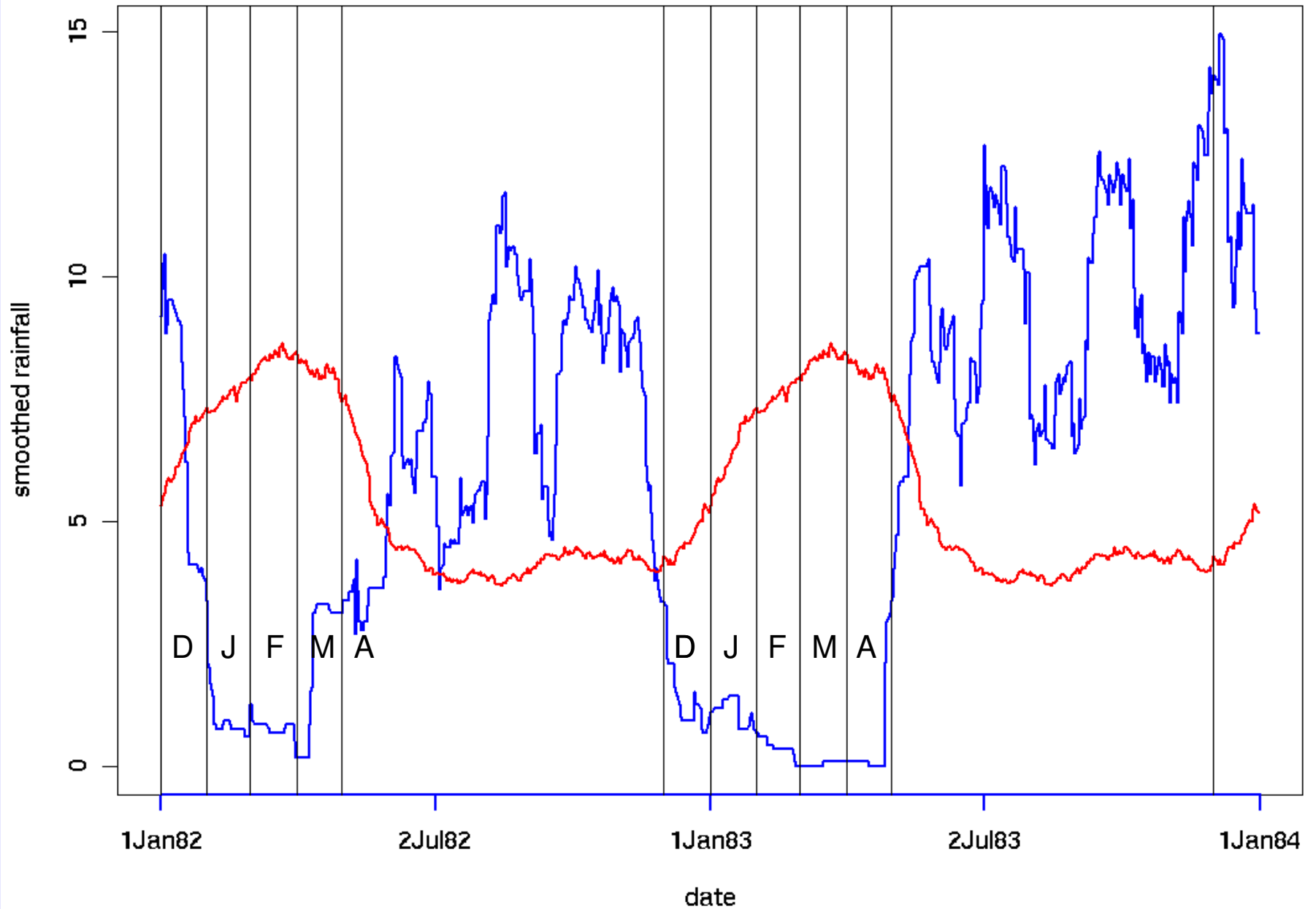


Tropical forest changes and climatic drivers

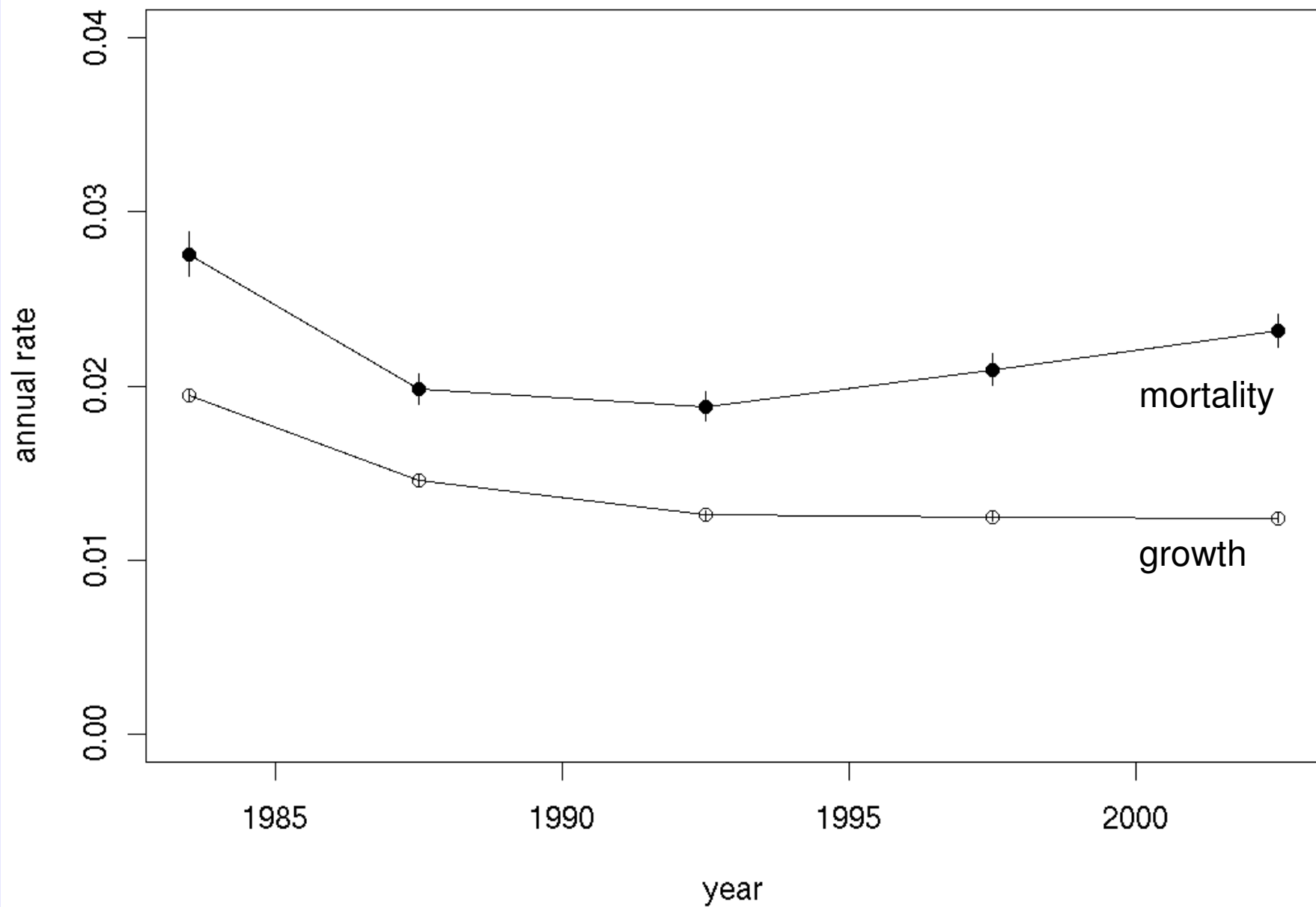
Nordforsk PhD Summer School
July-August 2008

Richard Condit
Sue & Bill Laurance
Simon Lewis

unusually severe 1983 dry season

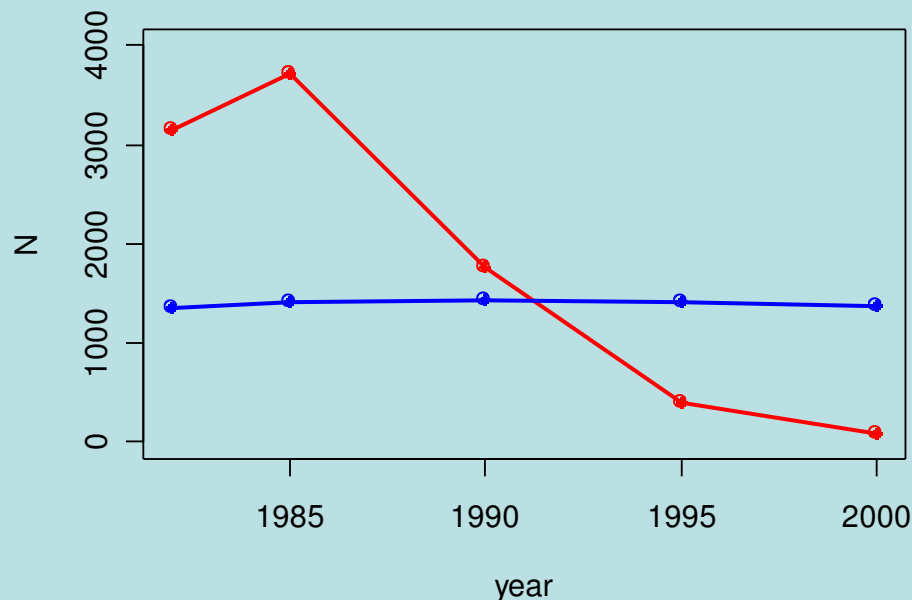


Fluctuations in Barro Colorado tree demography



Are tree populations stable through time?

- Determine how much a population would change under random drift (random mortality and recruitment)
- Estimate a community-wide distribution of rates of population change as a measure of forest stability (correcting for random change)
- Compare stability of different forests
- Compare stability of rare and common species

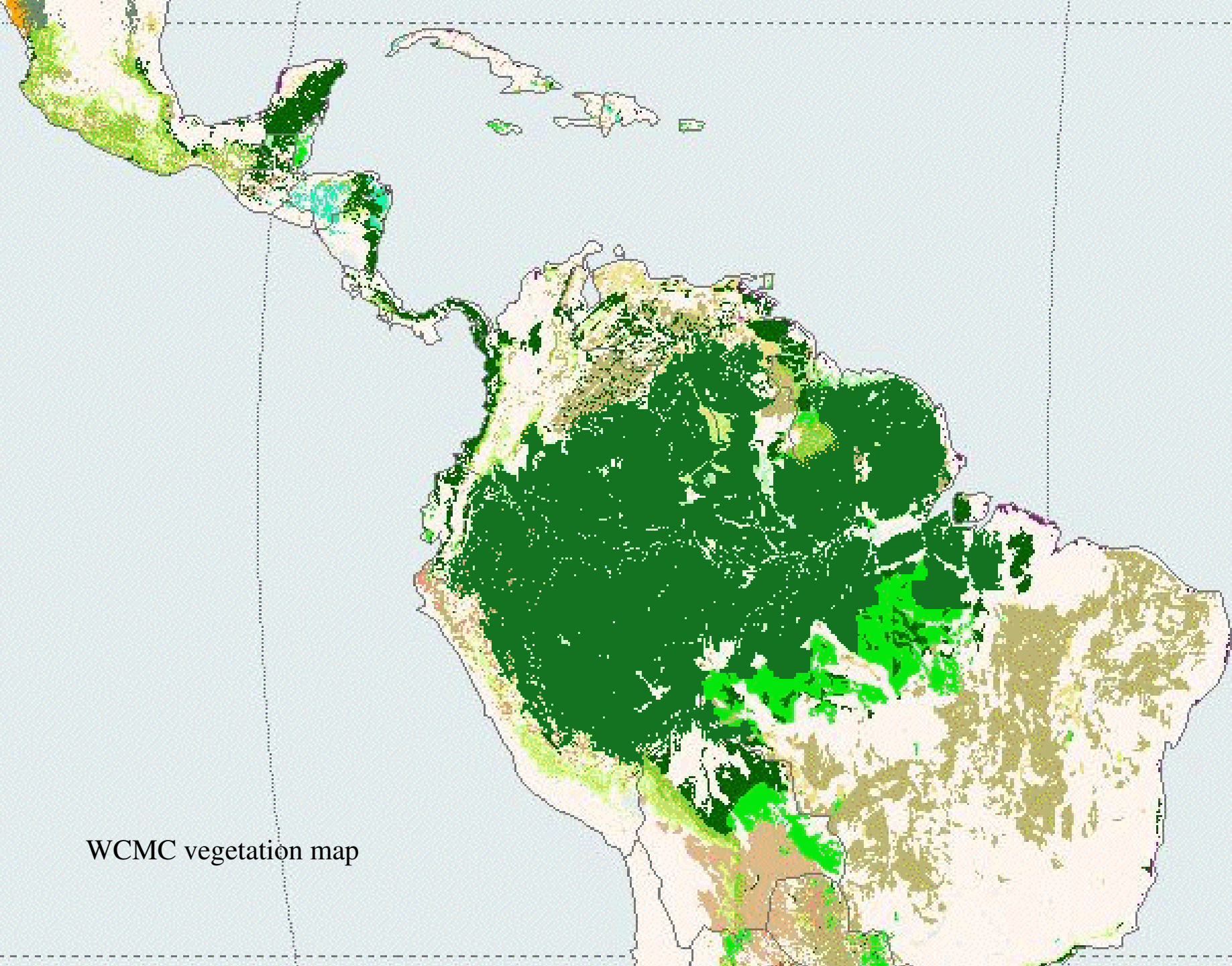


Prioria copaifera, BCI

$\lambda = 1.001$

Piper cordulatum, BCI

$\lambda = 0.819$



WCMC vegetation map

Increasing mortality and biomass in Amazon forests?

Lewis, S.L., Malhi, Y., Phillips, O.L. 2004. Fingerprinting the impacts of global change on tropical forests. *Phil. Trans. R. Soc. Lond. B* (2004) 359, 437–462.



Tree mortality rates

Susan G. W. Laurance

Henrique Nascimento

William Laurance

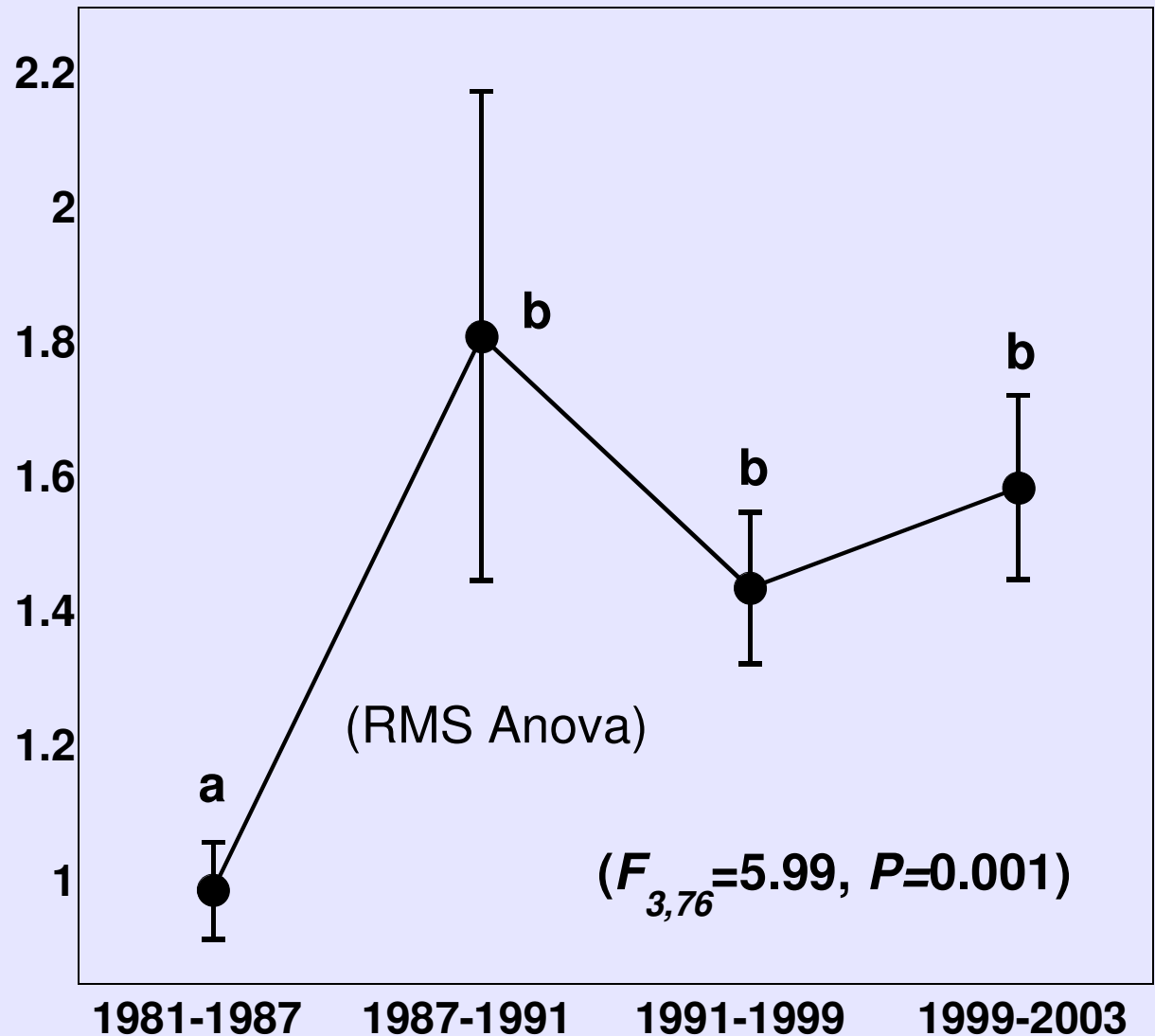
Ana Andrade

Phillip Fearnside,

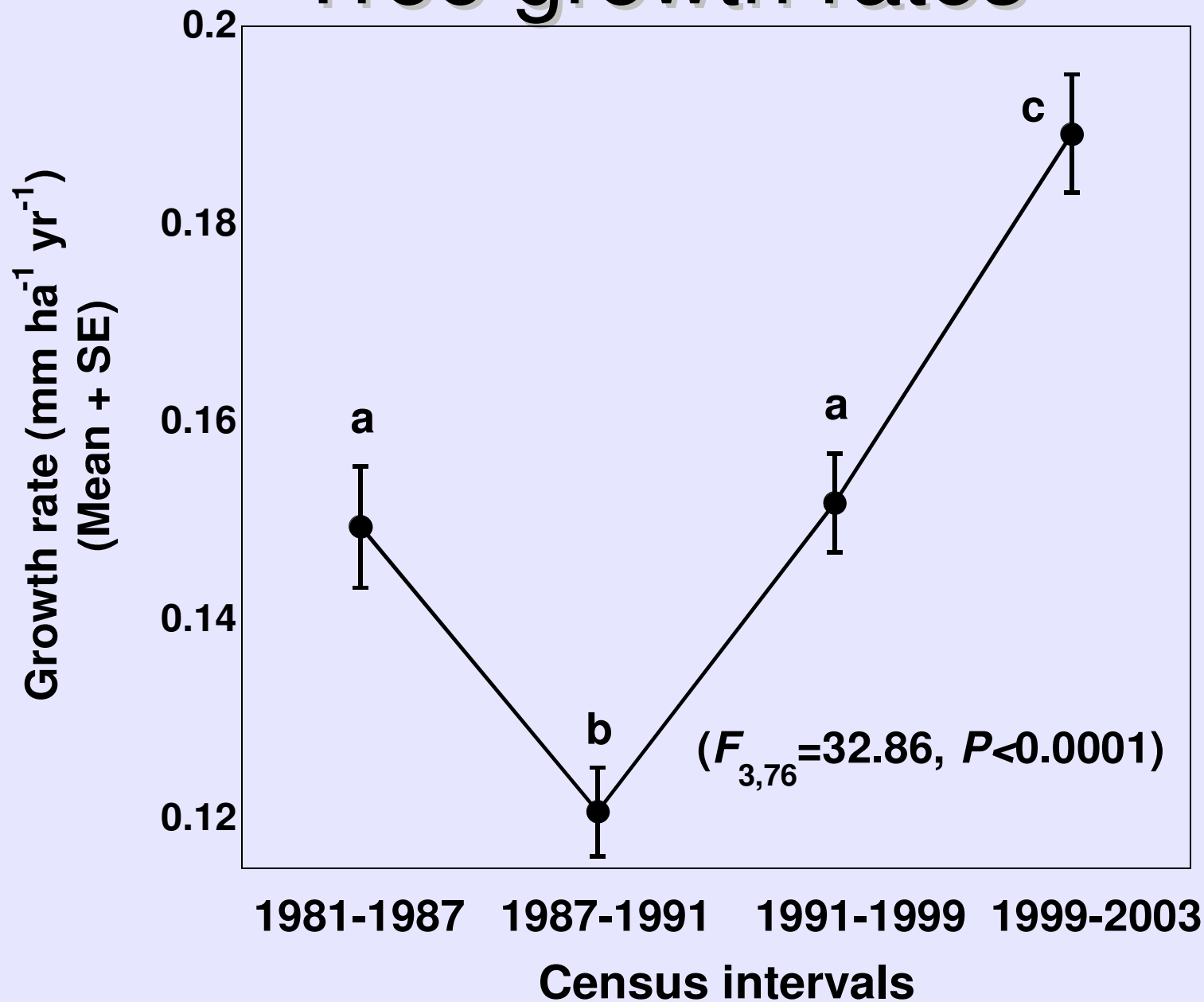
Expedito Rebelo,

Richard Condit

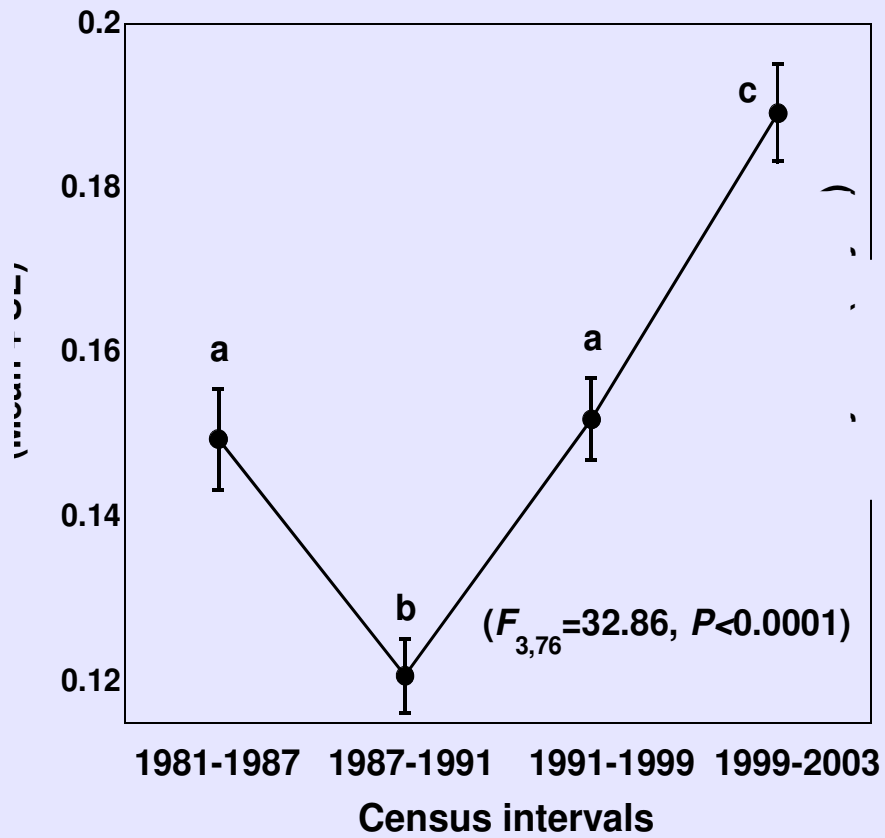
Mortality rate (% yr⁻¹)
(Mean ± SE)



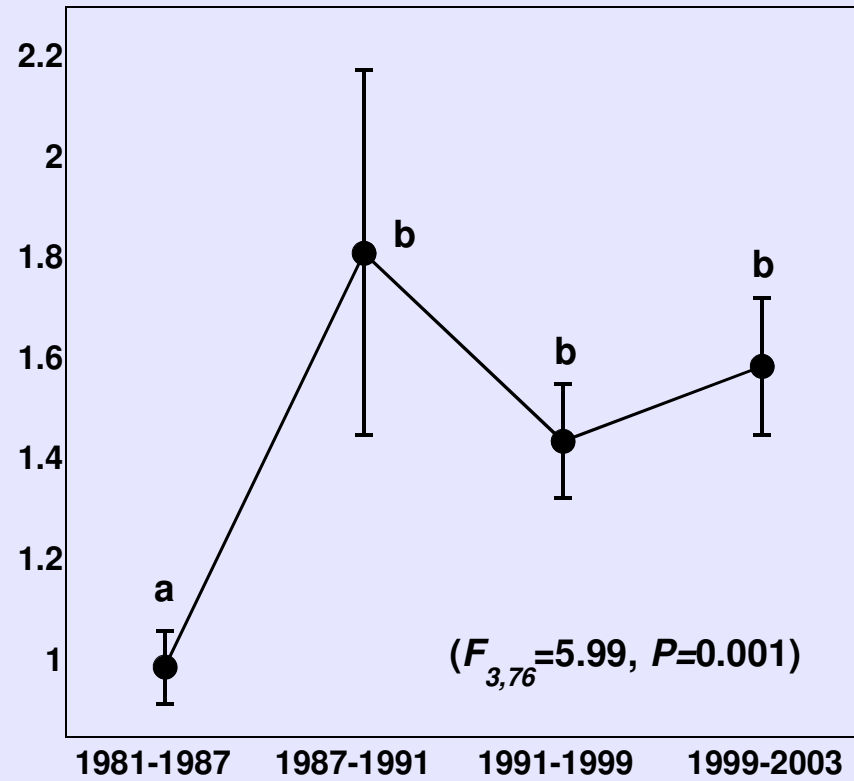
Tree growth rates



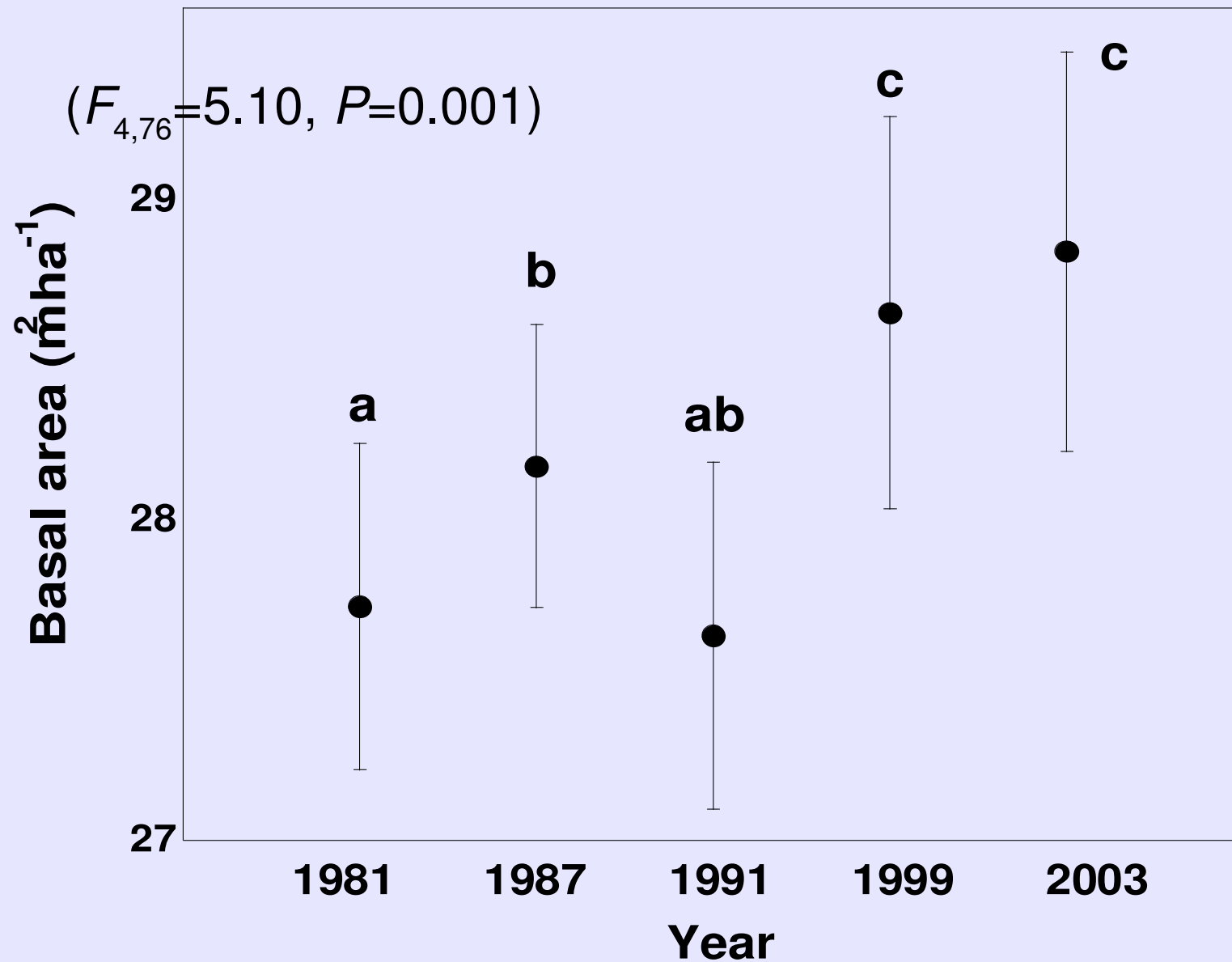
growth



mortality

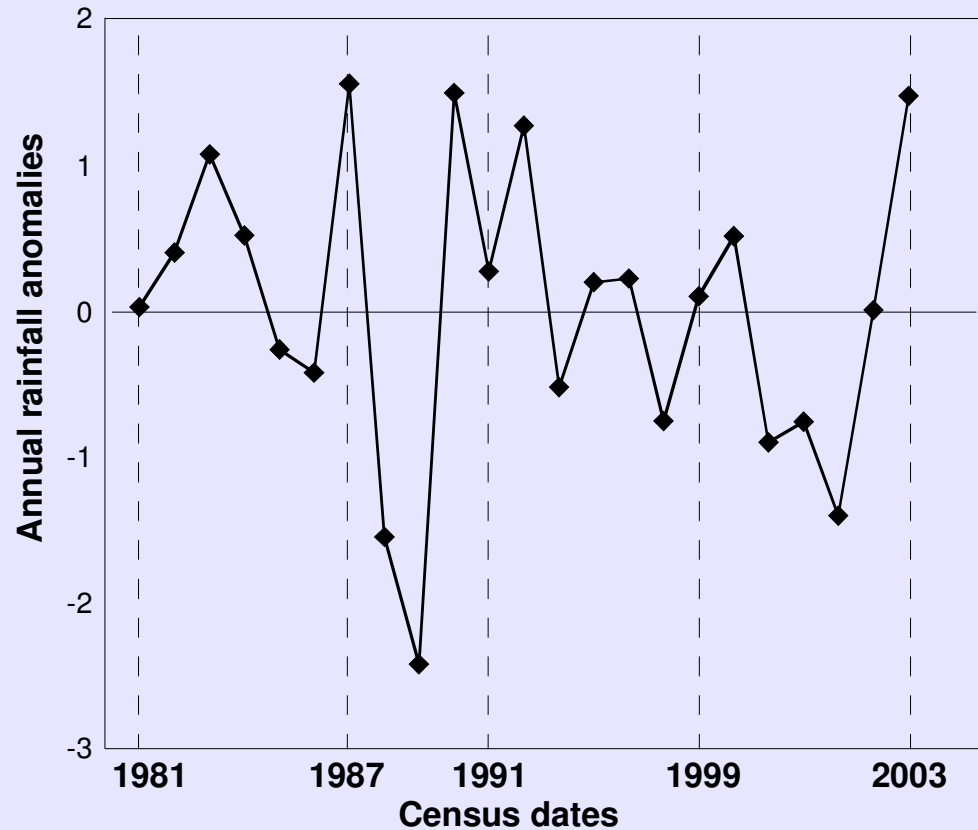


Basal area

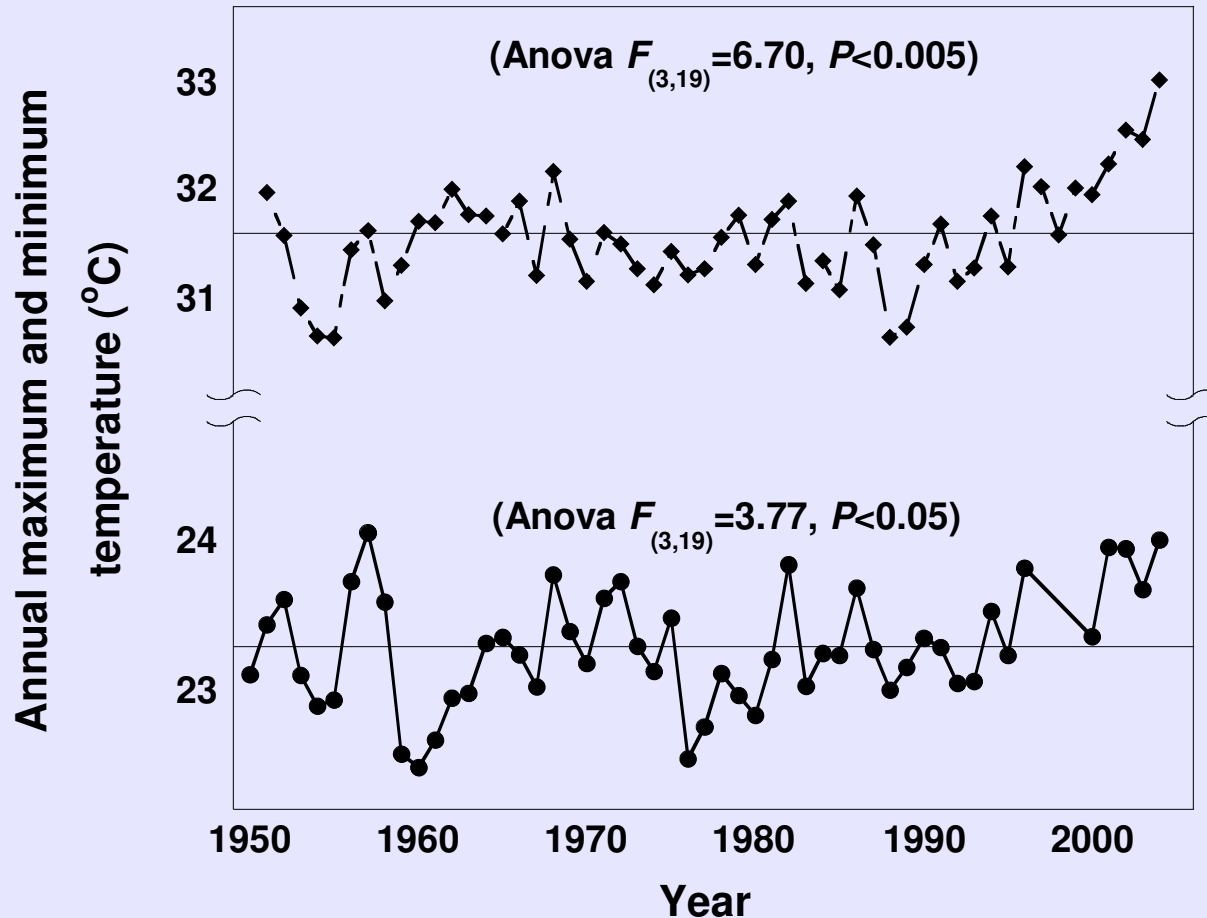


Climate factors: annual & unusual rainfall

Census interval 2
experiences
significantly more
unusual rainfall
compared to intervals
1,3,& 4
(ANOVA $F_{(3,19)}=7.44$,
 $P<0.002$)



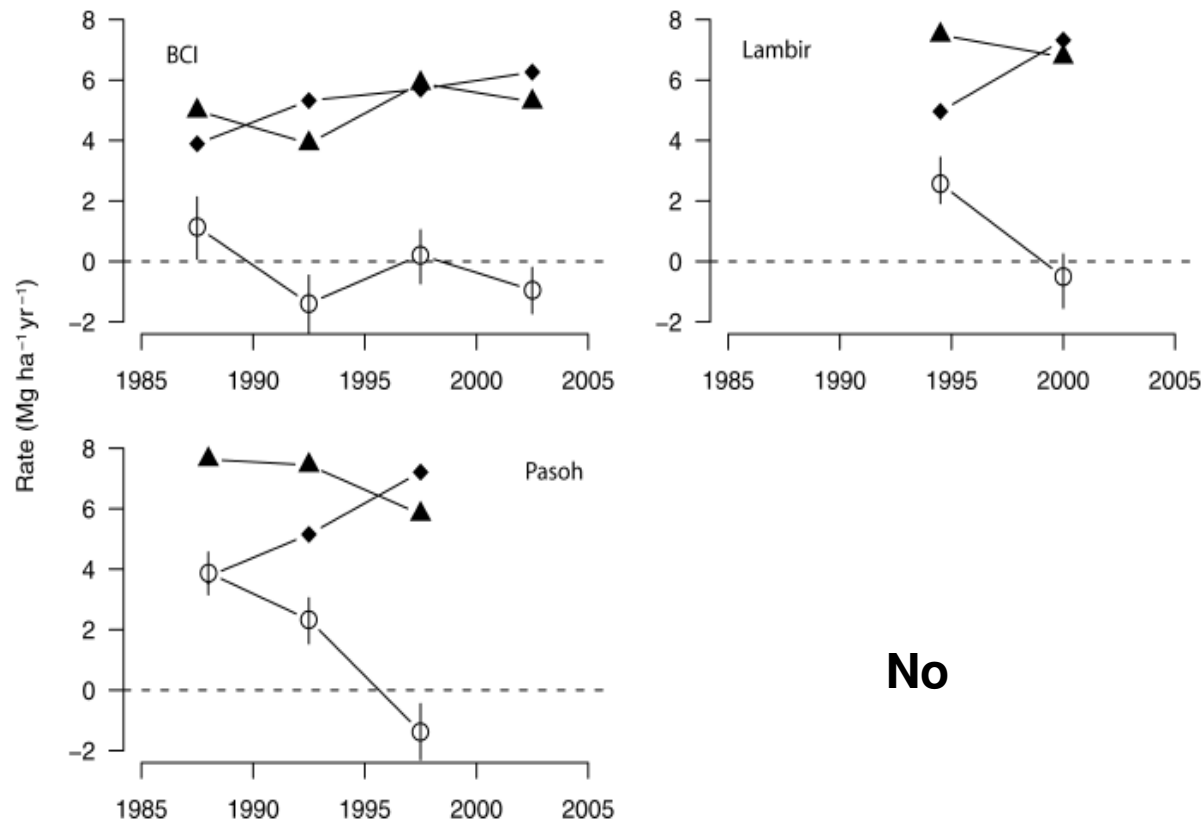
Climate factors: temperature



Significantly
higher
temperatures
in the 4th
census interval
compared to
other census
intervals

Increase in biomass productivity?

▲ growth
◆ mortality
○ net



No

Chave et al. PLoS
Biol (2008)

Increase in fast-growing species?

Table 1. Stocks and Changes in Total Aboveground Biomass (AGB) and across Growth Groups for Ten Undisturbed Tropical Forest Plots

Site	AGB Mg ha ⁻¹	Growth Rate in Mg ha ⁻¹ y ⁻¹	Recruitment Rate in Mg ha ⁻¹ y ⁻¹	Loss Rate in Mg ha ⁻¹ y ⁻¹	Net Biomass Change		Fast-Growing Group Change	Slow-Growing Group Change
					in Mg ha ⁻¹ y ⁻¹	in % y ⁻¹	in % y ⁻¹	in % y ⁻¹
BCI	306.5	5.01	0.033	5.29	-0.25 [-1.20,0.63]	-0.08 [-0.39,0.21]	0.27 [-0.39,0.88]	0.16 [-0.49,0.71]
Edoro	397.7	6.65	0.015	6.42	0.24 [-1.22,1.82]	0.06 [-0.31,0.46]	-0.06 [-1.13,0.84]	0.12 [-0.74,0.97]
Lenda	541.6	5.78	0.016	4.36	1.44 [0.17,2.63]	0.27 [0.03,0.49]	0.53 [-0.63,1.56]	0.37 [0.10,0.63]
HKK	211.2	3.56	0.058	3.85	-0.24 [-0.71,0.24]	-0.11 [-0.34,0.11]	-0.23 [-0.65,0.15]	0.18 [-0.55,0.69]
La Planada	177.6	4.75	0.091	3.57	1.27 [0.92,1.58]	0.72 [0.52,0.89]	0.37 [-0.18,0.92]	1.44 [1.11,1.74]
Lambir	497.2	7.13	0.041	6.14	1.03 [0.19,1.84]	0.21 [0.04,0.37]	0.16 [-0.25,0.51]	0.36 [0.10,0.58]
Palanan	290.1	4.80	0.102	4.69	0.21 [-1.24,1.53]	0.07 [-0.43,0.53]	0.36 [-0.48,1.14]	0.77 [0.22,1.24]
Pasoh	339.8	6.96	0.024	5.37	1.61 [0.80,2.39]	0.47 [0.24,0.70]	-0.16 [-0.82,0.43]	0.91 [0.61,1.19]
Sinharaja	357.9	7.40	0.028	8.41	-0.98 [-2.48,0.40]	-0.27 [-0.69,0.11]	1.73 [0.81,2.70]	-2.44 [-3.55,-1.47]
Yasuni	282.4	6.76	0.050	6.22	0.38 [-0.47,1.25]	0.13 [-0.17,0.44]	0.31 [-0.25,0.84]	0.20 [-0.43,0.64]
Average	340.3	5.87	0.046	5.44	0.47 [0.14,0.79]	0.15 [0.05,0.24]	0.33 [0.09,0.55]	0.21 [0.02,0.37]
Average (excluding Sinharaja)	338.4	5.70	0.050	5.11	0.63 [0.30,0.96]	0.19 [0.09,0.29]	0.17 [-0.08,0.40]	0.50 [0.32,0.65]
Luquillo ^a	276.09	6.65	0.080	10.78	-3.95 [-5.61,-2.92]	-1.43 [-2.03,-1.06]	-2.39 [-3.99,-0.61]	0.69 [0.17,1.26]
Mudumalai ^a	174.23	2.74	0.013	1.51	1.26 [0.97,1.49]	0.72 [0.55,0.86]	0.65 [0.40,0.90]	1.37 [0.77,1.98]

No, but an increase in slow-growing species

Tree-ring records and forest change

Scots pine in N. Finland

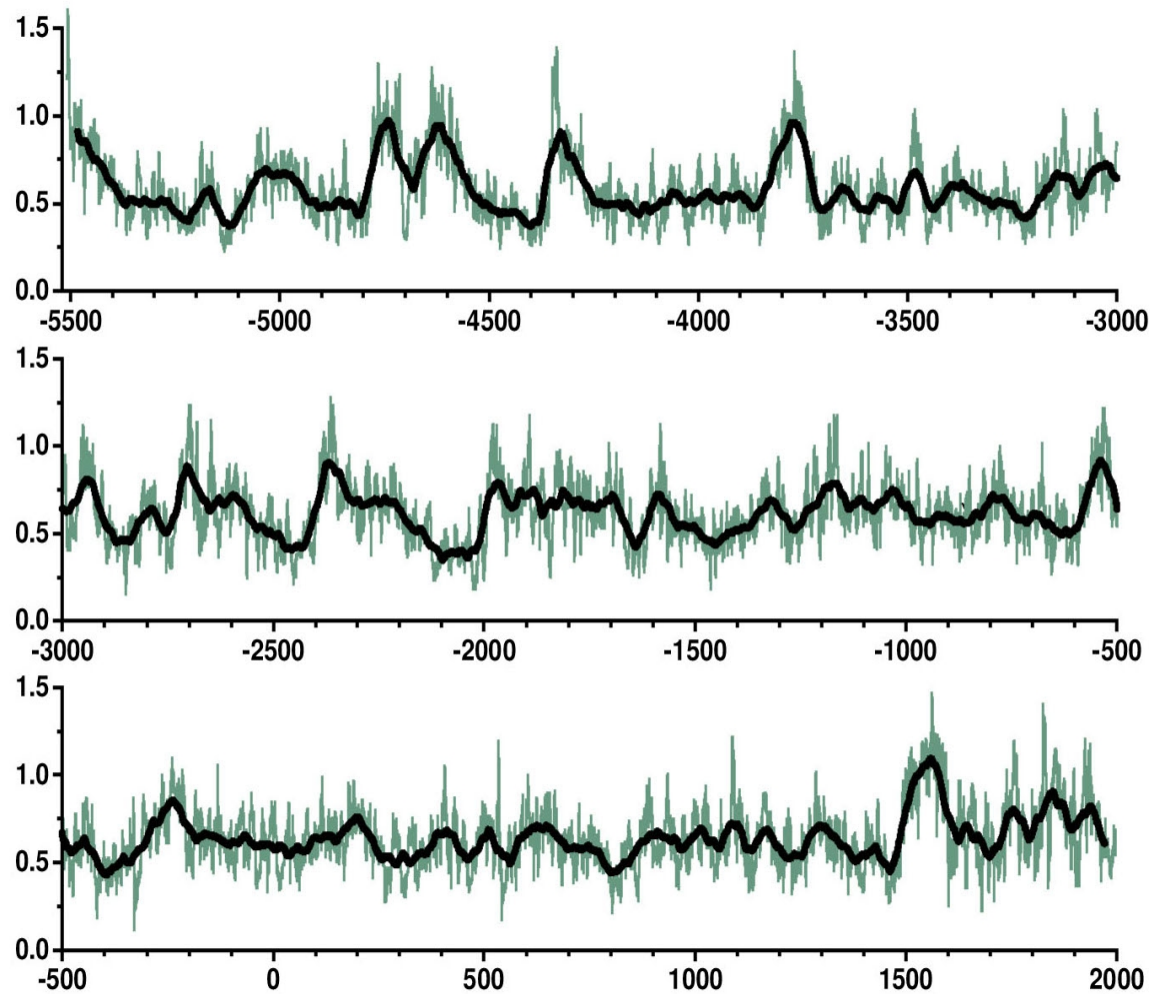


Figure 6 The mean raw data 7519-year Finnish Lapland pine tree-ring chronology, extending back to 5520 BC. The average ring width remains surprisingly constant at about 0.6 mm yr^{-1} throughout the whole length of the chronology. The thin line indicates annual ring-width variability (in mm) and the bold line 50-year running means.