

Ackerman, J. D. and Roubik, D. W. 2012. Can extinction risk help explain plant–pollinator specificity among euglossine bee pollinated plants? – Oikos 121: 1821-1827.

Table A1. Plant species and their euglossine pollinators of Pipeline Road, Parque Nacional Soberiana, Panama. The stability index is the mean of the variance of the natural logarithm of annual abundance. The average bee abundance is based on the average number of bees per month censused when the plant was in flower. The bee abundance index = $\Sigma(\text{average bee abundance})(\text{relative frequency of the bee species as a pollinator of the plant species})$, which takes into account sampling effort and the relative importance of each bee species as a pollinator.

Plant Species	Reward system	Months flowering	Pollinators	Euglossine bee species	Pollinator frequency	Stability index (SI)	Combined SI_{adj}	Average bee abundance	Bee abundance index
<i>Aspasia principisa</i>	Nectar	6	6	<i>Exaerete frontalis</i>	42	-2.64	-2.17	4.28	7.12
	deception	JFMAMJ		<i>Eulaema meriana</i>	15	-1.18		10.8	
				<i>Eulaema nigrita</i>	2	-2.72		21.3	
				<i>Eulaema bombiformis</i>	3	-0.42		4.8	

				<i>Eulaema marcii</i>	2	-2.87		33.6	
				<i>Exaerete</i>	2	-0.91		0.25	
				<i>smaragdina</i>					
<i>Calathea latifolia</i> ^a	Nectar	6	3	<i>Euglossa imperialis</i>	14	-3.87	-2.58	116	65.78
		JASONDJ							
				<i>Exaerete</i>	4	-0.91		0.2	
				<i>smaragdina</i>					
				<i>Eulaema meriana</i>	8	-1.18		10	
<i>Calathea marantifolia</i> ^b	Nectar	5	2	<i>Eulaema marcii</i>		-2.87	-3.37	121.5	59.64
		ASOND							
				<i>Euglossa imperialis</i>		-3.87		341.9	
<i>Catasetum bicolor</i>	Fragrance	12	13	<i>Euglossa tridentata</i>	14	-2.91	-1.92	30.6	19.52
		JFMAMJJAS							
		OND							
				<i>Euglossa dissimula</i>	10	-1.77*		37.1	
				<i>Euglossa mixta</i>	5	-1.77*		8.5	
				<i>Euglossa cognata</i>	3	-0.49		10.7	
				<i>Euglossa variabilis</i>	3	-0.38		2.1	
				<i>Euglossa dodsoni</i>	2	-0.92		2.2	

				<i>Euglossa</i>	2	-1.77*		1.8	
				<i>gorgonensis</i>					
				<i>Euglossa deceptrix</i>	2	-1.77*		2.2	
				<i>Euglossa sapphirina</i>	2	-1.77*		7.1	
				<i>Euglossa</i>	1	-2.68		1	
				<i>heterosticta</i>					
				<i>Euglossa cybelia</i>	1	-1.77*		0.3	
				<i>Euglossa allosticta</i>	1	-2.65		4.2	
				<i>Euglossa bursigera</i>	1	-1.77*		11.6	
<i>Catasetum</i>	Fragrance	12	2	<i>Eulaema marcii</i>	119	-2.87	-2.87	23.4	23.33
<i>viridiflavum</i>		JFMAMJJAS							
		OND							
				<i>Eulaema nigrita</i>	1	-2.72		15.7	
<i>Clowesia</i>	Fragrance	5	2	<i>Eulaema</i>	22	-0.42	-0.71	4.0	4.46
<i>warscewizii</i>		NDJFM		<i>bombiformis</i>					
				<i>Eulaema nigrita</i>	1	-2.72		16.5	
<i>Coryanthes</i>	Fragrance	10	3	<i>Euglossa tridentata</i>	85	-2.91	-2.67	35.2	25.68
<i>“maculata”^f</i>		DJFMAMJJ							
		SO							

				<i>Euglossa milenae</i>	36	-2.1		2.1	
				<i>Euglossa despecta</i>	2	-2.46		38.7	
<i>Coryanthes</i>	Fragrance	8	2	<i>Euglossa dressleri</i>	12	-1.11	-1.06	16.4	15.85
<i>“speciosa”^f</i>		JJASONDJ							
				<i>Euglossa cognata</i>	1	-0.49		9.7	
<i>Costus allenii^g</i>	Nectar	5	2	<i>Euglossa imperialis</i>	38**	-3.87	-3.84	341.9	333.3
		MJJAS							
				<i>Exaerete frontalis</i>	1**	-2.64		12.2	0.3
<i>Costus laevis^g</i>	Nectar	7	2	<i>Euglossa imperialis</i>	38**	-3.87	-3.84	117.3	113.9
		JJASOND							
				<i>Exaerete frontalis</i>	1**	-2.64		3.9	
<i>Cycnoches</i>	Fragrance	4	5	<i>Euglossa cybelia</i>	2	-1.77	-2.01	0.2	28.53
<i>guttulatum</i>		JJAS							
				<i>Euglossa bursigera</i>	1	-1.77*		14.7	
				<i>Euglossa dissimula</i>	7	-2.71		29.4	
				<i>Euglossa cognata</i>	4	-0.49		15.4	
				<i>Euglossa imperialis</i>	1	-3.85		135.6	
<i>Dichaea panamensis</i>	Fragrance	8	9	<i>Euglossa tridentata</i>	37	-2.91	-2.08	40.5	127.3
		NDJFMAMJ							
				<i>Euglossa variabilis</i>	33	-0.38		2.9	
				<i>Euglossa dissimula</i>	29	-2.71		43.6	

				<i>Euglossa allosticta</i>	11	-2.65		5.1	
				<i>Euglossa cyanaspis</i>	5	-1.77*		0.7	
				<i>Euglossa despecta</i>	8	-1.77*		42.5	
				<i>Euglossa mixta</i>	5	-1.77*		9.1	
				<i>Euglossa</i>	3	-2.68		1.1	
				<i>heterosticta</i>					
				<i>Eufriesea pulchra</i>	2	-2.08		2.1	
<i>Gongora</i>	Fragrance	10	19	<i>Euglossa tridentata</i>	281	-2.91	-2.43	35.7	35.39
<i>quinquenervis</i>		DJFMAMJJA							
		S							
				<i>Euglossa despecta</i>	191	-1.77*		39.6	
				<i>Euglossa variabilis</i>	19	-0.38		2.5	
				<i>Euglossa imperialis</i>	17	-3.87		125.8	
				<i>Euglossa mixta</i>	10	-1.77*		9.7	
				<i>Euglossa</i>	12	-2.68		1.0	
				<i>heterosticta</i>					
				<i>Euglossa bursigera</i>	15	1.77*		12.5	
				<i>Euglossa cyanaspis</i>	4	1.77*		0.5	
				<i>Euglossa milenae</i>	3	-2.1		2.2	

				<i>Euglossa dissimula</i>	3	-2.71		42.6
				<i>Euglossa dressleri</i>	4	-1.11		11.8
				<i>Euglossa dodsoni</i>	1	-0.92		2.3
				<i>Euglossa townsendi</i>	1	1.77*		0.0
				<i>Euglossa cognata</i>	4	1.77*		12.1
				<i>Euglossa deceptrix</i>	3	1.77*		2.6
				<i>Euglossa</i>	3	1.77*		1.7
				<i>gorgonensis</i>				
				<i>Euglossa hansonii</i>	2	1.77*		2.1
				<i>Euglossa</i>	3	1.77*		0.2
				<i>hemichlora</i>				
				<i>Euglossa allosticta</i>	2	-2.65		4.0
<i>Gongora tricolor</i>	Fragrance	6	1	<i>Euglossa cyanura</i>	1	-1.77*	-1.77	
		FMAMJJ						
<i>Houlletia tigrina</i>	Fragrance		2	<i>Eulaema marcii</i>	2	-2.87	-2.82	120.5
				<i>Eulaema nigrita</i>	1	-2.72		63.5
<i>Kefersteinia lactea</i>	Fragrance		4	<i>Euglossa cybelia</i>	1	-1.77*	-2.09	1
				<i>Euglossa bursigera</i>	3	-1.77*		26.2
				<i>Euglossa tridentata</i>	2	-2.91		282.5

				<i>Euglossa dodsoni</i>	1	-1.77*		4.9	
<i>Kefersteinia</i>	Fragrance	4	2	<i>Euglossa deceptrix</i>	1	-1.77*	-1.77	1.7	5.573
<i>costaricensis</i>		JF JJ							
				<i>Euglossa mixta</i>	1	-1.77*		9.5	
<i>Macradenia</i>	Fragrance	4	2	<i>Euglossa</i>	1	-1.77*	-1.77	0.4	0.172
<i>brassavolae</i>		SOND		<i>villosiventris</i>					
				<i>Euglossa</i>	2 ^c	-1.77*		0.7	
				<i>hemichlora</i>					
<i>Mormodes cartonii</i>	Fragrance	4	1	<i>Euglossa variabilis</i>	2	-0.38	-0.38	4.0	4.003
		DJFM							
<i>Mormodes igneum</i>	Fragrance	4	1	<i>Euglossa dissimula</i>	28	-2.71	-2.71	30.8	30.83
		DJFM							
<i>Mormodes powellii</i>	Fragrance	5	1	<i>Euglossa tridentata</i>	82	-2.91	-2.91	52.1	52.11
		DJFMA							
<i>Notylia albida</i>	Fragrance	3	1	<i>Euglossa</i>	2	-1.77*	-1.77	0.2	0.153
		AMJ		<i>hemichlora</i>					
<i>Notylia barkeri</i>	Fragrance	6	3	<i>Euglossa tridentata</i>	28	-2.91	-2.6	51.7	48.58
		JFMAMJ							
				<i>Euglossa dissimula</i>	26	-2.71		54.5	
				<i>Euglossa variabilis</i>	5	-0.38		3.7	

<i>Notylia linearis</i>	Fragrance	5	3	<i>Euglossa dodsoni</i>	2	-0.92	-1.43	1.8	4.673
		JJASO D							
				<i>Eulossa dressleri</i>	1	-1.77*		18.5	
				<i>Euglossa deceptrix</i>	2	-1.77*		0.6	
<i>Notylia pentachne</i>	Fragrance	8	5	<i>Eulaema marcii</i>	136	-2.87	-2.62	27.7	25.39
		NDJFMAMJ							
				<i>Euglossa cognata</i>	11	-0.49		9.6	
				<i>Exaerete frontalis</i>	2	-2.64		3.5	
				<i>Eulaema meriana</i>	4	-1.18		9.3	
				<i>Eulaema</i>	2	-0.42		4.4	
				<i>bombiformis</i>					
<i>Peristeria elata</i>	Fragrance	4	3	<i>Eulaema nigrita</i>	1	-2.72	-2.09	10.8	3.562
		JJAS							
				<i>Eufriesea concava</i>	1	-1.77*			
				<i>Eufriesea</i>	1	-1.77*			
				<i>surinamensis</i>					
<i>Spathiphyllum</i>	Fragrance	12	12	<i>Eufriesea pulchra</i>	58	-2.08	-1.79	1.9	8.402
<i>friedrichsthali</i> ^c		JFMAMJJAS							
		OND							
				<i>Eulaema meriana</i>	43	-1.18		10.6	

				<i>Eulaema marcii</i>	41	-2.87		23.4	
				<i>Euglossa cognata</i>	40	-0.49		10.7	
				<i>Exaerete frontalis</i>	30	-2.64		3.8	
				<i>Euglossa mixta</i>	22	-1.77*		8.5	
				<i>Euglossa villosiventris</i>	20	-1.77*		0.2	
				<i>Eufriesea lucifer</i>	8	-1.77*			
				<i>Euglossa sapphirina</i>	5	-2.29		7.1	
				<i>Euglossa crassipunctata</i>	4	-0.27		4.7	
				<i>Eufriesea caribaea</i>	3	-1.77*			
				<i>Euglossa purpurea</i>	3	-1.77*			
<i>Spathiphyllum quinduense</i> ^d	Fragrance	6	3	<i>Euglossa tridentata</i>	1	-2.91	-1.76	16.8	7.275
		MJJASO		<i>Euglossa crassipunctata</i>	1	-0.27		4.9	
				<i>Euglossa cyanaspis</i>	1	-1.77*		0.3	
<i>Stanhopea costaricensis</i>	Fragrance	3	4	<i>Eulaema nigrata</i>	9	-2.72	-2.38	15.8	12.86
		MJJ							

				<i>Eulaema meriana</i>	1	-1.18		20.7	
				<i>Eufriesea</i>	2	-1.77*		2.1	
				<i>schmidtiana</i>					
				<i>Eulaema seabrai</i>	1	-1.77*			
<i>Stemmadenia</i>	Nectar	12	4	<i>Euglossa imperialis</i>	20	-3.87	-3.36	119.0	74.09
<i>grandiflora</i> ⁱ		JFMAMJJAS							
		OND							
				<i>Euglossa allosticta</i>	11	-2.65		4.2	
				<i>Eulaema</i>	1	-1.77*			
				<i>polychroma</i>					
				<i>Exaerete frontalis</i>	1	-2.64		3.8	
<i>Trichocentrum</i>	Fragrance	8	4	<i>Euglossa tridentata</i>	91	-2.91	-2.4	29.0	19.76
<i>capistratum</i>		ASONDJFM							
				<i>Euglossa bursigera</i>	56	-1.77*		7.9	
				<i>Euglossa variabilis</i>	5	-0.38		2.2	
				<i>Euglossa deceptrix</i>	6	-1.77*		2.6	
<i>Trichopilia maculata</i>	Fragrance	4	4	<i>Euglossa bursigera</i>	13	-1.77*	-2.32	9.0	22.53
		NDJF							
				<i>Euglossa imperialis</i>	2	-3.87		90.7	
				<i>Euglossa dissimula</i>	5	-2.71		21.4	

				<i>Euglossa tridentata</i>	4	-2.91		34.6	
<i>Trichopilia subulata</i>	Fragrance	5	2	<i>Euglossa dressleri</i>	2	-1.11	-1.33	19.3	12.91
	?	ASOND							
				<i>Eufriesea mussitans</i>	1	-1.77*			
<i>Vanilla planifolia</i>	Fragrance	5	1	<i>Euglossa tridentata</i>	27	-2.91	-2.91	59.1	59.05
	?	JFMAM							
<i>Vanilla pompona</i>	Fragrance	7	3	<i>Eulaema marcii</i>	43	-2.87	-2.76	30.9	28.74
	?	JFMAMJJ							
				<i>Eulaema nigrita</i>	5	-2.71		20.0	
				<i>Eulaema meriana</i>	3	-1.18		13.6	
<i>Warczewiczella</i>	Nectar	5	4	<i>Eulaema meriana</i>	66	-1.18	-1.07	6.9	6.398
<i>lipscombiae</i>	deception	NDJF							
				<i>Eulaema</i>	18	-0.42		4.1	
				<i>bombiformis</i>					
				<i>Eulaema marcii</i>	2	-2.87		15.4	
				<i>Eulaema nigrita</i>	1	-2.72		12.7	
				<i>Exaerete frontalis</i>	1	-2.64		1.3	
<i>Xiphidium</i>	Fragrance	5	1	<i>Euglossa</i>		-3.87	-3.87	127.4	127.4
<i>caeruleum</i> ^h	& pollen	JJASO		<i>imperialis</i>					

Note: frequency is based on the number of bees either seen visiting the flowers or by the number of bees seen with pollinaria (orchids only). Stability indices indicated by an asterisk (*) are estimated by taking the mid point between the lowest value of the most stable populations (-2.08) and the highest value of the least stable populations (-1.45). Only the most and least stable bee populations were reported in Roubik and Ackerman (1987). Pollinator frequencies indicated by a double asterisk (**) are estimated by their relative mean annual abundances from Roubik and Ackerman (1987). See methods for further explanation of the stability index (SI). Combined adjusted SI (SI_{adj}) takes into account the estimated relative importance of each bee species of a plant's pollinator pool. All plant species are Orchidaceae except *Calathea* spp. (Marantaceae), *Costus* spp. (Costaceae), *Spathiphyllum* spp. (Araceae), *Stemmadenia* (Apocynaceae), and *Xiphidium* (Haemodoraceae).

^aBased on actual number of visits observed. Data from Ackerman et al. (1982).

^bData from Kennedy (1978). Relative importance of pollinators not given; assumed to be equal.

^cBased on actual number of visits observed. Data from Montalvo and Ackerman (1986).

^dData from Williams and Dressler (1976). Relative importance of pollinators not given; assumed to be equal.

^eData from N.H. Williams (pers. comm.)

^fReported in the literature as *Coryanthes maculata* and *C. speciosa* (Ackerman 1983b), but subsequent taxonomic work indicates these species do not occur in the region. *Coryanthes picturata* and *C. panamensis* are present (G. Gerlach pers. comm.) but it is currently unclear to which pollinator pool they are associated.

^gPollinator and phenology data from Schemske (1981) and Kimsey (1979).

^hPollinator and phenology data from Buchmann (1980). Also uncommonly pollinated by *Paratetrapedia calcarata* (Apidae).

ⁱBased on Ackerman and A. M. Montalvo (unpubl.) and Ackerman (1985).