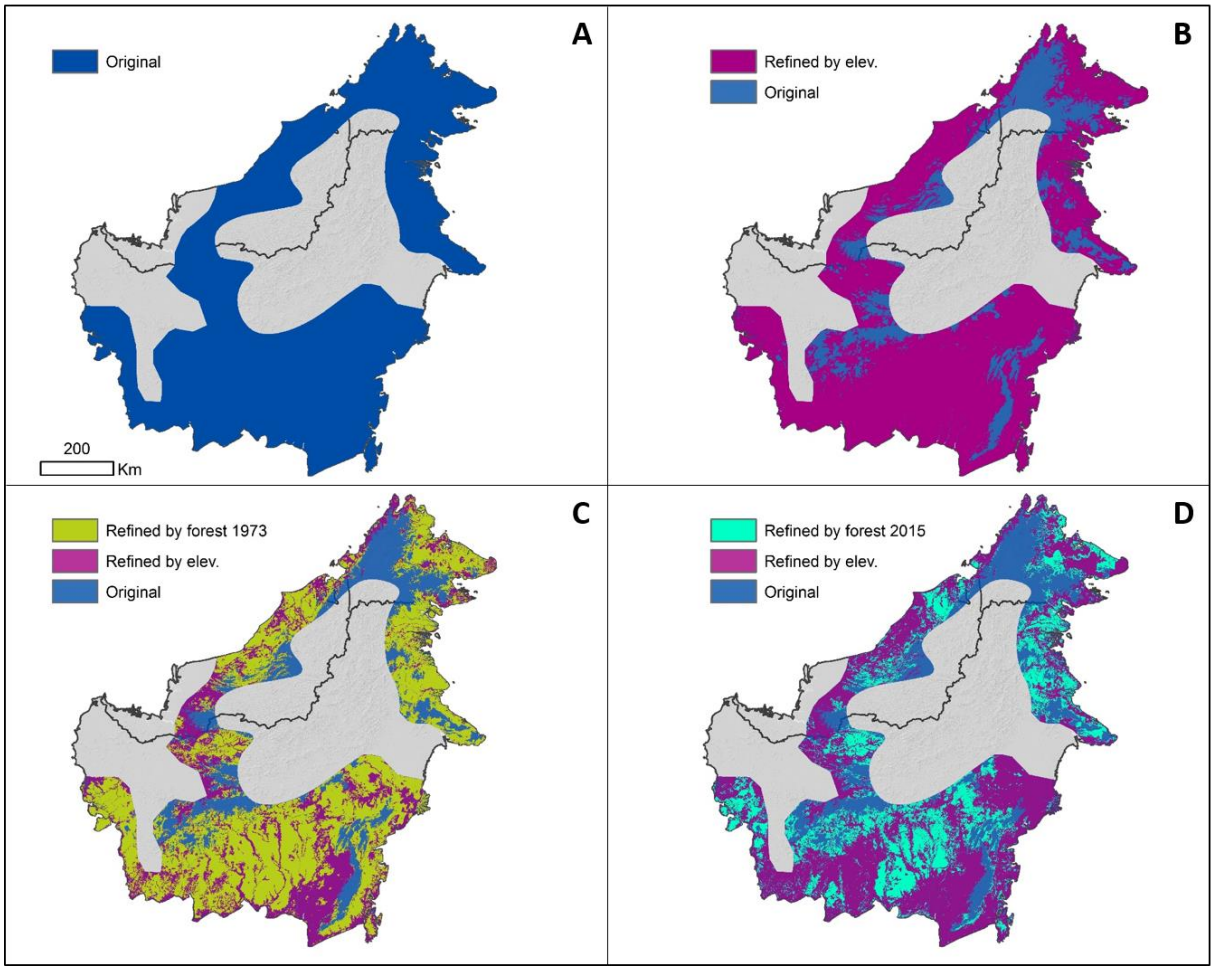
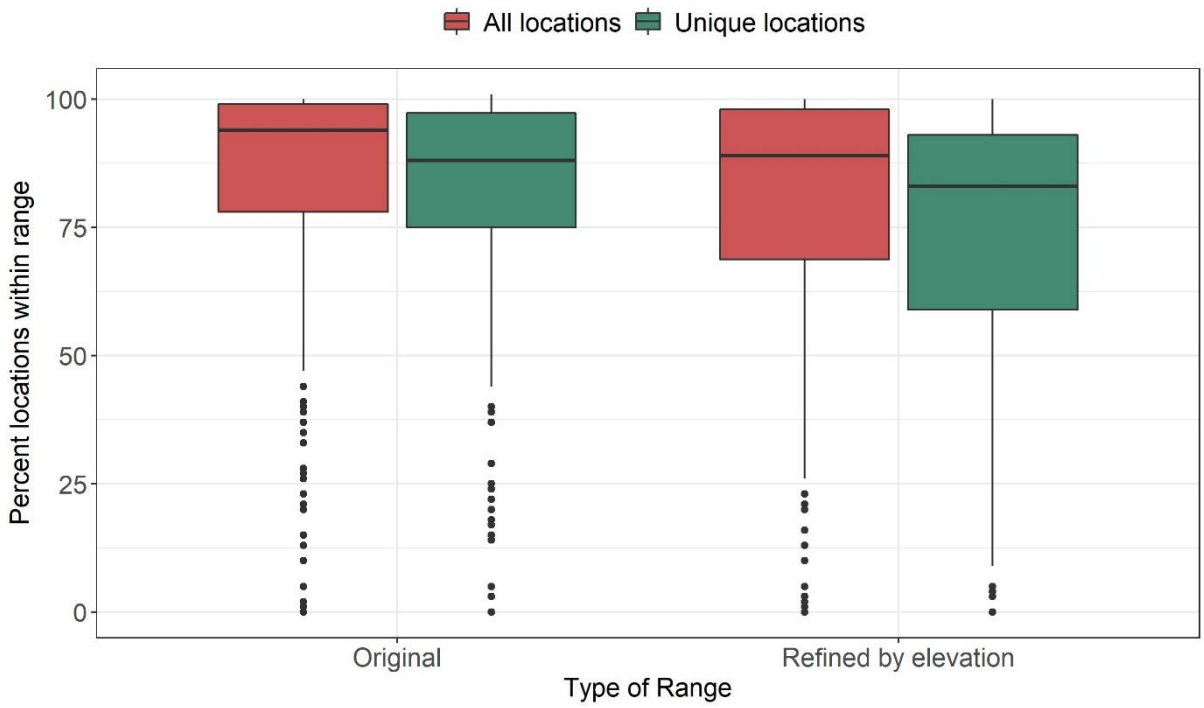
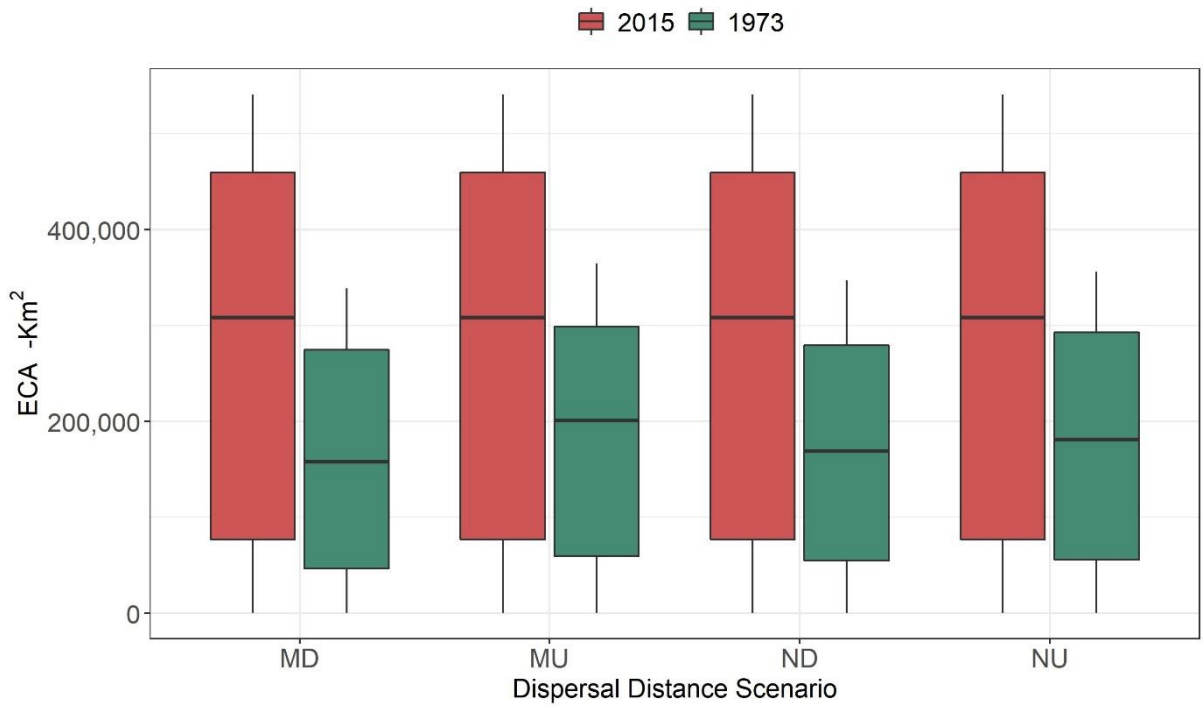
Supplementary Figures



Supplementary Figure 1. Range refining example for the Black Hornbill (*Anthracoceros malayanus*), a forest-specialist bird with elevational range 0-200m. A) Unrefined range map as downloaded from BirdLife International and- Handbook of the Birds of the World (2016). B) Range refined by elevation using a Digital Elevation Model (Jarvis *et al.*, 2008) and selecting only areas under 200m. C) Range refined by forest using a 1973 forest cover map (Gaveau *et al.*, 2016). D) Range refined by forest using a 2015 forest cover map (Gaveau *et al.*, 2016).

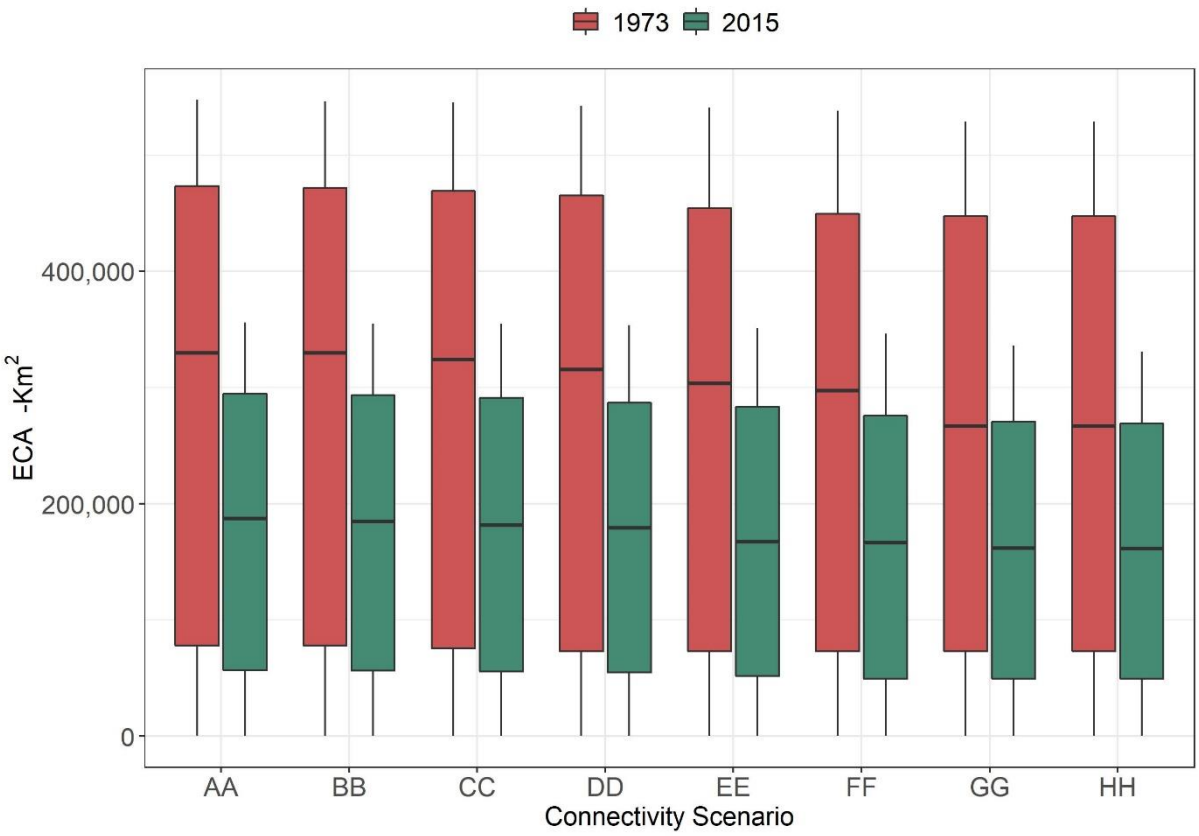


Supplementary Figure 2. Boxplot of percent GBIF (Global Biodiversity Information Facility) locations (all and unique) that fall within original range and within the range refined by elevation for 212 forest birds and mammals. 33 species had fewer than 5 sightings in Borneo on the database and were thus excluded.



Supplementary Figure 3. Comparison of Equal Connected Area (ECA) for different natal dispersal distance scenarios (described in Suppl. Table 5), by year for 245 forest-specialist vertebrates on Borneo. Scenarios MD and MU were constructed by reducing or increasing,

respectively, species' dispersal distance by an order of magnitude. Scenarios ND and NU were constructed by reducing or increasing 50%, respectively, species' dispersal distance. ANOVA testing for differences between scenarios p=0.711.



Supplementary Figure 4. Comparison of Equal Connected Area (ECA) for different connectivity scenarios (described in Suppl. Table 3), by year for 245 forest-specialists vertebrates on Borneo. Scenarios were constructed from a resistance gradient that ranged from no resistance to movement in open areas and plantations (scenario AA), to full resistance/impermeability to movement in open areas and plantations (scenario HH). ANOVA testing for differences between scenarios p>0.1.

Supplementary Tables

Supplementary Table 1. Information about forest-specialist birds and mammals of Borneo (N=245) regarding ecological characteristics, habitat preference, and threat. Results from habitat and connectivity modelling, and vulnerability assessment also shown. Provided as Excel file due to size of file.

Attached Excel file

Supplementary Table 2. Species excluded from analyses and reasons for exclusion

Taxon	Scientific name	Reason for exclusion from analyses
Bird	*Anhinga melanogaster*	No weight found
Bird	*Carpococcyx radiceus*	No weight found
Bird	*Chlamydochaera jefferyi*	No weight found
Bird	*Dicrurus annectens*	No weight found
Bird	*Ducula pickeringii*	No weight found
Bird	*Garrulax calvus*	No weight found
Bird	*Garrulax palliatus*	No weight found
Bird	*Garrulax treacheri*	No weight found
Bird	*Halcyon pileata*	No weight found
Bird	*Lanius cristatus*	No weight found
Bird	*Lanius tigrinus*	No weight found
Bird	*Locustella accentor*	No weight found
Bird	*Megapodius cumingii*	No weight found
Bird	*Muscicapa ferruginea*	No weight found
Bird	*Myophonus borneensis*	No weight found
Bird	*Oriolus consanguineus*	No weight found
Bird	*Oriolus xanthornus*	Artificial patch edge due to forest mapping error
Bird	*Pachycephala homeyeri*	No weight found
Bird	*Pericrocotus divaricatus*	No weight found
Bird	*Pitta moluccensis*	No weight found
Bird	*Pitta nympha*	No weight found
Bird	*Platysmurus aterrimus*	No weight found
Bird	*Polyplectron schleiermacheri*	No weight found
Bird	*Psittacula alexandri*	No weight found
Bird	*Ramphiculus jambu*	No weight found
Bird	*Rhabdotorrhinus corrugatus*	Discrepancy between altitudinal range and spatial information
Bird	*Setornis criniger*	No weight found
Bird	*Todiramphus sanctus*	No weight found
Bird	*Urosphena whiteheadi*	No weight found
Bird	*Vauriella gularis*	No weight found
Bird	*Zoothera everetti*	No weight found
Mammal	*Cynopterus brachyotis*	No weight found
Mammal	*Cynopterus sphinx*	No weight found
Mammal	*Hipposideros ater*	No weight found
Mammal	*Hipposideros cineraceus*	No weight found
Mammal	*Hylobates muelleri*	No weight found

Mammal	*Myotis hasseltii*	No weight found
Mammal	*Tupaia dorsalis*	No weight found
Mammal	*Tylonycteris robustula*	No weight found

Supplementary Table 3. Information about spatial congruence of GBIF (Global Biodiversity Information Facility) sightings with original and range refined by elevation for 212 vertebrates that have 5 or more sightings within Borneo. Provided as Excel file due to size of file.

Supplementary Table 4. Description of different dispersal distance scenarios tested for the Equivalent Connected Area analysis.

MD	Dispersal distance reduced by an order of magnitude (e.g. if dispersal distance for main results (scenario DD) is 1 km, then the dispersal distance used here is 0.1 km)
MU	Dispersal distance increased by an order of magnitude (e.g. if dispersal distance for main results (scenario DD) is 1 km, then the dispersal distance used here is 10 km)
ND	Dispersal distance reduced by 50% (e.g. if dispersal distance for main results (scenario DD) is 1 km, then the dispersal distance used in scenario ND is 0.5 km)
NU	Dispersal distance increased by 50% (e.g. if dispersal distance for main results (scenario DD) is 1 km, then the dispersal distance used in scenario ND is 1.5 km)

Supplementary Table 5. Description of different matrix resistance scenarios tested for the Equivalent Connected Area analysis. Shaded in grey is the selected scenario. Dispersion threshold= 100Km, which corresponds to the 0.9 probability for the best disperser

		Resistance values (sigma value)						
Scenario	**Habitat**	**Stepping stones**	**Open areas**	**Second. forest**	**Forest outside elevation range**	**Plantations**	**Water**	**NoData**
AA	Strict forest-specialist	0.01	0.01	0.01	0.01	0.01	0.99	Exclude
	Able to move through plantations	0.01	0.01	0.01	0.01	0.01	0.99	Exclude
	Able to move through plantations and open areas	0.01	0.01	0.01	0.01	0.01	0.99	Exclude
BB	Strict forest-specialist	0.01	0.25	0.01	0.01	0.25	0.99	Exclude
	Able to move through plantations	0.01	0.25	0.01	0.01	0.01	0.99	Exclude
	Able to move through plantations and open areas	0.01	0.01	0.01	0.01	0.01	0.99	Exclude
CC	Strict forest-specialist	0.01	0.5	0.01	0.01	0.5	0.99	Exclude
	Able to move through plantations	0.01	0.5	0.01	0.01	0.01	0.99	Exclude

	Able to move through plantations and open areas	0.01	0.01	0.01	0.01	0.01	0.99	Exclude
DD	Strict forest-specialist	0.01	0.75	0.01	0.01	0.75	0.99	Exclude
	Able to move through plantations	0.01	0.75	0.01	0.01	0.01	0.99	Exclude
	Able to move through plantations and open areas	0.01	0.25	0.01	0.01	0.01	0.99	Exclude
EE	Strict forest-specialist	0.01	0.99	0.01	0.01	0.99	0.99	Exclude
	Able to move through plantations	0.01	0.75	0.01	0.01	0.25	0.99	Exclude
	Able to move through plantations and open areas	0.01	0.5	0.01	0.01	0.25	0.99	Exclude
FF	Strict forest-specialist	0.01	0.99	0.01	0.01	0.99	0.99	Exclude
	Able to move through plantations	0.01	0.99	0.01	0.01	0.5	0.99	Exclude
	Able to move through plantations and open areas	0.01	0.75	0.01	0.01	0.5	0.99	Exclude
GG	Strict forest-specialist	0.01	0.99	0.01	0.01	0.99	0.99	Exclude
	Able to move through plantations	0.01	0.99	0.01	0.01	0.75	0.99	Exclude
	Able to move through plantations and open areas	0.01	0.99	0.01	0.01	0.75	0.99	Exclude
HH	Strict forest-specialist	0.01	0.99	0.01	0.01	0.99	0.99	Exclude
	Able to move through plantations	0.01	0.99	0.01	0.01	0.99	0.99	Exclude
	Able to move through plantations and open areas	0.01	0.99	0.01	0.01	0.99	0.99	Exclude

Supplementary Table 6. Parameter estimates and model metrics for the candidate models.

Intercept	Max Elev.	Total area	Mean Fractal Index	Max elev.: Mean Fractal Index	df	log-likelihood	BIC	delta AIC	weight
0.341	-0.033	-0.139	NA	NA	5	114.411	-201.316	0	0.911
0.342	NA	-0.143	NA	NA	4	109.335	-196.666	4.651	0.089
0.347	-0.046	NA	-0.055	0.042	6	53.406	-73.804	127.512	0
0.343	-0.057	NA	-0.048	NA	5	49.347	-71.187	130.129	0
0.342	-0.055	NA	NA	NA	4	42.443	-62.88	138.436	0
0.342	NA	NA	-0.045	NA	4	40.625	-59.244	142.072	0
0.342	NA	NA	NA	NA	3	35.075	-53.646	147.67	0

Supplementary Table 7. Anova table from linear mixed effects model to evaluate factors affecting changes in relative Equivalent Connected Area for forest-specialist birds and mammals (N=245) from 1973 to 2015 in Borneo.

	Df	*Sum Sq*	*Mean Sq*	*F value*
Δ Total area	1	4.2490	4.2490	193.94
Maximum elevational range	1	0.5819	0.5819	26.56

Supplementary methods

Calculation of Equivalent Connected Area (ECA)

To calculate ECA, we followed the approach proposed by (Saura et al 2011) using the following expression:

$$ECA = \sqrt{\sum_{i=1}^{i=n}\sum_{j=1}^{j=n} a_i a_j p_{ij}^{*}} \quad , \quad eqn.1$$

Where a_i and a_j are the habitat area in patches i and j, and p^*_{ij} is the maximum product probability of dispersal between i and j as defined below.

We calculated the probability p that the species is able to directly disperse between patches i and j (p_{ij}) through a negative exponential function, as done in many studies (Moilanen, 2004), of the matrix-adjusted distance m_{ij} , which accounts for the average dispersal distance d of the species.

$$p_{ij} = e^{-m_{ij}/d} \quad , \quad eqn.2$$

The area-weighted average matrix resistance m_{ij}, was calculated by modifying the Euclidian distance E_{ij} between two patches:

$$m_{ij} = \frac{E_{ij}}{1 - \sum_{t=1}^{t=c} r_k \sigma_k} \quad , \quad eqn.3$$

where c is the number of cover types (matrix components) in the landscape, r_k is the proportional area of the cover type k relative to the total area of the matrix, and σ_k is a measure

of the sensitivity of the taxon to the transformed habitat (quantified as the proportional decrease in the number of species [$0 < \sigma < 1$]).

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