

SUPPORTING INFORMATION

**Resource Tracking and its Conservation Implications for an
Obligate Frugivore (*Procnias tricarunculatus*, the Three-wattled
Bellbird)**

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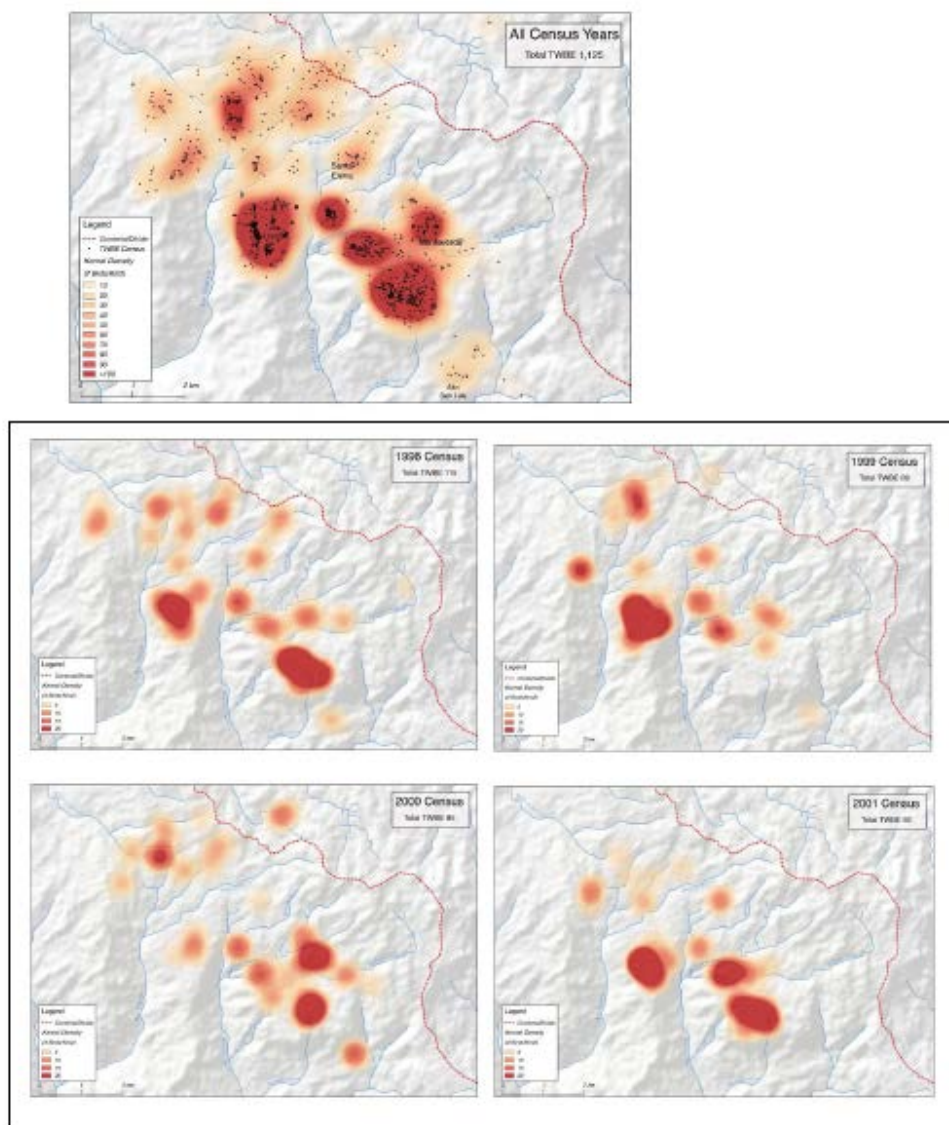
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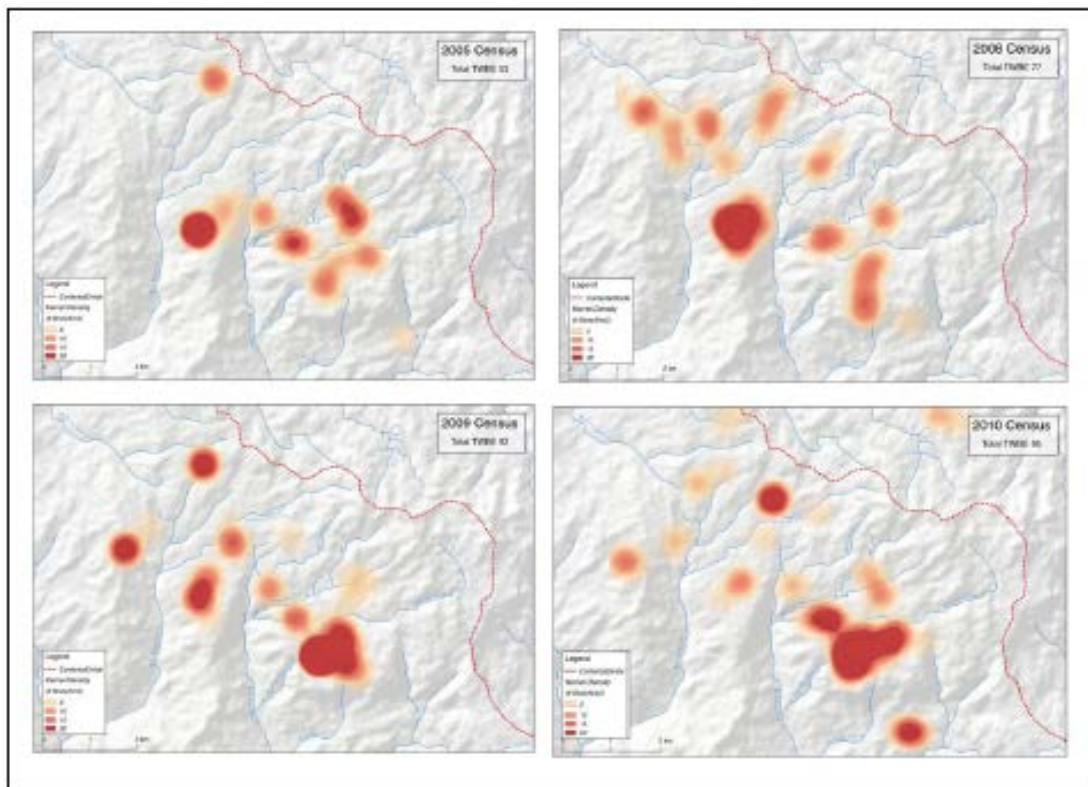
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FIGURE S1. Three-wattled Bellbird census data subset which shows the use of alternate regions of the Premontane Wet Life zone in different years: (A) summary of all 12 years of census data using Kernel density analysis to highlight bellbird ‘hot spots’ in the Monteverde region in the month of July; (B) initial three years of census data (1998, 1999, and 2000) that clearly show the use of alternate habitats; (C) census results of regional bellbird counts performed during our study period.





(FIGURE S1C. *continued*)

FIGURE S2. *Ocotea montevertensis* distribution map. Map of all the *O. montevertensis* trees that were visibly flowering in aerial photographs on July 8, 2015 across the bulk of the species range (from lower Monteverde to La Cruz). Each red dot represents an individual tree. We estimate that these 600 trees represent 78% of the entire population (approximately 770).

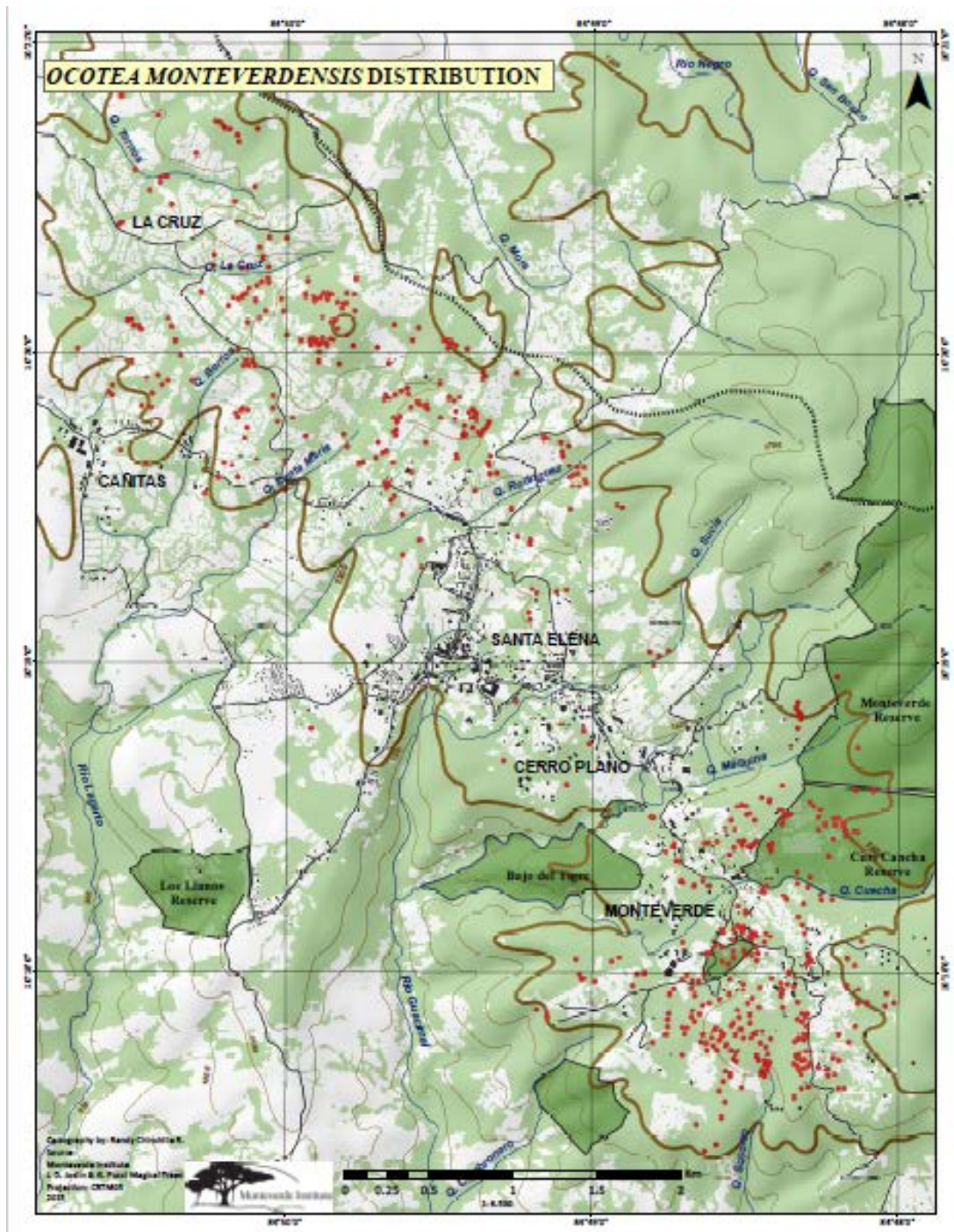
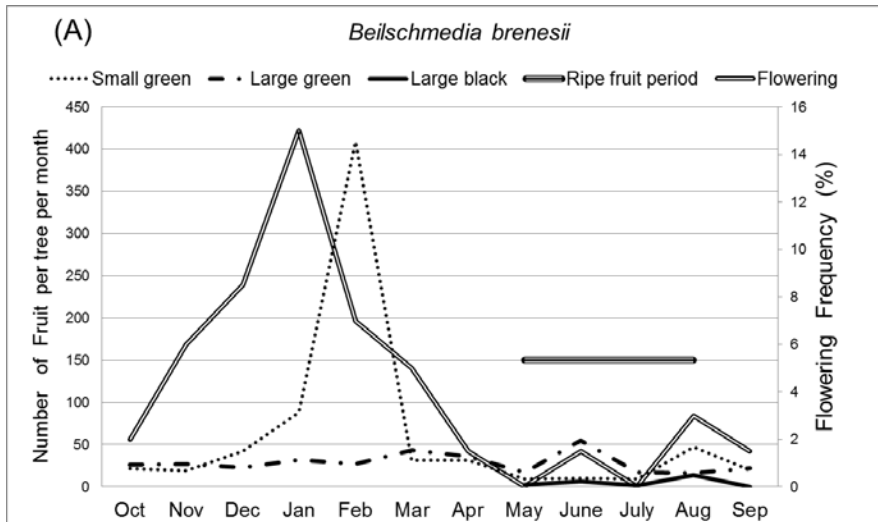
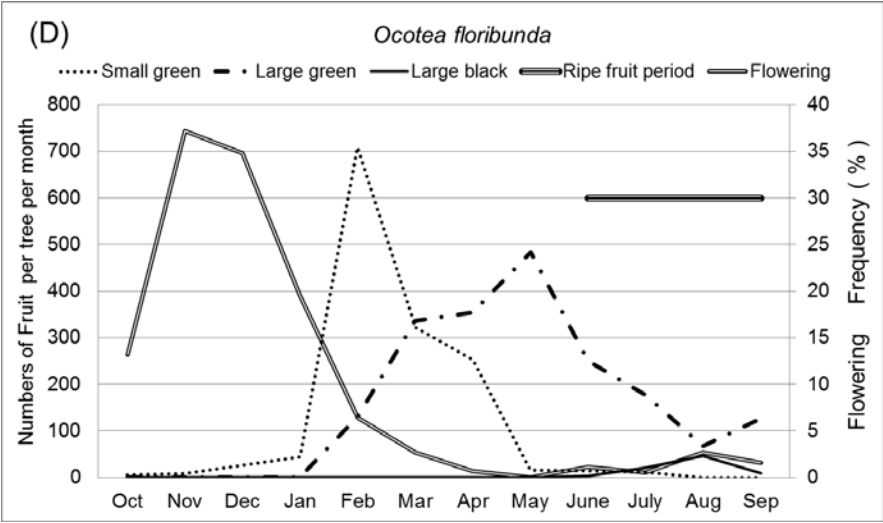
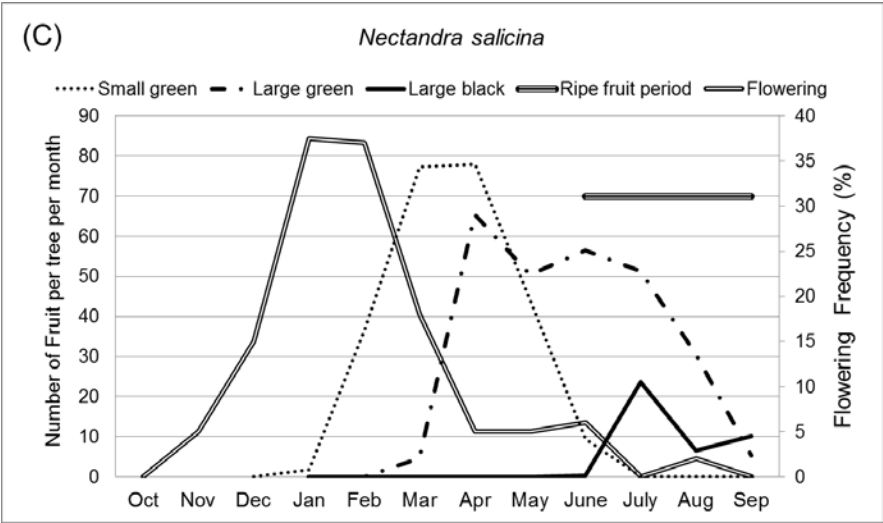
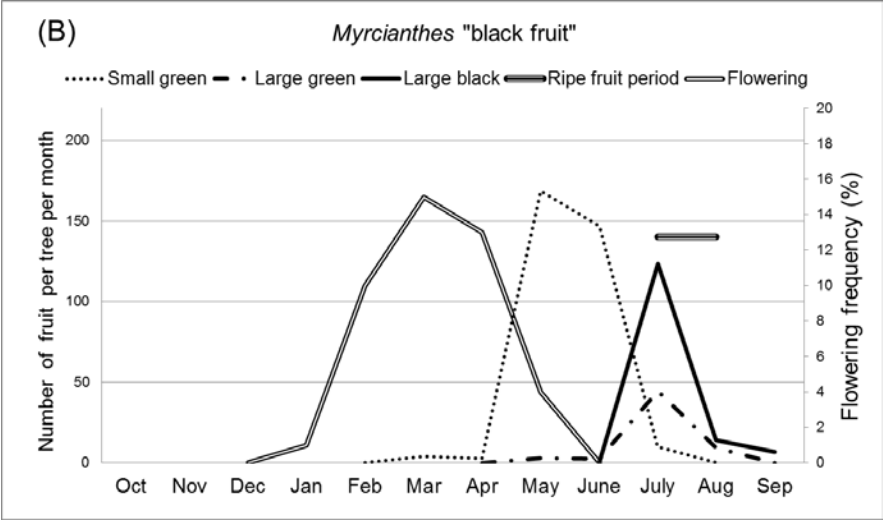


FIGURE S3. Phenology of flowering and fruiting in 6 principal species. Mean values per month of the year for the entire study period shown by species for flowering, small green fruit, large green fruit, and large black (mature) fruit. Flowering observations recorded as the percentage of trees that flowered ('full crown' or 'scattered') in a given month of the year averaged across the entire study. For the occasional months when observations were not made, values were extrapolated by averaging the preceding month and following month. For the sole dioecious species (*O. floribunda*), only trees determined to be female were included in the calculations. Fruiting is reported by month of year as the average number of fruit in a given size class per tree per month observed, using all individuals that fruited at least one time during the study. For species where the entire flowering and fruiting cycle required more than 12 months, and where fruiting occurred in a synchronized fashion in alternate years (*O. whitei*), 24-month cycles are depicted; years when flowering predominated are separated from the years when fruiting predominated.





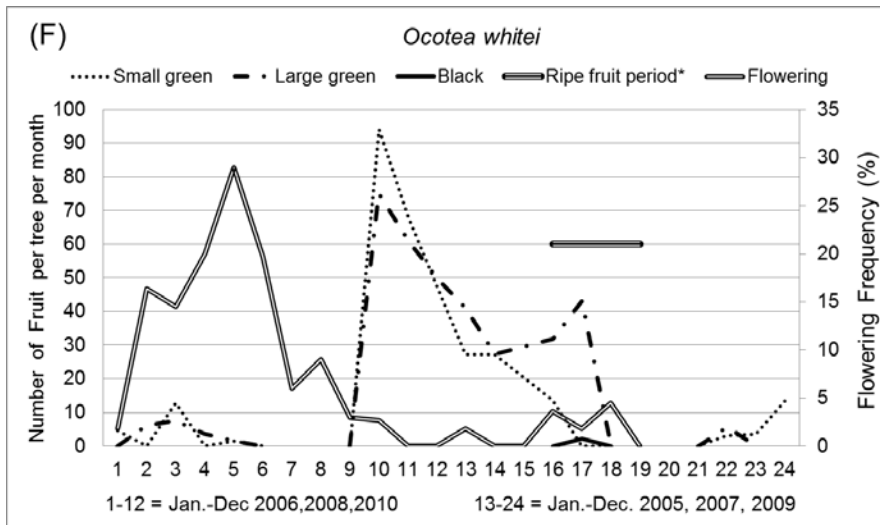
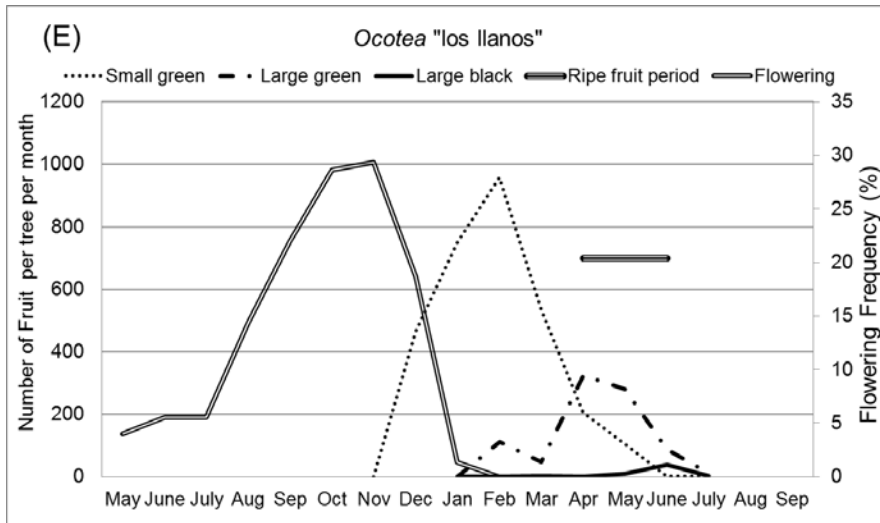


FIGURE S4. Relationships between diameter (A) and crown class (B) and fruit production by species. Crown classes based on Smith (1962): Dominant trees have crowns extending above the general canopy level, receiving full light from above and partly from the side; co-dominant crowns form the canopy, receiving full light from above but little from the sides; intermediate trees are shorter than two preceding classes, receiving sparse direct light from above and none from the sides; suppressed: crowns entirely below the canopy, receiving no direct light. Note: *Myrcianthes* not listed because all study trees were co-dominants, with diameters > 50 cm.

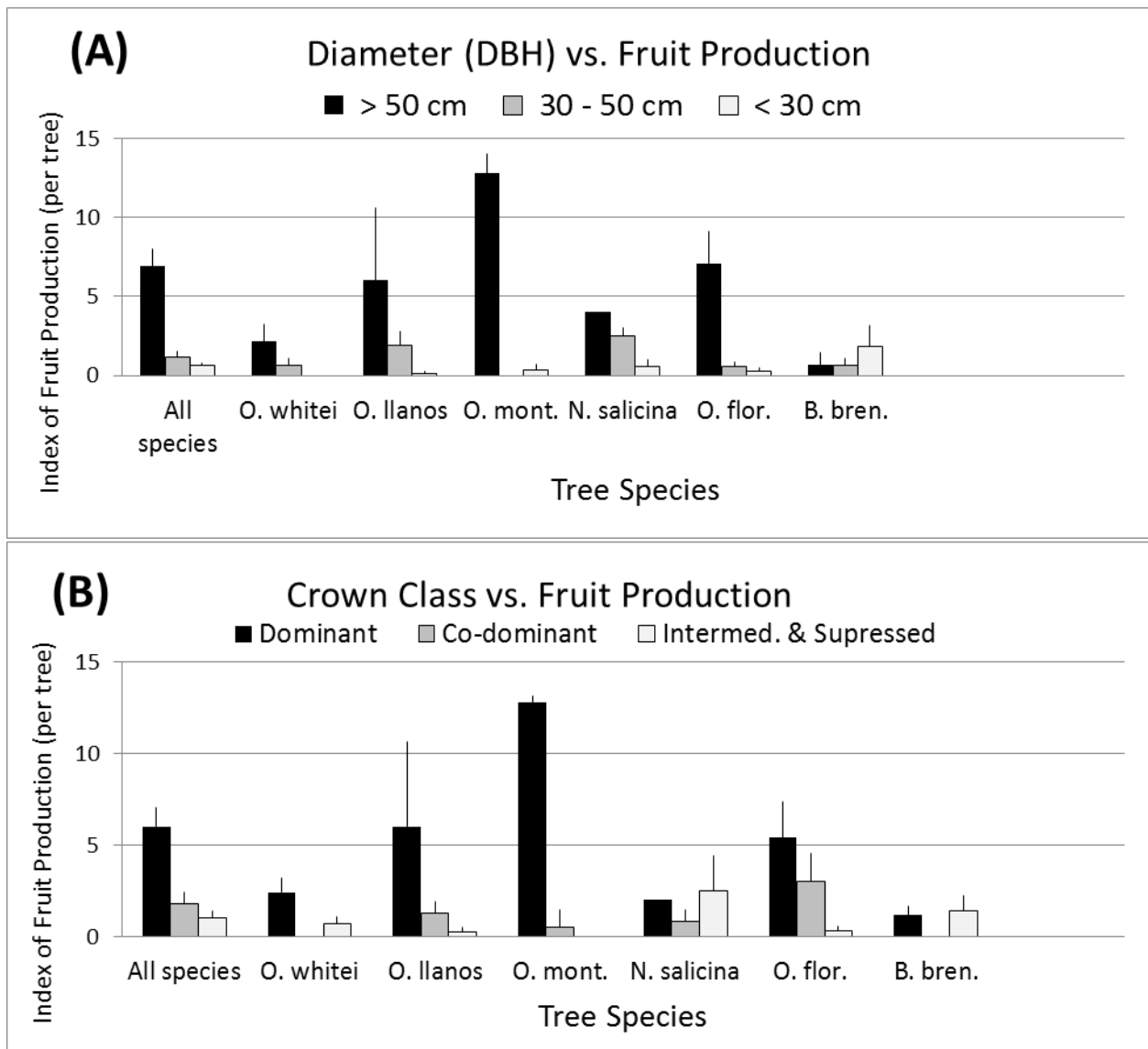


TABLE S1. *CHARACTERISTICS of Lauraceae fruit by species in the study, including records of frugivorous birds eating fruit. Fruit diameter data are based on means reported by Mazer and Wheelwright (1993), except O. whitei (Burger & van der Werff, 1992) and O. "los llanos" (estimated by authors). g = observed eating fruit of species by Guindon (1997), w = observed eating fruit of species in Wheelwright et al. (1984), a = observed eating fruit of species by authors, o = bird species observed by authors in tree species with ripe fruit, c = presence of bird species correlated (P < .01) with abundance of fruit of species (Guindon 1997). Bird species listed in descending order of size of gape.*

	<i>O. "los llanos"</i>	<i>O. floribunda</i>	<i>O. whitei</i>	<i>N. salicina</i>	<i>O. monteverdensis</i>	<i>B. brenesii</i>
Fruit diameter (cm)	1.7	1.75	1.8	1.84	1.85	2.31
Fruit size: (diameter) ² times length = (cm ³)	6.4	5.4	9.1	8.9	11.4	19.4
Keel-billed toucan (<i>Ramphastos sulfuratus</i>)	c	o, c	a	o, c	a, w	o
Emerald toucanet (<i>Aulacorhynchus prasinus</i>)		O	o	O	a, g, w	g, o
Three-wattled bellbird (<i>Procnias tricarunculatus</i>)	o, g, c	a, g, c	a	g, o, c	a, g, w	g, o
Crested guan (<i>Penelope purpurascens</i>)			a			
Black guan (<i>Chamaepetes unicolor</i>)					a, w	o
Oilbird (<i>Steatornis caripensis</i>)					A	
Brown jay (<i>Cyanocorax morio</i>)	o					o
Resplendent quetzal (<i>Pharomachrus mocinno</i>)		O		g	a, g, w	g, o, c
Orange-bellied trogon (<i>Trogon aurantiiventris</i>)		O	o		O	o
Red-billed pigeon (<i>Patagioenas flavirostris</i>)					O	
Squirrel cuckoo (<i>Piaya cayana</i>)					O	
Masked tityra (<i>Tityra semifasciata</i>)	o					
Swainson's thrush (<i>Catharus ustulatus</i>)	o	O				
Clay-colored thrush (<i>Turdus grayi</i>)	o					
Mountain thrush (<i>Turdus plebejus</i>)					o	o
Orange-billed nightingale-thrush (<i>Catharus aurantiirostris</i>)	o					

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APPENDIX S1. *Description of study tree species. While 16 tree species characteristic of the Premontane Wet Life Zone were studied—13 of them in the family Lauraceae— we provide species information for the six lauraceous species and one non-lauraceous species that were analyzed in this study. Four of these species range widely through the neotropics, while three are endemic to Mesoamerica. Descriptions below rely on information from Wheelwright et al. 1984; Burger & Van der Werff 1990; Mazer and Wheelwright 1999; Guindon 1997; Setzer et al. 1999; Leon & Poveda 2000; Van der Werff 2002; Haber et al. 2006; Setzer et al. 2006; Gonzalez & Poveda 2007; Cole et al. 2008; tropicos.org 2017; and W. Haber, pers. comm. A list of the remaining nine species originally tagged but not included in our results appears at the bottom of this appendix.*

Beilschmiedia breneisii C. K. Allen (common names: chanco, chanco colorado) is endemic to Costa Rica and Panama and is found on the Pacific slope of both countries between 500 and 1800 m elevation. In Panama it is known from the Chiriqui highlands, elevations 1400-1800 m. In Costa Rica it is confined to the Cordilleras de Guanacaste and Tilaran, chiefly between 1000 and 1500 m. It reaches a maximum height of 35 m, and its fruit is the largest of the 8 species, averaging 23 mm diameter, 36 mm in length.

***Myrcianthes* new species “black fruit”** is a species of the Myrtaceae family and occurs from 800 m to 1450 m on the Pacific slope of the Cordillera de Tilaran, from El Dos de Tilaran to San Rafael de Abangares to Monteverde and San Luis. It grows to 30 m and has red brown bark that peels in large flakes and strips. The globose fruit is 1.1 mm diameter, black when mature, seeds 1-2, kidney-shaped.

(<http://www.tropicos.org/Specimen/310796>, collection number, Haber 9275; also Haber 10596, 10601, 11057, and 11123)

Nectandra salicina C. K. Allen (ira coralillo) is largely confined to Costa Rica and Panama at 600 to 1950 m, though one specimen has been confirmed in southern Mexico. Like *B. breneisii*, it grows in the Chiriqui highlands of Panama (900 to 1950 m) and on the Pacific slope of the Cordilleras de Guanacaste and Tilaran in Costa Rica (500 to 1550 m). It is a small tree, reaching only 20 m, and has relatively large elongated fruit, 18.4 mm diameter, 26.3 mm length.

Ocotea floribunda (Sw.) Mez. (quizzara quina) ranges from the West Indies and Nicaragua to Bolivia and Venezuela. It can be found throughout much of Costa Rica up to 1500 m. On the Pacific slope, it is chiefly found between 1200 and 1500 m. It reaches a height of 40 m, and its round fruit averages 17.5 mm diameter.

Ocotea monteverdensis Burger (quizzara blanco) is endemic to the Cordillera de Tilaran in Costa Rica. On the Pacific slope of those mountains it grows between 1200 and 1500 m. It is a large tree (max. height 35 m) with large elongated fruit (avg. diam. 18.5 mm, avg. length 33.4 mm).

Ocotea new species “los llanos” is endemic to Pacific slope of Cordillera de Tilaran in Costa Rica between 800 and 1250 m, from El Dos de Tilaran to San Rafael de Abangares to Santa Elena. It grows to 25 m and mature round fruit is black in a red cupule (avg. diam. approx. 17 mm). (<http://www.tropicos.org/Specimen/892851>, collection number, Haber 11063)

Ocotea whitei Woodson (ira rosa, ira paton) ranges from Guatemala to Colombia where it grows from sea level to 2000 m. In Costa Rica it is chiefly found on the Pacific slope; in the Cordillera de Tilaran, it has only been found between 1300 and 1725 m. *O. whitei* can reach a height of 35 m, and its fruit averages 17.8 mm diameter, 28.1 mm in length.

Tree species tagged in the original study, but not analyzed as part of our results because insufficient fruit was produced during June-September for analysis– all are in the Lauraceae family unless otherwise

noted: *Beilschmiedia* “chancho blanco”; *Cinnamomum paratriplinerve*; *Cinnamomum* spp (previously identified as *triplinerve*); *Nectandra membranacea*; *Ocotea meziana*; *Persea americana*; *Persea* “small leaf”; *Hasseltia floribunda* (Family Flacourtiaceae) *Symplocus limoncillo* (Family Symplocaceae).

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