

Supporting Information. Céspedes-Arias, L.N., S. Wilson, and N.J. Bayly. 2021. Community modeling reveals the importance of elevation and land cover in shaping migratory bird abundance in the Andes. *Ecological Applications*.

Appendix S1

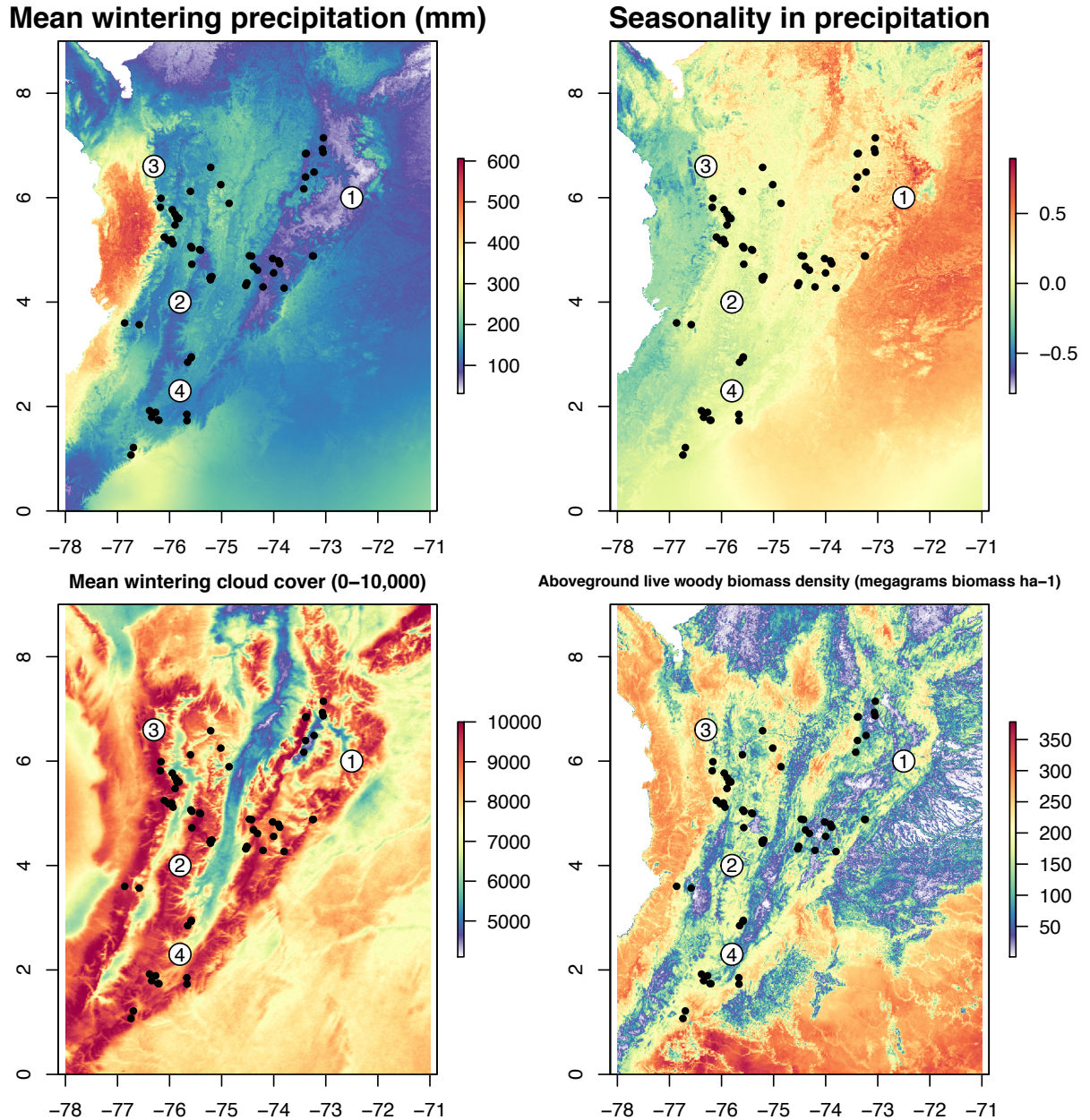


Figure S1: Variation in selected environmental variables across the Colombian Andes based on raster layers used to extract values for individual point counts. In all cases, light and cold hues correspond to low values (or negative, in the case of seasonality), and warm hues to high values. Sampling localities are shown as black dots, and the numbers correspond to topographic features, as in Figure 1 (1= Eastern Andes, 2= Central Andes, 3= Western Andes, 4= Upper Magdalena).

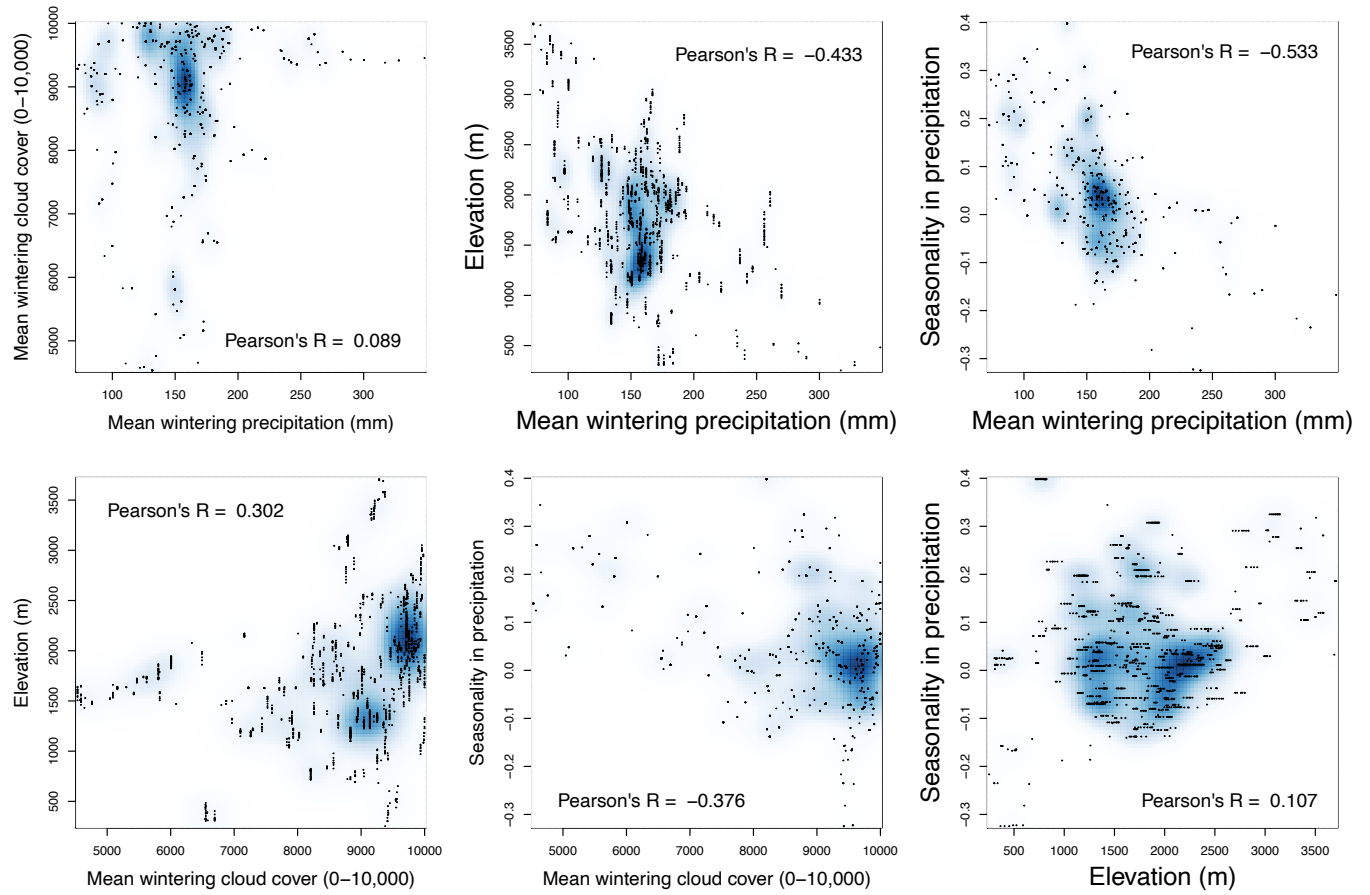


Figure S2: Correlations among environmental variables included in the multispecies hierarchical model, including overwintering cloud cover, elevation, overwintering precipitation and seasonality in precipitation. In general variables were not correlated with the exception of a weak negative correlation between wintering precipitation and elevation, and wintering precipitation and seasonality in rainfall.

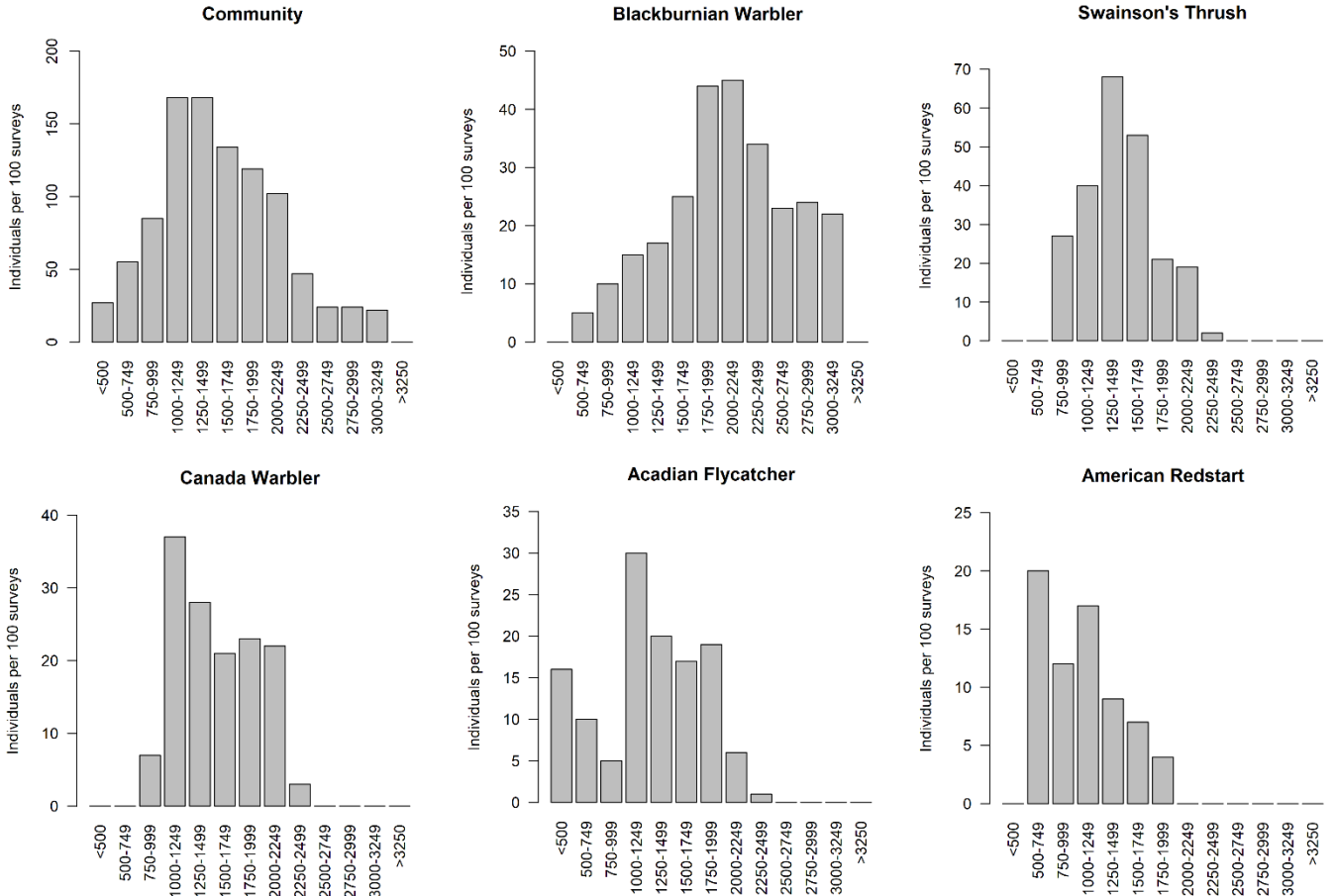


Figure S3: Histograms showing abundance along the elevational gradient (250 m intervals) for the full migratory bird community and the five most common species detected based on raw observations. We only used information from mature and secondary forest because only these two habitat classes spanned the full elevational gradient. Counts were scaled to the expected number per 100 surveys in each elevation interval because of differences in the number of surveys in each interval.

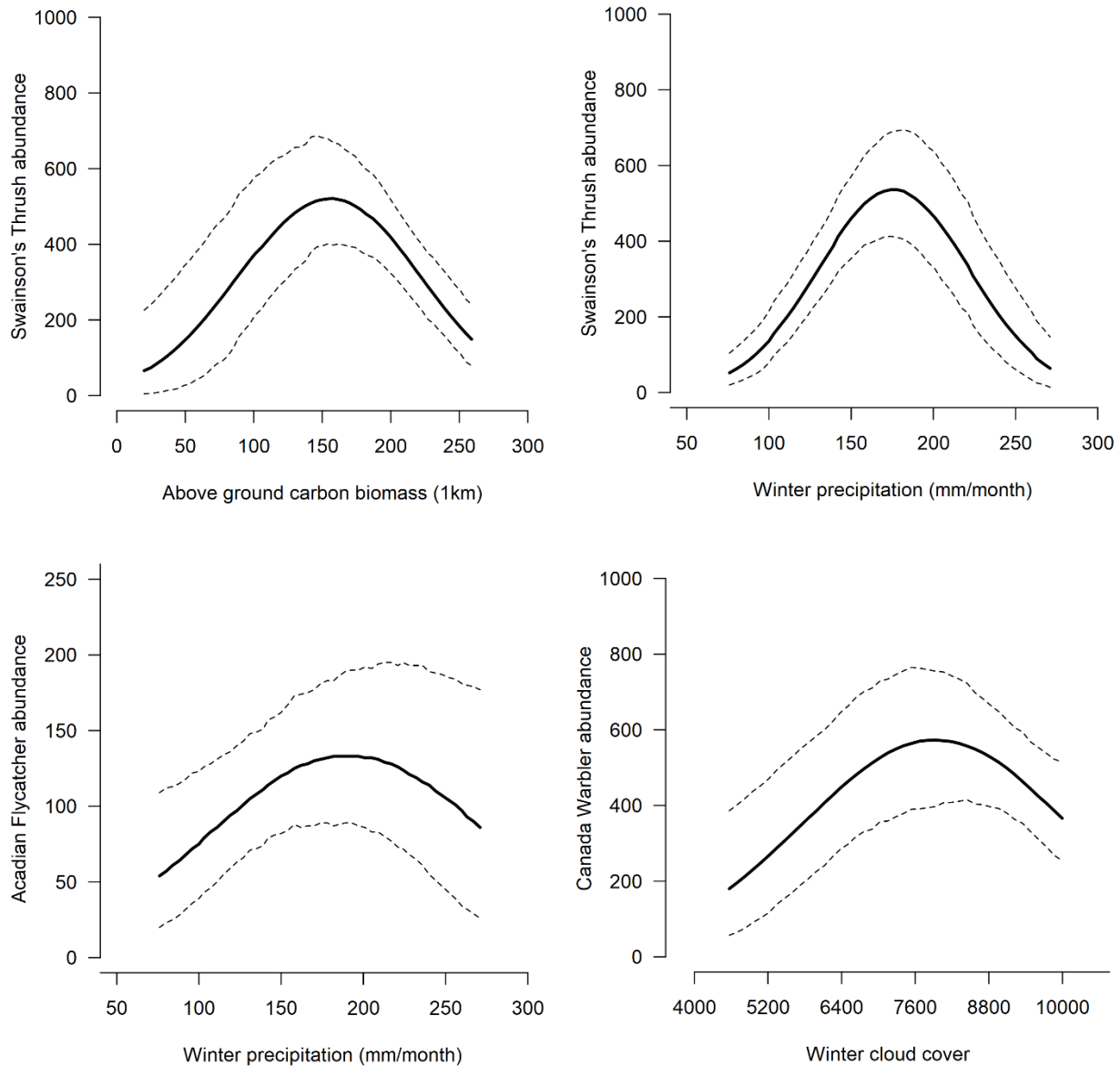


Figure S4: Predicted abundance (individuals/km²) for species that showed a significant curvilinear response to woody biomass at 1km², mean winter precipitation or mean winter cloud cover. Cloud cover values when multiplied by 0.01 refer to the proportion of days with cloud cover. Solid lines represent the mean.

Table S1. Common name, scientific name and number of detections for all Nearctic-Neotropical migrants recorded on 40m radius point count surveys in the Colombian Andes. Species with an asterisk were not included in the analysis because our surveys were either at the periphery of their range or were not designed to adequately survey the habitats they select (e.g. waterbirds).

Common Name	Scientific Name	Detections
Blue-winged Teal*	<i>Spatula discors</i>	2
Broad-winged Hawk	<i>Buteo platypterus</i>	1
Greater Yellowlegs*	<i>Tringa melanoleuca</i>	1
Olive-sided Flycatcher	<i>Contopus cooperi</i>	6
Western Wood Pewee	<i>Contopus sordidulus</i>	11
Eastern Wood Pewee	<i>Contopus virens</i>	1
Acadian Flycatcher	<i>Empidonax virens</i>	204
Alder Flycatcher	<i>Empidonax alnorum</i>	1
Yellow-throated Vireo	<i>Vireo flavifrons</i>	3
Gray-cheeked Thrush	<i>Catharus minimus</i>	12
Swainson's Thrush	<i>Catharus ustulatus</i>	418
Northern Waterthrush	<i>Parkesia noveboracensis</i>	5
Golden-winged Warbler	<i>Vermivora chrysoptera</i>	1

Common Name	Scientific Name	Detections
Black-and-white Warbler	<i>Mniotilta varia</i>	28
Prothonotary Warbler*	<i>Protonotaria citrea</i>	1
Tennessee Warbler	<i>Leiothlypis peregrina</i>	64
Mourning Warbler	<i>Geothlypis philadelphia</i>	42
American Redstart	<i>Setophaga ruticilla</i>	80
Cerulean Warbler	<i>Setophaga cerulea</i>	24
Bay-breasted Warbler	<i>Setophaga castanea</i>	31
Blackburnian Warbler	<i>Setophaga fusca</i>	502
American Yellow Warbler	<i>Setophaga petechia</i>	16
Blackpoll Warbler*	<i>Setophaga striata</i>	2
Canada Warbler	<i>Cardellina canadensis</i>	273
Summer Tanager	<i>Piranga rubra</i>	89
Scarlet Tanager	<i>Piranga olivacea</i>	1
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	2
Baltimore Oriole*	<i>Icterus galbula</i>	2
Orchard Oriole*	<i>Icterus spurius</i>	1

Table S2. Median estimates and 90% credible intervals for land cover associations of Neotropical migrants overwintering in the Colombian Andes. Values are on the log scale. Mature forest was the basal group in the model and therefore, estimates for mature forest refer to the intercept while estimates for all other classes refer to the difference in expected log abundance relative to mature forest. Estimates are shown only for species with ≥ 10 detections.

Species	Habitat class	Median	Lower 5%	Upper 95%
Acadian Flycatcher	Mature Forest	-0.548	-0.824	-0.282
Acadian Flycatcher	Second Growth	0.214	-0.168	0.588
Acadian Flycatcher	Shade Coffee	-0.418	-0.846	0.038
Acadian Flycatcher	Sun Coffee	-1.143	-2.750	0.097
Acadian Flycatcher	Forest Fragment	-0.178	-0.917	0.535
Acadian Flycatcher	Live Fence	-1.305	-3.446	0.434
Acadian Flycatcher	Paramo	-7.365	-21.952	3.191
American Redstart	Mature Forest	-1.656	-2.221	-1.082
American Redstart	Second Growth	-0.159	-0.715	0.434
American Redstart	Shade Coffee	-0.527	-1.213	0.106
American Redstart	Sun Coffee	-1.201	-3.656	0.324
American Redstart	Forest Fragment	-0.742	-2.048	0.438
American Redstart	Live Fence	-1.228	-3.406	0.567
American Redstart	Paramo	-7.414	-23.011	2.821
Black-and-white Warbler	Mature Forest	-1.897	-2.606	-1.289
Black-and-white Warbler	Second Growth	-0.014	-0.777	0.777

Black-and-white Warbler	Shade Coffee	0.208	-0.879	1.161
Black-and-white Warbler	Sun Coffee	-0.644	-3.199	1.410
Black-and-white Warbler	Forest Fragment	-0.063	-1.967	1.459
Black-and-white Warbler	Live Fence	1.175	-0.845	3.036
Black-and-white Warbler	Paramo	-7.516	-22.978	1.632
Bay-breasted Warbler	Mature Forest	-4.429	-5.745	-3.207
Bay-breasted Warbler	Second Growth	-0.302	-1.158	0.459
Bay-breasted Warbler	Shade Coffee	0.322	-0.564	1.210
Bay-breasted Warbler	Sun Coffee	-0.862	-3.276	1.025
Bay-breasted Warbler	Forest Fragment	-1.193	-3.757	0.610
Bay-breasted Warbler	Live Fence	-2.064	-6.237	0.955
Bay-breasted Warbler	Paramo	-7.428	-22.640	3.012
Blackburnian Warbler	Mature Forest	0.961	0.781	1.141
Blackburnian Warbler	Second Growth	0.207	-0.072	0.449
Blackburnian Warbler	Shade Coffee	0.771	0.476	1.055
Blackburnian Warbler	Sun Coffee	0.235	-0.498	1.010
Blackburnian Warbler	Forest Fragment	-0.264	-0.843	0.258
Blackburnian Warbler	Live Fence	0.575	-0.108	1.183
Blackburnian Warbler	Paramo	-7.469	-21.102	1.169
Canada Warbler	Mature Forest	0.783	0.555	1.006
Canada Warbler	Second Growth	-0.603	-1.042	-0.185
Canada Warbler	Shade Coffee	-0.655	-1.066	-0.272
Canada Warbler	Sun Coffee	-1.088	-2.222	-0.179

Canada Warbler	Forest Fragment	-1.543	-2.662	-0.588
Canada Warbler	Live Fence	-3.426	-7.228	-1.038
Canada Warbler	Paramo	-7.382	-22.594	2.436
Cerulean Warbler	Mature Forest	-2.837	-3.712	-1.996
Cerulean Warbler	Second Growth	-0.357	-1.364	0.465
Cerulean Warbler	Shade Coffee	0.633	-0.327	1.511
Cerulean Warbler	Sun Coffee	-0.760	-3.152	1.266
Cerulean Warbler	Forest Fragment	-0.874	-3.568	1.016
Cerulean Warbler	Live Fence	-1.863	-6.186	1.235
Cerulean Warbler	Paramo	-7.418	-23.070	2.865
Grey-cheeked Thrush	Mature Forest	-4.114	-5.270	-3.069
Grey-cheeked Thrush	Second Growth	-0.019	-0.985	0.950
Grey-cheeked Thrush	Shade Coffee	-0.460	-2.250	0.976
Grey-cheeked Thrush	Sun Coffee	-0.496	-3.098	1.782
Grey-cheeked Thrush	Forest Fragment	2.220	0.551	3.746
Grey-cheeked Thrush	Live Fence	-1.186	-6.049	2.829
Grey-cheeked Thrush	Paramo	-7.348	-23.325	2.252
Mourning Warbler	Mature Forest	-2.747	-3.532	-2.040
Mourning Warbler	Second Growth	0.249	-0.536	1.040
Mourning Warbler	Shade Coffee	1.291	0.522	2.099
Mourning Warbler	Sun Coffee	0.566	-1.086	2.189
Mourning Warbler	Forest Fragment	1.243	-0.081	2.347
Mourning Warbler	Live Fence	1.917	0.522	3.243

Mourning Warbler	Paramo	-7.440	-22.915	2.357
Summer Tanager	Mature Forest	-1.514	-1.913	-1.135
Summer Tanager	Second Growth	-0.145	-0.733	0.379
Summer Tanager	Shade Coffee	-0.180	-0.753	0.394
Summer Tanager	Sun Coffee	-0.084	-1.260	1.031
Summer Tanager	Forest Fragment	-0.560	-1.761	0.485
Summer Tanager	Live Fence	-0.276	-1.676	0.992
Summer Tanager	Paramo	-7.399	-22.309	2.351
Swainson's Thrush	Mature Forest	0.562	0.378	0.759
Swainson's Thrush	Second Growth	0.267	-0.013	0.548
Swainson's Thrush	Shade Coffee	-0.299	-0.591	-0.007
Swainson's Thrush	Sun Coffee	-1.223	-2.345	-0.249
Swainson's Thrush	Forest Fragment	-0.699	-1.356	-0.105
Swainson's Thrush	Live Fence	-3.396	-7.125	-1.026
Swainson's Thrush	Paramo	-7.384	-23.592	2.301
Tennessee Warbler	Mature Forest	-2.494	-3.314	-1.765
Tennessee Warbler	Second Growth	0.366	-0.407	1.284
Tennessee Warbler	Shade Coffee	1.978	1.241	2.889
Tennessee Warbler	Sun Coffee	-0.027	-1.735	1.787
Tennessee Warbler	Forest Fragment	-0.023	-1.923	1.601
Tennessee Warbler	Live Fence	-0.193	-2.695	1.935
Tennessee Warbler	Paramo	-7.433	-22.585	2.784
Western Wood Pewee	Mature Forest	-4.122	-5.315	-3.118

Western Wood Pewee	Second Growth	-0.074	-0.948	0.936
Western Wood Pewee	Shade Coffee	0.905	-0.219	2.110
Western Wood Pewee	Sun Coffee	0.977	-0.904	2.985
Western Wood Pewee	Forest Fragment	-0.612	-3.318	1.583
Western Wood Pewee	Live Fence	-1.479	-6.105	2.148
Western Wood Pewee	Paramo	-7.350	-23.132	2.288
Yellow Warbler	Mature Forest	-4.802	-6.522	-3.328
Yellow Warbler	Second Growth	-0.205	-1.353	0.749
Yellow Warbler	Shade Coffee	0.767	-0.510	2.010
Yellow Warbler	Sun Coffee	0.154	-1.669	2.196
Yellow Warbler	Forest Fragment	1.308	-0.291	2.867
Yellow Warbler	Live Fence	1.794	0.256	3.406
Yellow Warbler	Paramo	-7.257	-22.609	2.931

Table S3. Posterior summaries for community parameter coefficients (on log scale) from a community distance-sampling model for Nearctic-Neotropical migrant landbirds in the Colombian Andes. In this version, climate and tree cover were included as quadratic terms to test whether community abundance was higher at intermediate values (Table 1 in the main manuscript includes linear relationships for these variables). Lower 5% and Upper 95% are the lower and upper bounds of the 90% credible interval. Mature forest was the basal categorical group and therefore categorical habitat responses are effects relative to mature forest.

Parameter	Median	Lower 5%	Upper 95%
Elevation	-1.34	-2.05	-0.75
Elevation ²	-0.95	-1.39	-0.64
Latitude	0.15	-0.12	0.45
Second Growth	-0.10	-0.47	0.24
Shade Coffee	0.24	-0.31	0.80
Sun Coffee	-0.49	-1.46	0.43
Forest Fragment	-0.09	-0.97	0.74
Live Fence	-1.01	-2.88	0.44
Paramo	-11.56	-22.92	0.93
Tree Cover	-0.09	-0.31	0.16
Tree Cover ²	-0.06	-0.18	0.05

Mean Precipitation	-0.05	-0.34	0.19
Mean Precipitation ²	-0.10	-0.25	0.03
Precipitation Seasonality	-0.01	-0.25	0.22
Precipitation Seasonality ²	-0.07	-0.20	0.06
Cloud Cover	-0.03	-0.24	0.16
Cloud Cover ²	-0.04	-0.15	0.07

Table S4. Posterior summaries for detectability coefficients (on log scale) from a community distance-sampling model for Nearctic-Neotropical migrant birds in the Colombian Andes. One of the four observers was represented as the basal group and therefore, the other three categories represent the deviation from this observer. Time of day and canopy height estimates are species-specific and shown only for those species with ≥ 10 detections.

Parameter	Species	Median	Lower 5%	Upper 95%
Observer2	NA	0.207	0.034	0.373
Observer3	NA	0.369	0.209	0.546
Observer4	NA	-0.021	-0.196	0.152
Time of day	Acadian Flycatcher	-0.076	-0.131	-0.022
Time of day	American Redstart	-0.016	-0.093	0.067
Time of day	Black-and-White Warbler	-0.040	-0.188	0.114
Time of day	Bay-breasted Warbler	-0.061	-0.210	0.091
Time of day	Blackburnian Warbler	0.017	-0.016	0.050
Time of day	Canada Warbler	-0.004	-0.051	0.039
Time of day	Cerulean Warbler	0.120	-0.058	0.301
Time of day	Grey-cheeked Thrush	0.072	-0.255	0.458
Time of day	Mourning Warbler	0.034	-0.077	0.145

Time of day	Summer Tanager	0.024	-0.070	0.114
Time of day	Swainson's Thrush	-0.046	-0.084	-0.007
Time of day	Tennessee Warbler	-0.047	-0.135	0.046
Time of day	Western Wood Pewee	-0.176	-0.531	0.130
Time of day	Yellow Warbler	-0.083	-0.306	0.149
Canopy height	Acadian Flycatcher	0.087	0.015	0.163
Canopy height	American Redstart	-0.026	-0.140	0.083
Canopy height	Black-and-White Warbler	0.106	-0.075	0.303
Canopy height	Bay-breasted Warbler	-0.034	-0.225	0.168
Canopy height	Blackburnian Warbler	0.065	0.022	0.107
Canopy height	Canada Warbler	0.095	0.033	0.154
Canopy height	Cerulean Warbler	0.021	-0.247	0.288
Canopy height	Grey-cheeked Thrush	0.698	0.036	1.638
Canopy height	Mourning Warbler	-0.048	-0.213	0.102
Canopy height	Summer Tanager	0.053	-0.046	0.148
Canopy height	Swainson's Thrush	0.099	0.047	0.152
Canopy height	Tennessee Warbler	-0.018	-0.170	0.118

Canopy height	Western Wood Pewee	0.107	-0.108	0.334
Canopy height	Yellow Warbler	-0.180	-0.370	0.015

Table S5. Posterior summaries for community detection distances (meters) from a community distance-sampling model for Nearctic-Neotropical migrant birds in the Colombian Andes.

Detection distance refers to the estimated horizontal distance to a detected individual from the observer standing at the point count center.

Parameter	Median	Lower 5%	Upper 95%
Acadian Flycatcher	10.14	8.38	12.07
Alder Flycatcher	8.38	4.87	13.73
American Redstart	8.14	6.62	9.76
Black-and-White Warbler	7.78	6.05	9.99
Bay-breasted Warbler	8.37	6.65	10.51
Blackburnian Warbler	8.01	6.67	9.41
Broad-winged Hawk	8.53	5.21	14.04
Canada Warbler	8.44	7.04	10.03
Cerulean Warbler	8.38	6.36	10.78
Eastern Wood Pewee	8.55	5.27	13.82
Grey-checked Thrush	9.60	6.82	13.80
Golden-winged Warbler	8.25	4.75	13.43
Mourning Warbler	8.71	7.01	11.07

Northern Waterthrush	7.95	4.85	12.16
Olive-sided Flycatcher	10.57	7.13	15.97
Rose-breasted Grosbeak	8.61	5.34	14.02
Scarlet Tanager	8.36	4.91	13.53
Summer Tanager	12.12	9.84	14.87
Swainson's Thrush	10.07	8.33	11.82
Tennessee Warbler	7.80	6.28	9.56
Western Wood Pewee	11.56	8.27	16.93
Yellow-throated Vireo	8.17	4.91	13.20
Yellow Warbler	6.93	5.09	9.40