

Small vertebrates are key elements in the frugivory networks of a hyperdiverse tropical forest

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Electronic Supplemental Material 1

Climatic and vegetative characteristics of the study sites, located in Serra do Mar - Serra do Mar State Park – nucleus of Santa Virginia, Itamambuca and Vargem Grande; Serra de Paranapiacaba - Carlos Botelho State Park and Intervales and continental islands - Ilha do Cardoso State Park and Ilhabela State Park, in Brazil.

Site	Geographic coordinate	Area size (ha)	Vegetal cover	Annual temperature	Annual rainfall	Reference
Nucleus of Santa Virginia	23°25'S to 44°50'W	315.000	Atlantic ombrophiles dense forest (high and low lands), and secondary forest.	21°C	2.200 mm	São Paulo 2006
Carlos Botelho State Park	24° 06' S and 47° 47'	37.794	Dense ombrophiles forest (forest primary in step terrains, and by secondary forests in flat areas).	17°C to 22°C	1.700 to 2.400 mm	São Paulo 2008
Intervales State Park	24°15'S, 48°10'W	41.704	Dense ombrophiles forest (forest primary in step terrains, and by secondary forests in flat areas).	21°C	1.600 to 1.700	São Paulo 2008b
Ilha do Cardoso State Park	48°05'W and 25°03'S	15.100	Many types of ecosystems beaches, estuary, rivers, restinga forests, tropical rainforest of	21°C	2.300 mm	São Paulo 2001

Ilhabela State Park	23°57' S and 34.754 45°27' O	the coastal plain and mangroves. The natural areas were historically occupied by sugar cane and small artisanal industries, only in the twentieth century did activities cease and the secondary forests covered much of the perimeter of the island (about 84%). It presents vegetation types of dense ombrophiles lowland and submontane forest, dense montane ombrophiles forest and mountain refuges	22°C	1.500 mm	São Paulo 2015
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Electronic Supplemental Material 2

Abundance of visits (V) and frugivory (F) by birds and mammals in the Atlantic forest, São Paulo, Brazil.

Species/Taxa	Category	Diet	IUCN	Total		CB		SV-I		SV-VG		IC		INT		IB	
				V	F	V	F	V	F	V	F	V	F	V	F	V	F
<i>Tayassu pecari</i>	mammal	very large frugivore	VU	1258	40	51	0	766	28	3	0	438	12	0	0	0	0
<i>Tinamus solitarius</i>	bird	large frugivore	NT	525	56	173	19	30	6	38	5	21	0	113	12	150	14
<i>Turdus albicollis</i>	bird	medium frugivore	LC	491	26	82	2	68	6	42	0	232	16	22	2	45	0
<i>Geotrygon montana</i>	bird	medium frugivore	LC	384	14	24	3	5	0	8	0	294	9	18	2	35	0
<i>Odontophorus capueira</i>	bird	medium frugivore	LC	382	13	124	8	68	3	122	0	35	2	28	0	5	0
<i>Turdus rufiventris</i>	bird	medium frugivore	LC	360	2	4	0	241	0	102	2	7	0	5	0	1	0
Small rodents**	mammal		-	269	12	21	0	11	0	122	10	6	0	30	1	79	1
<i>Chamaeza</i> sp.	bird	omnivore	-	204	0	119	0	13	0	31	0	3	0	17	0	21	0
<i>Crypturellus obsoletus</i>	bird	medium frugivore	LC	191	5	34	3	18	1	108	0	9	1	22	0	0	0
<i>Cuniculus paca</i>	mammal	large frugivore	LC	190	34	69	21	31	13	33	0	0	0	17	0	40	0
<i>Guerlinguetus brasiliensis</i>	mammal	small frugivore	LC	164	83	37	23	27	33	34	10	0	0	3	0	63	17
<i>Formicarius colma</i>	bird	insectivore	LC	156	0	0	0	0	0	1	0	154	0	1	0	0	0
<i>Tapirus terrestris</i>	mammal	very large frugivore	VU	113	3	32	0	48	2	3	0	0	0	30	1	0	0
Sigmodontinae	mammal		-	107	13	6	2	14	0	71	10	1	0	5	0	10	1
<i>Trinomys iheringi</i>	mammal	small frugivore	-	101	15	16	0	0	0	33	11	0	0	0	0	52	4
<i>Grallaria varia</i>	bird	omnivore	LC	87	0	1	0	54	0	28	0	0	0	4	0	0	0
<i>Didelphis aurita</i>	mammal	medium frugivore	LC	80	1	6	1	8	0	8	0	2	0	26	0	30	0
<i>Pyriglena leucoptera</i>	bird	insectivore	LC	73	0	12	0	7	0	38	0	11	0	1	0	4	0
<i>Chamaeza meruloides</i>	bird	omnivore	LC	69	0	37	0	3	0	19	0	6	0	4	0	0	0

Species/Taxa	Category	Diet	IUCN	Total		CB		SV-I		SV-VG		IC		INT		IB	
				V	F	V	F	V	F	V	F	V	F	V	F	V	F
<i>Leptotila rufaxilla</i>	bird	medium frugivore	LC	67	1	4	0	32	0	8	1	1	0	2	0	20	0
<i>Pecari tajacu</i>	mammal	very large frugivore	LC	67	1	2	0	56	1	2	0	0	0	7	0	0	0
<i>Leptotila verreauxi</i>	bird	omnivore	LC	56	0	2	0	10	0	5	0	1	0	8	0	30	0
<i>Leptotila</i> sp.	bird	omnivore	-	52	0	7	0	16	0	10	0	2	0	1	0	16	0
<i>Conopophaga lineata</i>	bird	insectivore	LC	51	0	1	0	2	0	38	0	0	0	1	0	9	0
Didelphidae	mammal	--	-	50	4	0	0	1	0	13	2	1	0	29	2	6	0
<i>Puma concolor</i>	mammal	carnivore	LC	46	0	6	0	11	0	9	0	9	0	11	0	0	0
Rodentia (subfamília Sigmodontinae e família Echimyidae)	mammal	--	-	45	8	9	0	8	4	21	3	5	0	0	1	2	0
<i>Crypturellus</i> sp.	bird	medium frugivore	-	45	6	5	2	7	2	30	2	1	0	2	0	0	0
<i>Mazama</i> sp.	mammal	very large frugivore	-	45	1	18	1	0	0	0	0	11	0	16	0	0	0
<i>Sclerurus scansor</i>	bird	insectivore	LC	44	0	2	0	4	0	22	0	7	0	4	0	5	0
<i>Leopardus pardalis</i>	mammal	carnivore	LC	43	0	10	0	14	0	4	0	6	0	8	0	1	0
<i>Philander frenatus</i>	mammal	small frugivore	LC	41	0	24	0	4	0	2	0	0	0	0	0	11	0
<i>Chamaeza campanisona</i>	bird	small frugivore	LC	41	1	16	0	1	0	3	0	0	0	1	0	20	1
<i>Myrmoderus squamosus</i>	bird	insectivore	LC	41	0	8	0	4	0	25	0	2	0	0	0	2	0
<i>Penelope obscura</i>	bird	large frugivore	LC	41	20	27	8	6	12	3	0	4	0	1	0	0	0
<i>Dasypus novemcinctus</i>	mammal	omnivore	LC	38	0	1	0	1	0	1	0	2	0	0	0	33	0
<i>Nasua nasua</i>	mammal	medium frugivore	LC	35	0	30	0	5	0	0	0	0	0	0	0	0	0
<i>Marmosops</i> sp.	mammal	small frugivore	-	30	0	9	0	8	0	13	0	0	0	0	0	0	0
<i>Myiothlypis rivularis</i>	bird	insectivore	LC	29	0	0	0	5	0	19	0	5	0	0	0	0	0

Species/Taxa	Category	Diet	IUCN	Total		CB		SV-I		SV-VG		IC		INT		IB	
				V	F	V	F	V	F	V	F	V	F	V	F	V	F
<i>Turdus</i> sp.	bird	omnivore	-	26	0	2	0	17	0	4	0	2	0	1	0	0	0
<i>Canis lupus familiaris</i>	mammal	carnivore	LC*	25	0	2	0	3	0	4	0	7	0	1	0	8	0
<i>Metachirus nudicaudatus</i>	mammal	small frugivore	LC	22	0	4	0	1	0	7	0	8	0	1	0	1	0
<i>Cerdocyon thous</i>	mammal	carnivore	LC	20	0	1	0	0	0	4	0	13	0	2	0	0	0
<i>Turdus flavipes</i>	bird	small frugivore	LC	20	1	0	0	0	0	0	0	15	1	4	0	1	0
<i>Eira barbara</i>	mammal	medium frugivore	LC	17	5	4	0	6	5	3	0	0	0	4	0	0	0
<i>Aramides saracura</i>	bird	omnivore	LC	17	0	6	0	2	0	8	0	0	0	1	0	0	0
<i>Caracara plancus</i>	bird	omnivore	LC	17	0	0	0	17	0	0	0	0	0	0	0	0	0
<i>Baryphthengus ruficapillus</i>	bird	omnivore	LC	16	0	5	0	1	0	3	0	1	0	6	0	0	0
<i>Batara cinerea</i>	bird	omnivore	LC	16	0	6	0	0	0	10	0	0	0	0	0	0	0
<i>Oligoryzomys nigripes</i>	mammal	small frugivore	LC	15	5	7	1	8	4	0	0	0	0	0	0	0	0
<i>Aramides</i> sp.	bird	omnivore	-	12	0	0	0	0	0	11	0	0	0	1	0	0	0
<i>Myiothlypis</i> sp.	bird	insectivore	-	12	0	0	0	4	0	6	0	2	0	0	0	0	0
<i>Schiffornis virescens</i>	bird	omnivore	LC	12	0	2	0	1	0	3	0	5	0	0	0	1	0
<i>Conopophaga melanops</i>	bird	insectivore	LC	11	0	2	0	0	0	2	0	0	0	4	0	3	0
<i>Habia rubica</i>	bird	omnivore	LC	10	0	7		1	0	0	0	2	0	0	0	0	0
<i>Dasypus</i> sp.	mammal	omnivore	-	9	0	0	0	0	0	0	0	0	0	1	0	8	0
<i>Aburria jacutinga</i>	bird	large frugivore	EN	9	0	1	0	0	0	0	0	0	0	2	0	6	0
Dendrocolaptidae	bird	--		8	0	0	0	2	0	0	0	6	0	0	0	0	0
<i>Leopardus guttulus</i>	mammal	carnivore	VU	7	0	0	0	2	0	5	0	0	0	0	0	0	0
Marsupialia	mammal	--	-	7	0	2	0	1	0	4	0	0	0	0	0	0	0
<i>Trichothraupis melanops</i>	bird	omnivore	LC	7	0	0	0	0	0	0	0	7	0	0	0	0	0

Species/Taxa	Category	Diet	IUCN	Total		CB		SV-I		SV-VG		IC		INT		IB	
				V	F	V	F	V	F	V	F	V	F	V	F	V	F
<i>Leopardus wiedii</i>	mammal	carnivore	NT	6	0	3	0	2	0	1	0	0	0	0	0	0	0
<i>Leopardus</i> sp.	mammal	carnivore	-	4	0	0	0	0	0	1	0	0	0	2	0	1	0
<i>Myrmecophaga tridactyla</i>	mammal	insectivore	VU	4	0	0	0	0	0	0	0	0	0	4	0	0	0
<i>Tamandua tetradactyla</i>	mammal	insectivore	LC	4	0	1	0	0	0	0	0	1	0	1	0	1	0
<i>Lepus capensis</i>	mammal	herbivore	LC	3	0	3	0	0	0	0	0	0	0	0	0	0	0
<i>Puma yagouaroundi</i>	mammal	carnivore	LC	3	0	0	0	0	0	2	0	1	0	0	0	0	0
<i>Sapajus apella</i>	mammal	medium frugivore	LC	3	1	2	0	0	0	0	0	0	0	0	0	1	1
<i>Sylvilagus brasiliensis</i>	mammal	herbivore	LC	3	0	0	0	3	0	0	0	0	0	0	0	0	0
<i>Automolus leucophthalmus</i>	bird	insectivore	LC	3	0	0	0	0	0	0	0	3	0	0	0	0	0
<i>Drymophila squamata</i>	bird	insectivore	LC	3	0	0	0	0	0	0	0	3	0	0	0	0	0
<i>Merulaxis ater</i>	bird	insectivore	NT	3	0	0	0	0	0	2	0	0	0	0	0	1	0
<i>Tachyphonus coronatus</i>	bird	omnivore	LC	3	0	2	0	0	0	0	0	0	0	0	0	1	0
<i>Cabassous</i> cf. <i>tatouay</i>	mammal	insectivore	LC	2	0	0	0	0	0	0	0	1	0	0	0	1	0
<i>Monodelphis</i> cf. <i>americana</i>	mammal	small frugivore	LC	2	0	1	0	1	0	0	0	0	0	0	0	0	0
<i>Procyon cancrivorus</i>	mammal	very large frugivore	LC	2	0	0	0	0	0	0	0	0	0	2	0	0	0
<i>Falco femoralis</i>	bird	carnivore	LC	2	0	0	0	2	0	0	0	0	0	0	0	0	0
Strigidae	bird	--	-	2	0	0	0	0	0	1	0	1	0	0	0	0	0
<i>Dasyprocta leporina</i>	mammal	medium frugivore	LC	1	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Didelphis</i> sp.	mammal	medium frugivore	-	1	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Felis silvestris catus</i>	mammal	carnivore	LC*	1	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Lontra longicaudis</i>	mammal	carnivore	NT	1	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Marmosops</i> cf. <i>incanus</i>	mammal	small frugivore	LC	1	0	0	0	0	0	0	0	0	0	1	0	0	0

Species/Taxa	Category	Diet	IUCN	Total		CB		SV-I		SV-VG		IC		INT		IB	
				V	F	V	F	V	F	V	F	V	F	V	F	V	F
<i>Marmosa</i> (Micoureus)	mammal	small frugivore	-	1	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Panthera onca</i>	mammal	carnivore	NT	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Amadonastur lacernulatus</i>	bird	carnivore	VU	1	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Celeus flavescens</i>	bird	omnivore	LC	1	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Colaptes melanochloros</i>	bird	omnivore	LC	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Crypturellus tataupa</i>	bird	omnivore	LC	1	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Cyanocorax caeruleus</i>	bird	medium frugivore	NT	1	4	0	0	0	0	0	0	1	4	0	0	0	0
<i>Hypoedaleus guttatus</i>	bird	insectivore	LC	1	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Laterallus</i> sp.	bird	omnivore	-	1	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Lochmias nematura</i>	bird	insectivore	LC	1	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Micrastur semitorquatus</i>	bird	carnivore	LC	1	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Myiothlypis leucoblephara</i>	bird	insectivore	LC	1	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Penelope</i> sp.	bird	large frugivore	-	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Philydor rufum</i>	bird	insectivore	LC	1	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Platyrinchus mystaceus</i>	bird	insectivore	LC	1	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Ramphocelus bresilius</i>	bird	small frugivore	LC	1	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Rupornis magnirostris</i>	bird	omnivore	LC	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Sittasomus griseicapillus</i>	bird	insectivore	LC	1	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Urubitinga urubitinga</i>	bird	carnivore	LC	1	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Xiphocolaptes albicollis</i>	bird	omnivore	LC	1	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Ramphastos vitellinus</i>	bird	large frugivore	VU	0	1	0	0	0	0	0	0	0	1	0	0	0	0

*Domestic species. **Small rodents: small mammal rodents unidentified. States Parks in CB: Carlos Botelho; SV-I: Itamambuca, SV-VG: Vargem Grande, IC. Ilha do Cardoso, INT: Intervales, IB: Ilhabela. IUCN: Red List of Threatened Species – LC: least concern, NT: near threatened, VU: vulnerable, EN: endangered. *Visits = number of visits per site, Freq=frequency, States Parks in CB: Carlos Botelho; SV-I: Itamambuca, SV-VG: Vargem Grande, IC. Ilha do Cardoso, IB: Ilhabela, INT: Intervales.

Electronic Supplemental Material 3

Defaunation index of sampling sites in the Atlantic Forest, Brazil. The index is based on the frequency of species of medium and large mammals and their body mass in a reference area (Giacomini and Galetti, 2013) and in the States Parks in CB: Carlos Botelho; SV-I: Itamambuca, SV-VG:

Taxon	Frequency (%)	CB (visits)	CB (freq.)	SV-I (visits)	SV-I (freq.)	SV-VG (visits)	SV-VG (freq.)	IC (visits)	IC (freq.)	IB (visits)	IB (freq.)	INT (visits)	INT (freq.)
<i>Dasyprocta</i> sp.	87.69	0	0.00	0	0.00	1	3.44	0	0.00	0	0	0	0,00
<i>Dasytus</i> sp.	76.15	1	3.33	1	4.16	1	3.44	1	4.16	8	40	1	4,16
<i>Eira barbara</i>	72.31	3	10.00	7	29.16	3	10.34	0	0.00	0	0	4	16,66
<i>Leopardus</i> sp.	56.92	8	26.66	11	45.83	5	17.24	4	16.66	2	10	7	29,16
<i>Mazama</i> sp.	69.23	8	26.66	0	0.00	0	0.00	4	16.66	0	0	6	25,00
<i>Nasua nasua</i>	73.08	3	10.00	2	8.33	0	0.00	0	0.00	0	0	0	0,00
<i>Panthera onca</i>	26.15	0	0.00	0	0.00	0	0.00	0	0.00	0	0	1	4,16
<i>Pecari tajacu</i>	69.23	1	3.33	4	16.66	1	3.44	0	0.00	0	0	3	12,50
<i>Puma concolor</i>	51.54	4	13.33	7	29.16	8	27.58	3	12.50	0	0	5	20,83
<i>Tapirus terrestris</i>	38.46	13	43.33	10	41.66	2	6.89	0	0.00	0	0	10	41,66
<i>Tayassu pecari</i>	33.08	6	20.00	14	58.33	1	3.44	14	58.33	0	0	0	0,00
Defaunation index			0.31		0.23		0.73		0.68		0.93		0.32

Vargem Grande, IC. Ilha do Cardoso, IB: Ilhabela, INT: Intervales.

Electronic Supplemental Material 4

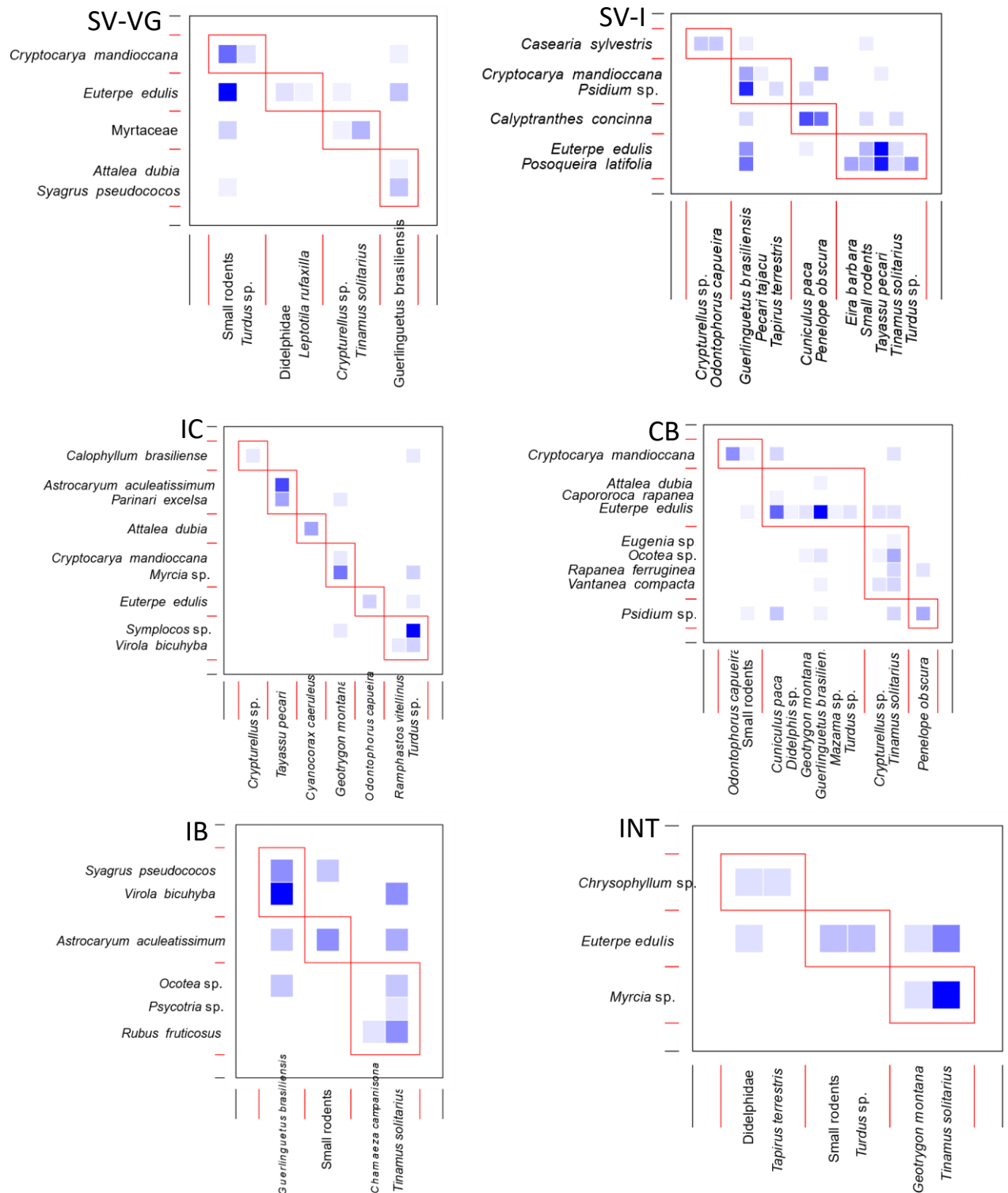


Fig 4 Modules in the plant–frugivore interaction matrix. The matrix shows the most common modules. The intensity of shades of blue represents the interaction frequency. The darker the blue the greater the number of interactions performed in the Atlantic forest, Brazil. State Parks: SV-I – Itamambuca, CB - Carlos Botelho, INT- Intervales, SV-VG -Vargem Grande, IC - Ilha do Cardoso and IB -Ilhabela.

Electronic Supplemental Material 5

Species strength of species of mammals, birds and trees in the Atlantic forest, Brazil.
State Parks: SV-I – Itamambuca, CB - Carlos Botelho, INT- Intervalles, SV-VG -Vargem Grande, IC - Ilha do Cardoso and IB -Ilhabela.

		Species strenght					
	Species	CB	INT	SV-I	SV-VG	IC	IB
Mammals	<i>Cuniculus paca</i>	1.76	--	0.57	--	--	--
	Didelphidae	--	0.60	--	0.08	--	--
	<i>Didelphis aurita</i>	0.03	--	--	--	--	--
	<i>Eira barbara</i>	--	--	0.13	--	--	--
	<i>Guerlinguetus brasiliensis</i>	1.88	--	1.84	2.04	--	2.08
	<i>Mazama</i> sp.	0.03	--	--	--	--	--
	<i>Pecari tajacu</i>	--	--	0.09	--	--	--
	<i>Small rodents</i>	0.16	0.20	0.46	1.98	--	0.78
	<i>Tapirus terrestris</i>	--	0.50	0.12	--	--	--
	<i>Tayassu pecari</i>	--	--	0.95	--	1.80	--
Birds	<i>Chamaeza campanisona</i>	--	--	--	--	--	0.20
	<i>Crypturellus</i> sp.	0.48	--	0.37	0.15	0.50	--
	<i>Cyanocorax caeruleus</i>	--	--	--	--	1.00	--
	<i>Geotrygon montana</i>	0.15	0.21	--	--	2.03	--
	<i>Leptotila rufaxilla</i>	--	--	--	0.04	--	--
	<i>Odontophorus capueira</i>	0.57	--	0.37	--	0.67	--
	<i>Penelope obscura</i>	0.80	--	0.69	--	--	--
	<i>Ramphastos vitellinus</i>	--	--	--	--	0.33	--
	<i>Tinamus solitarius</i>	3.09	1.29	0.21	0.55	--	2.94
	<i>Turdus albicollis</i>	0.05	0.20	0.15	--	--	--
	<i>Turdus rubiventris</i>	--	--	--	0.15	--	--
	<i>Turdus</i> sp.	--	--	--	--	2.67	--
	<i>Plants</i>						
Plants	<i>Astrocaryum aculeatissimum</i>	--	--	--	--	0.67	0.10
	<i>Attalea dubia</i>	0.04	--	--	0.10	1.00	--
	<i>Calophyllum brasiliense</i>	--	--	--	--	1.06	--
	<i>Calypttranthes concinna</i>	--	--	2.01	--	--	--
	<i>Capororoca rapanea</i>	0.05	--	--	--	--	--

<i>Casearia sylvestris</i>	--	--	2.12	--	--	--
<i>Chrysophyllum</i> sp.	--	1.50	--	--	--	--
<i>Cryptocarya mandioccana</i>	1.59	--	1.52	1.42	0.11	--
<i>Eugenia</i> sp.	0.05	--	--	--	--	--
<i>Euterpe edulis</i>	5.86	3.33	1.45	3.45	1.06	--
<i>Myrcia</i> sp.	--	1.17	--	--	0.78	--
Myrtaceae	--	--	--	1.60	--	--
<i>Ocotea</i> sp.	0.92	--	--	--	--	0.26
<i>Parinari excelsa</i>	--	--	--	--	0.44	--
<i>Posoqueira latifolia</i>	--	--	3.40	--	--	--
<i>Psidium</i> sp.	1.49	--	1.51	--	--	--
<i>Psycotria</i> sp.	--	--	--	--	--	0.07
<i>Rapanea ferruginea</i>	0.40	--	--	--	--	--
<i>Rubus fruticosus</i>	--	--	--	--	--	1.28
<i>Syagrus pseudococos</i>	--	--	--	0.43	--	0.57
<i>Symplocos</i> sp.	--	--	--	--	0.76	--
<i>Vantanea compacta</i>	0.59	--	--	--	--	--
<i>Virola bicuhyba</i>	--	--	--	--	1.12	0.81

