Supplemental materials: How environmental tracking shapes communities in stationary & non-stationary systems

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1 Literature review

We systematically reviewed the literature for studies examining tracking and other traits. We searched ISI in August 2019 for:

1. Topic: 'phenolog* chang*' and Title: phenolog* AND trait*
2. Topic: 'warming shift*' AND trait* and Title: phenolog*
3. Topic: 'phenolog* track*' AND trait* and Title: phenolog*
4. Topic: 'phenolog* sensitiv*' AND trait* and Title: phenolog*

which resulted in 176 papers. From here we used the following criteria to determine from which papers we could not extract data: no phenology or phenological change measured (58 papers), no trait(s) measured or analyzed (44 papers), single-species studies focused on intra-specific variation (32 papers), modeling or theory studies without data (8 papers), or papers without new data presented (reviews, etc.: 4 papers), or miscellaneous reasons (1 paper measured a phenological response to grazing, while another ... XX). This left us with only 27 papers including relevant data.

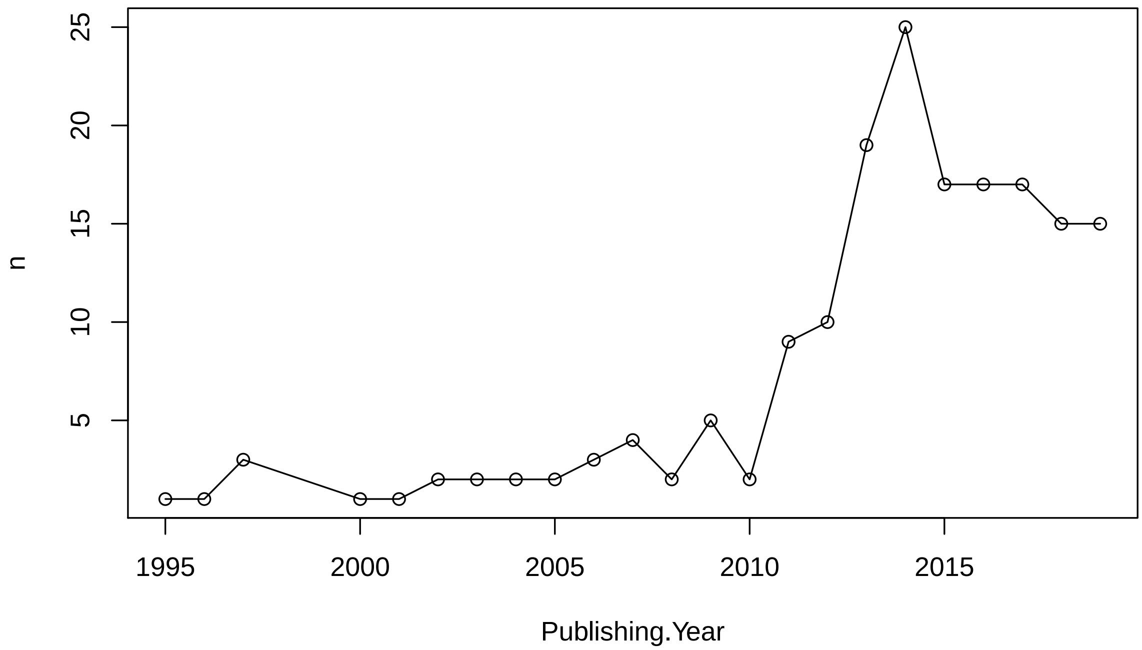

Figure 1: Trends in all papers using search terms over time. Of papers from which we could extract data all were published in 2016 or onward.

2 Model

2.1 Dimensional analysis

3 Model runs

Analyses: Ran XX models ...

Table 1: Table of parameter values, their definitions and lightweight version of their dimensions (i.e., not yet deemed 'grams' or such).

Parameter	Definition	Unit
N_i	seedbank of species i	seeds
s_i	survival of species i	unitless
δ (peak biomass)	total length of growing season	days
B_i	biomass of species i	biomass
R	resource	resource
c_i	conversion of R uptake to biomass of species i	$\frac{\text{biomass}}{\text{resource}}$
m_i	maintenance costs of species i	days^{-1}
a_i	uptake increase as R increases for species i	days^{-1}
u_i	max uptake for species i	$\frac{\text{(days)(biomass)}}{\text{resource}}$
ϕ_i	converesion of biomass to seedbank for species, includes overwintering of seeds i	biomass^{-1}, but conceptually $\frac{\text{seeds}}{\text{(biomass)(seeds)}}$
ϵ	abiotic loss of R	days^{-1}
$g_{max,i}$	max germination of species i	unitless
h_i	controls the the rate at which germination declines as τ_p deviates from optimum for species i	days^{-2}
g_i	germination fraction	unitless
τ_p	timing of pulse	days
τ_i	timing of max germination of species i	days
α_i	phenological tracking of species i	unitless
θ_i	shape of uptake for species i	unitless
b_i	seedling biomass of species i	$\frac{\text{biomass}}{\text{seeds}}$
$f_i(R)$	R uptake $f(x)$ for species i	$\frac{\text{resource}}{\text{(days)(biomass)}}$
d_i	death rate of species i, used in calculations of lifespan	unitless
t	between year time (formerly T)	years
$0 \rightarrow \delta$	within season time (formerly τ)	days
b_0	initial biomass per germinant (seed)	biomass
ξ	$\frac{\text{final biomass}}{\text{initial biomass}}$	unitless