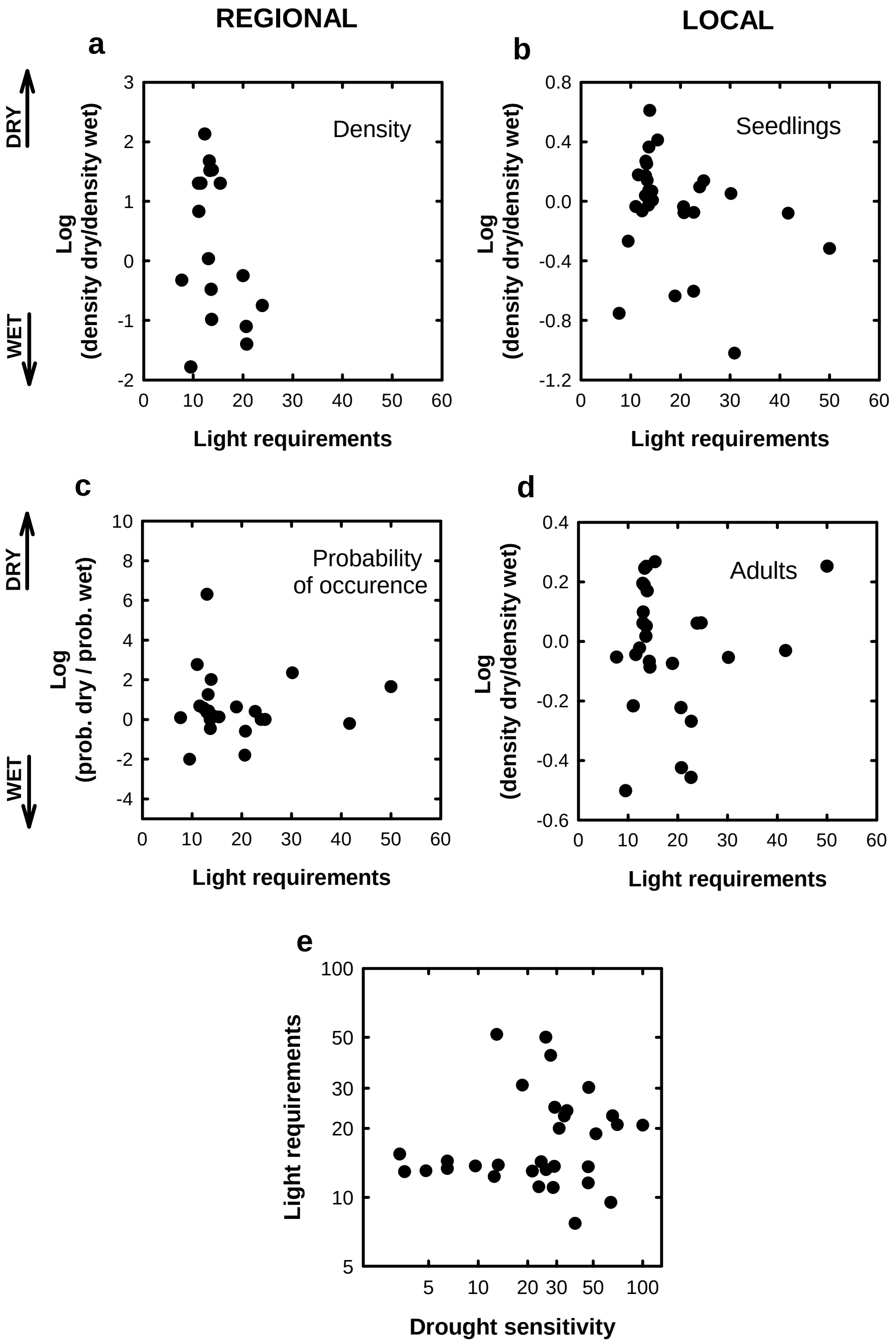
Supplementary Information:

Supplementary Table 1. **List of the 48 focal species from 29 families, with their drought sensitivity and local distribution. a**, The drought sensitivity index is the relative survival difference of first year seedlings in a dry vs. an irrigated treatment in the understorey of a semideciduous tropical forest in Central Panama, adjusted for differences between years. Survival and sample sizes, p-values for Fisher's exact test for treatment differences within species, as well as the year the species was studied, are given. **b**, Species densities (individuals/ha) in plateau sites and slopes for adults (≥1 cm dbh[27]) and seedlings (20 cm tall to 1 cm dbh[28]) in the 50 ha Forest Dynamics Plots on BCI, Central Panama. Species with less than 10 seedlings or adults in the focal habitats were excluded from the analysis.

		(a) Drought sensitivity[2]							(b) Local species distributions			
			dry		wet				adults		seedlings	
species	Family[1]	Drought sensitivity index	% survival	n	% survival	n	P[3]	year	density plateaus	density slopes	density plateaus	density slopes
Alibertia edulis	Rubia	26.54	76	29	97	28	***0.0517***	2003	8.07	5.22	36.17	20.23
Anaxagorea panamensis	Annona	19.58	87	30	100	30	n.s.	2003	2.37	49.37	9.65	101.13
Andira inermis	Faboid	31.03	41	29	60	29	n.s.	2001				
Beilschmiedia pendula	Laura	100.00	0	30	53	30	**<0.0001***	2001	47.69	79.59	2915.59	3175.57
Brosimum alicastrum	Mora	13.84	93	30	100	30	n.s.	2003	18.20	19.15	179.26	208.33
Brosimum utile	Mora	59.71	40	30	100	30	**<0.0001***	2003				
Calophyllum longifolium	Clusia	70.00	33	30	83	30	**0.0002***	2003	14.53	38.61	127.01	151.70
Capparis frondosa	Brassica	8.11	100	30	100	30	n.s.	2003	61.04	74.53	860.13	847.49
Casearia arguta	Flacourtia	14.15	90	29	93	30	n.s.	2003				
Cordia alliodora	Boragina	25.77	60	30	79	30	n.s.	2003	2.41	1.34	32.15	66.75
Crossopetalum parviflorum	Celastra	19.58	87	30	100	29	n.s.	2003				
Cupania sylvatica	Sapinda	13.24	84	31	97	29	n.s.	2001	27.12	18.35	32.96	8.09
Dipteryx panamensis	Faboid	0.00	73	30	73	30	n.s.	2001	1.14	1.03	21.70	28.32
Faramea occidentalis	Rubia	8.11	100	30	100	30	n.s.	2003	614.68	349.21	1771.70	1282.36
Garcinia intermedia	Clusia	1.67	100	30	100	30	n.s.	2003	96.23	73.66	261.25	200.24
Guapira standleyana	Nyctagina	13.84	93	30	93	30	n.s.	2003	4.40	2.85	17.68	8.09
Guarea guidonia	Melia	64.34	33	27	100	30	**<0.0001***	2003	31.14	57.75	132.64	157.77
Herrania purpurea	Malva	46.66	53	30	97	30	**0.0002***	2003	10.47	11.87	13.67	12.14
Hybanthus prunifolius	Viola	21.34	77	30	100	26	**0.0105**	2003	764.91	663.92	1888.26	1274.27
Hymenaea courbaril	Caesal	21.74	60	30	77	30	n.s.	2001				
Inga cocleensis[4]	Mimos	14.25	87	30	97	30	n.s.	2003				
Inga multijuga[4]	Mimos	4.17	77	30	83	30	n.s.	2001				
Inga sapindoides	Mimos	28.18	77	30	100	29	**0.0105**	2003	6.04	6.49	18.49	22.25
Lacistema aggregatum	Lacistemata	46.67	53	30	100	30	**<0.0001***	2001	34.81	33.47	125.40	133.50

Lacmellea panamensis	Apocyna	13.33	87	30	100	30	n.s.	2001	2.09	1.42	16.88	22.25
Licania platypus	Chrysobalana	33.33	60	30	90	30	**0.0153**	2001	4.37	12.50	4.02	16.18
Mouriri myrtilloides	Melastomata	11.08	93	30	97	30	n.s.	2003	165.95	92.88	1410.77	610.84
Myrcia gatunensis	Myrta	38.89	60	30	97	30	**0.0011***	2003	0.98	1.11	3.22	18.20
Ouratea lucens	Ochna	3.33	97	30	100	30	n.s.	2001	28.70	15.51	192.93	74.84
Picramnia latifolia	Simarouba	28.57	67	30	93	30	**0.0211**	2001	19.30	31.80	130.23	141.59
Piper trigonum	Pipera	82.14	17	30	93	30	**<0.0001***	2001				
Posoqueria latifolia	Rubia	10.98	97	30	100	30	n.s.	2003				
Pouteria unilocularis	Sapota	34.62	57	30	87	30	**0.0204**	2001	33.86	29.43	897.11	720.06
Pseudobombax septenatum	Malva	11.11	80	30	90	30	n.s.	2001				
Psidium friedrichsthalianum	Myrta	87.66	15	27	60	30	**0.0009***	2003				
Psychotria horizontalis	Rubia	3.57	93	30	97	30	n.s	2003	99.34	63.45	542.60	497.57
Pterocarpus rohrii	Fabiod	29.17	71	24	100	30	**0.0035***	2001	34.34	29.75	30.55	22.25
Sorocea affinis	Mora	46.67	53	30	100	30	**<0.0001***	2001	62.06	68.75	179.26	119.34
Swartzia simplex	Fabiod	4.81	96	27	96	26	n.s.	2003	116.04	92.56	710.61	382.28
Tabebuia rosea	Bignona	51.98	43	30	93	30	**<0.0001**	2003	4.34	5.14	14.47	62.70
Tetragastris panamensis	Bursera	29.53	70	30	90	28	n.s.	2003	88.89	78.96	875.40	742.31
Thevetia ahouai	Apocyna	23.37	69	29	90	30	***0.0575***	2001				
Trichilia tuberculata	Melia	24.14	76	29	100	30	**0.0046***	2001	235.66	275.08	722.67	618.93
Unonopsis panamensis	Annona	73.35	23	30	97	30	**<0.0001***	2003				
Virola surinamensis	Myristica	85.82	10	30	90	30	**<0.0001***	2003	3.16	9.10	8.04	14.16
Vochysia ferruginea	Vochysia	63.31	30	30	87	30	**<0.0001***	2003				
Xylopia macrantha	Annona	64.00	36	25	100	30	**<0.0001***	2001	15.51	49.21	57.88	107.20
Xylosma chlorantha	Flacourtia	24.00	80	25	100	30	**0.0204**	2001				
2001 data for species tested in 2001 *and* 2003:												
Calophyllum longifolium			20	30	100	30	**<0.0001**	2001				
Cordia alliodora			73	26	96	28	**0.0222**	2001				
Garcinia intermedia			97	30	100	30	n.s.	2001				
Hybanthus prunifolius			84	31	100	30	***0.0525***	2001				
Psychotria horizontalis			93	29	97	30	n.s.	2001				
Swartzia simplex			87	30	50	60	n.s.	2001				
Tabebuia rosea			40	30	90	30	**<0.0001**	2001				
Virola surinamensis			20	30	97	30	**<0.0001**	2001				

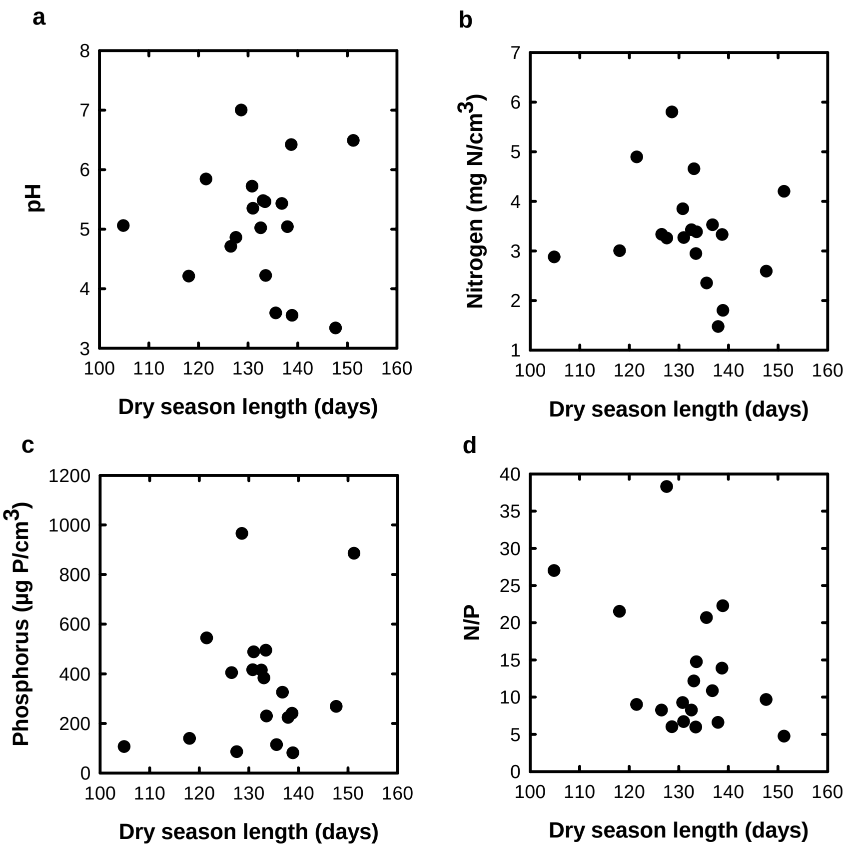
[1] family names are given omitting *aceae*, subfamilies of Fabaceae omitting *oideae,* [2] data are combined from experiments in 2000/2001[14] and 2002/2003, [3] treatment differences significant after Bonferroni adjustment are marked * , [4] two Inga species were excluded from analyses of distribution patterns because of uncertainties in species identification.



Supplementary Figure 1: **Relationship between species' light requirements and their distribution or drought sensitivity.** The index of light requirement is based on descriptive data[30]. Regional distribution across the Isthmus of Panama (**a, c**), and local distribution within the 50-ha Forest Dynamics Plot (**b, d**) were assessed as in Figure 2. **e**, Shows the relation between light requirements and experimentally quantified drought sensitivity. None of the relationships are significant (Supplementary Table 2).

Supplementary Table 2: **Regressions of regional and local distributions with species' light requirements.** Coefficients of determination (r^2) and p-values are given. Species' light requirements are based on observational data on relative recruitment in low canopy sites (i.e. gaps) in the 50-ha Forest Dynamics Plot on BCI[30]. Regional and local distribution parameters are described in more detail in the methods and Supplementary Information. The number of species included in each regression is given as n. Data transformations necessary to meet the requirements of constant variance and to approach normality are also specified. One strong outlier (*Anaxagorea panamensis*) was excluded from the last analysis (local, adults).

scale	distribution parameter	data transformation		r^2	p	n
		distribution	light requirement			
REGIONAL						
	(density Cocoli + 1)/ (density Sherman + 1)	log	log	0.07	0.30	17
	probability dry/probability wet	log	log	0.00	0.99	25
LOCAL						
	seedling density plateau/ density slopes	log	log-log	0.04	0.33	28
	adult density plateau/ density slopes	log	log	0.00	0.93	27



Supplementary Figure 2. **Relationships between dry season length and soil characteristics.** **a**, soil pH, **b**, total nitrogen, **c**, total phosphorus, and **d**, nitrogen to phosphorus ratios are given for 19 sites across the Isthmus of Panama. None of the relationships were significant (for pH: $r^2 = 0.001$, $p = 0.89$; for N: $r^2 = 0.018$, $p = 0.57$; for P: $r^2 = 0.056$, $p = 0.32$; for N/P: $r^2 = 0.18$, $p = 0.07$).

Supplementary Methods 1: **Modelling dry season length.** There is an abrupt annual dry season through most of Central America, running from the end of December until mid-April. The length of the dry season, though, is much longer on the Pacific coast, reflecting the strong gradient in precipitation across the Isthmus of Panama[24]. To quantify the length of the dry season and its variation, we used rainfall data at 44 locations in the Panama Canal watershed where ≥ 4 complete (every day) annual records were available. Mean annual rainfall at these sites varies from 1750 mm on the Pacific side to 4800 mm on the Atlantic side[24]. To assess the dry season, we also used daily evaporation data collected over 12 years at Barro Colorado Island (Smithsonian Tropical Research Institute Environmental Sciences Program. ULR http://striweb.si.edu/esp/meta_data/details_bci_evap.htm). A kernel was calculated for both rainfall and evaporation on each day by first averaging daily rainfall over years available since 1960, then averaging over the prior 30 days' rainfall. The number of days from November through May at each site where the smoothed rainfall was smaller than the smoothed evaporation was used as a measure of dry season duration, d. From the 44 rainfall stations, a linear regression relating d to latitude, longitude, and elevation was calculated. Let x = the zone 17 UTM coordinate (east) and y = UTM (north), each divided by 1000 (i.e. kilometers instead of meters), and z = elevation in meters, then the regression was $d = 0.0920x - 0.6081y - 0.0506z$, with $r^2 = 0.627$. This was used to give an estimated dry season length at each of the 122 tree inventory sites. Supplementary Data 1 gives estimated dry season duration at the 44 rainfall stations, and Supplementary Data 2 the predicted dry season at 122 tree inventory sites.

Supplementary Methods 2: **Modelling the probability of species occurrence against dry season duration.** Species presence/absence data was assessed at 122 locations across the rainfall gradient (sites listed in Supplementary Data 2; tree data in Supplementary Data 3). Some inventories were permanent sample plots where all individual trees were measured and identified[4,5,25]; others were day-long surveys where species presence was noted in an area < 1 km^2, but individual trees were not counted[26]. The probability of occurrence k for each species was modeled against dry season duration d (Supplementary Information) at the 122 sites by fitting a kernel using an optimized bandwidth[31] (bandwidth is the standard deviation of the Gaussian kernel). This technique was designed for species-habitat models, and requires no *a priori* assumptions about the shape of the response. It produces an estimated probability of occurrence for each species at any dry season duration.

The kernel was fitted using a Gibbs sampler based on the likelihood of observing a species (presence or absence) given the model's estimated probability of occurrence. The algorithm is presented in full in Supplementary Program1. For a single species, the output was a chain of 4000 estimated kernel bandwidths, and for each, an estimated occurrence probability at any dry season duration. We used the fitted value at d = 145 days, k_{145}, as an index of the species occurrence toward the dry end of the rainfall gradient, and at d = 110 days, k_{110}, for the wet end of the gradient. Dry season lengths of 145 and 110 days represent the most extreme points of the rainfall gradient where there were sufficient inventory data to accurately estimate the probability of occurrence for all species. The ratio k_{145}/k_{110} was used a measure of the climatic response of a species; we used the median value of the 4000 Gibbs replicates of $\log(k_{145}/k_{110})$, where log is the log base 10. Log-ratios > 0 indicate a species is associated with drier climate, while ratios < 0 indicate a preference for wetter climate. Estimated habitat ratios for 44 species tested are given in Supplementary Data 4, and graphed habitat responses are shown in Supplementary Figures 3.

Since there is error in the estimated dry season length (as indicated by the regression given in Supplementary Methods 1), the confidence limits produced by this Gibbs sampler are underestimates. All these errors propagate through to our assessment of the species' dry season responses vs. experimental drought tolerance.