SUPPLEMENTARY MATERIAL

Villegas, M., et al. (2024) Bird communities respond to the seasonal fruit and flower availability in a fragmented tropical Andean landscape. Ornitología Neotropical 35: 38–45

Supporting Figures

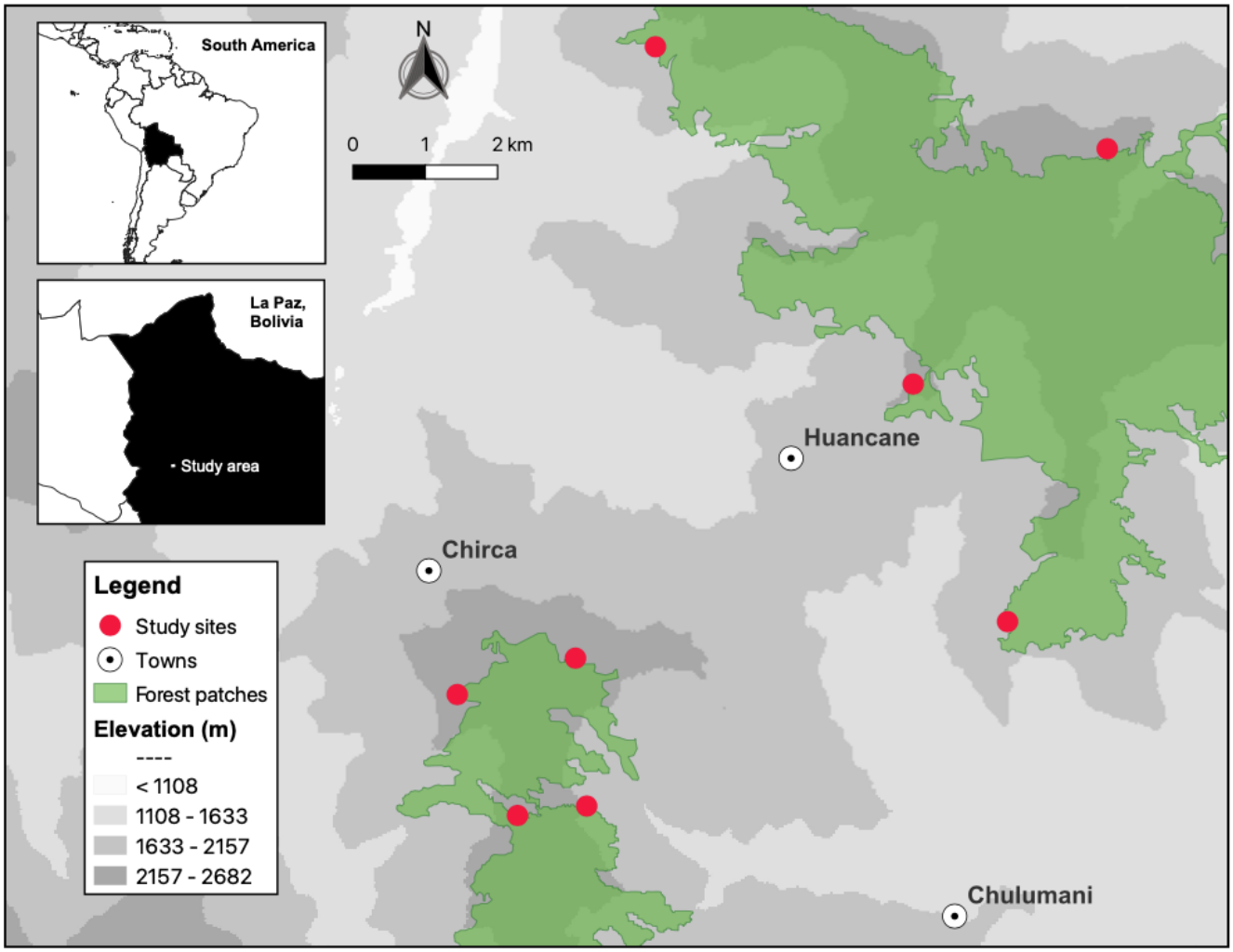

Figure S1. Study area located northwest of Chulumani, Sud Yungas province, department of La Paz, Bolivia. Our eight study sites were located on the borders of two large forest remnants.

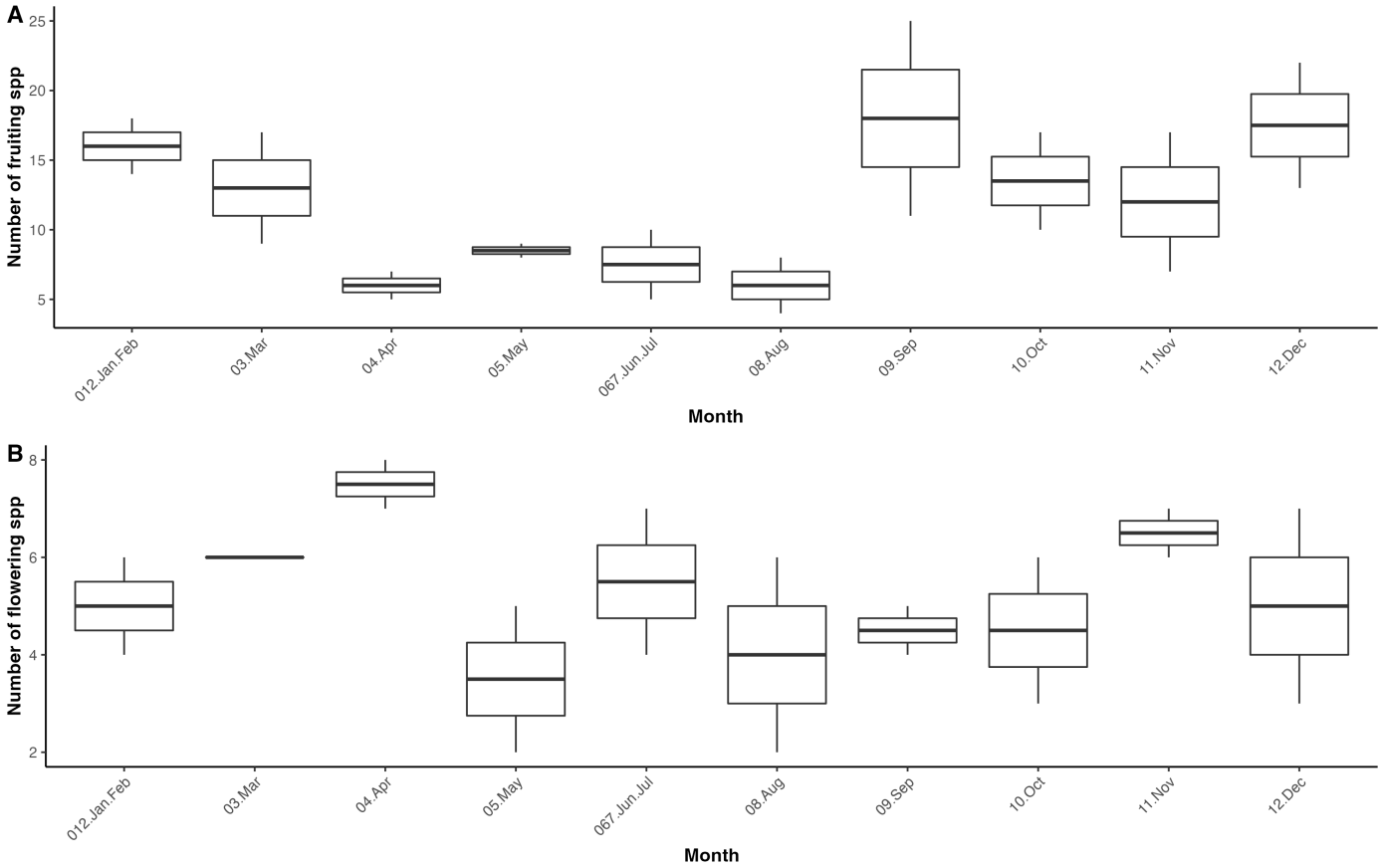

Figure S2. Number of A) fruiting and B) flowering plant species throughout the sampling year. This year encompassed the following three seasons: transition (August until November 2020), wet (between December 2020 to March 2021) and dry season (May until June-July 2021).

Supporting Tables

Table S1. List of plant species and morphospecies whose fruits and/or flowers are typically consumed by birds. Cell colors represent the timing of fruiting plant species (dark grey cells), timing of flowering plant species (light grey cells) and timing of both fruiting and flowering plant species (light blue). We recorded reproductive phenology during the three seasons of the study (Aug 2020 until Jun-Jul 2021). Plant habitat affinity was based on plant abundance, expert knowledge (S. Gallegos and C. López), and literature review (e.g., Killeen et al. 1993).

				Transition				Rainy			Dry		
Family	**Species / morpho-species**	**Resource consumed by birds**	**Habitat affinity**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan-Feb**	**Mar**	**Apr**	**May**	**Jun-Jul**
ACANTHACEAE	Ruellia haenkeana	Flowers	Forest edge										
ACANTHACEAE	Justicia boliviensis	Flowers	Forest edge										
ACTINIDACEAE	Saurauia peruviana	Fruits	Forest edge										
AMARILIDACEAE	Hippeastrum sp. 1	Flowers	Forest edge										
ARALIACEAE	Oreopanax membranaceus	Fruits	Forest edge										
ARALIACEAE	Oreopanax trollii	Fruits	Forest edge										
ARECACEAE	Arecaceae sp. 1	Fruits	Forest edge										
ARECACEAE	Syagrus sp. 1	Fruits	Bracken										
CAMPANULACEAE	Siphocampylus orbignianus	Flowers	Bracken										
CAMPANULACEAE	Siphocampylus corymbifer	Flowers	Bracken										
CAMPANULACEAE	Siphocampylus andinus	Flowers	Forest edge										
CHLORANTHACEAE	Hedyosmum angustifolium	Fruits	Forest edge										
CHLORANTHACEAE	Hedyosmum racemosum	Fruits	Forest edge										
CHLORANTHACEAE	Hedyosmum cuatrecazanum	Fruits	Forest edge										
CLUSIACEAE	Clusia lechleri	Fruits	Forest edge										
CLUSIACEAE	Clusia cf. lechleri	Fruits	Forest edge										
CLUSIACEAE	Clusia elongata	Fruits	Forest edge										
CLUSIACEAE	Clusia trochiformis	Fruits	Forest edge										
CONVOLVULACEAE	Ipomoea sp. 1	Flowers	Forest edge										
CONVOLVULACEAE	Ipomoea cairica	Flowers	Forest edge										
CONVOLVULACEAE	Ipomoea alba	Flowers	Forest edge										
CUCURBITACEAE	Cucurbitaceae SGA5135	Fruits	Forest edge										
CUCURBITACEAE	Cucurbitaceae SGA5136	Fruits	Forest edge										
ERICACEAE	Gaultheria reticulata	Fruits	Bracken										
ERICACEAE	Gaultheria erecta	Fruits	Bracken										
ERICACEAE	Gaultheria eriophylla	Fruits	Bracken										
ERICACEAE	Bejaria aestuans	Flowers	Bracken										
ERICACEAE	Cavendishia pubescens	Both	Bracken										
ERICACEAE	Cavendishia martii	Both	Bracken										
ERICACEAE	Gaultheria cf. buxifolia	Fruits	Bracken										
ERICACEAE	Thibaudia crenulata	Both	Forest edge										
ERICACEAE	Diogenesia cf. boliviana	Fruits	Burned										
ESCALLONIACEAE	Escallonia paniculata	Fruits	Burned										
EUPHORBIACEAE	Alchornea glandulosa	Fruits	Forest edge										
EUPHORBIACEAE	Alchornea triplinervia var. boliviana	Fruits	Forest edge										
EUPHORBIACEAE	Alchornea triplinervia var. sabana	Fruits	Bracken										
EUPHORBIACEAE	Alchornea triplinervia var. montana	Fruits	Forest edge										
EUPHORBIACEAE	Tetrorchidium cf. andinum	Fruits	Forest edge										
EUPHORBIACEAE	Acalypha sp. 1	Fruits	Forest edge										
HELICONIACEAE	Heliconia sp. 1	Flowers	Forest edge										
HELICONIACEAE	Heliconia sp. 2	Flowers	Forest edge										
HELICONIACEAE	Heliconia subulata	Both	Forest edge										
LAURACEAE	Nectandra cuspidata	Fruits	Forest edge										
LAURACEAE	Ocotea solomonii	Fruits	Bracken										
LAURACEAE	Ocotea comata	Fruits	Forest edge										
LAURACEAE	Ocotea puberula	Fruits	Bracken										
LAURACEAE	Persea caerulea	Fruits	Forest edge										
LAURACEAE	Persea sp.	Fruits	Bracken										
LAURACEAE	Beilschmiedia latifolia	Fruits	Forest edge										
LAURACEAE	Nectandra acutifolia	Fruits	Forest edge										
LEGUMINOSAE	Erythrina falcata	Both	Forest edge										

LEGUMINOSAE	Inga fendleriana	Both	Forest edge										
LEGUMINOSAE	Collaea speciosa	Flowers	Bracken										
LEGUMINOSAE	Inga adenophylla	Both	Bracken										
LEGUMINOSAE	Erythrina poeppigiana	Flowers	Forest edge										
LORANTHACEAE	Passovia cf. beckii	Fruits	Forest edge										
LORANTHACEAE	Gaiadendron punctatum	Both	Bracken										
LORANTHACEAE	Phoradendron undulatum	Fruits	Forest edge										
LYTHRACEAE	Cuphea cordata	Flowers	Bracken										
MALPIGHIACEAE	Byrsonima crassifolia	Flowers	Bracken										
MALVACEAE	Calianthe sp. 1	Flowers	Forest edge										
MELASTOMATACEAE	Miconia cyanocarpa var. hirsuta	Fruits	Bracken										
MELASTOMATACEAE	Meriania brittoniana	Flowers	Forest edge										
MELASTOMATACEAE	Tibouchina granulosa	Flowers	Bracken										
MELASTOMATACEAE	Tibouchina bicolor	Flowers	Forest edge										
MELASTOMATACEAE	Miconia cordata	Fruits	Forest edge										
MELASTOMATACEAE	Miconia cf. dolichorrhyncha	Fruits	Forest edge										
MELASTOMATACEAE	Miconia theaezans	Fruits	Bracken										
MELASTOMATACEAE	Miconia elongata	Fruits	Forest edge										
MELASTOMATACEAE	Miconia calvescens	Fruits	Forest edge										
MELASTOMATACEAE	Miconia sessilifolia	Fruits	Bracken										
MELASTOMATACEAE	Miconia minutiflora	Fruits	Bracken										
MELASTOMATACEAE	Miconia plumifera	Fruits	Forest edge										
MELASTOMATACEAE	Miconia aff. cordata	Fruits	Bracken										
MELASTOMATACEAE	Miconia staphidioides	Fruits	Forest edge										
MELASTOMATACEAE	Miconia aff. brittonii	Fruits	Forest edge										
MELASTOMATACEAE	Miconia cf. leacrenata	Fruits	Bracken										
MELASTOMATACEAE	Miconia hygrophila	Fruits	Bracken										
MELASTOMATACEAE	Miconia uvifera	Fruits	Forest edge										
MELASTOMATACEAE	Miconia micropetala	Fruits	Forest edge										
MELASTOMATACEAE	Leandra carassana	Fruits	Bracken										
MELASTOMATACEAE	Miconia sp. 1	Fruits	Forest edge										
MELASTOMATACEAE	Miconia sp.18	Fruits	Forest edge										
MONIMIACEAE	Mollinedia repanda	Fruits	Forest edge										
MORACEAE	Ficus sp. SGA 5236	Fruits	Forest edge										
MORACEAE	Ficus americana subsp. guianensis	Fruits	Forest edge										
MORACEAE	Ficus cuatrecasasiana	Fruits	Forest edge										
MYRICACEAE	Morella pubescens	Fruits	Bracken										
MYRSINACEAE	Myrsine coriacea	Fruits	Bracken										
MYRSINACEAE	Myrsine cf. latifolia	Fruits	Bracken										
MYRTACEAE	Myrcia splendens	Both	Bracken										
MYRTACEAE	Myrcia fenzliana	Fruits	Forest edge										
MYRTACEAE	Myrcia paivae	Both	Bbracken										
MYRTACEAE	Myrcia cf. lonchophylla	Fruits	Bracken										
MYRTACEAE	Myrcia cf. fallax	Fruits	Bracken										
MYRTACEAE	Psidium guineense	Both	Bracken										
MYRTACEAE	Eucalyptus camaldulensis	Flowers	Bracken										
MYRTACEAE	Myrcia fallax	Fruits	Forest edge										
MYRTACEAE	Myrcia sp. 1	Fruits	Forest edge										
ONAGRACEAE	Fuchsia boliviana	Both	Forest edge										
PHYLLANTACEAE	Hieronyma fendleri	Fruits	Bracken										
PHYLLANTACEAE	Hieronyma fendleri var. boliviensis	Fruits	Bracken										
PHYLLANTACEAE	Hyeronima vel. Sp. Nov	Fruits	Forest edge										
PHYTOLACCACEAE	Phytolacca bogotensis	Fruits	Forest edge										
PIPERACEAE	Piper elongatum	Fruits	Bracken										
PIPERACEAE	Piper bangii	Fruits	Forest edge										
POLEMONIACEAE	Cobaea scandens	Fruits	Forest edge										
POLYGALACEAE	Monnina pseudostipulata	Fruits	Forest edge										
RHAMNACEAE	Rhamnus sphaerosperma	Fruits	Forest edge										
ROSACEAE	Hesperomeles ferruginea	Fruits	Forest edge										
ROSACEAE	Rubus boliviensis	Fruits	Forest edge										
RUBIACEAE	Palicourea flavifolia	Both	Forest edge										
RUBIACEAE	Palicourea (Psychotria) reticulata	Fruits	Forest edge										
RUBIACEAE	Palicourea (Psychotria) tristis	Fruits	Forest edge										

RUBIACEAE	Palicourea cf. tristis	Fruits	Forest edge										
RUBIACEAE	Palicourea attenuata	Fruits	Forest edge										
RUBIACEAE	Palicourea cf. amethystina	Fruits	Forest edge										
RUBIACEAE	Palicourea amethystina	Both	Forest edge										
RUBIACEAE	Palicourea buchtienii	Fruits	Forest edge										
RUBIACEAE	Palicourea bryophila	Fruits	Forest edge										
RUBIACEAE	Palicourea cf. stipularis	Fruits	Forest edge										
RUBIACEAE	Psychotria carthagenensis	Fruits	Forest edge										
RUBIACEAE	Manettia tatei	Flowers	Forest edge										
RUBIACEAE	Coccocypselum lanceolatum	Fruits	Bracken										
RUBIACEAE	Faramea candelabrum	Fruits	Forest edge										
RUBIACEAE	Galium hypocarpium	Fruits	Forest edge										
RUBIACEAE	Rubiaceae sp. 1	Fruits	Forest edge										
RUBIACEAE	Rubiaceae sp. 2	Flowers	Forest edge										
SALICACEAE	Banara guianensis	Fruits	Forest edge										
SIPARUNACEAE	Siparuna tomentosa	Fruits	Forest edge										
SIPARUNACEAE	Siparuna aspera	Fruits	Forest edge										
SIPARUNACEAE	Siparunaceae sp. 1	Fruits	Forest edge										
SMILACACEAE	Smilax tomentosa	Fruits	Forest edge										
SMILACACEAE	Smilacaceae sp. 1	Fruits	Bracken										
SYMPLOCACEAE	Symplocos arechea	Fruits	Forest edge										
URTICACEAE	Cecropia elongata	Fruits	Forest edge										
URTICACEAE	Coussapoa david-smithii	Fruits	Forest edge										
URTICACEAE	Urticaceae sp. 1	Fruits	Forest edge										
VERBENACEAE	Lantana sp. 2	Both	Forest edge										
VIBURNACEAE	Viburnum seemenii	Fruits	Forest edge										
VIBURNACEAE	Viburnum cf. ayavacense	Fruits	Bracken										
VITACEAE	Cissus trianae	Fruits	Forest edge										
ZINGIBERACEAE	Hedychium coronarium	Flowers	Forest edge										

Table S2. All bird species along with their codes, guilds, specialization, abundance per habitat and total abundances recorded in this study.

Species	Code	Guild [a]	Specialization [b]	Abundance per habitat		Total abundance
				Forest edge	Bracken	
Adelomyia melanogenys	ADME.N	Nectarivorous	SPE	7	17	24
Aglaiocercus kingi	AGKI.N	Nectarivorous	SPE	1	4	5
Amazilia (Elliotomyia) chionogaster	AMCH.N	Nectarivorous	SPE	0	4	4
Amazilia sp.	AMSP.N	Nectarivorous	SPE	0	1	1
Anisognathus somptuosus	ANSU.F	Frugivorous	GEN	0	2	2
Arremon torquatus	ARTO.O	Omnivorous	GEN	1	2	3
Atlapetes rufinucha	ATRU.O	Omnivorous	GEN	6	3	9
Aulacorhynchus coeruleicinctis	AUCO.O	Omnivorous	GEN	0	2	2
Basileuterus tristriatus	BATR.I	Insectivorous	SPE	3	0	3
Catamblyrhynchus diadema	CADI.O	Omnivorous	SPE	1	0	1
Catharus ustulatus	CAUS.F	Frugivorous	GEN	2	1	3
Chaetocercus mulsant	CHMU.N	Nectarivorous	SPE	0	1	1
Chalcostigma ruficeps	CHRU.N	Nectarivorous	SPE	0	5	5
Chiroxiphia boliviana	CHBO.F	Frugivorous	GEN	11	1	12
Chlorospingus flavopectus	CHFL.F	Frugivorous	GEN	3	2	5
Cnemotriccus bimaculatus (fuscatus)	CNBI.I	Insectivorous	SPE	4	2	6
Coeligena coeligena	COCO.N	Nectarivorous	SPE	1	3	4
Coereba flaveola	COFL.N	Nectarivorous	GEN	0	4	4
Colibri coruscans	COLCO.N	Nectarivorous	SPE	0	2	2
Colibri delphinae	CODE.N	Nectarivorous	SPE	0	1	1
Colibri thalassinus	COTH.N	Nectarivorous	SPE	1	27	28
Conopophaga ardesiaca	COAR.I	Insectivorous	SPE	3	0	3
Contopus fumigatus	COFU.I	Insectivorous	SPE	0	1	1
Cyclarhis gujanensis	CYGU.O	Omnivorous	SPE	0	1	1
Diglossa carbonaria	DICA.N	Nectarivorous	GEN	0	1	1
Diglossa cyanea	DICY.N	Nectarivorous	GEN	0	1	1
Diglossa sittoides	DISI.N	Nectarivorous	GEN	0	10	10
Dysithamnus mentalis	DYME.I	Insectivorous	SPE	1	0	1
Elaenia albiceps	ELAL.F	Frugivorous	GEN	0	23	23
Elaenia obscura	ELOB.F	Frugivorous	GEN	0	8	8
Elaenia pallatangae	ELPA.F	Frugivorous	GEN	0	1	1
Elaenia sp.	ELSP.F	Frugivorous	GEN	0	2	2
Entomodestes leucotis	ENLE.F	Frugivorous	GEN	0	1	1
Eriocnemis glaucopoides	ERGL.N	Nectarivorous	SPE	0	2	2
Euphonia xanthogaster	EUXA.F	Frugivorous	SPE	1	0	1
Haplophaedia assimilis	HAAS.F	Nectarivorous	SPE	4	10	14
Hemispingus (Sphenopsis) melanotis	HEME.I	Insectivorous	SPE	0	2	2
Leptopogon superciliaris	LESU.I	Insectivorous	SPE	1	0	1
Mecocerculus leucophrys	MELE.I	Insectivorous	SPE	0	2	2
Metallura tyrianthina	METY.N	Nectarivorous	SPE	0	7	7
Mionectes striaticollis	MIST.F	Frugivorous	GEN	18	15	33
Myioborus miniatus	MYMI.I	Insectivorous	SPE	4	4	8
Myiophobus fasciatus	MYFA.F	Insectivorous	SPE	0	1	1
Myiothlypis coronata	MYCO.I	Insectivorous	SPE	1	0	1
Myiothlypis signata	MYSI.I	Insectivorous	SPE	0	1	1
Ocreatus underwoodii	OCUN.N	Nectarivorous	SPE	0	5	5
Phaethornis malaris	PHMA.N	Nectarivorous	SPE	3	1	4
Pheugopedius genibarbis	PHGE.I	Insectivorous	SPE	0	1	1
Phyllomyias sclateri	PHSC.I	Insectivorous	SPE	0	1	1
Phylloscartes ventralis	PHVE.I	Insectivorous	SPE	0	1	1
Picumnus dorbignyanus	PIDO.I	Insectivorous	SPE	0	1	1
Pipreola frontalis	PIFR.F	Frugivorous	SPE	0	1	1
Platyrinchus mystaceus	PLMY.I	Insectivorous	SPE	4	0	4
Poecilotriccus plumbeiceps	POPL.I	Insectivorous	SPE	4	3	7
Pygochelidon cyanoleuca	PYCY.I	Insectivorous	SPE	0	1	1

Pyriglena leuconota	PYLE.I	Insectivorous	SPE	2	0	2
Pyrrhomyias cinnamomeus	PYCI.I	Insectivorous	SPE	1	0	1
Ramphocelus carbo	RACA.O	Omnivorous	GEN	1	2	3
Schistes geoffroyi	SCGE.N	Nectarivorous	SPE	0	1	1
Setophaga pitiayumi	SEPI.I	Insectivorous	GEN	0	1	1
Sittasomus griseicapillus	SIGR.I	Insectivorous	SPE	2	0	2
Spinus xanthogastrus	SPXA.O	Omnivorous	SPE	0	3	3
Synallaxis azarae	SYAZ.I	Insectivorous	SPE	1	1	2
Syndactyla rufosuperciliata	SYRU.I	Insectivorous	SPE	1	0	1
Tangara nigroviridis	TANI.I	Insectivorous	SPE	0	1	1
Tangara vassorii	TAVA.F	Frugivorous	GEN	0	2	2
Thamnophilus caerulescens	THCA.F	Insectivorous	SPE	1	0	1
Thlypopsis ruficeps	THRU.I	Insectivorous	SPE	1	5	6
Thraupis (Sporathraupis) cyanocephala	THCY.F	Frugivorous	GEN	0	1	1
Tiaris (Asemospiza) obscura	TIOB.O	Omnivorous	SPE	1	1	2
Troglodytes solstitialis	TRSO.I	Insectivorous	SPE	0	1	1
Turdus amaurochalinus	TUAM.F	Frugivorous	GEN	1	0	1
Xiphorhynchus triangularis	XITR.I	Insectivorous	SPE	1	0	1
Zimmerius bolivianus	ZIBO.I	Insectivorous	SPE	0	2	2

[a] Based on Herzog et al. (2016) and Billerman et al. (2022).

[b] We used the database by Wilman et al. (2014). We considered specialists (SPE) those species that feed on a single item (i.e., invertebrates, fruits, nectar, seeds) at a percentage > 70%, and generalists (GEN) all other species that feed on two or more items (dos Anjos et al. 2019).

Table S3. Best GLMM models of the effects of habitat, fruiting species (sppFr), flowering species (sppFl) and their interactions on total bird species richness and abundance of all bird species. *P*-values in bold are statistically significant (*P*<0.05).

	Best model compared with the null	**Estimate**	**Std. Error**	***Z* value**	***P*-value**	**AICc**	**Delta AICc**	**Weight**
Total bird species richness	Habitat + sppFr + sppFl + Habitat:sppFl + sppFl:sppFr + (1|Site)					209.26	0.0	0.995
	Intercept	1.722	0.673	2.558	**0.0105**			
	Habitat Forest.edge	-3.098	0.701	-4.420	**<0.001**			
	sppFr	0.113	0.061	1.847	0.0647			
	sppFl	-0.048	0.122	-0.398	0.6902			
	HabitatForest.edge:sppFl	0.437	0.121	3.602	**0.0003**			
	sppFr:sppFl	-0.017	0.011	0.011	0.1118			
	Null	1.528	0.137	11.14	**<0.001**	240.09	30.83	<0.002
Total bird abundance	Habitat + sppFr + sppFl + Habitat:sppFl + sppFl:sppFr + (1|Site)					248.92	0.0	0.997
	Intercept	1.399	0.610	2.293	**0.021**			
	Habitat Forest.edge	-3.157	0.603	-5.229	**<0.001**			
	sppFr	0.194	0.054	3.596	**0.0003**			
	sppFl	0.061	0.109	0.558	0.5769			
	HabitatForest.edge:sppFl	0.439	0.105	4.193	**<0.001**			
	sppFr:sppFl	-0.032	0.009	-3.218	**0.001**			
	Null	1.8317	0.1649	11.11	**<0.001**	314.96	66.04	<0.001

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