0.0194*t.age))^1.1344)) /* Eiche (DÖBBELER ET. AL. 2001) */
Höhenzuwachs [m]	t.hinc = t.h*((((1.2164*t.si*(1.0-exp(-0.0194*(t.age+5.0)))^1.1344)-(1.2164*t.si*(1.0-exp(-0.0194*t.age))^1.1344))/sp.h100)+(0.01676*(t.hinc^1.3349))) /*

	Eiche (DÖBBELER ET. AL. 2001) */
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-6.5350+1.3260*ln((3.141593*(t.cw/2.0)/(6.0*(t.h-t.cb)^2.0))*(((4.0*(t.h-t.cb)^2.0+(t.cw/2.0)^2.0)^1.5)-(t.cw/2.0)^3.0))-0.8437*ln(t.age)-0.9373*t.c66xy+0.1239*t.c66cxy-0.1263*ln(5.0)) /* Eiche (DÖBBELER ET. AL. 2001) */
Durchmesserzuwachsstreuung [cm]	herror = 0.617
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = 0.0001*3.141592/ (16*0.000002807*0.5814*(t.h^(0.9082-1.1830))) /* Eiche Nordwest (DÖBBELER 2004) */
Maximales Alter [Jahre]	MaxAlter = 600
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	80.0
Höhe der 1. Durchforstung [m]	14.0
Mäßige Durchforstung [m;NB°]	14.0;0.75;18.0;18.0;0.80;24.0;24.0;0.85;100.0
Farbe (RGB)	255;255;51
Plugin: Einwuchs	Ingrowth2
Plugin: Konkurrenzindex	Competition
Plugin: Schaftformfunktion	TaperFunctionBySchmidt
Volumenfunktion Schaftholz [m³]	

Tabelle 10: Baumart 211 – Buche (Fagus silvatica)

Durchmessergenerierung [cm]	t.d = (-4.282+1.132*sp.dg)*(((6.9/(-4.282+1.132*sp.dg))^(4.518+0.317*sp.dg-0.200*dmax))-ln(1.0-random))^(1.0/(4.518+0.317*sp.dg-0.200*dmax)) /* Buche (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.20213328*(1.0-(sp.dg/t.d)))*exp(5.64023296*((1.0/sp.dg)-(1.0/t.d))) /*Buche (NAGEL 1999) */
Höhenvariabilität [m]	t.hv = 1.1217150+0.2203473*ln(sp.BHD_STD) /* Buche (ALBERT 2000)*/
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.4039+0.0017335*t.h+1.1267/t.h-118.188/(t.d*t.d*t.d)+0.0000042*t.d*t.d) /*Buche Derbholz (BERGEL 1973) */
Kronenbreite [m]	t.cw = (2.0837+0.15*t.d)*(1.0-exp(-exp(ln(t.d/5.7292)*1.3341))) /* Buche (DÖBBELER ET. AL. 2001) */

Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((0.25704+0.11819*t.h/t.d-0.002065*t.d+0.13831*ln(sp.h100))))) /* Buche (DÖBBELER ET. AL. 2001) */
Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = (sp.h100+75.65900-23.19200*ln(t.age) +1.46800*((ln(t.age))^2.0))/(0.00000+0.21520*ln(t.age)) /* Buche (NAGEL 1999) */
Höhe entsprechend der Bonität [m]	Höhe = -75.65900+23.19200*ln(t.age)-1.46800*(ln(t.age)^2)+0.0*t.si+0.21520*t.si*ln(t.age) /* Buche (NAGEL 1999) */
Potentieller Höhenzuwachs [m]	ihpot = ((-75.65900+23.19200*ln(t.age+5)-1.46800*((ln(t.age+5))^2.0)+0.21520*t.si*(ln(t.age+5)))-(-75.65900+23.19200*ln(t.age)-1.46800*((ln(t.age))^2.0)+0.21520*t.si*(ln(t.age)))) /* Buche (NAGEL 1999) */
Höhenzuwachs [m]	t.hinc = t.h*((((-75.65900+23.19200*ln(t.age+5)-1.46800*((ln(t.age+5))^2.0)+0.21520*t.si*(ln(t.age+5)))-(-75.65900+23.19200*ln(t.age)-1.46800*((ln(t.age))^2.0)+0.21520*t.si*(ln(t.age))))/sp.h100)+(0.00159*(t.hinc^1.9086))) /* Buche (DÖBBELER ET. AL. 2001) */
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-7.393+1.375*ln(3.14159265359*(t.cw/2.0)/(6.0*(t.h-t.cb)^2)*((4.0*(t.h-t.cb)^2 +(t.cw/2)^2)^1.5 - (t.cw/2)^3))-0.791*ln(t.age)-0.793*t.c66xy+0.809*t.c66cxy-0.0*ln(5.0)) /* Buche (DÖBBELER ET. AL. 2001) */
Durchmesserzuwachsstreuung [cm]	herror = 0.762
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = 0.0001*3.141592/ (16*0.00000010829*8.3652*(t.h^(1.5374-1.7365))) /* Buche Nordwest (DÖBBELER 2004) */
Maximales Alter [Jahre]	MaxAlter = 300
Totholzzersetzung (Faktor)	(1.0-(((1.0-exp(-0.0658*(t.age)))^2.2529))) /* Buche (MEYER 2009) */
Zielstärkendurchmesser [cm]	60.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.7;22.0;22.0;0.65;28.0;28.0;0.75;100.0
Farbe (RGB)	199;83;28
Plugin: Einwuchs	Ingrowth2
Plugin: Konkurrenzindex	Competition
Plugin: Schaftformfunktion	TaperFunctionBySchmidt

Volumenfunktion Schaftholz [m³]	

Tabelle 11: Baumart 511 – Fichte (Picea abies)

Durchmessergenerierung [cm]	t.d = (-2.492+1.104*sp.dg)*(((6.9/(-2.492+1.104*sp.dg))^(3.418+0.353*sp.dg-0.192*dmax))-ln(1.0-random))^(1.0/(3.418+0.353*sp.dg-0.192*dmax)) /* Fichte (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.18290951*(1.0-(sp.dg/t.d)))*exp(5.68789430*((1.0/sp.dg)-(1.0/t.d))) /*Fichte (NAGEL 1999)*/
Höhenvariabilität [m]	t.hv = 0.1441427+0.5552640*ln(sp.BHD_STD) /* Fichte (ALBERT 2000)*/
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.04016-27.56211/(t.d*t.d) +1.36195/ln(t.d) +0.057654*t.h/t.d) /* Fichte Derbholz (BERGEL 1987)*/
Kronenbreite [m]	t.cw = (1.2644+0.1072*t.d)*(1.0-exp(-exp(ln(t.d/0.000001)*1.0))) /* Fichte (NAGEL 1999)*/
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((2.0417-0.3335*t.h/t.d+0.00906*t.d-0.9004*ln(sp.h100))))) /* Fichte (DÖBBELER ET AL 2002) */
Kronentype in Grafik:	Kronentyp= 1 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = (sp.h100+49.87200-7.33090*ln(t.age)-0.77338*((ln(t.age))^2.0))/(0.52684+0.10542*ln(t.age)) /*Fichte (NAGEL 1999)*/
Höhe entsprechend der Bonität [m]	Höhe = -49.87200+7.33090*ln(t.age) +0.77338*(ln(t.age)^2)+0.52684*t.si+0.10542*t.si*ln(t.age) /* Fichte (NAGEL 1999)*/
Potentieller Höhenzuwachs [m]	ihpot = ((1.2164*t.si*(1.0-exp(-0.0194*(t.age+5.0)))^1.1344)-(1.2164*t.si*(1.0-exp(-0.0194*t.age))^1.1344)) /* Fichte (NAGEL 1999)*/
Höhenzuwachs [m]	t.hinc = t.h*((((-49.87200+7.33090*ln(t.age+5)+0.77338*((ln(t.age+5))^2.0)+0.52684*t.si +0.10542*t.si*(ln(t.age+5)))-(-49.87200+7.33090*ln(t.age) +0.77338*((ln(t.age))^2.0)+0.52684*t.si+0.10542*t.si*(ln(t.age))))/sp.h100)+(0.00271*(t.hinc^2.1725))) /* Fichte (DÖBBELER ET AL 2002) */
Höhenzuwachsstreuung [m]	herror = 0.082

Grundflächenzuwachs [cm²]	t.dinc = exp(-6.2018+1.2984*ln(3.14159265359*(t.cw/2.0)/(6.0*(t.h-t.cb)^2)*((4.0*(t.h-t.cb)^2 +(t.cw/2)^2)^1.5 - (t.cw/2)^3))-0.9366*ln(t.age)-1.2835*t.c66xy+0.2962*t.c66cxy+0.2926*1.6094) /* Fichte (DÖBBELER ET AL 2002) */
Durchmesserzuwachsstreuung [cm]	herror = 0.638
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = 0.0001*3.141592/(16*0.0000012874*1.2842*(t.h^(0.7148-1.1914))) /* Fichte Nordwest (DÖBBELER 2004) */
Maximales Alter [Jahre]	MaxAlter = 240
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/50.0)
Zielstärkendurchmesser [cm]	45.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.7;20.0;20.0;0.75;26.0;26.0;0.8;100.0
Farbe (RGB)	0;102;255
Plugin: Einwuchs	Ingrowth2
Plugin: Konkurrenzindex	Competition
Plugin: Schaftformfunktion	TaperFunctionBySchmidt
Volumenfunktion Schaftholz [m³]	3.141592*t.h*(t.d/200)^2*(0.5848+3.34262/(t.h*t.h)-1.73375/(t.h*t.d)-0.26215*log(t.d)/log(10.0)+0.18736*log(t.h)/log(10.0)+11.34436/(t.d*t.h*t.h)) /* Fichte Schaftholz (BERGEL 1973)*/

Tabelle 12: Baumart 611 – Douglasie (Pseudosuga menziezii)

Durchmessergenerierung [cm]	t.d = (-0.621+1.060*sp.dg)*(((6.9/(-0.621+1.060*sp.dg))^(4.380+0.236*sp.dg-0.141*dmax))-ln(1.0-random))^(1.0/(4.380+0.236*sp.dg-0.141*dmax)) /* Douglasie (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.19965100*(1.0-(sp.dg/t.d)))*exp(4.63277655*((1.0/sp.dg)-(1.0/t.d))) /* Douglasie (NAGEL 1999) */
Höhenvariabilität [m]	t.hv = 0.2071047+0.5843520*ln(sp.BHD_STD) /* Douglasie (ALBERT 2000)*/
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(-200.31914/(t.h*t.d*t.d)+0.8734/t.d-0.0052*ln(t.d)*ln(t.d)+7.3594/(t.h*t.d)+0.46155) /* Douglasie Derbholz (BERGEL 1987)*/

Kronenbreite [m]	t.cw = (2.919+0.0939*t.d)*(1.0-exp(-exp(ln(t.d/10.0161)*1.362))) /* Douglasie (DÖBBELER ET AL 2002) */
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((-1.8796+0.34056*t.h/t.d-0.00610*t.d+0.8262*ln(sp.h100))))) /* Douglasie (DÖBBELER ET AL 2002) */
Kronentype in Grafik:	Kronentyp= 1 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = (sp.h100+47.09070-11.4322*ln(t.age)+0.0*((ln(t.age))^2.0))/(-0.0+0.20063*ln(t.age))/* Douglasie (NAGEL 1999)*/
Höhe entsprechend der Bonität [m]	Höhe = -47.09070+11.4322*ln(t.age)-0.0*(ln(t.age)^2)-0.0*t.si+0.20063*t.si*ln(t.age) /* Douglasie (NAGEL 1999)*/
Potentieller Höhenzuwachs [m]	ihpot = ((-47.09070+11.4322*ln(t.age+5)-0.0*((ln(t.age+5))^2.0)-0.0*t.si+0.20063*t.si*(ln(t.age+5)))-(-47.09070+11.4322*ln(t.age)-0.0*((ln(t.age))^2.0)-0.0*t.si+0.20063*t.si*(ln(t.age)))) /* Douglasie (NAGEL 1999)*/
Höhenzuwachs [m]	t.hinc = t.h*((((-47.09070+11.4322*ln(t.age+5)-0.0*((ln(t.age+5))^2.0)-0.0*t.si+0.20063*t.si*(ln(t.age+5)))-(-47.09070+11.4322*ln(t.age)-0.0*((ln(t.age))^2.0)-0.0*t.si+0.20063*t.si*(ln(t.age))))/sp.h100)+(0.00159*(t.hinc^2.5255))) /* Douglasie (DÖBBELER ET AL 2002) */
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-7.9766+1.5135*ln(3.14159265359*(t.cw/2.0)/(6.0*(t.h-t.cb)^2)*((4.0*(t.h-t.cb)^2 +(t.cw/2)^2)^1.5 - (t.cw/2)^3))-1.0009*ln(t.age)-0.4481*t.c66xy+0.5099*t.c66cxy+0.3038*1.6094) /* Douglasie (DÖBBELER ET AL 2002) */
Durchmesserzuwachsstreuung [cm]	herror = 0.725
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = 0.0001*3.141592/ (16.0*0.00000089306*2.4088*(t.h^(0.7726-1.3555))) /* Douglasie suedwest (DÖBBELER 2004) */
Maximales Alter [Jahre]	MaxAlter = 280
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/50.0)
Zielstärkendurchmesser [cm]	65.0
Höhe der 1. Durchforstung [m]	14.0
Mäßige Durchforstung [m;NB°]	14.0;0.65;20.0;20.0;0.70;26.0;26.0;0.7;100.0
Farbe (RGB)	255;128;255
Plugin: Einwuchs	Ingrowth2
Plugin: Konkurrenzindex	Competition
Plugin: Schaftformfunktion	TaperFunctionBySchmidt

Volumenfunktion Schaftholz [m³]	3.141592*t.h*(t.d/200)^2*(0.10798+0.71858/(log(t.d*10.0)/ log(10.0))+0.04065*(t.h/t.d)) /* Douglasie Schaftholz (BERGEL 1971)*/

Tabelle 13: Baumart 711 – Kiefer (Pinus silvestris)

Durchmessergenerierung [cm]	t.d = (-0.047+1.047*sp.dg)*(((6.9/(-0.047+1.047*sp.dg))^(3.640+0.332*sp.dg-0.180*dmax))-ln(1.0-random))^(1.0/(3.640+0.332*sp.dg-0.180*dmax)) /* Kiefer (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.25963741*(1.0-(sp.dg/t.d)))*exp(1.30645374*((1.0/sp.dg)-(1.0/t.d))) /* Kiefer (NAGEL 1999) */
Höhenvariabilität [m]	t.hv = -1.8315300+0.9701583*ln(sp.dg) /* Kiefer (ALBERT 2000) */
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.40804-318.3342/(t.h*t.d*t.d) +36.90522/(t.h*t.d)-4.05292/(t.d*t.d)) /* Kiefer Derbholz (BERGEL 1987)*/
Kronenbreite [m]	t.cw = (1.2783+0.11388*t.d)*(1.0-exp(-exp(ln(t.d/8.705220)*1.33944))) /* Kiefer (DÖBBELER ET AL 2002) */
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((1.2085-0.2392*t.h/t.d+0.00742*t.d-0.7897*ln(sp.h100))))) /* Kiefer (DÖBBELER ET AL 2002) */
Kronentype in Grafik:	Kronentyp= 1 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = (sp.h100+31.67480-11.64500*ln(t.age) +1.04989*((ln(t.age))^2.0))/(-0.43221+0.31253*ln(t.age)) /* Kiefer (NAGEL 1999) */
Höhe entsprechend der Bonität [m]	Höhe = -31.67480+11.64500*ln(t.age)-1.04989*(ln(t.age)^2)-0.43221*t.si+0.31253*t.si*ln(t.age) /* Kiefer (NAGEL 1999) */
Potentieller Höhenzuwachs [m]	ihpot = ((-31.67480+11.64500*ln(t.age+5)-1.04989*((ln(t.age+5))^2.0)-0.43221*t.si+0.31253*t.si*(ln(t.age+5)))-(-31.67480+11.64500*ln(t.age)-1.04989*((ln(t.age))^2.0)-0.43221*t.si+0.31253*t.si*(ln(t.age)))) /* Kiefer (NAGEL 1999) */
Höhenzuwachs [m]	t.hinc = t.h*((((-31.67480+11.64500*ln(t.age+5)-1.04989*((ln(t.age+5))^2.0)-0.43221*t.si+0.31253*t.si*(ln(t.age+5)))-(-31.67480+11.64500*ln(t.age)-1.04989*((ln(t.age))^2.0)-0.43221*t.si+0.31253*t.si*(ln(t.age))))/sp.h100)+(0.0000*(t.hinc^1.0))) /* Kiefer (DÖBBELER ET AL 2002) */
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-5.0479+0.9508*ln(3.14159265359*(t.cw/2.0)/(6.0*(t.h-t.cb)^2)*((4.0*(t.h-t.cb)^2 +(t.cw/2)^2)^1.5 - (t.cw/2)^3))-0.7835*ln(t.age)-0.7639*t.c66xy+0.7113*t.c66cxy-0.1891*1.6094) /* Kiefer (DÖBBELER ET AL 2002) */
Durchmesserzuwachsstreuung [cm]	herror = 0.649

Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = 0.0001*3.141592/(16*0.0000025729*0.2838*(t.h^(0.6277-0.7621))) /* Kiefer Nordwest (DÖBBELER 2004) */
Maximales Alter [Jahre]	MaxAlter = 280
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/50.0)
Zielstärkendurchmesser [cm]	45.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.7;18.0;18.0;0.75;24.0;24.0;0.8;100.0
Farbe (RGB)	153;153;153
Plugin: Einwuchs	Ingrowth2
Plugin: Konkurrenzindex	Competition
Plugin: Schaftformfunktion	TaperFunctionBySchmidt
Volumenfunktion Schaftholz [m³]	3.141592*t.h*(t.d/200)^2* (0.35096+0.93964/t.d+1.5464/t.h-2.0482/(t.d*t.d)-5.7305/(t.d*t.h)+17.444/(t.h*t.d*t.d)) /* Kiefer Schaftholz (BERGEL 1974) */

Tabelle 14: Baumart 113 - Roteiche

Durchmessergenerierung [cm]	t.d = (0.267+1.031*sp.dg)*(((6.9/(0.267+1.031*sp.dg))^(6.122+0.374*sp.dg-0.258*dmax))-ln(1.0-random))^(1.0/(6.122+0.374*sp.dg-0.258*dmax)) /* Roteiche (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.26932445*(1.0-(sp.dg/t.d)))*exp(4.32123002*((1.0/sp.dg)-(1.0/t.d))) /* Roteiche (NAGEL 1999) */
Höhenvariabilität [m]	t.hv = -0.1944676+0.3535610*ln(sp.dg) /* Eiche (ALBERT 2000)*/
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.4237+0.039178/t.d-4.69154/(t.d*t.d)+38.5469/(t.h*t.d)-335.8731/(t.h*t.d*t.d)) /* Roteiche Derbholz (BERGEL 1974) */
Kronenbreite [m]	t.cw = (2.6618+0.1152*t.d)*(1.0-exp(-exp(ln(t.d/8.3381)*1.4083))) /* Eiche (DÖBBELER ET AL 2002) */
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((0.3652+0.3556*t.h/t.d-0.00558*t.d+0.1373*ln(sp.h100))))) /* Roteiche (DÖBBELER ET AL 2002) */
Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = sp.h100/(1.3952*(1.0-exp(-0.0321*t.age))^1.5033) /* Roteiche NAGEL 1999 */
Höhe entsprechend der	Höhe = 1.3952*t.si*(1.0-exp(-0.0321*t.age))^1.5033 /* Roteiche

Bonität [m]	NAGEL 1999 */
Potentieller Höhenzuwachs [m]	ihpot = ((1.3952*t.si*(1.0-exp(-0.0321*(t.age+5.0)))^1.5033)-(1.3952*t.si*(1.0-exp(-0.0321*t.age))^1.5033)) /* Roteiche NAGEL 1999 */
Höhenzuwachs [m]	t.hinc = t.h*((((1.3952*t.si*(1.0-exp(-0.0321*(t.age+5.0)))^1.5033)-(1.3952*t.si*(1.0-exp(-0.0321*t.age))^1.5033))/sp.h100)+(-0.00102*(t.hinc^2.6855))) /* Roteiche (DÖBBELER ET AL 2002) */
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-6.7960+1.4050*ln((3.141593*(t.cw/2.0)/(6.0*(t.h-t.cb)^2.0))*(((4.0*(t.h-t.cb)^2.0+(t.cw/2.0)^2.0)^1.5)-(t.cw/2.0)^3.0))-0.8437*ln(t.age)-1.0990*t.c66xy+0.8281*t.c66cxy-0.2111*ln(5.0)) /* Roteiche (DÖBBELER ET AL 2002) */
Durchmesserzuwachsstreuung [cm]	herror = 0.569
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(18800.0/(3.141592*(t.cw/2.0)^2.0)) /* Roteiche (DÖBBELER ET AL 2002) */
Maximales Alter [Jahre]	MaxAlter = 300
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	60.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.75;18.0;18.0;0.80;24.0;24.0;0.85;100.0
Farbe (RGB)	255;255;20
Plugin: Einwuchs	Ingrowth2
Plugin: Konkurrenzindex	Competition
Plugin: Schaftformfunktion	TaperFunctionBySchmidt

Tabelle 15: Baumart 221 – Hainbuche (Carpinus betulus)

Funktionen wie Code	211
Kronenbreite [m]	t.cw = (3.002+0.1851*t.d) /* Hainbuche (DÖBBELER ET AL 2002) */
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((-0.8466+0.1534*t.h/t.d-0.01084*t.d+0.6002*ln(sp.h100))))) /* Hainbuche (DÖBBELER ET AL 2002) */
Grundflächenzuwachs [cm²]	t.dinc = exp(-8.7786+1.1773*ln(3.14159265359*(t.cw/2.0)/(6.0*(t.h-t.cb)^2)*((4.0*(t.h-t.cb)^2 +(t.cw/2)^2)^1.5 - (t.cw/2)^3))-0.3176*ln(t.age)-0.5691*t.c66xy+0.0*t.c66cxy-0.7319*ln(5.0)) /* Hainbuche (DÖBBELER ET AL 2002) c66c auf nNull gesetzt*/
Durchmesserzuwachsstreuung [cm]	herror = 0.762

Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(21100/(3.141592*(t.cw/2.0)^2.0)) /* Hainbuche (DÖBBELER ET AL 2002) */
Maximales Alter [Jahre]	MaxAlter = 300
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	65.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.7;22.0;22.0;0.65;28.0;28.0;0.75;100.0
Farbe (RGB)	199;83;28

Tabelle 16: Baumart 311 – Esche (Fraxinus excelsior)

Durchmessergenerierung [cm]	t.d = (-1.937+1.082*sp.dg)*(((6.9/(-1.937+1.082*sp.dg))^(4.669+0.366*sp.dg-0.234*dmax))-ln(1.0-random))^(1.0/(4.669+0.366*sp.dg-0.234*dmax)) /* Eiche (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.14657227*(1.0-(sp.dg/t.d)))* exp(3.78686023*((1.0/sp.dg)-(1.0/t.d))) /*Eiche (NAGEL 1999) */
Höhenvariabilität [m]	t.hv = -0.1944676+0.3535610*ln(sp.dg) /*Buche (ALBERT 2000) */
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.4786-(1.011176/t.d)+(2.10428/t.h)-(203.1997/(t.d*t.h*t.h))) /*Buche Derbholz (BERGEL 1973) */
Kronenbreite [m]	t.cw = (17.372-0.0646*t.d)*(1.0-exp(-exp(ln(t.d/45.371)*1.238)))/* Esche (DÖBBELER ET AL 2002) */
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((-0.3708+0.4211*t.h/t.d-0.0030*t.d+0.3242*ln(sp.h100))))) /* Esche (DÖBBELER ET AL 2002) */
Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = (sp.h100+46.046-15.81886*ln(t.age) +1.33618*((ln(t.age))^2.0))/(0.00000+0.22808*ln(t.age)) /* Esche (NAGEL 1999) */
Höhe entsprechend der Bonität [m]	Höhe = -46.046+15.81886*ln(t.age)-1.33618*(ln(t.age)^2)+0.0*t.si+0.22808*t.si*ln(t.age)/* Esche (NAGEL 1999) */
Potentieller Höhenzuwachs [m]	ihpot = ((-46.046+15.81886*ln(t.age+5)-1.33618*((ln(t.age+5))^2.0)+0.22808*t.si*(ln(t.age+5)))-(-46.046+15.81886*ln(t.age)-1.33618*((ln(t.age))^2.0)+0.22808*t.si*(ln(t.age) /* Esche (NAGEL 1999) */

Höhenzuwachs [m]	t.hinc = t.h*((((-46.046+15.81886*ln(t.age+5)-1.33618*((ln(t.age+5))^2.0)+0.22808*t.si*(ln(t.age+5)))-(-46.046+15.81886*ln(t.age)-1.33618*((ln(t.age))^2.0)+0.22808*t.si*(ln(t.age))))/sp.h100)+(0.0*(t.hinc^1.0)))/* Esche (DÖBBELER ET AL 2002) */
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-6.1407+1.1068*ln((3.141593*(t.cw/2.0)/(6.0*(t.h-t.cb)^2.0))*(((4.0*(t.h-t.cb)^2.0+(t.cw/2.0)^2.0)^1.5)-(t.cw/2.0)^3.0))-0.5533*ln(t.age)-1.2802*t.c66xy+2.1916*t.c66cxy-0.5044*ln(5.0))/* Esche (DÖBBELER ET AL 2002) */
Durchmesserzuwachsstreuung [cm]	herror = 0.685
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(14100.0/(3.141592*(t.cw/2.0)^2.0))/* Esche (DÖBBELER ET AL 2002) */
Maximales Alter [Jahre]	MaxAlter = 300
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	60.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.85;18.0;18.0;0.90;24.0;24.0;0.95;100.0
Farbe (RGB)	0;153;0

Tabelle 17: Baumart 321 - Bergahron

Durchmessergenerierung [cm]	t.d = (-1.937+1.082*sp.dg)*(((6.9/(-1.937+1.082*sp.dg))^(4.669+0.366*sp.dg-0.234*dmax))-ln(1.0-random))^(1.0/(4.669+0.366*sp.dg-0.234*dmax)) /* Eiche (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.14657227*(1.0-(sp.dg/t.d)))*exp(3.78686023*((1.0/sp.dg)-(1.0/t.d))) /*Eiche (NAGEL 1999*/
Höhenvariabilität [m]	t.hv = -0.1944676+0.3535610*ln(sp.dg) /*Buche (ALBERT 2000) */
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.4786-(1.011176/t.d)+(2.10428/t.h)-(203.1997/(t.d*t.h*t.h))) /*Buche Derbholz (BERGEL 1973) */
Kronenbreite [m]	t.cw = (2.7916+0.1340*t.d)*(1.0-exp(-exp(ln(t.d/2.7198)*0.4197))) /* Ahorn (DÖBBELER ET AL 2002) */
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((-0.3191+0.0475*t.h/t.d-0.0057*t.d+0.4066*ln(sp.h100))))) /* Ahorn (DÖBBELER ET AL 2002) */

Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = 296.0432*(sp.h100/296.0432)^(1.0/exp((-0.62388/((1.30296-1.0)* 100.0^(1.30296-1.0)))+(0.62388/((1.30296-1.0)*t.age^(1.30296-1.0))))) /* NAGEL 1985 */
Höhe entsprechend der Bonität [m]	Höhe = 296.0432*(t.si/296.0432)^exp((-0.62388/((1.30296-1.0)*100.0^(1.30296-1.0)))+(0.62388/((1.30296-1.0)*t.age^(1.30296-1.0)))) /* NAGEL 1985 */
Potentieller Höhenzuwachs [m]	ihpot = (296.0432*(t.si/296.0432)^exp((-0.62388/((1.30296-1.0)*100.0^(1.30296-1.0)))+(0.62388/((1.30296-1.0)*(t.age+5.0)^(1.30296-1.0))))-296.0432*(t.si/296.0432)^exp((-0.62388/((1.30296-1.0)*100.0^(1.30296-1.0)))+(0.62388/((1.30296-1.0)*t.age^(1.30296-1.0))))) /* NAGEL 1985 */
Höhenzuwachs [m]	t.hinc = t.h*(((296.0432*(t.si/296.0432)^exp((-0.62388/((1.30296-1.0)*100.0^(1.30296-1.0)))+(0.62388/((1.30296-1.0)*(t.age+5.0)^(1.30296-1.0))))-296.0432*(t.si/296.0432)^exp((-0.62388/((1.30296-1.0)*100.0^(1.30296-1.0)))+(0.62388/((1.30296-1.0)*t.age^(1.30296-1.0)))))/sp.h100)+(0.0*(t.hinc^1.0))) /* Ahorn (DÖBBELER ET AL 2002) */
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-5.9842+1.3801*ln((3.141593*(t.cw/2.0)/(6.0*(t.h-t.cb)^2.0))* (((4.0*(t.h-t.cb)^2.0+(t.cw/2.0)^2.0)^1.5)-(t.cw/2.0)^3.0))-0.7104*ln(t.age)-0.7518* t.c66xy+0.0*t.c66cxy-1.0577*ln(5.0)) /* Ahorn (DÖBBELER ET AL 2002) */
Durchmesserzuwachsstreuung [cm]	herror = 0.563
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(19800.0/(3.141592*(t.cw/2.0)^2.0)) /* Ahorn (DÖBBELER ET AL 2002) */
Maximales Alter [Jahre]	MaxAlter = 280
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	60.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.55;18.0;18.0;0.60;24.0;24.0;0.65;100.0
Farbe (RGB)	0;153;0

Tabelle 18: Baumart 342 – Winterlinde (Tilia cordata)

wie	211

Bonität (Höhe im Alter 100) [m]	t.si = 96.173358*(sp.h100/96.173358)^(1.0/exp((-0.495586/ ((1.101126-1.0)*100.0^(1.101126-1.0)))+(0.495586/((1.101126-1.0)*t.age^(1.101126-1.0))))) /* BÖCKMANN 1990 */
Höhe entsprechend der Bonität [m]	Höhe = 96.173358*(t.si/96.173358)^exp((-0.495586/((1.101126-1.0)*100.0^(1.101126-1.0)))+(0.495586/((1.101126-1.0)*t.age^(1.101126-1.0))))/* BÖCKMANN 1990 */
Potentieller Höhenzuwachs [m]	ihpot = (96.173358*(t.si/96.173358)^exp((-0.495586/((1.101126-1.0)*100.0^(1.101126-1.0)))+(0.495586/((1.101126-1.0)*(t.age+5.0)^(1.101126-1.0))))-96.173358*(t.si/96.173358)^exp((-0.495586/((1.101126-1.0)*100.0^(1.101126-1.0)))+(0.495586/((1.101126-1.0)*t.age^(1.101126-1.0))))) /* BÖCKMANN 1990 */
Höhenzuwachs [m]	t.hinc = (96.173358*(t.si/96.173358)^exp((-0.495586/((1.101126-1.0)*100.0^(1.101126-1.0)))+(0.495586/((1.101126-1.0)*(t.age+5.0)^(1.101126-1.0))))-96.173358*(t.si/96.173358)^exp((-0.495586/((1.101126-1.0)*100.0^(1.101126-1.0)))+(0.495586/((1.101126-1.0)*t.age^(1.101126-1.0)))))/* BÖCKMANN 1990 */
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(14600.0/(3.141592*(t.cw/2.0)^2.0))
Maximales Alter [Jahre]	MaxAlter = 280

Tabelle 19: Baumart 354 – Kirsche (Prunus avium)

wie	211
Bonität (Höhe im Alter 100) [m]	t.si = 84.185464*(sp.h100/84.185464)^(1.0/exp((-0.800089/ ((1.150926-1.0)*100.0^(1.150926-1.0)))+(0.800089/((1.150926-1.0)*t.age^(1.150926-1.0))))) /* RÖÖS 1990 */
Höhe entsprechend der Bonität [m]	Höhe = 84.185464*(t.si/84.185464)^exp((-0.800089/((1.150926-1.0)*100.0^(1.150926-1.0)))+(0.800089/((1.150926-1.0)*t.age^(1.150926-1.0)))) /* RÖÖS 1990 */
Potentieller Höhenzuwachs [m]	ihpot = (84.185464*(t.si/84.185464)^exp((-0.800089/((1.150926-1.0)*100.0^(1.150926-1.0)))+(0.800089/((1.150926-1.0)*(t.age+5.0)^(1.150926-1.0))))-84.185464*(t.si/84.185464)^exp((-0.800089/((1.150926-1.0)*100.0^(1.150926-1.0)))+(0.800089/((1.150926-1.0)*t.age^(1.150926-1.0))))) /* RÖÖS 1990 */
Höhenzuwachs [m]	t.hinc = (84.185464*(t.si/84.185464)^exp((-0.800089/((1.150926-1.0)* 100.0^(1.150926-1.0)))+(0.800089/((1.150926-1.0)*(t.age+5.0)^(1.150926-1.0))))-84.185464*(t.si/84.185464)^exp((-0.800089/((1.150926-1.0)* 100.0^(1.150926-1.0)))+(0.800089/((1.150926-1.0)*t.age^(1.150926-1.0))))) /* RÖÖS 1990 */
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(15400.0/(3.141592*(t.cw/2.0)^2.0))

Tabelle 20: Baumart 357 - Elsbeere (Sorbus torminalis)

Durchmessergenerierung [cm]	t.d = (-1.937+1.082*sp.dg)*(((6.9/(-1.937+1.082*sp.dg))^(4.669+0.366*sp.dg-0.234*dmax))-ln(1.0-random))^(1.0/(4.669+0.366*sp.dg-0.234*dmax)) /* Eiche (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.14657227*(1.0-(sp.dg/t.d)))*exp(3.78686023*((1.0/sp.dg)-(1.0/t.d))) /*Eiche (NAGEL 1999*/
Höhenvariabilität [m]	t.hv = -0.1944676+0.3535610*ln(sp.dg) /*Buche (ALBERT 2000) */
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.4786-(1.011176/t.d) +(2.10428/t.h)-(203.1997/(t.d*t.h*t.h))) /*Eiche Derbholz (BERGEL 1974)*/
Kronenbreite [m]	t.cw = (2.227+0.121*t.d)*(1.0-exp(-exp(ln(t.d/5.332)*2.261))) /* KAHLE 2004 */
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-(0.629+0.197*(t.h/t.d))^2.0)) /* KAHLE 2004 */
Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = 785.400774*(sp.h100/785.400774)^(1.0/exp((-0.20576727/((1.03088451-1.0)*100.0^(1.03088451-1.0)))+(0.20576727/((1.03088451-1.0)*t.age^(1.03088451-1.0))))) /* KAHLE 2004 */
Höhe entsprechend der Bonität [m]	Höhe = 785.400774*(t.si/785.400774)^exp((-0.20576727/((1.03088451-1.0)*100.0^(1.03088451-1.0)))+(0.20576727/((1.03088451-1.0)*t.age^(1.03088451-1.0)))) /* KAHLE 2004 */
Potentieller Höhenzuwachs [m]	ihpot = (785.400774*(t.si/785.400774)^exp((-0.20576727/((1.03088451-1.0)*100.0^(1.03088451-1.0)))+(0.20576727/((1.03088451-1.0)*(t.age+5.0)^(1.03088451-1.0))))-785.400774*(t.si/785.400774)^exp((-0.20576727/((1.03088451-1.0)*100.0^(1.03088451-1.0)))+(0.20576727/((1.03088451-1.0)*t.age^(1.03088451-1.0)))))/sp.h100 /* KAHLE 2004 */
Höhenzuwachs [m]	t.hinc = t.hinc
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-5.755+1.073*ln((3.141593*(t.cw/2.0)/(6.0*(t.h-t.cb)^2.0))*(((4.0*(t.h-t.cb)^2.0+(t.cw/2.0)^2.0)^1.5)-(t.cw/2.0)^3.0))-0.882*ln(t.age)-0.727*t.c66xy) /* KAHLE 2004 */
Durchmesserzuwachsstreuung [cm]	herror = 0.563
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(19800.0/(3.141592*(t.cw/2.0)^2.0)) /* KAHLE 2004 */
Maximales Alter [Jahre]	MaxAlter = 280
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	60.0

Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.55;18.0;18.0;0.60;24.0;24.0;0.65;100.0
Farbe (RGB)	0;153;0

Tabelle 21: Baumart 412 – Moorbirke (Betula pubescens)

Durchmessergenerierung [cm]	t.d = (-1.937+1.082*sp.dg)*(((6.9/(-1.937+1.082*sp.dg))^(4.669+0.366*sp.dg-0.234*dmax))-ln(1.0-random))^(1.0/(4.669+0.366*sp.dg-0.234*dmax)) /* Eiche (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.14657227*(1.0-(sp.dg/t.d)))*exp(3.78686023*((1.0/sp.dg)-(1.0/t.d))) /* Eiche (NAGEL 1999)*/
Höhenvariabilität [m]	t.hv = -0.1944676+0.3535610*ln(sp.dg) /* Eiche (ALBERT 2000)*/
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.4039+0.0017335*t.h+1.1267/t.h-118.188/(t.d*t.d*t.d)+0.0000042*t.d*t.d) /*Buche Derbholz (BERGEL 1973) */
Kronenbreite [m]	t.cw = 0.38051+0.221417*t.d /* Moorbirke (NAGEL 2009*/
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((-0.586706+0.445061*t.h/t.d+0.008464*t.d+0.27464*ln(sp.h100))))) /* Moorbirke (NAGEL 2009*/
Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = sp.h100*((1.0-exp(-0.0658938*100.0))/(1.0-exp(-0.0658938*t.age)))^4.1319191 /* Moorbirke Lock ausgeglichen (NAGEL 2009) */
Höhe entsprechend der Bonität [m]	Höhe = t.si/((1.0-exp(-0.0658938*100.0))/(1.0-exp(-0.0658938*t.age)))^4.1319191 /* Moorbirke Lock ausgeglichen (NAGEL 2009*/
Potentieller Höhenzuwachs [m]	ihpot = ((t.si/((1.0-exp(-0.0658938*100.0))/(1.0-exp(-0.0658938*(t.age+5.0))))^4.1319191)-(t.si/((1.0-exp(-0.0658938*100.0))/(1.0-exp(-0.0658938*(t.age))))^4.1319191)) /* Moorbirke Lock ausgeglichen (NAGEL 2009*/
Höhenzuwachs [m]	t.hinc = ((t.si/((1.0-exp(-0.0658938*100.0))/(1.0-exp(-0.0658938*(t.age+5.0))))^4.1319191)-(t.si/((1.0-exp(-0.0658938*100.0))/(1.0-exp(-0.0658938*(t.age))))^4.1319191)) /* Moorbirke Lock ausgeglichen (NAGEL 2009*/
Höhenzuwachsstreuung [m]	herror = 0.05
Grundflächenzuwachs [cm²]	t.dinc = (exp(4.972+1.52733*ln(3.14159265359*(t.cw/2.0)/(6.0*(t.h-t.cb)^2)*((4.0*(t.h-t.cb)^2 +(t.cw/2)^2)^1.5 - (t.cw/2)^3))-1.75899*ln(t.age)-1.52027*t.c66xy-1.077*t.c66cxy))/10000 /* Moorbirke (NAGEL 2009*/
Durchmesserzuwachsstreuung [cm]	herror = 0.05

Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(9900.0/ (3.141592*(t.cw/2.0)^2.0)) /* Moorbirke (NAGEL 2009*/
Maximales Alter [Jahre]	MaxAlter = 90
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	40.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.55;18.0;18.0;0.60;24.0;24.0;0.65;100.0
Farbe (RGB)	204;204;0

Tabelle 22: Baumart 421 – Roterle (Schwarzerle)

Durchmessergenerierung [cm]	t.d = (-1.937+1.082*sp.dg)*(((6.9/(-1.937+1.082*sp.dg))^(4.669+0.366*sp.dg-0.234*dmax))-ln(1.0-random))^(1.0/(4.669+0.366*sp.dg-0.234*dmax)) /* Eiche (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.14657227*(1.0-(sp.dg/t.d)))*exp(3.78686023*((1.0/sp.dg)-(1.0/t.d))) /* Eiche (NAGEL 1999)*/
Höhenvariabilität [m]	t.hv = -0.1944676+0.3535610*ln(sp.dg) /* Eiche (ALBERT 2000)*/
Volumenfunktion [m³]	t.v = exp(-10.262754+2.155525*ln(t.d) +0.976678* ln(t.h)-0.043148*(ln(t.d))^2 +0.010716 * (ln(t.h)) ^2 *(1.811999-7.382763*(1.0/t.d)- 0.032335*t.d+0.0005276708*t.d^2)-0.00000246995 *t.d^3.0) /*Schwarzerle LOCKOW (1994)*/
Kronenbreite [m]	t.cw = 0.17998*(t.d^0.75155)*((t.h-t.cb)^0.35611) /*Schwarzerle SCHRÖDER ()*/
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((-1.662864+0.166908*t.h/t.d-0.013784*t.d+0.977588*ln(sp.h100))))) /*Schwarzerle SCHRÖDER ()*/
Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = 4.0*sp.h100*exp(2.733015-1.668158*ln(t.age) +0.167998*ln(t.age)^2.0) /*Schwarzerle LOCKOW (1994)*/
Höhe entsprechend der Bonität [m]	Höhe = t.si/(4.0*exp(2.733015-1.668158*ln(t.age+5)+0.167998*ln(t.age+5)^2.0)) /*Schwarzerle LOCKOW (1994)*/
Potentieller Höhenzuwachs [m]	ihpot = ((1.2164*t.si*(1.0-exp(-0.0194*(t.age+5.0)))^1.1344)-(1.2164*t.si*(1.0-exp(-0.0194*t.age))^1.1344)) /*Schwarzerle Lockow (1994)*/
Höhenzuwachs [m]	t.hinc = ((1.2164*t.si*(1.0-exp(-0.0194*(t.age+5.0)))^1.1344)-(1.2164*t.si*(1.0-exp(-0.0194*t.age))^1.1344))

Höhenzuwachsstreuung [m]	herror = 0.05
Grundflächenzuwachs [cm²]	t.dinc = exp(-7.23687+1.05135*ln(3.14159265359*(t.cw/2.0)/ (6.0*(t.h-t.cb)^2)*((4.0*(t.h-t.cb)^2 +(t.cw/2)^2)^1.5 - (t.cw/2)^3))- 0.50283*ln(t.age)-0.80185*t.c66xy) /*Schwarzerle SCHRÖDER ()*/
Durchmesserzuwachsstreu ung [cm]	herror = 0.05
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(sp.dg/200.0)^2.0)*(5518.3*exp(- 0.0645*sp.dg)) /*Schwarzerle Schröder*/
Maximales Alter [Jahre]	MaxAlter = 125
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	40.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.55;18.0;18.0;0.60;24.0;24.0;0.65;100.0
Farbe (RGB)	204;204;0
Plugin: Einwuchs	Ingrowth2
Plugin: Konkurrenzindex	Competition
Plugin: Schaftformfunktion	TaperFunctionBySchmidt

Tabelle 23: Baumart 451 – Eberesche (Sorbus aucuparia)

wie	211
Volumenfunktion [m³]	t.v = 0.000904+0.96266*(0.0000272*t.h*t.d^2+0.00007719*t.d*t.h+ 0.000058*t.h) +0.13248*(0.0000272*t.h*t.d^2+0.00007719*t.d*t.h+ 0.000058*t.h)^2 /*Eberesche (HILLEBRAND 1996)*/
Kronenbreite [m]	t.cw = 1.02199+0.13849*t.d /*Eberesche (Hillebrand 1996)*/
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-(0.74928+0.21639*t.h/t.d)^2.0))
Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = 66.9903*(sp.h100/66.9903)^(1.0/exp((-0.23515/((0.79707- 1.0)*100.0^(0.79707-1.0)))+(0.23515/((0.79707- 1.0)*t.age^(0.79707-1.0))))) /*Eberesche (HILLEBRAND 1996)*/
Höhe entsprechend der Bonität [m]	Höhe = 66.9903*(t.si/66.9903)^exp((-0.23515/((0.79707- 1.0)*100.0^(0.79707-1.0)))+(0.23515/((0.79707- 1.0)*t.age^(0.79707-1.0)))) /*Eberesche (HILLEBRAND 1996)*/

Potentieller Höhenzuwachs [m]	ihpot = (66.9903*(t.si/66.9903)^exp((-0.23515/((0.79707-1.0)*100.0^(0.79707-1.0)))+(0.23515/((0.79707-1.0)*(t.age+5.0)^(0.79707-1.0))))-66.9903* (t.si/66.9903)^exp((-0.23515/((0.79707-1.0)*100.0^(0.79707-1.0)))+(0.23515/((0.79707-1.0)*t.age^(0.79707-1.0))))) /*Eberesche (HILLEBRAND 1996)*/
Höhenzuwachs [m]	t.hinc = (66.9903*(t.si/66.9903)^exp((-0.23515/((0.79707-1.0)*100.0^(0.79707-1.0)))+(0.23515/((0.79707-1.0)*(t.age+5.0)^(0.79707-1.0))))-66.9903* (t.si/66.9903)^exp((-0.23515/((0.79707-1.0)*100.0^(0.79707-1.0)))+(0.23515/((0.79707-1.0)*t.age^(0.79707-1.0))))) /*Eberesche (HILLEBRAND 1996)*/
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(17700.0/(3.141592*(t.cw/2.0)^2.0))
Maximales Alter [Jahre]	MaxAlter = 120
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	60.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.55;18.0;18.0;0.60;24.0;24.0;0.65;100.0
Farbe (RGB)	204;204;0

Tabelle 24: Baumart 521 – Weisstanne (Abies alba)

wie	511
Kronenbreite [m]	t.cw = 1.84810+0.10350*t.d /*Weisstanne (NAGEL 1999)*/
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-(0.784+0.207*t.h/t.d)^2.0)) /* Weisstanne (NAGEL 1999)*/
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(15000.0/(3.141592*(t.cw/2.0)^2.0))

Tabelle 25: Baumart 523 – Küstentanne (Abies grandis)

wie	511
Volumenfunktion [m³]	t.v = exp(1.64134*ln(t.d)+0.84522*ln(t.h-1.3)+0.45253*ln(1.0-(7.0/t.d))-8.45379) /* Kta Derbholz Nagel 1988*/
Kronenbreite [m]	t.cw = (3.152709+0.064306*t.d)*(1.0-exp(-exp(ln(t.d/14.069376)*1.938416))) /*Kta (GEB 2009*/
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((-1.7040199+0.5945605*t.h/t.d-0.0067069*t.d+0.6850744*ln(sp.h100))))) /* Kta (GEB 2009) */
Kronentype in Grafik:	Kronentyp= 1 (0=Laubholz, 1= Nadelholz)

Bonität (Höhe im Alter 100) [m]	t.si = sp.h100*((1.0-exp(-0.0371*50.0))/(1.0-exp(-0.0371*t.age)))^2.08562 /* Kta (GEB 2009) */
Höhe entsprechend der Bonität [m]	Höhe = t.si/((1.0-exp(-0.0371*50.0))/(1.0-exp(-0.0371*t.age))) ^2.08562 /* Kta (GEB 2009) */
Potentieller Höhenzuwachs [m]	ihpot = ((t.si/((1.0-exp(-0.0371*50.0))/(1.0-exp(-0.0371*(t.age+5.0))))^2.08562)-(t.si/((1.0-exp(-0.0371*50.0))/(1.0-exp(-0.0371*(t.age))))^2.08562)) /* Kta (GEB 2009) */
Höhenzuwachs [m]	t.hinc = ((t.si/((1.0-exp(-0.0371*50.0))/(1.0-exp(-0.0371*(t.age+5.0))))^2.08562)-(t.si/((1.0-exp(-0.0371*50.0))/(1.0-exp(-0.0371*(t.age))))^2.08562)) *1.053041*(t.h/sp.h100)^0.021848 /* Kta (GEB 2009) */
Höhenzuwachsstreuung [m]	herror = 1.29
Grundflächenzuwachs [cm²]	t.dinc = (exp(3.5581+1.018355*ln(t.d*t.d)-1.207076*ln(t.age)-0.968107*t.c66xy+0.541826*t.c66cxy))/10000.0 /* Kta (GEB 2009) */
Durchmesserzuwachsstreuung [cm]	herror = -9.0
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = 0.0001*3.141592/(16*0.000005758*0.7637*(t.h^(0.2706-1.0760))) /* Kta (GEB 2009) */
Maximales Alter [Jahre]	MaxAlter = 200
Totholzzersetzung (Faktor)	
Zielstärkendurchmesser [cm]	60.0
Höhe der 1. Durchforstung [m]	10.0
Mäßige Durchforstung [m;NB°]	10.0;0.6;20.0;20.0;0.6;26.0;30.0;0.8;100.0

Tabelle 26: Baumart 811 – Europäische Lärche (Larix decidua)

Durchmessergenerierung [cm]	t.d = (-2.492+1.104*sp.dg)*(((6.9/(-2.492+1.104*sp.dg))^(3.418+0.353*sp.dg-0.192*dmax))-ln(1.0-random))^(1.0/(3.418+0.353*sp.dg-0.192*dmax)) /* Fichte (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.12931522*(1.0-(sp.dg/t.d)))*exp(4.44234560*((1.0/sp.dg)-(1.0/t.d))) /*ELae (NAGEL 1999*/
Höhenvariabilität [m]	t.hv = -0.6860345+0.551803*ln(sp.dg) /* ELae (ALBERT 2000)*/
Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.583+4.52132/(t.h*t.h)-5.59827/(t.h*t.d)-0.2101*ln(t.d)/ln(10.0)+0.12363*ln(t.h)/ln(10.0)+21.92938/ (t.d*t.h*t.h)) /*ELae Derbholz (BERGEL 1974)*/
Kronenbreite [m]	t.cw = (3.6962+0.0762*t.d)*(1.0-exp(-exp(ln(t.d/21.8046)*1.53))) /* Lae (DÖBBELER ET AL 2002) */

Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((0.8225-0.4688*t.h/t.d-0.00317*t.d-0.4282*ln(sp.h100))))) /* Lae (DÖBBELER ET AL 2002) */
Kronentype in Grafik:	Kronentyp= 1 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = (sp.h100+0.53515)/(-0.78758+0.38982*ln(t.age)) /* Lae (DÖBBELER ET AL 2002) */
Höhe entsprechend der Bonität [m]	Höhe = -0.53515-0.78758*t.si+0.38982*t.si*ln(t.age) /* Lae (DÖBBELER ET AL 2002) */
Potentieller Höhenzuwachs [m]	ihpot = ((-0.53515-0.78758*t.si+0.38982*t.si*(ln(t.age+5)))-(-0.53515-0.78758*t.si+0.38982*t.si*(ln(t.age)))) /* Lae (DÖBBELER ET AL 2002) */
Höhenzuwachs [m]	t.hinc = ((-0.53515-0.78758*t.si+0.38982*t.si*(ln(t.age+5)))-(-0.53515-0.78758*t.si+0.38982*t.si*(ln(t.age)))) /* Lae (DÖBBELER ET AL 2002) */
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-7.1927+0.8621*ln(3.14159265359*(t.cw/2.0)/(6.0*(t.h-t.cb)^2)*((4.0*(t.h-t.cb)^2 +(t.cw/2)^2)^1.5 -(t.cw/2)^3))-0.5193*ln(t.age)-0.7122*t.c66xy+0.3619*t.c66cxy+0.7316*1.6094) /* Lae (DÖBBELER ET AL 2002) */
Durchmesserzuwachsstreuung [cm]	herror = 0.629
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(8400.0/(3.141592*(t.cw/2.0)^2.0)) /* Lae (DÖBBELER ET AL 2002) */
Maximales Alter [Jahre]	MaxAlter = 240
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/50.0)
Zielstärkendurchmesser [cm]	60.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.7;20.0;20.0;0.75;26.0;26.0;0.8;100.0
Farbe (RGB)	255;0;0

Tabelle 27: Baumart 812 – Japanische Lärche (Larix kaempferi)

Durchmessergenerierung [cm]	t.d = (-2.492+1.104*sp.dg)*(((6.9/(-2.492+1.104*sp.dg))^(3.418+0.353*sp.dg-0.192*dmax))-ln(1.0-random))^(1.0/(3.418+0.353*sp.dg-0.192*dmax)) /* Fichte (NAGEL u. BIGING 1995) */
Einheitshöhenkurve [m]	t.h = 1.3+(sp.hg-1.3)*exp(0.53934489*(1.0-(sp.dg/t.d)))*exp(4.16512685*((1.0/sp.dg)-(1.0/t.d))) /*JLae (NAGEL 1999*/
Höhenvariabilität [m]	t.hv = -0.6810186+0.523771*ln(sp.dg) /* JLae (ALBERT 2000)*/

Volumenfunktion [m³]	t.v = 3.141592*t.h*(t.d/200)^2*(0.5073+7.41736/(t.h*t.h)-7.57701/ (t.h*t.d)-0.32268*ln(t.d)/ln(10.0)+ 0.30583*ln(t.h)/ln(10.0)+20.75427/ (t.d*t.h*t.h)) /*JLae Derbholz (BERGEL 1973)*/
Kronenbreite [m]	t.cw = 2.3805+0.1073*t.d /* JLae (DÖBBELER ET AL 2002) */
Kronenansatz [m]	t.cb = t.h*(1.0-exp(-abs((-1.041+0.4789*t.h/t.d-0.00914*t.d+0.6266*ln(sp.h100))))) /* JLae (DÖBBELER ET AL 2002) */
Kronentype in Grafik:	Kronentyp= 1 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = sp.h100/(1.88062*(1.0-exp(-0.009296*t.age))^0.6345) /* JLae (WESTPHAL 1997) */
Höhe entsprechend der Bonität [m]	Höhe = 1.88062*t.si*(1.0-exp(-0.009296*t.age))^0.6345 /* JLae (WESTPHAL 1997) */
Potentieller Höhenzuwachs [m]	ihpot = ((1.88062*t.si*(1.0-exp(-0.009296*(t.age+5.0)))^0.6345)-(1.88062*t.si*(1.0-exp(-0.009296*t.age))^0.6345)) /* JLae (WESTPHAL 1997) */
Höhenzuwachs [m]	t.hinc = t.h*((((1.88062*t.si*(1.0-exp(-0.009296*(t.age+5.0)))^0.6345)-(1.88062*t.si*(1.0-exp(-0.009296*t.age))^0.6345))/sp.h100)+(0.0188*(t.hinc^3.5922))) /* JLae (DÖBBELER ET AL 2002) */
Höhenzuwachsstreuung [m]	herror = 0.082
Grundflächenzuwachs [cm²]	t.dinc = exp(-8.1122+1.3016*ln((3.141593*(t.cw/2.0)/(6.0*(t.h-t.cb)^2.0))*(((4.0*(t.h-t.cb)^2.0+(t.cw/2.0)^2.0)^1.5)-(t.cw/2.0)^3.0))-0.6979*ln(t.age)-0.5081*t.c66xy+0.4766*t.c66cxy+0.3520*ln(5.0)) /* JLae (DÖBBELER ET AL 2002) */
Durchmesserzuwachsstreuung [cm]	herror = 0.57
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = (3.141592*(t.d/200.0)^2.0)*(22800.0/ (3.141592*(t.cw/2.0)^2.0)) /* JLae (DÖBBELER ET AL 2002) */
Maximales Alter [Jahre]	MaxAlter = 240
Totholzzersetzung (Faktor)	1.0-((sp.year-t.out-5.0)/30.0)
Zielstärkendurchmesser [cm]	60.0
Höhe der 1. Durchforstung [m]	12.0
Mäßige Durchforstung [m;NB°]	12.0;0.75;18.0;18.0;0.80;24.0;24.0;0.85;100.0
Farbe (RGB)	254;0;0

Tabelle 28: Grass 999 – Vergrasung wird wie eine Baumart geführt, Code 999 kann nicht geändert werden

Durchmessergenerierung [cm]	t.d =
Einheitshöhenkurve [m]	t.h =

Höhenvariabilität [m]	t.hv =
Volumenfunktion [m³]	t.v = 0
Kronenbreite [m]	t.cw =
Kronenansatz [m]	t.cb =
Kronentype in Grafik:	Kronentyp= 0 (0=Laubholz, 1= Nadelholz)
Bonität (Höhe im Alter 100) [m]	t.si = 1
Höhe entsprechend der Bonität [m]	Höhe = 1
Potentieller Höhenzuwachs [m]	ihpot = 0
Höhenzuwachs [m]	t.hinc = 0
Höhenzuwachsstreuung [m]	herror = 0.0
Grundflächenzuwachs [cm²]	t.dinc = 0
Durchmesserzuwachsstreuung [cm]	herror = 0.0
Maximale Dichte der Grundfläche [m²/ha]	MaxDichte = 0.003848*6000/5.0
Maximales Alter [Jahre]	MaxAlter = 900
Totholzzersetzung (Faktor)	0.0
Zielstärkendurchmesser [cm]	999.0
Höhe der 1. Durchforstung [m]	120.0
Mäßige Durchforstung [m;NB°]	12.0;0.55;18.0;18.0;0.60;24.0;24.0;0.65;100.0
Farbe (RGB)	255;102;55

5.2 Ingrowth Model

Tabelle 29: Koeffizienten für Wahrscheinlichkeit von Einwuchs nach führender Baumart

Führende Baumart	p0	p1
Eiche	0.237	-0.6551
Buche	0.2551	-0.5288
ALH/ALN	0.2446	-0.4435
Fichte	0.1659	-0.6086
Douglasie	0.1800	-0.8022
Kiefer	0.2946	-0.2795
Lärche	0.2829	-0.7482

$$nE=e^{p0+p1\cdot c66Kl}$$

Tabelle 30: Koeffizienten zur Bestimmung der Anzahl der einwachsenden Bäume in Abhängigkeit der führenden Baumart

Führende Baumart	**p0**	**p1**
Eiche	3.2874	-1.1275
Buche	3.14664	-0.94789
ALH/ALN	2.80772	-0.87383
Fichte	2.7331	-0.7096
Douglasie	2.7331	-0.7096
Kiefer	2.9338	-1.1701
Lärche	2.5012	-0.4793

– Bestimmung der Baumart

Tabelle 31: Führende Baumart Eiche

c66kl	**Art**	**111**	**112**	**211**	**221**	**321**	**342**	**411**	**411**	**431**	**451**	**511**	**711**	**731**	**811**
0.1	p	0.254	0.724	0.752	0.752	0.752	0.752	0.921	0.970	0.970	0.985	1.00	1.0	1.0	1.0
0.3	p	0.203	0.811	0.849	0.862	0.862	0.862	0.875	0.875	0.888	0.901	0.964	0.989	1.000	1.000
0.5	p	0.177	0.673	0.786	0.821	0.821	0.821	0.835	0.870	0.870	0.898	0.990	0.997	0.997	0.997
0.7	p	0.169	0.662	0.859	0.887	0.887	0.887	0.901	0.901	0.901	0.915	0.985	0.985	0.985	0.999
0.9	p	0.043	0.532	0.766	0.787	0.787	0.787	0.808	0.808	0.808	0.851	1.000	1.000	1.000	1.000
1.1	p	0.217	0.608	0.847	0.890	0.890	0.933	0.933	0.933	0.933	0.955	0.998	0.998	0.998	0.998
1.3	p	0.000	0.333	0.666	0.666	0.666	0.777	0.777	0.777	0.777	0.999	0.999	0.999	0.999	0.999
1.5+>	p	0.000	0.250	0.625	0.750	0.875	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Tabelle 32: Führende Baumart Buche (Teil 1)

c66kl	Art	111	112	211	221	311	321	331	342	365
0.1	p	0.007	0.007	0.918	0.918	0.918	0.918	0.918	0.918	0.918
0.3	p	0.008	0.008	0.942	0.942	0.942	0.942	0.942	0.942	0.942
0.5	p	0.000	0.008	0.919	0.919	0.919	0.919	0.919	0.919	0.923
0.7	p	0.030	0.060	0.872	0.872	0.872	0.885	0.889	0.893	0.893
0.9	p	0.046	0.059	0.934	0.954	0.954	0.954	0.954	0.954	0.954
1.1	p	0.008	0.008	0.969	0.969	0.969	0.969	0.969	0.969	0.969
1.3	p	0.000	0.000	0.961	0.961	0.969	0.969	0.969	0.977	0.977
1.5 +>	p	0	0	1	1	1	1	1	1	1

Tabelle 33: Führende Baumart Buche (Teil2)

c66k l	Art	411	441	451	452	511	513	521	611	711	811
0.1	p	0.940	0.944	0.944	0.944	0.996	0.996	0.996	0.996	0.996	1.000
0.3	p	0.965	0.965	0.965	0.965	0.988	0.988	0.988	0.992	0.992	1.000

0.5	p	0.935	0.935	0.951	0.951	0.991	0.995	0.995	0.995	0.995	1.000
0.7	p	0.906	0.906	0.906	0.906	0.974	0.974	0.974	0.983	0.992	1.000
0.9	p	0.954	0.954	0.954	0.954	0.980	0.980	1.000	1.000	1.000	1.000
1.1	p	0.969	0.969	0.977	0.977	1.000	1.000	1.000	1.000	1.000	1.000
1.3	p	0.977	0.977	0.985	0.985	1.00	1.00	1.00	1.00	1.00	1.00
1.5 + >	p	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Tabelle 34: Führende Baumart Alh oder Aln (Teil1)

c66kl	Art	111	112	211	221	311	321	342	354	411	412	421
0.1	p	0.000	0.051	0.229	0.229	0.229	0.263	0.263	0.271	0.618	0.643	0.685
0.3	p	0.116	0.195	0.256	0.262	0.268	0.268	0.268	0.268	0.628	0.701	0.738
0.5	p	0.016	0.016	0.154	0.154	0.154	0.178	0.194	0.194	0.560	0.576	0.592
0.7	p	0.021	0.032	0.117	0.117	0.213	0.266	0.266	0.266	0.745	0.745	0.766
0.9	p	0.000	0.028	0.334	0.334	0.334	0.445	0.445	0.445	0.528	0.528	0.556
1.1	p	0.107	0.107	0.357	0.357	0.393	0.429	0.429	0.429	0.608	0.608	0.679
1.3 + >	p	0.053	0.053	0.421	0.421	0.421	0.474	0.474	0.474	0.579	0.579	0.579

Tabelle 35: Führende Baumart Alh oder Aln (Teil2)

c66kl	Art	411	441	451	452	511	513	521	611	711	811
0.1	p	0.940	0.944	0.944	0.944	0.996	0.996	0.996	0.996	0.996	1.000
0.3	p	0.965	0.965	0.965	0.965	0.988	0.988	0.988	0.992	0.992	1.000
0.5	p	0.935	0.935	0.951	0.951	0.991	0.995	0.995	0.995	0.995	1.000
0.7	p	0.906	0.906	0.906	0.906	0.974	0.974	0.974	0.983	0.992	1.000
0.9	p	0.954	0.954	0.954	0.954	0.980	0.980	1.000	1.000	1.000	1.000
1.1	p	0.969	0.969	0.977	0.977	1.000	1.000	1.000	1.000	1.000	1.000
1.3	p	0.977	0.977	0.985	0.985	1.00	1.00	1.00	1.00	1.00	1.00
1.5 + >	p	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Tabelle 36: Führende Baumart Fichte (Teil1)

c66kl	Art	112	113	211	321	411	412	421	441	451
0.1	p	0.000	0.000	0.065	0.065	0.102	0.102	0.102	0.107	0.107
0.3	p	0.031	0.031	0.080	0.080	0.127	0.127	0.132	0.135	0.148

0.5	p	0.016	0.020	0.134	0.134	0.250	0.259	0.259	0.259	0.270
0.7	p	0.003	0.003	0.152	0.169	0.218	0.218	0.218	0.218	0.256
0.9	p	0.000	0.000	0.101	0.101	0.163	0.163	0.163	0.163	0.192
1.1	p	0.000	0.000	0.254	0.254	0.282	0.296	0.296	0.296	0.352
1.3	p	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1.5	p	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Tabelle 37: Führende Baumart Fichte (Teil1)

c66kl	Art	511	512	525	551	611	711	811	812
0.1	p	0.986	0.986	0.986	0.986	0.986	1.000	1.000	1.000
0.3	p	0.964	0.967	0.967	0.967	0.972	0.995	1.000	1.000
0.5	p	0.964	0.964	0.964	0.966	0.982	0.995	0.997	1.000
0.7	p	0.950	0.950	0.953	0.953	0.960	0.995	0.998	1.000
0.9	p	0.966	0.966	0.966	0.966	0.980	0.999	0.999	1.000
1.1	p	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1.3	p	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.5 + >	p	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Tabelle 38: Führende Baumart Douglasie

c66kl	Art	111	112	211	411	511	611	711
0.1	p	0	0	0	0	0	1	1
0.3	p	0.000	0.000	0.018	0.036	0.179	1.000	1.000
0.5	p	0.000	0.071	0.071	0.071	0.214	0.928	0.999
0.7	p	0.048	0.048	0.096	0.191	0.381	1.000	1.000
0.9 + >	p	0	0	0	0	0	1	1

Tabelle 39: Führende Baumart Kiefer (Teil1)

c66kl	Art	111	112	113	211	311	411	412	421	431	441	451
0.1	p	0.139	0.139	0.139	0.139	0.139	0.153	0.153	0.153	0.153	0.153	0.153
0.3	p	0.010	0.074	0.074	0.077	0.080	0.202	0.202	0.202	0.202	0.205	0.205
0.5	p	0.005	0.012	0.015	0.024	0.024	0.135	0.154	0.154	0.154	0.154	0.163
0.7	p	0.002	0.007	0.007	0.042	0.042	0.194	0.203	0.205	0.207	0.207	0.230
0.9	p	0.006	0.006	0.006	0.031	0.031	0.156	0.162	0.168	0.168	0.168	0.180
1.1	p	0.05	0.05	0.05	0.05	0.05	0.50	0.50	0.50	0.50	0.50	0.50
1.3 +	p	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5

>												

Tabelle 40: Führende Baumart Kiefer (Teil2)

c66kl	Art	511	513	531	611	711	811	812
0.1	p	0.167	0.167	0.167	0.167	1.000	1.000	1.000
0.3	p	0.384	0.384	0.384	0.387	0.995	0.998	0.998
0.5	p	0.413	0.415	0.417	0.451	0.996	0.999	1.001
0.7	p	0.580	0.580	0.580	0.594	0.994	0.999	0.999
0.9	p	0.680	0.680	0.680	0.711	0.999	0.999	0.999
1.1	p	0.95	0.95	0.95	0.95	1.00	1.00	1.00
1.3 + >	p	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Tabelle 41: Führende Baumart Lärche

c66kl	Art	112	211	321	411	421	422	441	451	511	611	711	811	812
0.1	p	0.083	0.500	0.500	0.750	0.750	0.833	0.833	0.833	0.833	0.833	0.916	0.999	0.999
0.3	p	0.022	0.435	0.435	0.522	0.522	0.522	0.544	0.544	0.587	0.739	0.782	0.999	0.999
0.5	p	0.014	0.405	0.434	0.535	0.564	0.564	0.564	0.636	0.882	0.896	0.925	0.997	0.997
0.7	p	0.000	0.852	0.852	0.852	0.852	0.852	0.852	0.868	0.901	0.950	0.966	0.982	0.998
0.9	p	0.000	0.824	0.824	0.883	0.883	0.883	0.883	0.912	0.971	0.971	0.971	1.000	1.000
1.1+>	p	0	1	1	1	1	1	1	1	1	1	1	1	1

5.3 Taper Functions

Java Klasse: treegross.base.TaperByBrink

Für die Sortimentierung werden die Schaftformfunktionen von SCHMIDT (2001) verwendet.

Modifizierte Brinkfunktion (Laubholzarten)

Tabelle 42: Buche

Koeffizient	Wert	Std. Fehler	t-Wert
k	0.6946140	0.00975345	71.2173
p	0.0862735	0.00427386	20.1863

q	0.1359840	0.00304893	44.6007
Residual Std. Fehler (mm)	0.683244 bei 6331 Freiheitsgraden		

Tabelle 43: Eiche

Koeffizient	Wert	Std. Fehler	t-Wert
k	0.5698770	0.01181670	48.2263
p	0.0450652	0.00354560	12.7102
q	0.2452940	0.00724047	33.8782
Residual Std. Fehler (mm)	0.504138 bei 9421 Freiheitsgraden		

Painfunktion (Nadelholzarten)

Tabelle 44: Fichte

Koeffizient	Wert	Std. Fehler	t-Wert	Pr(>|t|)
a_0	-0.223	0.0615	-3.632	0.0003
a_1	1.595	0.0138	115.608	0.0000
a_2	-3.155	0.0667	-47.307	0.0000
b_0	0.512	0.0333	15.386	0.0000
b_1	-0.158	0.0075	-21.042	0.0000
b_2	-0.502	0.0362	-13.847	0.0000
Residual Std. Fehler (mm)	0.504 bei 9763 Freiheitsgraden			
Multiples Bestimmtheitsmaß	0.997			
F-Statistik	591400 bei 6 und 9763 Freiheitsgraden, *p*-Wert = 0			

Tabelle 45: Douglasie

Koeffizient	Wert	Std. Fehler	t-Wert	Pr(>|t|)
a_0	-0.5828	0.0251	-23.2380	0.0000
a_1	1.4423	0.0046	315.5793	0.0000
a_2	-2.1807	0.0301	-72.4895	0.0000
b_0	0.4369	0.0135	32.2455	0.0000
b_1	-0.2008	0.0025	-79.1233	0.0000
b_2	-0.2836	0.0167	-17.0032	0.0000
Residual Std. Fehler (mm)	0.5274 bei 28350 Freiheitsgraden			

Multiples Bestimmtheitsmaß	0.9970
F-Statistik	1575000 bei 6 und 28350 Freiheitsgr., *p*-Wert = 0

Tabelle 46: Kiefer

Koeffizient	Wert	Std. Fehler	t-Wert	Pr(>|t|)
a_0	-1.7258	0.0194	-88.9947	0.0000
a_1	1.3311	0.0072	185.5373	0.0000
a_2	-0.7016	0.0350	-20.0722	0.0000
b_0 n. signifikant				
b_1	-0.2142	0.0035	-60.5993	0.0000
b_2	0.1306	0.0188	6.9432	0.0000
Residual Std. Fehler (mm)	0.4822 bei 10723 Freiheitsgraden			
Multiples Bestimmtheitsmaß	0.9976			
F-Statistik	882000 bei 5 und 10723 Freiheitsgraden, *p*-Wert = 0			