

Coexistence and climate change:
The role of temporal-variability in structuring future
communities
Updating To Do List from Skype Meetings

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Contents

1	Skype Meeting - August 24, 2014	2
2	Megan: September 8 and 15, 2014	2
3	Megan: September 22, 2014	4
4	Megan: September 29, 2014	4
5	Megan Lizzie meeting: Oct 8, 2014	4

1 Skype Meeting - August 24, 2014

- Running PhenologyModel.R does not produce coexistence even with two species set with the same parameters as Chesson et al 2004. In Chesson et al 2004, species' biomasses bounce around 0.2. Our sims drop to very low numbers by year 30. Why?
- Previous sims which stepped thru within year dynamics resulted in coexistence
- Tried: decreasing extinction threshold to 1/100000 from 1/10000. This does increase persistence (obviously) but does not change the pattern of species bouncing at very low densities
- Tried: increasing the within-season time to 8 days from 5 days. I did this because the in some years it wasn't clear from the plots (I did not check the numerics) that the species had reached max biomass. Not clear that this had any effect.
- Compared to Chesson: there are a few details of the simulation that aren't clearly laid out in Chesson et al 2004. Particularly, it isn't clear when "flowering" occurs. That is, when is the end of the season? we take the max biomass of each species, but could have a set flowering time for both species (say, when $R_i R^*$). However, I think we have made a reasonable choice here and that, while it might result in differences with Chesson et al 2004, it should not result in the problem at hand.
- Things to look at: what does R-uptake look like within a season? Does it match the patters in Fig 2 of Chesson et al 2004?
- : To do: when preparing for ASN, I changed the within-year simulation from a for-loop to an ode solver. I did this because the within-season step size needed to be adjusted for differences in initial biomass and resource level: if step size was small enough to catch the crossing of the R^* threshold, then it took forever the rest of the season. However, I never completed the comparison of the ode solver and the within year for-loop. That is the next task

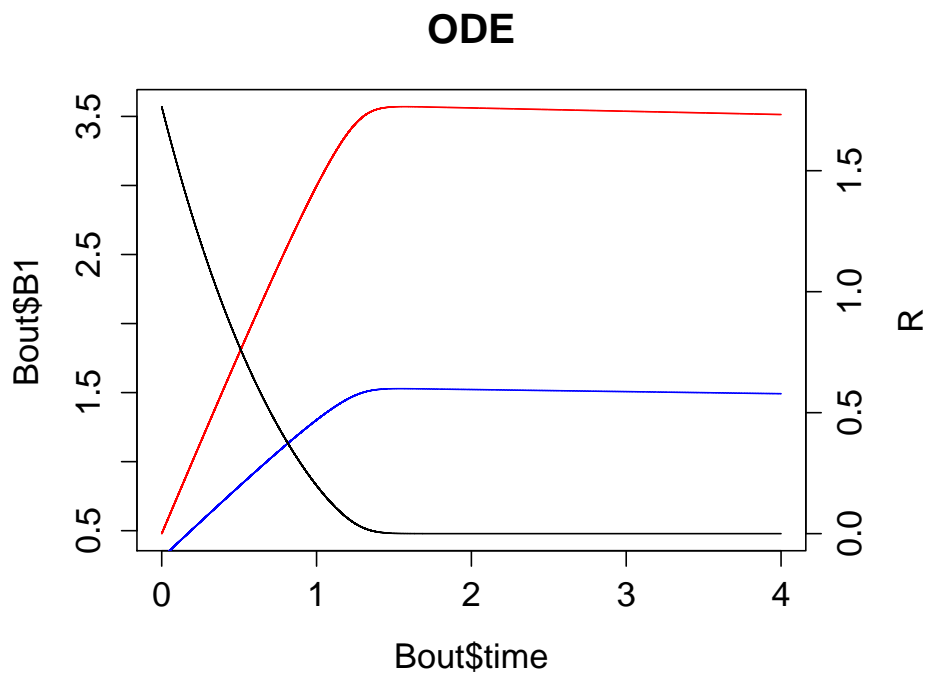


Figure 1: Compare ODE and StepStep solutions to our equations

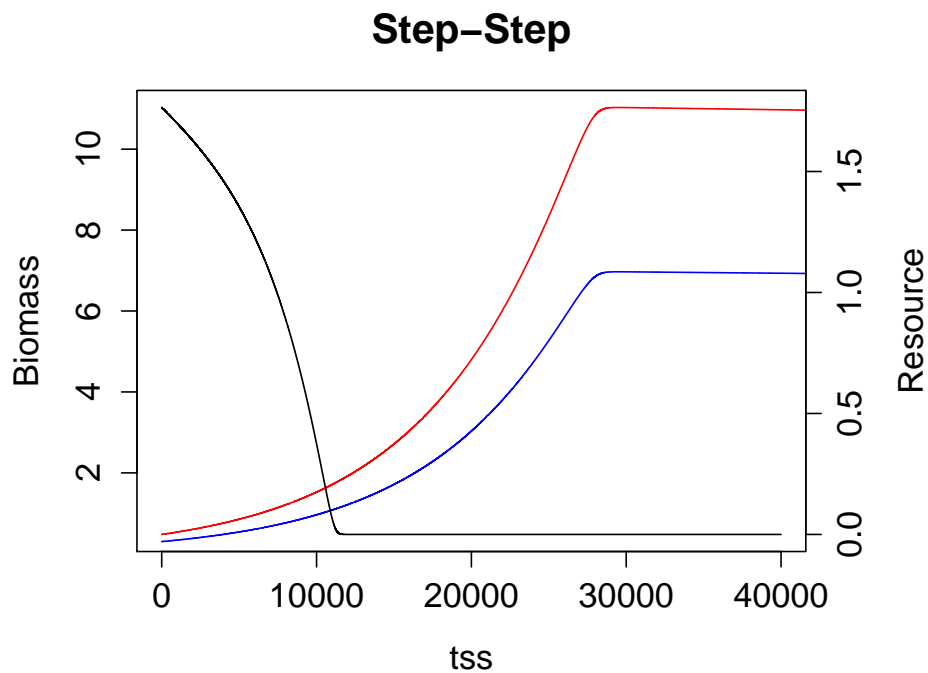


Figure 2: Compare ODE and StepStep solutions to our equations

2 Megan: September 8 and 15, 2014

- Step-step solution is clearly incorrect: the resource does not decline exponentially, as it should, and there is no apparent relationship between the decline of resources and

the biomass of competing plants

- The ODE solution appears to be correct.
- Re-running the Nov 6, 2013 code that Lizzie dug up shows that in that simulation which we thought was working, resources do not decline exponentially. The Biomasses do stop rising abruptly when R reaches R^* , but that is because the loop is forced to end when $R \leq \min(R^*)$. The ODE solution does not end when $R \leq R^*$.
- NEXT STEPS:
- solve for long-term equilibrium solution for fixed value of R and g – where do we expect the equilibrium to be?
-

3 Megan: September 22, 2014

- Within year dynamics: with the current model runs, the only thing that changes from year to year are the initial conditions. The equations describing the within year dynamics are exactly the same - including the constants. The *only* differences are R_0 (initial condition for resources) and τ_{I1} and τ_{P1} , which determine the germination fraction and, therefore, B_0 for each species.
- essentially, create a map showing the end-of-year biomass of species 1 as a function of beginning of year biomass for species 1, beginning of year biomass for sp2, and R_0 (this is what the ODE solver does each time)
- then the question is simply: how do we get a long-run positive average of B_{out}/B_{in} for each species?

4 Megan: September 29, 2014

- So, create two 3 dimensional matrix with axes: initial biomass for sp1, initial biomass for sp2, and R_0 . Fill one with final biomass for sp 1 and fill the other with final biomass for sp2.
- Need to figure out how to make ode solver stop when R reaches R_{star} . Runs would be much faster if I could get that to work

5 Megan Lizzie meeting: Oct 8, 2014

- need to run within year dynamics longer for higher resource levels: the reason $R_0 = -4$ is parallel is because we aren't actually seeing competitive dynamics yet
- also plot $(B_{1In}/B_{1out})/(B_{2In}/B_{2Out})$

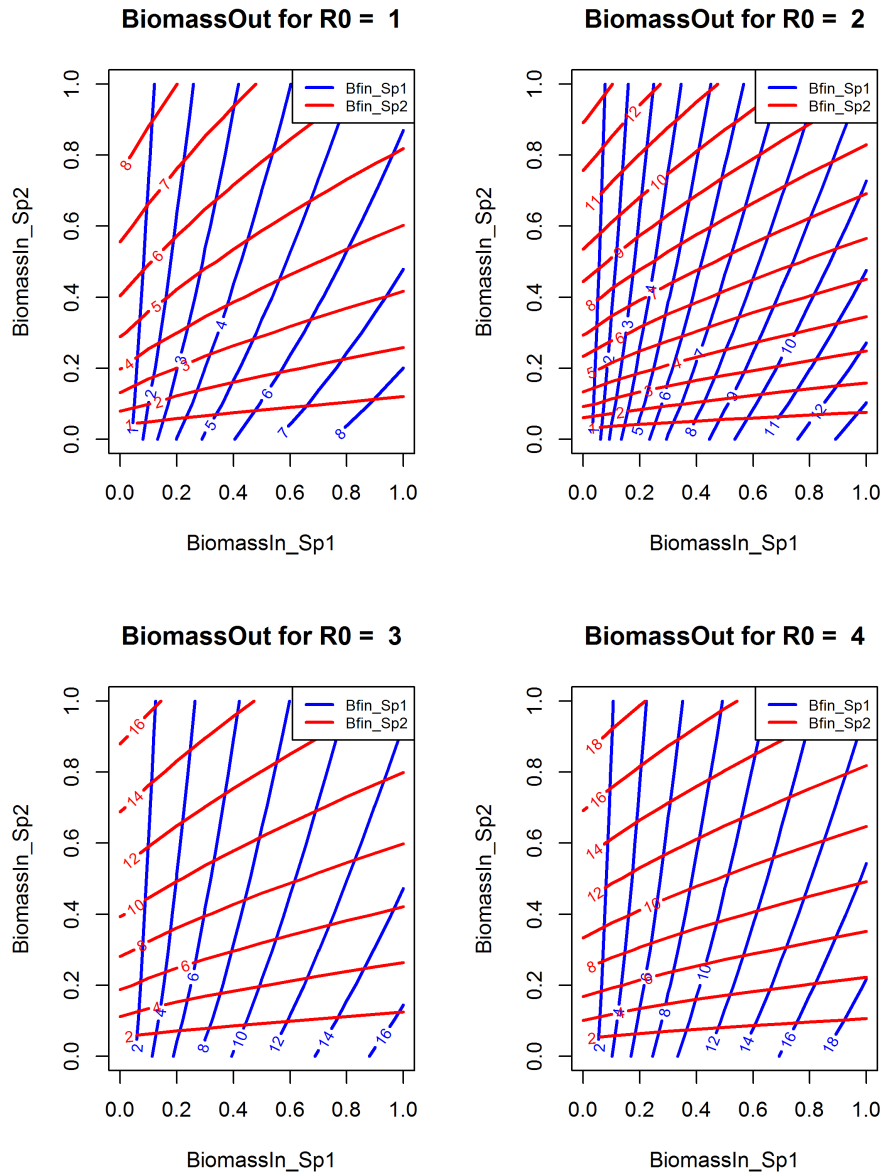


Figure 3: Contour plots of Biomass Out of Sp 1 (blue) and Sp 2 (Red) for BiomassIn of Sp1 (x-axis) and Sp2 (y-axis) at different levels of R_0

- figure out how to break ODE solver when $R = R_{star}$
- does it make sense to convert things to log scale to look at multiplicative rates of increase