SUPPLEMENTARY MATERIAL

SECTION 1: STUDY SITES

Table S1. Sites where nectar and visitation data were recorded for this study. GA: Greater Antilles, LA: Lesser Antilles, VI: Virgin Islands, ML: mainland.

Site ID	Site	Country	Geography	Form	Latitude	Longitude	Nectar	Visitation
YUM	Colmenar	Dominican Republic	GA	GA	18.360	-68.621	y	y
JAR	Fondo Paradí	Dominican Republic	GA	GA	17.788	71.471	y	y
ALL	Alligator Hole	Jamaica	GA	GA	17.868	-77.392	y	y
BUL	Bull Bay	Jamaica	GA	GA	17.943	-76.676	y	—
JMW	Little Bay	Jamaica	GA	GA	18.221	-78.251	y	y
GQI	Guaniquilla	Puerto Rico	GA	GA	18.035	-67.201	y	y
SJH	Cob Gut	St. John	VI	GA	18.315	-64.711	y	y
MIH	Mina Hill	St. John	VI	GA	18.366	-64.858	—	y
PCH	Pt. Chateaux	Guadeloupe	LA	LA	16.254	-61.231	y	y
SPO	Salt Pond	Guadeloupe	LA	LA	16.252	-61.190	y	y
STA	Statia	St. Eustatius	LA	LA	17.517	-62.992	y	y
CUR	PSC	Curaçao	LA	LA	12.305	-69.148	y	y
GNB	Guanabano	Colombia	ML	ML	10.841	-72.944	y	y
VCA	Sta. Veronica	Colombia	ML	ML	10.859	-75.108	y	—

SUPPLEMENTARY MATERIAL

SECTION 2: PHENOLOGY

Herbarium and digital sources that were consulted in this study

To estimate geographic patterns in floral phenology, we analysed data derived from our own fieldwork and others available in iNaturalist (www.inaturalist.org), in addition to herbarium specimens, which were consulted directly by visiting herbaria and from images of specimens available in digital repositories (Table S2).

Table S2. Herbarium and digital sources that were queried for phenological data, including their name, URL, and date they were accessed.

Source	Acronym	URL	n images	Date accessed
Herbario Nacional de México	MEXU	https://www.ib.unam.mx/ib/colecciones-biologicas/herbario-nacional/	20	28 Aug. 2017
New York Botanical Garden	NYBG	https://sweetgum.nybg.org/science/vh/	200	20 May 2020
Herbario Nacional Colombiano	COL	http://www.biovirtual.unal.edu.co/en/	89	16 Oct. 2018
Universidad Nacional de Antioquia	HUA	https://www.udea.edu.co/wps/portal/udea/web/inicio/unidades-academicas/ciencias-exactas-naturales/herbario	20	17 Oct. 2018
Integrated Digitized Biocollections	iDigbio	https://www.idigbio.org/	55	10 Sep. 2020
Harvard University Herbarium & Libraries	HUH	https://huh.harvard.edu/	8	6 May 2021
University of Sotuh Florida	USF	https://florida.plantatlas.usf.edu/	17	9 May 2021
Herbarium, Natural History Museum of Paris	P	https://science.mnhn.fr/institution/mnhn/collection/p/item/search	35	6 May 2021
iNaturalist	iNat	https://www.inaturalist.org	295	13 May 2021

Phenology including data from mainland populations

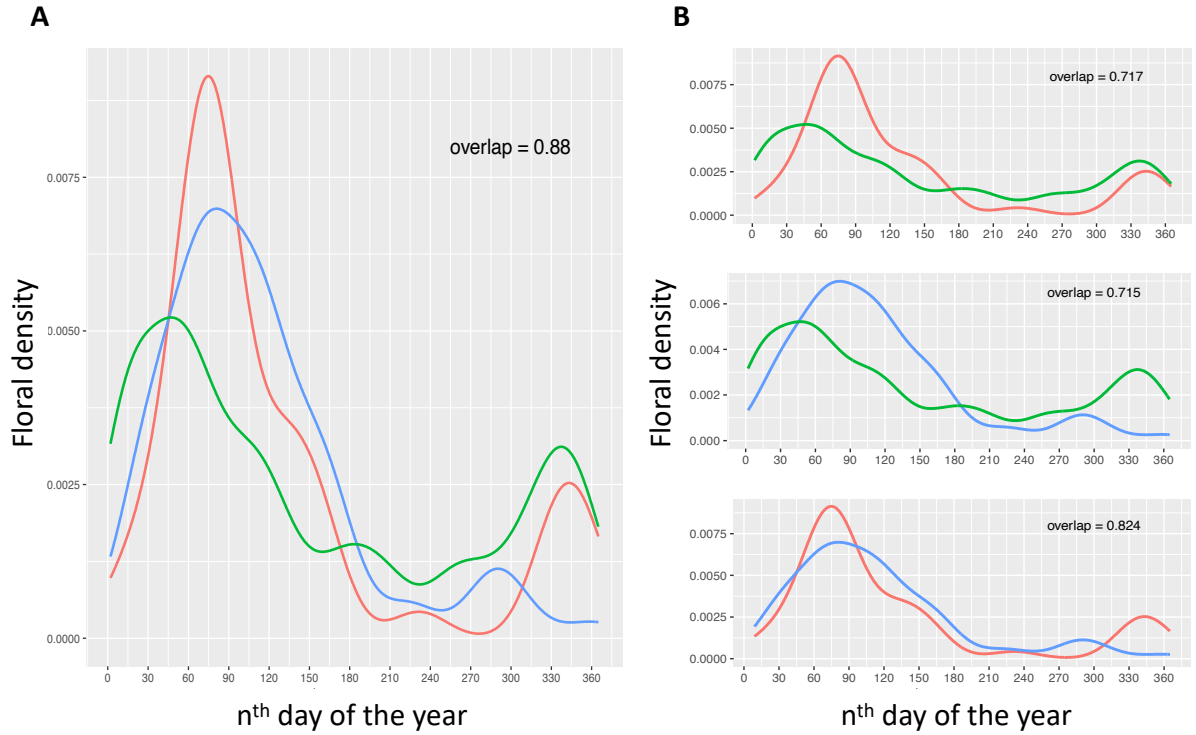

Figure S2.1. Our analyses reveal a considerable overall overlap (88%) in phenological activity of *Euphorbia tithymaloides* in the Caribbean, with pairwise overlap of 71.5–82.4%. Red: Greater Antilles; blue: Lesser Antilles; green: mainland.

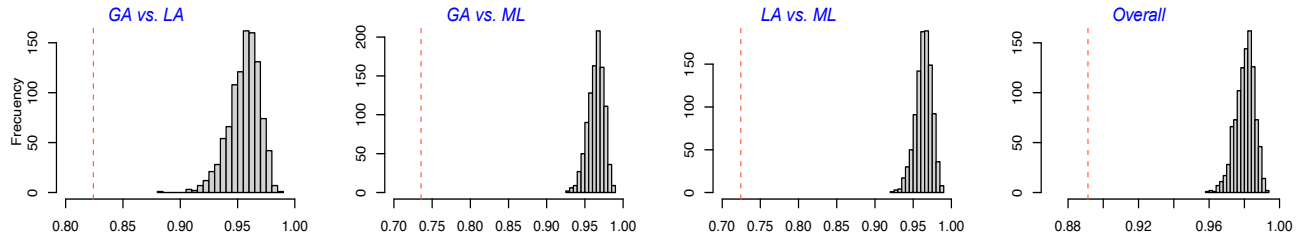

Figure S2.2. A randomization procedure removing geographic structure to the data suggests that overlap that we observe in phenological activity in *Euphorbia tithymaloides* across geographic areas (red dashed line) is lower than would be expected from non-geographically structured data.

Phenology in common garden

Populations

We studied 63 individuals of *Euphorbia tithymaloides* L. that come from 9 localities that represent ML and LA areas of the species range (Fig. S2.3).

Data

To facilitate tracking of floral activity, we labelled plants, their branches, and the floral clusters on them. When floral buds were spotted, we labelled them individually by attaching a coloured thread. We took data every two days for 23 months (25 Oct. 2019 – 31 Aug. 2021).

Number of floral units was plotted against time (day of the year) and compared among their areas of provenance (ML, LA). We converted dates to day of the year (1 to 365) using custom R scripts (R Core team 2019). Plots were smoothed using geom_density function of the R package ggplot2 v.3.5.0 (Wickham 2016), and overlap in flowering activity was estimated using the overlap function in the R package overlapping v.2.1 (Pastore 2018).

Results

Our data show a substantial overlap (61.15%) between phenological activity of *E. tithymaloides* from ML and LA areas (Fig. S2.4), suggesting that meaningful differences in floral activity have not yet evolved between populations in these areas. These results suggest that divergence between plants from ML and LA areas might be the result of forces other than differences in floral phenology or its consequences.

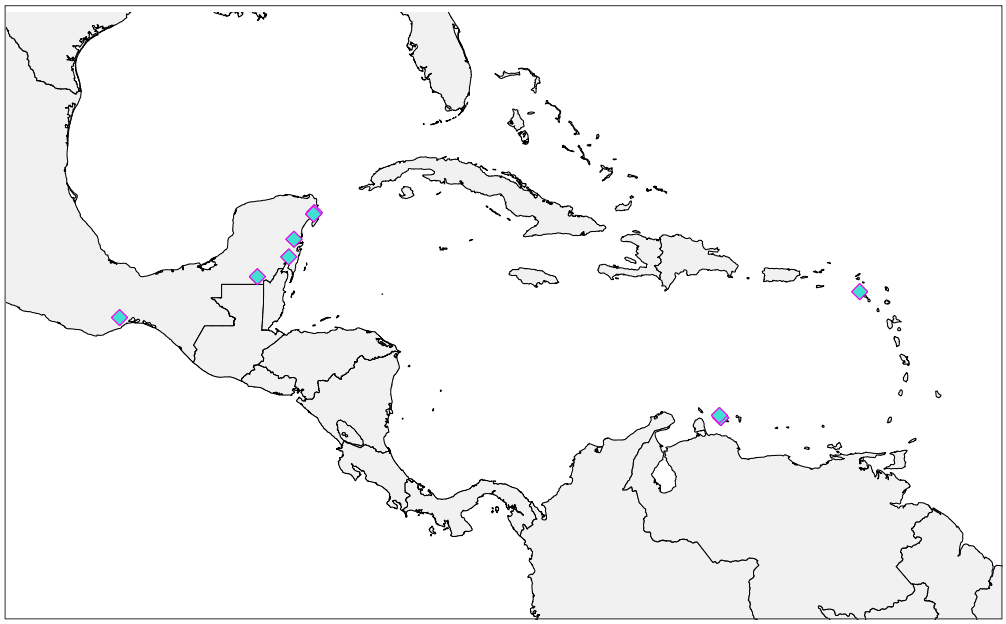

Figure S2.3. Map depicting provenance of individuals of *Euphorbia tithymaloides* in a common garden located in Mexico City, whose phenological activity was tracked in this study. Populations: Las Carmelas (Quintana Roo), Playa Daiboo (Curaçao), Playa Santa Cruz (Curaçao), Jalapa de Márquez (Oaxaca), Mahahual (Quintana Roo), Puerto Morelos (Quintana Roo), El Secreto (Quintana Roo), Santa Teresa (Quintana Roo), and Venus Bay (St. Eustatius).

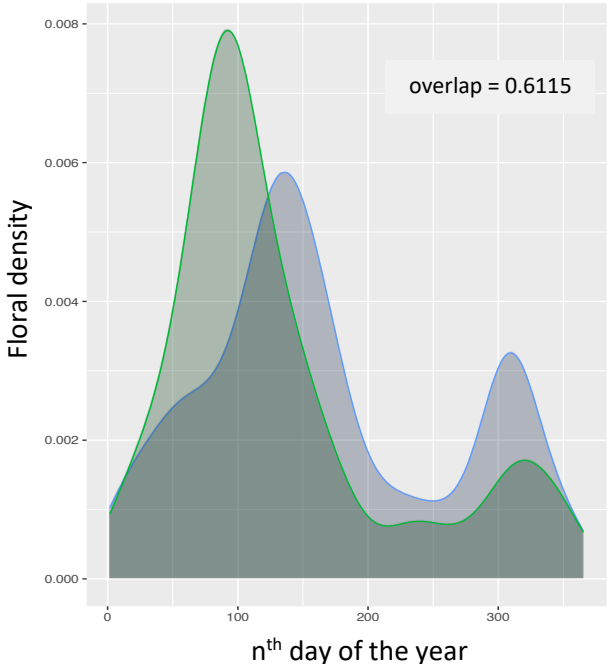

Figure S2.4. Phenological activity in individuals of *Euphorbia tithymaloides* from Mainland and Lesser Antillean populations kept in common garden conditions is highly synchronized, with an overlap of 61.1%. Blue: Lesser Antilles; green: mainland.

References

Pastore M (2018) A R package for estimating overlapping in empirical distributions. The Journal of Open Source Software 3: 1023. https://doi.org/10.21105/joss.01023

R Core Team (2019) R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org

Wickham H (2016) ggplot2: elegant graphics for data analysis. Springer-Verlag, New York, 1–260. https://doi.org/10.1007/978-3-319-24277-4

SUPPLEMENTARY MATERIAL

SECTION 3: REWARD (NECTAR)

Reward (nectar) data visualization

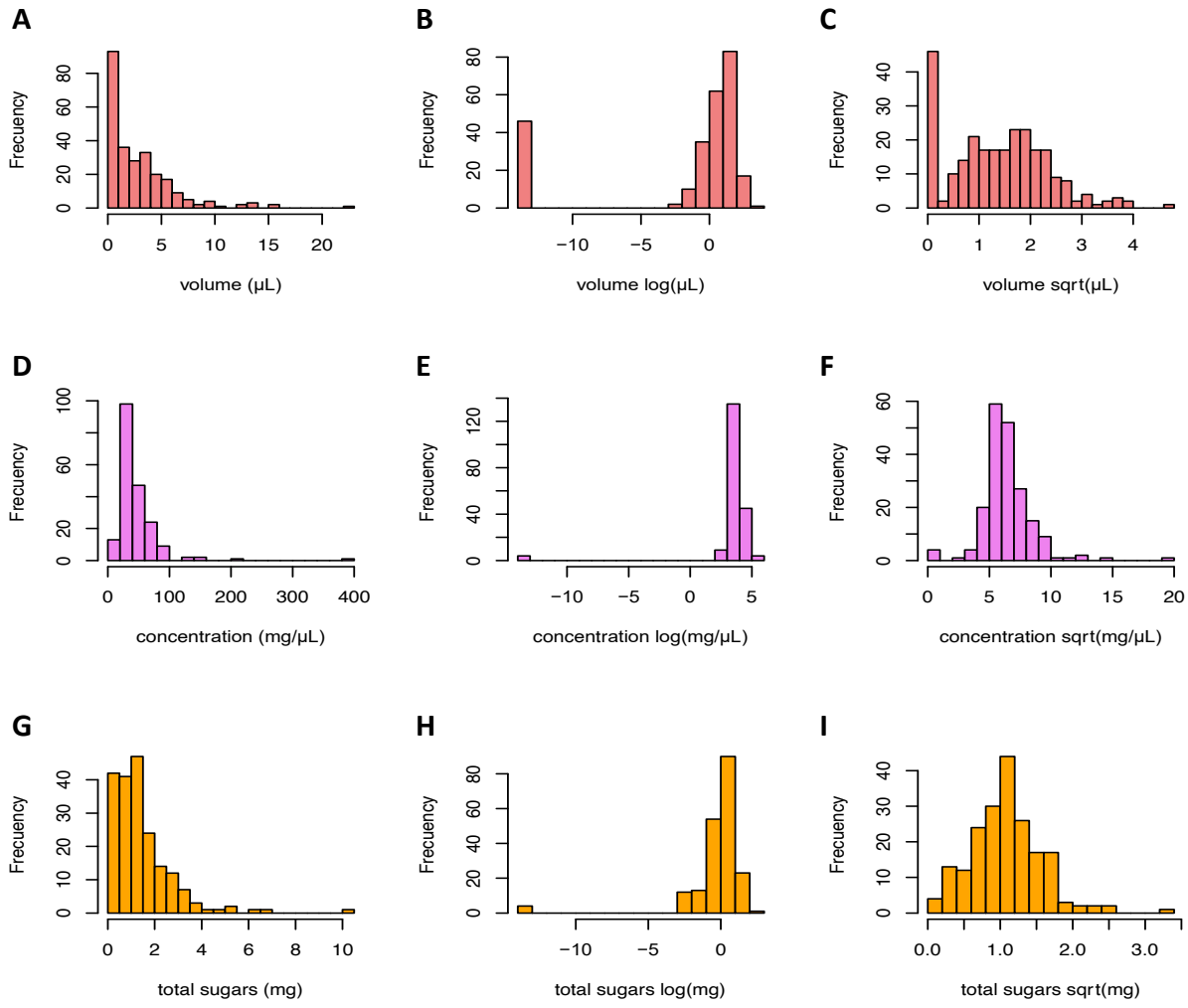

Figure S3.1. Histograms of nectar traits and transformations explored to improve normality. **A**–**C**. Nectar volume. **D**–**F**. Sugar concentration. **G**–**I**. Total sugar content. Transformations explored include logarithmic (B, E, H) and square root (C, F, I).

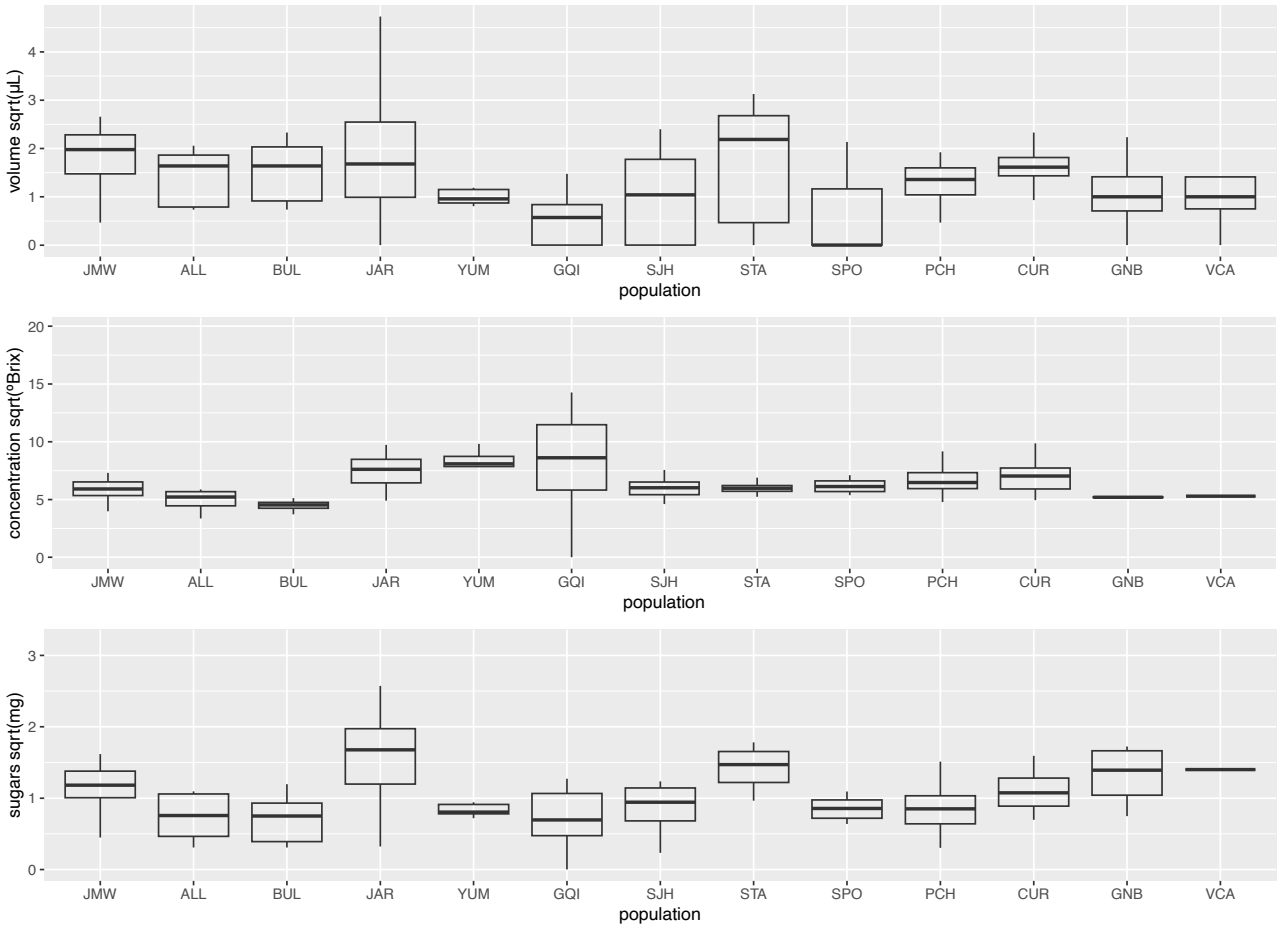

Figure S3.2. Variation in nectar volume (**top**), concentration (**middle**), and total sugar content (**bottom**) of *Euphorbia tithymaloides* across study sites in the Caribbean.

Reward (nectar) analyses with sites from the mainland

We sampled a total of 19 cyathia across sites in the mainland, for a total of n = 256 measurements (GA: 145, LA: 92, ML: 19; n cyathia/population: mean = 16, median = 18). We took a single sample for 4–37 cyathia per population (n cyathia/population: mean = 16, median = 18), for a total of n = 237 measurements (GA: 145, LA: 92).

Taking into account the data from mainland sites, *E. tithymaloides* produces 0–22.4 µL nectar (mean = 2.85 ± 3.2 µL; median= 2.0 µL), with sugar concentrations of up to 391.2 ºBrix (mean = 46.1 ± 35.9 ºBrix; median= 37.6 ºBrix) that amount to up to 10.3 mg of total sugars (mean =1.43 ± 1.29 mg; median= 1.2 mg), with no significant effect of geography (Greater Antilles, Lesser Antilles; Fig. S3.3, Table S3.3).

Table S3.1. Summary of overall nectar traits measured in this study. Summaries for the focal area (Greater and Lesser Antilles, GALA) and including mainland populations (wML) are provided. sd = standard deviation.

Variable	Dataset n	Min	Q1	Median	Mean	Q3	Max	sd
mean volume (µL)	GALA n=11	0.000	0.435	2.174	2.889	4.130	22.370	3.221
	all, n=13	0.000	0.500	2.000	2.848	4.130	22.370	3.229
mean sugar concentration (ºBrix)	GALA n=11	0.000	29.980	37.830	46.540	55.500	391.200	36.317
	all, n=13	0.000	29.010	37.600	46.050	54.310	391.200	35.980
mean total sugars (mg)	GALA n=11	0.000	0.602	1.193	1.421	1.879	10.254	1.297
	all, n=13	0.000	0.603	1.198	1.433	1.902	10.254	1.291

Table S3.2. Summary of means by study site, of nectar traits measured in this study. Summaries for the focal area (Greater and Lesser Antilles, GALA) and including mainland populations (wML) are provided. sd = standard deviation.

Variable	Dataset n	Min	Q1	Median	Mean	Q3	Max	sd
mean volume (µL)	GALA, n=11	0.580	1.552	2.296	2.516	3.149	5.127	1.403
	wML, n=13	0.580	1.746	2.296	2.484	2.748	5.127	1.283
mean sugar concentration (ºBrix)	GALA, n=11	20.150	37.370	39.560	47.490	58.420	86.870	20.037
	wML, n=13	20.150	29.160	39.150	44.410	47.990	86.870	19.772
mean total sugars (mg)	GALA, n=11	0.603	0.759	0.905	1.187	1.263	2.973	0.732
	wML, n=13	0.603	0.834	0.920	1.300	1.883	2.973	0.723

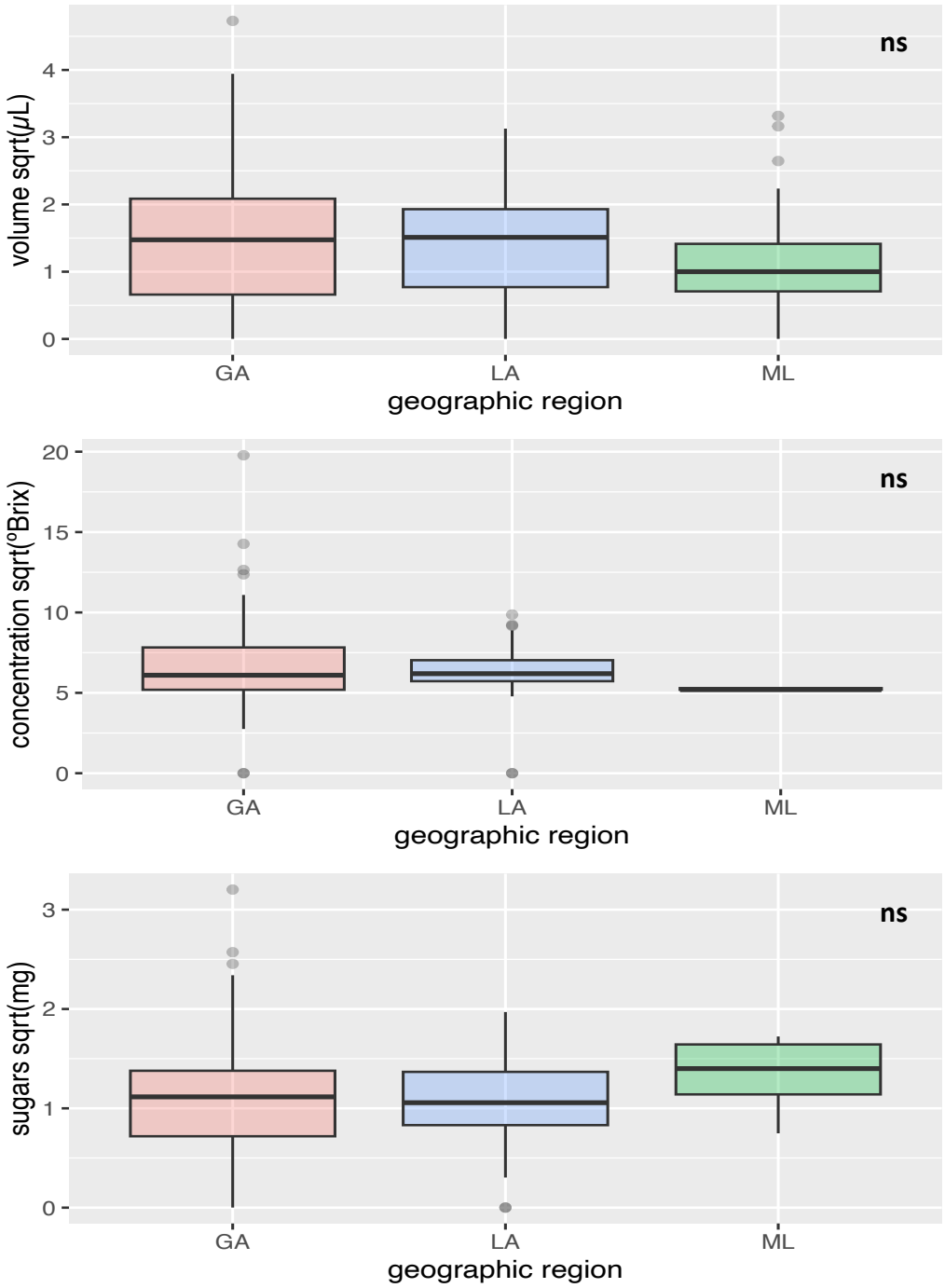

Figure S3.3. Our data do not support differences in volume (**top**), concentration (**middle**), or total sugar content (**bottom**) in the nectar of *Euphorbia tithymaloides* across its main three areas of occurrence in the Caribbean. Models are in Table S3.3.

Table S3.3. Linear mixed models show no effect of geography on nectar attributes of *E. tithymaloides* when the continental sites are included.

volume sqrt(µL)						
model:	nectarVol_TOTul.SQRT ~ geography + (1 | pop13id)					
REML cc:	686.2					
N observations:	256	N groups:	13			
Random effects:	Groups	Variance	Std.Dev.			
	pop13id	0.1704	0.4128			
	Residual	0.7906	0.8891			
Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)	significance
(Intercept)	1.34429	0.179955	10.8984	7.47	1.31E-05	***
geographyLA	0.002884	0.289445	9.97821	0.01	0.992	
geographyML	-0.155389	0.413854	14.3101	-0.375	0.713	
Correlation of Fixed Effects:	(Intr)	ggrpLA				
geographyLA	-0.622					
geographyML	-0.435	0.27				

sugar concentration sqrt(ºBrix)						
model:	nectar_grad_Brix.SQRT ~ geography + (1 | pop13id)					
REML cc:	835.7					
N observations:	197	N groups:	13			
Random effects:	Groups	Variance	Std.Dev.			
	pop13id	0.8984	0.9479			
	Residual	3.832	1.9576			
Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)	significance
(Intercept)	6.5585	0.4153	8.1653	15.791	2.08E-07	***
geographyLA	-0.258	0.6747	7.7012	-0.382	7.13E-01	
geographyML	-1.3358	1.2271	23.8894	-1.089	0.287	
Correlation of Fixed Effects:	(Intr)	ggrpLA				
geographyLA	-0.616					
geographyML	-0.338	0.208				

total sugars sqrt(mg)						
model:	azucares_mg.SQRT ~ geography + (1 | pop13id)					
REML cc:	234.6					
N observations:	197	N groups:	13			
Random effects:	Groups	Variance	Std.Dev.			
	pop13id	0.08144	0.2854			
	Residual	0.16801	0.4099			
Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)	significance
(Intercept)	0.96459	0.11684	10.6382	8.255	6.01E-06	***
geographyLA	0.09269	0.19128	10.1844	0.485	0.638	
geographyML	0.37772	0.31021	21.9195	1.218	0.236	
Correlation of Fixed Effects:	(Intr)	ggrpLA				
geographyLA	-0.611					
geographyML	-0.377	0.23				

Reward (nectar) data in common garden conditions

Using similar methods to those to characterize field reward data, we quantified volume and sugar content in 19 individuals from nine populations of *Euphorbia tithymaloides*.

We did not bag cyathia, as visitation in our greenhouse is not possible, and took measurements around 1400 h with a temperature-compensated hand refractometer 0–32% sugar by volume (ºBrix; VEE GEE Scientific BTX-1, QA Supplies, Norfolk, Virginia, U.S.A.) that is accurate to 0.2%. In a few instances, nectar was too concentrated to allow a reliable measurement with glass capillaries, so we first diluted nectar with distilled water, and then quantified. We took a total of 159 nectar quantifications, in n = 19 plants through 12 months (25 Mar. 2020 – 22 Mar. 2021).

Because our measurements of nectar characteristics were slightly higher for volume, sugar content, and concentration, compared to our measurements in the field ($p < 0.001$; Fig. S3.4), we analysed these data separately.

In contrast to measurements derived from field measurements, where we see no evidence of differences in reward production or quality among plants of *E. tithymaloides* coming from mainland, Lesser or Greater Antillean populations, populations in cultivation from the Lesser Antilles tend to produce more nectar and with higher sugar content than those from the mainland (Fig. S3.5). On average, plants of *E. tithymaloides* in cultivation produce 0.6–10 µL nectar (mean = 4.2 ± 2.1 µL; median= 3.9 µL) that has sugar concentrations between 20.5 and 262.5 ºBrix (mean = 67.3 ± 34.6 ºBrix; median= 59.4 ºBrix) that amount to 0.3–6.8 mg of total sugars (mean = 2.6 ± 1.5 mg; median= 2.2 mg).

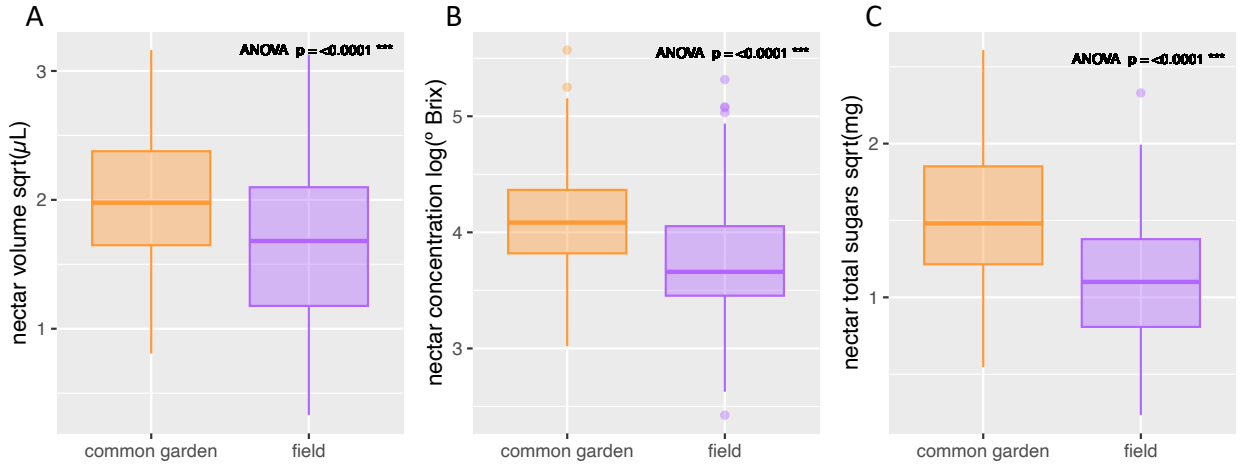

Figure S3.4. Our reward (nectar) data from plants of *Euphorbia tithymaloides* kept in common garden conditions differs from our measurements in the field for all metrics analysed, so we decided to keep separate for downstream analyses. **A**. Nectar volume. **B**. Nectar sugar concentration. **C**. Nectar total sugars.

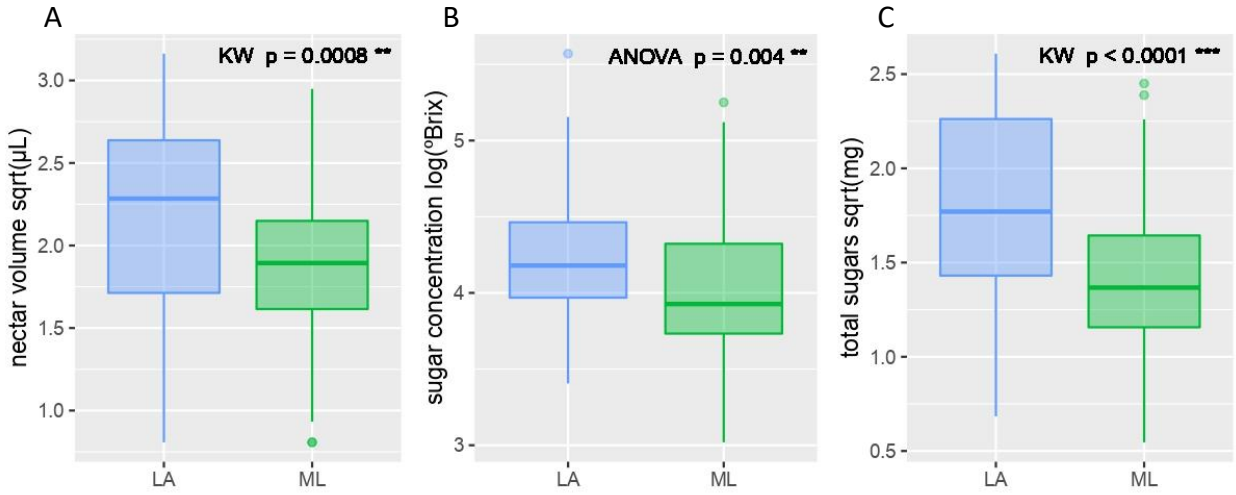

Figure S3.5. In common garden conditions, plants of *Euphorbia tithymaloides* from the Lesser Antilles produce more nectar, that is slightly more concentrated and that overall accounts for higher levels of total sugars offered as reward than plants from the mainland kept in the same conditions. **A**. Nectar volume. **B**. Nectar sugar concentration. **C**. Nectar total sugars.

SUPPLEMENTARY MATERIAL

SECTION 4: VISITATION

Visitation data including sites from the mainland

When including data form mainland sites, we recorded 4246 visits and 195 sightings in a total of 141.5 hours of observation across sites in all three areas (mean = 11.79 ± 4.25 h/site, n = 12). Our data reveal that hummingbirds are the main floral visitors of *Euphorbia tithymaloides* in all three areas examined: Greater Antilles: 61%, Lesser Antilles: 85%, mainland: 97% (all comparisons significant at $p < 0.05$; Fig. 5A, Tables S4.1 and S.4.2).

Table S4.1. According to visitation data amounting to a total of 141.5 hours of observation, hummingbirds account for most visitation events across 12 natural sites where *Euphorbia tithymaloides* occurs in the Caribbean. Insects are present and fly around plants of *E. tithymaloides* in all areas to the point that they account for most of the sightings in all areas, but do not stop by regularly to visit cyathia and thus account for very little visitation.

Geography	n visits /area	n sightings /area	Functional group	n visits	n sightings	% visits	% sightings
Greater Antilles	2160	134	hummingbird	1315	36	60.88	26.87
			other bird	790	42	36.57	31.34
			insect	55	56	2.55	41.79
Lesser Antilles	1952	36	hummingbird	1649	5	84.48	13.89
			other bird	265	1	13.58	2.78
			insect	38	30	1.95	83.33
Mainland	134	25	hummingbird	130	5	97.01	20.00
			other bird	0	0	0.00	0.00
			insect	4	20	2.99	80.00

Table S4.2. Comparisons among functional groups (hummingbirds, other birds, insects) within areas support that hummingbirds account for most visitations in all three main geographic areas of occurrence of *Euphorbia tithymaloides* in the Caribbean (Greater Antilles, Lesser Antilles, and Mainland), at a significance of alpha = 0.05. Implementation of the Marascuillo procedure followed the NIST/SEMATECH e-Handbook of Statistical Methods (https://www.itl.nist.gov/div898/handbook/; accessed 08.02.2023); for details see methods.

Geography	Group A	Group B	Value	Critical range	p	Conclusion
Greater Antilles	hummingbirds	birds	0.243	0.042	< 0.05	different
	hummingbirds	insects	0.583	0.031	< 0.05	different
	birds	insects	0.340	0.031	< 0.05	different
Lesser Antilles	hummingbirds	birds	0.709	0.036	< 0.05	different
	hummingbirds	insects	0.825	0.028	< 0.05	different
	birds	insects	0.126	0.026	< 0.05	different
Mainland	hummingbirds	birds	0.970	0.010	< 0.05	different
	hummingbirds	insects	0.940	0.015	< 0.05	different
	birds	insects	0.030	0.010	< 0.05	different

Table S4.3. Hummingbirds account for most visitation and sighting (an appearance of a potential visitor in close proximity of a focal plant that does not lead to a visit) events across 12 natural sites of *Euphorbia tithymaloides* in the Caribbean, derived from a total of 133.23 hours of observation.

Geography	Country	Functional group	n visits	n sightings	% visits	% sightings
Greater Antilles	Dominican Republic	hummingbird	69	6	57.02	54.55
		other bird	52	4	42.98	36.36
		insect	0	1	0.00	9.09
	Jamaica	hummingbird	1011	11	56.83	30.56
		other bird	722	18	40.58	50.00
		insect	46	7	2.59	19.44
	Puerto Rico	hummingbird	25	0	100.00	0.00
		other bird	0	0	0.00	0.00
		insect	0	0	0.00	0.00
	St. John	hummingbird	210	19	89.36	21.84
		other bird	16	20	6.81	22.99
		insect	9	48	3.83	55.17
Lesser Antilles	Curacao	hummingbird	483	0	98.17	0.00
		other bird	9	0	1.83	0.00
		insect	0	22	0.00	100.00
	Guadeloupe	hummingbird	1023	3	78.15	75.00
		other bird	252	1	19.25	25.00
		insect	34	0	2.60	0.00
	St. Eustatius	hummingbird	143	2	94.70	20.00
		other bird	4	0	2.65	0.00
		insect	4	8	2.65	80.00
Mainland	Colombia	hummingbird	130	5	97.01	20.00
		other bird	0	0	0.00	0.00
		insect	4	20	2.99	80.00

Table S4.4. Species identity, taxonomy and relative importance of floral visitors of *Euphorbia tithymaloides*, recorded across 12 sites in the Caribbean, including localities in the two main focal areas (Greater and Lesser Antilles) and sites in the mainland.

Country	Functional group	Visitor	Species code	n visits	n sightings	% visits	% sightings
Greater Antilles							
Dominican Republic	hummingbird	*Antrhacothorax dominicus*	ANDO	42	6	34.71	54.55
		Mellisuga minima	MEMI	27	0	22.31	0.00
	other bird	*Coereba flaveola*	BAQU	52	2	42.98	18.18
		Todus todus	TOTO	0	2	0.00	18.18
	insect	bee	BEE	0	1	0.00	9.09
Jamaica	hummingbird	*Mellisuga minima*	MEMI	193	7	10.85	19.44
		Trochilus polytmus	TRPO	818	4	45.98	11.11
	other bird	*Coereba flaveola*	BAQU	719	16	40.42	44.44
		Melopyrrha violacea	MEVI	3	0	0.17	0.00
		Todus todus	TOTO	0	2	0.00	5.56
	insect	bee	BEE	46	2	2.59	5.56
		lepidopteran	LEP	0	4	0.00	11.11
		wasp	WASP	0	1	0.00	2.78
Puerto Rico	hummingbird	*Chlorostilbon maugaeus*	CHMA	25	0	100.00	0.00
St. John	hummingbird	*Antrhacothorax dominicus*	ANDO	0	1	0.00	1.15
		Eulampis holosericeus	EUHO	5	7	2.13	8.05
		Orthorhyncus cristatus	ORCR	205	11	87.23	12.64
	other bird	*Coereba flaveola*	BAQU	16	9	6.81	10.34
		Loxigilla noctis	LONO	0	8	0.00	9.20
		Setophaga striata	SETR	0	3	0.00	3.45
	insect	bee	BEE	0	5	0.00	5.75
		Bombus sp.	BOMBUS	0	5	0.00	5.75
		lepidopteran	LEP	3	9	1.28	10.34
		odonata	DFLY	0	4	0.00	4.60
		Polistes canadensis	POCA	0	14	0.00	16.09
		wasp	WASP	6	11	2.55	12.64
Lesser Antilles							
Curaçao	hummingbird	*Chlorostilbon mellisugus*	CHME	483	0	98.17	0.00

	other bird	*Coereba flaveola*	BAQU	9	0	1.83	0.00
	insect	bee	BEE	0	22	0.00	100.00
Guadeloupe	hummingbird	*Orthorhyncus cristatus*	ORCR	1023	3	78.15	75.00
	other bird	*Coereba flaveola*	BAQU	252	1	19.25	25.00
	insect	bee	BEE	34	0	2.60	0.00
St. Eustatius	hummingbird	*Orthorhyncus cristatus*	ORCR	143	2	94.70	20.00
	other bird	*Coereba flaveola*	BAQU	4	0	2.65	0.00
	insect	bee	BEE	0	2	0.00	20.00
		lepidopteran	LEP	4	3	2.65	30.00
		wasp	WASP	0	3	0.00	30.00
Mainland							
Colombia	hummingbird	*Chlorostilbon gibsoni*	CHGI	130	5	97.01	20.00
	insect	ants	ants	2	18	1.49	72.00
		lepidopteran	LEP	0	2	0.00	8.00
		wasp	WASP	2	0	1.49	0.00

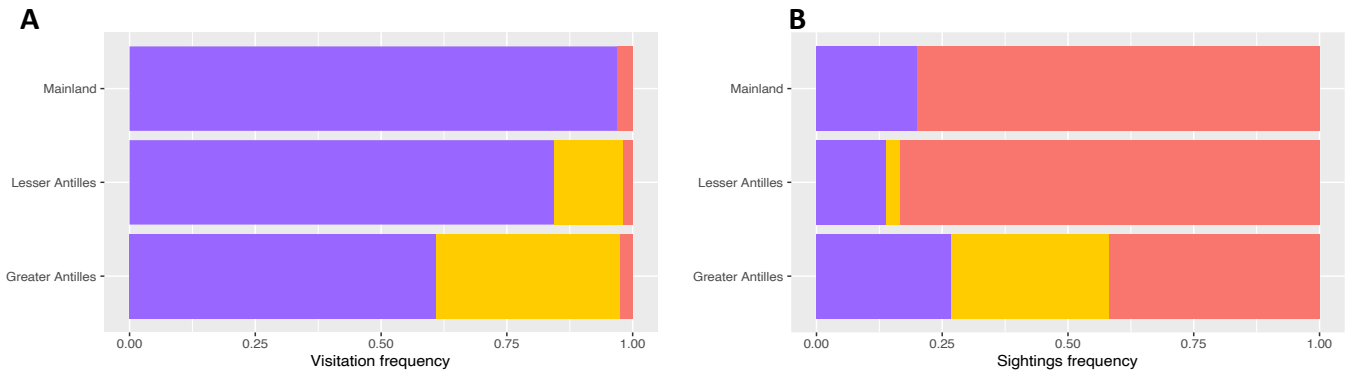

Figure S4.1. A. Visitation observations confirm that hummingbirds (purple) are the most important floral visitors and potential pollinators of *Euphorbia tithymaloides* in the Antilles and mainland sites. **B**. In all areas, other birds (yellow) and insects (red) have an important presence and are seen in proximity of *E. tithymaloides* cyathia, even landing on them, but this activity does not translate into actual visitation for this plant.

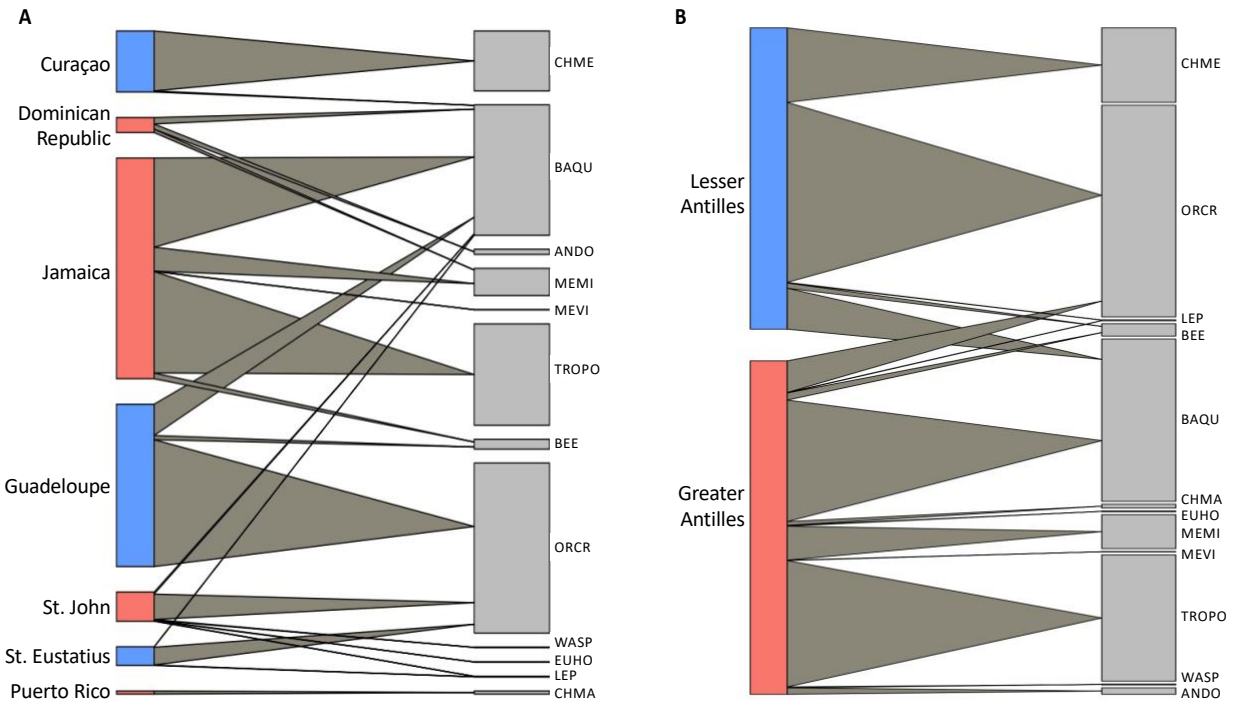

Figure S4.2. Bipartite networks by island/country (**A**) and by geographic area (**B**) showing floral visitor assemblages in areas where the 12 observation sites included in this study. Visitor acronyms follow Table 3.

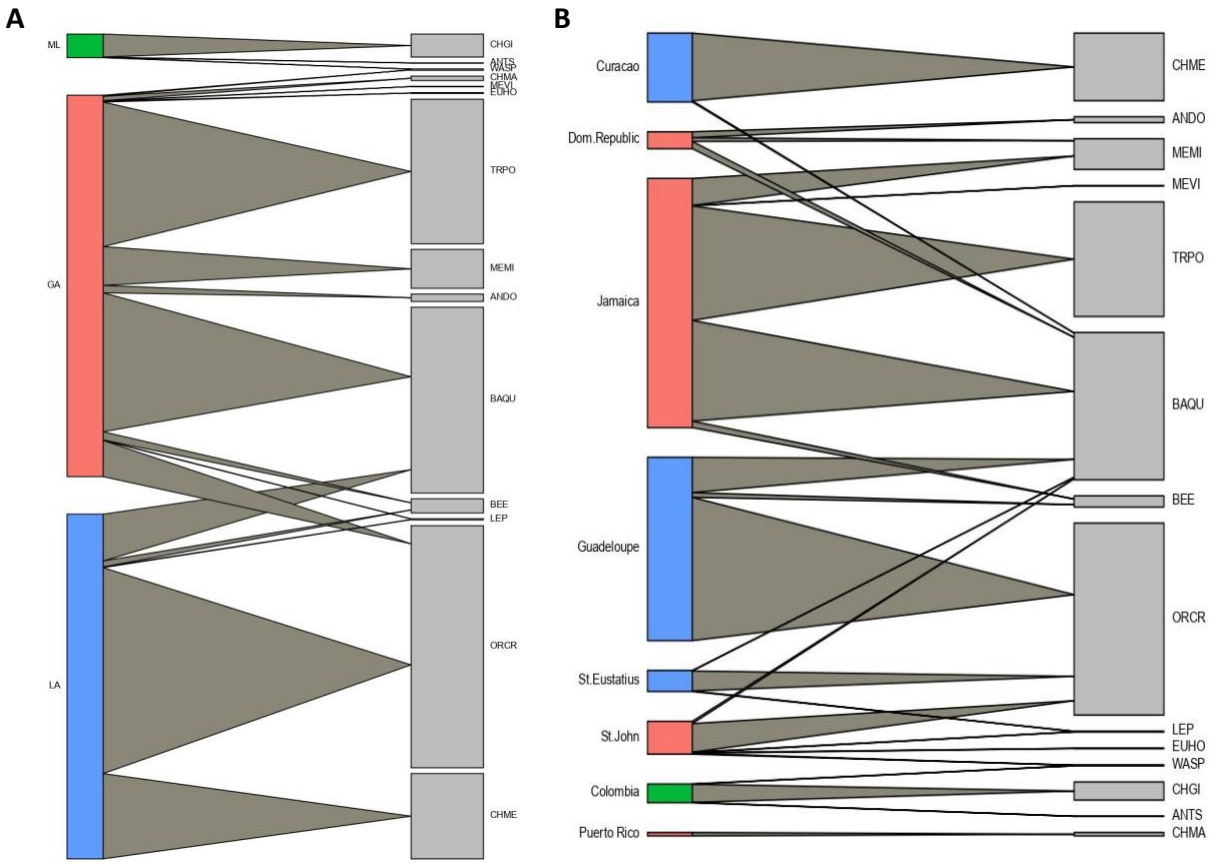

Figure S4.3. Bipartite networks based on geographic front (**A**), or island/country (**B**) for *E. tithymaloides* in the Caribbean, including data from the Mainland. Geographic front and island/country are on the left of each network, and floral visitors on the right. Colours represent fronts: red = Greater Antilles, blue = Lesser Antilles, green = Mainland. Locality and floral visitor acronyms follow Table S1 and Table 3, respectively. The network based on geographic area exhibits a higher connectance than the one based on locality ($C_{geography} = 0.45$, $C_{island} = 0.22$). It is also less specialized ($H_2'_{geography} = 0.64$, $H_2'_{island} = 0.79$), and less diverse ($H'_{geography} = 2.02$, $H'_{island} = 2.22$).