

**Warnings & disclaimers:** *Currently excluding Richardson2020 study, and I flip between counting papers at the start to looking more at rows, so you were forewarned on that.*

## 1 Current take home results

Out of 37 papers (we have currently 56 rows of data) 20 found evidence for GS x growth (any which way) and 10 found evidence for our definition of GS x growth. Those papers with any evidence are:

```
> sort(unique(eviary$paper_id))

[1] "chen2000"           "cuny2012"
[3] "delpierre2017"      "drew & downes 2018"
[5] "etzold2021"         "finzi2020"
[7] "francon2020"        "gao2022"
[9] "grossiord2022"      "keenan et al 2014"
[11] "mckown2016"         "michelot2012"
[13] "moser2019"          "oddi2022"
[15] "silvestro2023"      "soolananayakanahally2013"
[17] "vitasse2009"        "wheeler2016"
[19] "zhu2021"            "zohner2020"
```

And those papers with evidence of our definition are (side query: how come Zhang2021 is here, but not showing up above?):

```
> sort(unique(eviour$paper_id))

[1] "cuny2012"           "delpierre2017"      "drew & downes 2018"
[4] "grossiord2022"      "mckown2016"         "michelot2012"
[7] "oddi2022"           "silvestro2023"      "vitasse2009"
[10] "zhang2021"
```

and they cover both wood and plant vegetative studies:

```
> table(eviour$gsl)

plant vegetative phenology      satellite derived
                        6                        1
                        wood phenology
                        5
```

Broadening beyond our definition includes studies where GS is not measured, or climate is used instead:

```
> table(eviany$gsl)

not measured plant vegetative phenology
      3      9
satellite derived temperature or snow metric
      2      4
wood phenology
      5
```

I have not checked whether that is different than random, but you can contrast that with the overall suite of GSL metrics and it looks representative to me on quick glance:

```
> table(d$gsl)
```

	date	not measured
	1	10
plant vegetative phenology		satellite derived
	21	4
temperature or snow metric		wood phenology
	7	12

They also cover a pretty wide diversity of growth metrics:

```
> table(eviany$growth) # any definition
```

	annual core cell production (number of cells)
	3
dendrometer/circumference	ecosystem fluxes
	3
height	intra-annual core (xylogeneis)
	5
photosynthesis	root:shoot ratio
	1
stem density	
	1

```
> table(eviour$growth) # our definition
```

cell production (number of cells)	dendrometer/circumference
	1
	2
ecosystem fluxes	height
	1
	4
intra-annual core (xylogeneis)	photosynthesis
	2
	1
root:shoot ratio	
	1

Here's the full set of GS x growth that found it:

```
> table(eviany$gslxgrowth) # any definition
```

not measured x annual core	1
not measured x ecosystem fluxes	1
not measured x intra-annual core (xylogeneis)	1
plant vegetative phenology x ecosystem fluxes	1
plant vegetative phenology x height	5
plant vegetative phenology x intra-annual core (xylogeneis)	1
plant vegetative phenology x photosynthesis	1
plant vegetative phenology x root:shoot ratio	1
satellite derived x ecosystem fluxes	2
temperature or snow metric x annual core	2
temperature or snow metric x ecosystem fluxes	1
temperature or snow metric x stem density	1
wood phenology x cell production (number of cells)	1
wood phenology x dendrometer/circumference	3
wood phenology x intra-annual core (xylogeneis)	1

```
> table(eviour$gslxgrowth) # our definition
```

plant vegetative phenology x height	4
plant vegetative phenology x photosynthesis	1
plant vegetative phenology x root:shoot ratio	1
satellite derived x ecosystem fluxes	1

```

wood phenology x cell production (number of cells)
                                     1
    wood phenology x dendrometer/circumference
                                     2
    wood phenology x intra-annual core (xylogeneis)
                                     2

```

To contrast, here's what studies that did NOT find evidence looked like:

```

> table(noevianygslxgrowth) # any definition
                                     date x annual core
                                     1
    plant vegetative phenology x annual core
                                     3
plant vegetative phenology x annual core (simulated to intraannual)
                                     1
    plant vegetative phenology x biomass
                                     1
    satellite derived x annual core
                                     1
    temperature or snow metric x annual core
                                     1
    temperature or snow metric x dendrometer/circumference
                                     1
    wood phenology x dendrometer/circumference
                                     3
    wood phenology x intra-annual core (xylogeneis)
                                     2

```

```

> table(noeviourgslxgrowth) # our definition
    plant vegetative phenology x NDVI/greenness
                                     1
    plant vegetative phenology x annual core
                                     3
    plant vegetative phenology x biomass
                                     1
    plant vegetative phenology x photosynthesis
                                     1
    satellite derived x photosynthesis
                                     1
    wood phenology x dendrometer/circumference
                                     1
    wood phenology x intra-annual core (xylogeneis)
                                     1

```

## 2 Getting back to writing our paper

*Reminder of what we expected the table we worked on since April to help us with ...*

### 1. Section: Review three reasons for not growing

#### (a) Overview paragraph of three reasons

- i. Measurement – see box/figure (include measurement only here or briefly so we move through it fast)
- ii. Resource limitation
- iii. Constraints

#### (b) Resource limitation, evidence for an against

- i. Nutrients
- ii. Water
- iii. Is this more species-specific?

Table will help us with this

#### (c) Constraints, evidence for an against

- i. Leaf life span
- ii. Budset stuff ... (Zohner, Sool.)
- iii. Evidence across species? Or which is species-specific

Table will help us with this

### 2. What do do next (The future! Is there a framework to our future directions? It would be nice if we found one)

So, we hoped these studies would help with the prevalence of evidence for external and endogenous factors. I haven't got as far on this (and we did not consistently enter whether growth or GSL or both was limiting) but here's a quick look at the 26 papers that found evidence of external factors and 13 that found evidence of endogenous (in contrast to 9 papers that looked but did not find evidence of external or 20 endogenous factors).

For those that did, they looked at these GSL metrics:

```
> table(exoyes$gsl)
```

	date	not measured
	1	7
plant vegetative phenology		satellite derived
	18	1
temperature or snow metric		wood phenology
	5	5

```
> table(endoyes$gsl)
```

This needs a total over-haul after the table; figure out the section headers

not measured	plant vegetative phenology
6	11
satellite derived	wood phenology
1	4

And specifically:

```
> table(exoyes$gs_metric_used)
```

end metric only	6
start metric only	6
start to end	14
start to end (I think for SFGCC)	1
suitable days	1
time with growth estimated (from mar-may temperature records)	1
time with growth observed	2
unsure	2

```
> table(endoyes$gs_metric_used)
```

end metric only	none	start metric only
6	1	3
start to end time with growth observed		unsure
9	1	2

And these growth metrics (seems a bias towards annual core studies looking at external; we have 13 annual core results):

```
> table(exoyes$growth)
```

NDVI/greenness	annual core
2	10
annual core (simulated to intraannual)	biomass
1	2
dendrometer/circumference	ecosystem fluxes
3	4
height	intra-annual core (xylogeneis)
5	3
photosynthesis	root:shoot ratio
6	1

```

                                stem density
                                1
> table(endoyes$growth)

                                NDVI/greenness                                annual core                                biomass
                                1                                1                                2
dendrometer/circumference                                ecosystem fluxes                                growth anomalies
                                4                                4                                1
                                height                                photosynthesis                                root:shoot ratio
                                4                                5                                1

```

### 3 Next steps

1. How to finalize the table cleaning?
  - (a) I would prefer this all documented over github than being done over email
  - (b) Not sure how to resolve Richardson study
  - (c) And there are likely more ....
2. How do we want to analyze the table?
  - (a) One idea is to break out what parts of the paper people are working on and then they do their own analysis – but built off one set of shared cleaning code or such.
  - (b) Work on analysis using the table is centralized in one person
3. Do we want to make a figure that reviews the path diagram from GSL to growth and somehow summarizes what we have found?
4. Do we want to re-analyze any of the studies that have the data but did not test our definition? (Dow2022, Finzi2020, Stridbeck2022, zani2020, chen1998, ren2019)
5. What else?