

Tree growth rates: Introduction to workshop materials

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Parts of the workshop – Friday 1st September

1. Prepare repeat stem measurement data to estimate stem growth
2. Estimate stem growth rates, productivity and loss (carbon balance), recruitment and mortality (vital rates)
3. Apply estimates of stem growth rate to research questions
 - I. Analyse the drivers of variation in stem growth rates
 - II. Use growth rates to predict harvesting rates
 - III. Explore site-variation in carbon dynamics
4. Brainstorm ideas for studies using measures of carbon dynamics.

The SEOSAW dataset

Two tables, linked by columns `plot_id` and `census_date`:

- Plots – One row per census
- Stems – One row per measurement

Key columns in Stems table:

- `tree_id` - ID of tree
- `stem_id` - ID of stem
- `stem_status` - Stem mortality status (“a” = alive, “r” = resprouting, “d” = dead)
- `diam` - Stem diameter (cm)
- `pom` – Height of the diameter measurement (m)
- `agb` - Stem estimated above-ground woody biomass

The SEOSAW dataset

Two tables, linked by columns `plot_id` and `census_date`:

- Plots – One row per census
- Stems – One row per measurement

Key columns in Plots table:

- `plot_area` – Area of plot (ha)
- `min_diam_thresh` – Minimum stem diameter measured (cm)
- `longitude_of_centre`,
`latitude_of_centre` – Lat-Long coordinates (decimal degrees)

The SEOSAW dataset

See "[stem_columns.csv](#)" and "[plot_columns.csv](#)" for more information on table columns.

1	column	class	description	units	example
2	plot_id	chr	Unique identifier for plots. A three letter code, followed by a number referring to the plot	NA	ABG_1
5	stem_id	chr	Unique identifier for stems within a plot. Normally the tag ID if the plot has tag ID	NA	6
7	census_date	chr	The date of the census. This can be either YYYY, YYYY-MM, or YYYY-MM-DD.	NA	26/06/2022
10	notes_stem	chr	Miscellaneous notes related to the tree or stem	NA	Leaning around 45 d
11	diam	num	Stem diameter measurement in cm	cm	6.4
12	pom	num	The height at which diam was taken, in metres to one decimal place (nearest 10 cm)	m	1.3
13	x_grid	num	The x coordinate of the stem within the plot if a grid method was used. In metres	m	54.2
14	y_grid	num	The y coordinate of the stem within the plot if a grid method was used. In metres	m	35.6
15	latitude	num	The latitude coordinate of the stem within the plot if a GPS method was used. In decimal degrees	decimal degrees	-50.425622
16	longitude	num	The longitude coordinate of the stem within the plot if a GPS method was used. In decimal degrees	decimal degrees	30.446453
17	angle	num	If 'plot_shape' == "circle", and angular stem coordinates were used, the angle (in degrees)	degrees	43.2

Data requirements

Your data must:

- Have multiple censuses
- Be able to track stem identity between censuses (e.g. with tags)
- Be formatted in the SEOSAW style (see templates)

We have example datasets for those without their own data.

There will be no time to clean new datasets.



1	plot_id	subplot_id	tree_id	stem_id	tag_id	census_date	species_orig_binom	diam	pom	height	stem_status	agb
2	ABG_1	1	1	1	1	2018	Burkea africana	8.3	1.3	4.8	a	0.0154483
3	ABG_1	1	2	2	2	2018	Combretum collinum	7.1	1.4	4.4	a	0.014745
4	ABG_1	1	3	3	3	2018	Burkea africana	9.3	1.3	NA	a	0.0207905
5	ABG_1	1	4	4	4	2018	Julbernardia paniculata	28.1	1.3	10.2	a	0.3563868
6	ABG_1	1	5	5	5	2018	Combretum collinum	6.5	1.3	4.6	a	0.0111712

Software requirements

Your computer must have R version **3.5.0** or above.

`R.Version()$version.string`

You must have the following packages installed:

e.g. `install.packages("<pkg>")`

- `dplyr`
- `ggplot2`
- `taxize`
- `lme4`
- `ggeffects`
- `data.table`
- `seosawr` (see next slide)
- `ProdVital` (see next slide)
- `BIOMASS` (see next slide)



Installing extra R packages

The packages `seosawr`, `ProdVital`, and `BIOMASS`, are not available on CRAN.
Enter this code in R to install them:

```
install.packages("remotes")  
remotes::install_bitbucket("miombo/seosaw/seosawr/seosawr")  
remotes::install_github("johngodlee/ProdVital")  
remotes::install_github("umr-amap/BIOMASS")
```

15 minutes

- Open the [Sharepoint folder](#)
- Download this presentation (slides/1_prep_2023-08-29.pptx)
- Download the software preparation instructions (worksheets/1_prep_2023-08-29.html)
- Check your R version
- Install the required packages
- Open one of the dataset spreadsheets

Workshop scope

Practical skills:

- Estimate individual stem growth rates
- Aggregate growth rates (plots, taxonomy, demography, etc.)
- Estimate rates of productivity, loss, biomass change, vital rates
- Predicting time to harvest and analyse drivers of tree dynamics

Additionally:

- Brainstorming research ideas
- Sharing experience

Plan for next session – Friday 1st September

Short introduction to each stage of the analysis.

- Data preparation
- Methods
- Analysis

Self-led tutorials in breakout rooms using worksheets.

Discussions and troubleshooting after each stage.

Broader discussions and self-led work in the afternoon.

Data preparation

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Introduction

This worksheet provides examples of how to prepare repeat stem measurement data to measure stem growth rates. The code chunks are all written in R. The example dataset used in this worksheet ("stems_ABG.csv") can be found in the [workshop Sharepoint folder](#).

First, load the required packages. If you haven't installed the packages you should do so with `install.packages("<pkg>")`, where `<pkg>` is the name of the package.

```
library(dplyr)
library(ggplot2)
library(seosawr)
library(ProdVital)
```

Next, load the data. Either use your own data, or one of the example datasets provided for the workshop.

```
s <- read.csv("dat/stems_ABG.csv")
```

Each row in the stem data is one measurement of one stem in one census.

The key columns to remember for this workshop are:

- `plot_id` - ID of the plot
- `census_date` - Census date of measurement
- `tree_id` - ID value grouping stems into trees
- `stem_id` - ID value grouping measurements into stems
- `stem_status` - Vital status: alive (a), resprouting (r), dead (d)
- `diam` - Stem diameter (cm)
- `agb` - Estimated aboveground biomass (Mg)

Stem mortality timelines

Sometimes, a stem will appear to have died only to resurrect at a later date. Stems might also be missing stem status values. We can try to fix these issues using the `seosawr::statusImputGen()` function.

```
# Impute mortality status
status_est <- statusImputGen(s)

# Add new columns to stem data
s_sfix <- bind_cols(s, status_est)
```