Range-Wide Factors Shaping Space Use and Movements by the Neotropic's Flagship Predator: The Jaguar

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Range-wide factors shaping space use and movements by the Neotropic's flagship predator: the jaguar

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SUMMARY

Large terrestrial carnivores are have undergone some of the largest population and range reductions of any species which is of concern as they have disproportionately large effects on ecosystem dynamics and function[1–4]. The jaguar is the apex predator throughout the majority of the Neotropics, however, its distribution has been reduced by >50% and throughout the majority of its distribution it survives in increasingly isolated populations[5]. Consequently, the range-wide management of the jaguar (*Panthera onca*) depends upon maintaining core populations connected through multi-national, transboundary cooperation, which is dependent upon understanding the movement ecology and space use of jaguars throughout their range[6–8]. Using data from 116 jaguars from 13 ecoregions and seven countries, we examined the landscape-level environmental and anthropogenic factors related to jaguar home range size and movement parameters. Range-wide and at the ecoregional scale home range size decreased with increasing net productivity and increased with increasing road density. Also, range-wide, home range size decreased with increasing forest cover and decreasing human population density. Movement within home ranges was best explained by a different set of environmental covariates. Range-wide predictions of home range size were consistent with expectations based upon available density estimates. Using large-scale collaboration and open source data we overcame typical limitations of small sample sizes and limited geographic distribution of large carnivore data to demonstrate the jaguar as a model organism and in doing so provide a mechanism to evaluate range-wide habitat quality for jaguars and an inferential modeling framework adaptable to the conservation of other large terrestrial carnivores.

KEYWORDS

jaguar, *Panthera onca*, home range, AKDE, Neotropics, carnivore, Felidae, movement ecology

RESULTS

Using published GPS telemetry data from 111 (52 males, 59 females) [9], and additional data from 2 jaguars (1 male, 1 female) from the Colombian Llanos and 3 males from the Southwestern Amazon moist forests in Peru (Fig. 1), we developed 120 telemetry trajectories for 116 jaguars in 7 countries and 13 ecoregions. For four individuals we separated their data into two distinct sampling periods each as they were monitored for two periods that were separated by two to three years.

Home range and movement parameter estimates

All individuals demonstrated range residency, with their movements best characterized by the Ornstein–Uhlenbeck or Ornstein–Uhlenbeck with foraging models [10]. The 95% home range areas ranged from 17 km^2 to 2453 km^2 with home range size for males ranging from 32 – 2453 km^2 and 17 – 1815 km^2 for females (Table S1). For males, home range crossing times ranged from 0.8 – 23.8 days and 1.03 – 28.9 days for females, autocorrelation timescale ranged from 0.16 – 5.23 hours and 0.16 – 5.4 hours for males and females, respectively, and speed ranged from 6.1 – 40.2 km/day for males and 1.4 – 49.5 km/day for females (Table S1).

Factors associated with home range size and movement parameters

At both the range-wide and ecoregional scales there was a single best-fit model explaining each movement parameter (Table S2). For home range size at the range-wide scale the best-fit model contained percent forest cover and net primary productivity which negatively affected home range size and a positive effect from sex (male), human population density, and road density. Based upon the posterior distributions of the effect size of sex from the best-fit model analyzed in a Bayesian framework, males had a 95% probability of having larger home ranges than females (Table S3, Table

S4), while percent forest cover and net primary productivity had a 97% and 100% probability, respectively of being related with smaller home range size. Both human population density and road density had 100% probabilities of being related to increasing home range size (Fig. 2, Table S4).

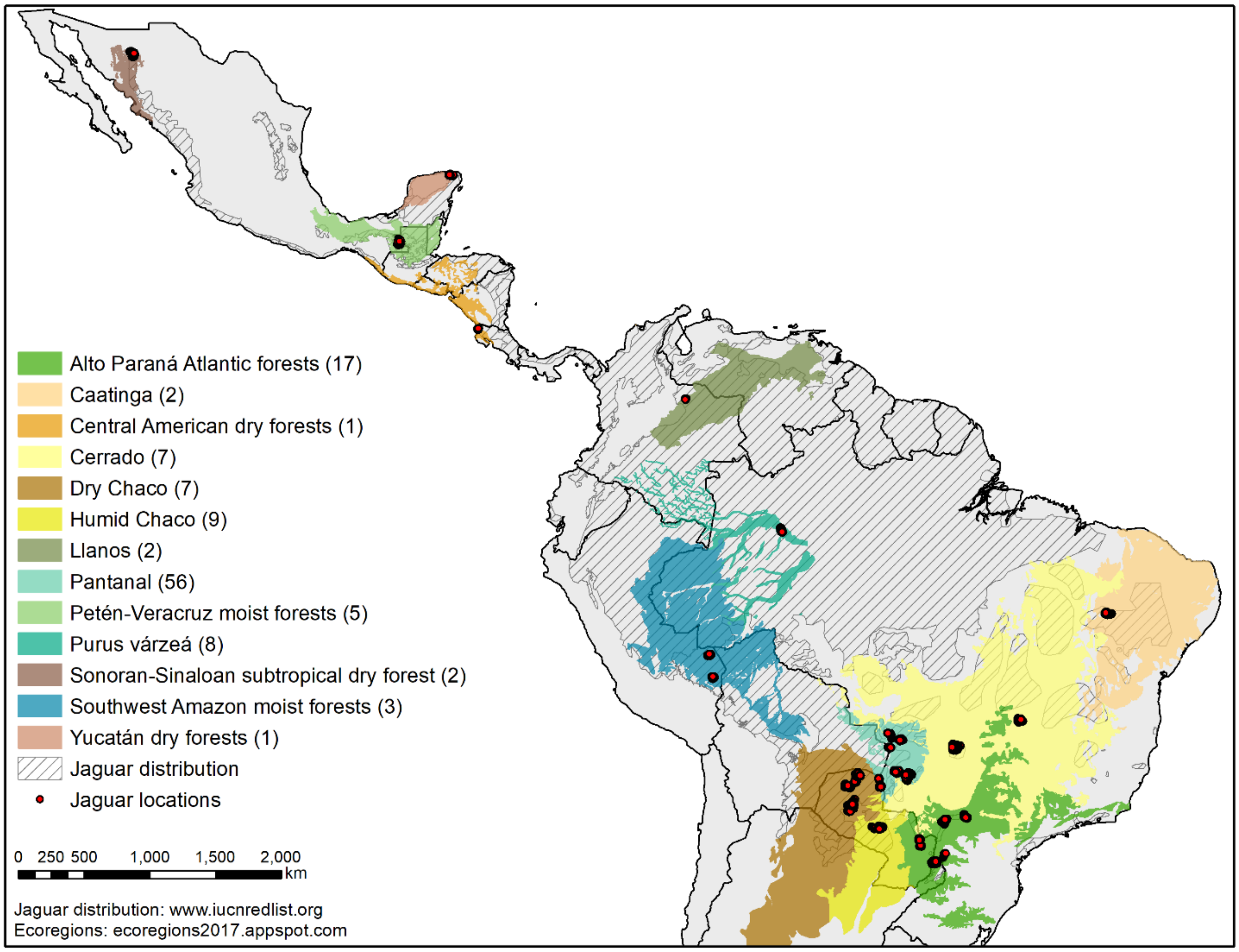

Fig. 1. **Telemetry data locations**. Locations in North and South America by ecoregion of telemetered jaguars included in the analysis. Numbers next to ecoregions represent the number of individuals telemetered.

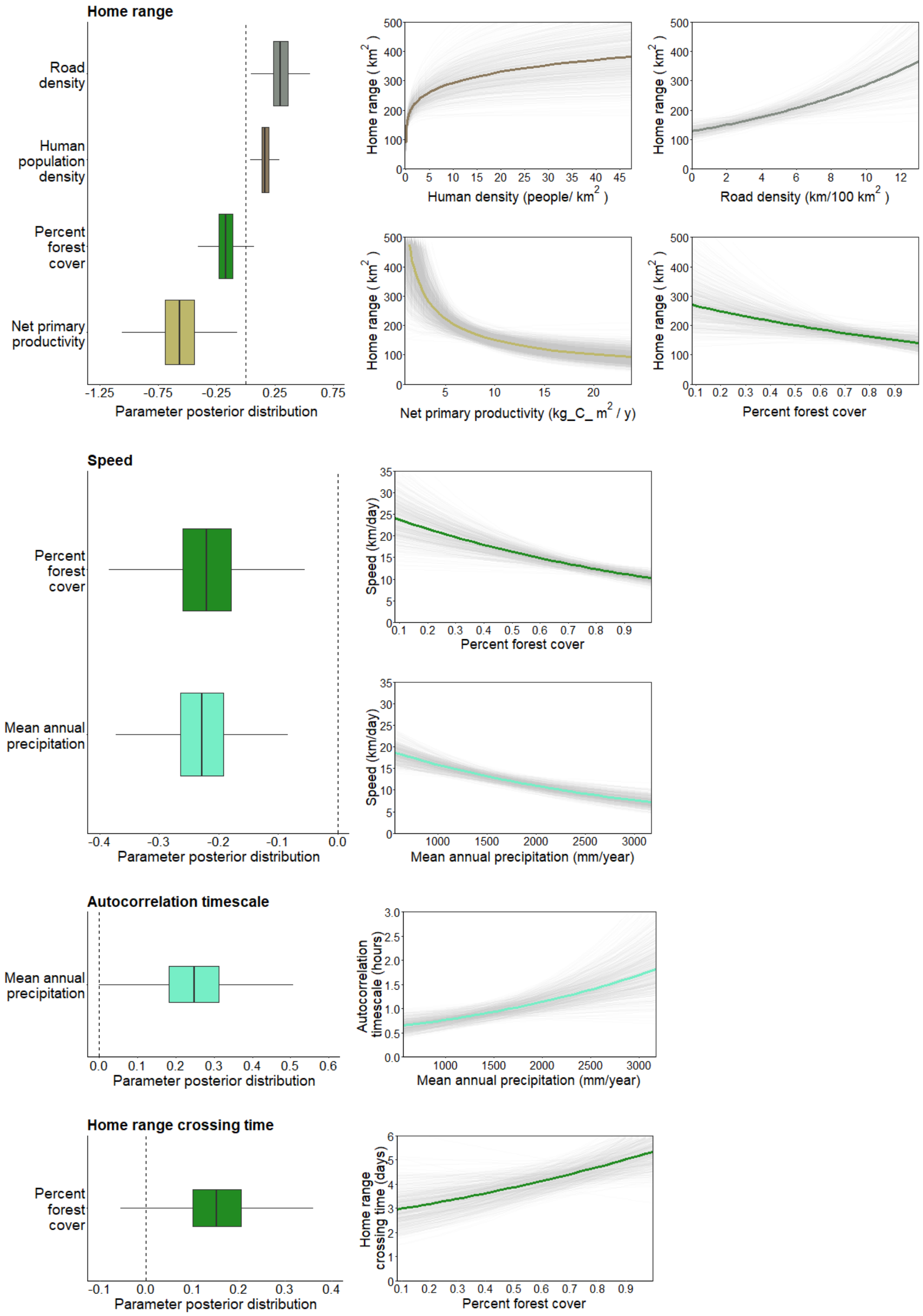

Fig. 2. Range-wide scale relationships of home range size with covariates. (left) Posterior distributions of the parameter estimates from the Bayesian analysis of the best fit range-wide generalized linear mixed model with sex as a random effect for home range size, speed, autocorrelation timescale, and home range crossing time. Boxplots represent the median, 25th and 75th quantiles and whiskers 1.5 times the upper and lower

interquartile range, with the dashed line representing the value of no effect upon the movement parameter by the covariate. (right) Estimated responses of home range size and movement parameters to landscape covariates. Colored lines represent mean effect and gray lines are 500 estimated responses based upon random draws from the parameter posterior distributions.

Comparatively, at the ecoregional scale estimated home range size was positively affected by sex (male) and road density and a negatively affected by net primary productivity. Sex and road density had a 100% probability of a positive relationship with home range size and net primary productivity a 92% probability of being associated with decreasing home range size (Fig. 3, Table S4). Comparing estimated home size among ecoregions by fixing the transformed covariate values to zero so that estimates are based upon model intercepts, estimated mean home range size was largest for the Cerrado (565.6 km^2) and smallest for the Pantanal (68.0 km^2) which had probabilities of being 92% greater and 88% smaller, respectively than the mean across all ecoregions (Table S3, Table S5, Fig. S1).

The relationship of estimated home range size and movement parameters with covariates demonstrates that at both the range-wide and ecoregional scale most responses are nearly linear, except for human population density at the range-wide scale and net primary productivity at both scales (Fig. 2, Fig. 3). At both scales home range size was estimated to sharply decline and then level off as net primary productivity approached about 5 kg C/m^2/yr, although the effect was stronger at the range-wide scale. Estimated home range size was sensitive to increasing human population density at the range-wide scale as human density increases from 0 to about 3 people/ km^2, with a reduced increase in the effect thereafter (Fig. 2).

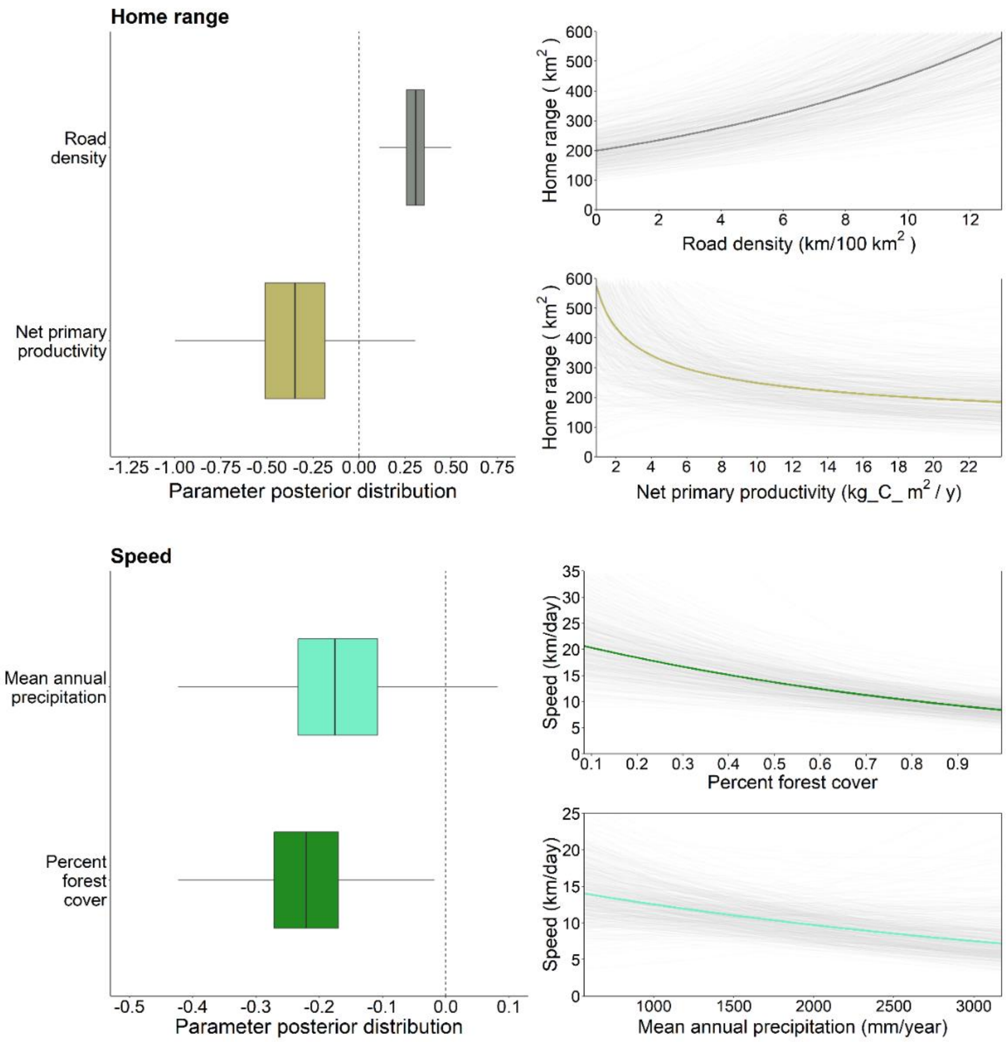

Fig. 3. Ecoregional scale relationships of home range size with covariates. (left) Posterior distributions of the parameter estimates from the Bayesian analysis of the best fit ecoregional scale generalized linear mixed model with ecoregion as a random effect for home range size and speed. Boxplots represent the median, 25th and 75th quantiles and whiskers 1.5 times the upper and lower interquartile range, with the dashed line representing the value of no effect upon the movement parameter by the covariate (left). Estimated responses of home range size and movement parameters to landscape covariates (right). Colored lines represent mean effect and gray lines are 500 estimated responses based upon random draws from the parameter posterior distributions.

Using the parameter estimates from the best-fit range-wide home range model and the corresponding landscape covariates, we spatially modeled the predicted mean home range size across the jaguar's current distribution, showing that ecoregions with lower productivity or higher road and human density such as the Caatinga, Cerrado, Dry Chaco, Central America and Mexican dry forests, and the Caribbean slope of Colombia were predicted to have larger home ranges (Fig. 4). Conversely, systems with high productivity and forest cover or with lower human and road densities such as the eastern slope of the Andes and portions of the Pantanal, Llanos, Amazon Basin, Atlantic forest, and humid Mesoamerican forests had the smallest predicted home range size (Fig. 4). However, within high productivity systems, including Atlantic forest, Amazon basin, Pantanal, and the Llanos, there are areas with high human population and road densities and relatively low forest cover, where predicted home range sizes were considerably larger compared to the expected values for the region.

At both the range-wide and ecoregional scales speed was strongly negatively related to percent forest cover and mean annual precipitation with both covariates having a 100% probability of being related to decreasing speed and males had a 98% probability of greater speed than females at both scales (Fig. 2,3; Table S3, S4, S5). Based upon model intercepts the differences in speed across ecoregions were relatively small with jaguars in Southwest Amazon moist forests having the highest mean estimated speed (19.7 km/day) and Purus várzeá forest the lowest (10.8 km/day), with a 75% and 30% probability, respectively of being greater than the ecoregional mean and an 86% probability that speed of jaguars in the Southwest Amazon moist forests was greater than those in the Purus várzeá forest (Table S3, Fig. S1).

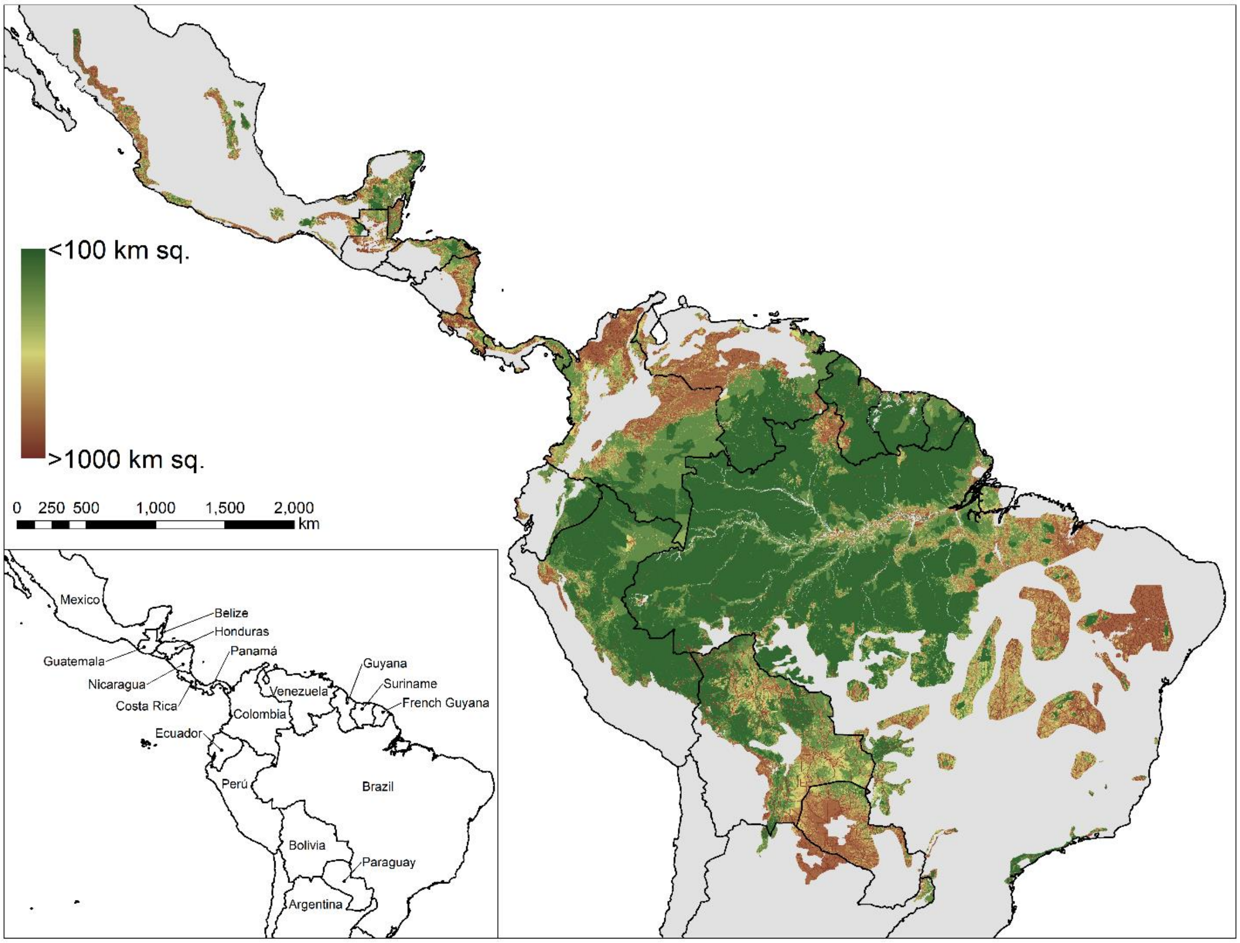

Fig. 4. Range-wide predicted mean jaguar home range size. Predicted mean home range size for jaguar across its distribution based upon the best fit range-wide home range model and corresponding covariates.

At the range-wide scale the autocorrelation timescale was nearly equal for males and females, with females having 51% probability of having a greater autocorrelation timescale, while there was a 100% probability of the autocorrelation timescale being positively related to mean annual precipitation (Fig. 2, Table S4). For home range crossing time at the range-wide scale the best fit model had a 98% probability of a positive effect from percent forest cover, with females having an 90% probability of a greater home range crossing time than males (Fig. 2, Table S4). At the ecoregional scale the autocorrelation timescale and home range crossing time were not affected by covariates, but differed among ecoregions. Jaguars had the smallest mean autocorrelation timescale (0.59 h) in the Humid Chaco and the largest (2.76 h) in the Péten-Veracruz moist forest, while the shortest estimated mean home range crossing time was in the Cerrado (4.1 days) and the longest in the Purus várzeá of the Amazon (5.9 days; Table S5, Fig. S1).

DISCUSSION

We demonstrated that jaguar home range size increased with increasing anthropogenic factors (human population density, road density), illustrating both the negative effects of human impacts and the plasticity in jaguar space use to cope with anthropogenic habitat degradation [11,12]. We also showed that increasing forest cover and ecosystem productivity were related to decreasing home range size. Additionally, jaguar movement within home ranges (speed, autocorrelation timescale, home range crossing time) was independent of home range size and instead related to a different suite of factors which did not include anthropogenic covariates. This indicates that decisions about movement at the relatively short sampling scale of our data (generally 1 – 4 hours) were most dependent upon environmental factors and that jaguars adjust their behavior to account for anthropogenic factors [11,13–16].

Our range-wide predictions of home range size coincide with predicted range-wide densities, which is intuitive as net primary productivity is strongly associated with jaguar densities [12]. Range-wide, forest cover and net primary productivity were important in determining jaguar home range size and regions with predicted smaller home range sizes coincided with observed high jaguar densities in productive systems such as the Pantanal [17], Llanos [18], Amazon flooded forest [19], and the western [20] and southwestern Amazon [21]. Similarly, regions with the largest predicted home range sizes coincided with semi-arid systems with recorded low jaguar densities such as the Caatinga, Cerrado, Sonoran-Sinaloan subtropical dry forest, and Dry Chaco, where net primary productivity is comparatively low and forest cover is reduced due to biotic factors and land use [22–25].

The relationship between home range size and density can be attributed to a greater amount of preferred habitat and prey in more productive systems which allows for smaller spatial needs, and conversely larger home ranges and lower densities in less productive systems [26]. Concurrently, habitat degradation, prey reduction, and direct killing stemming from increasing human population density, and facilitated by greater road density, can be attributed to increasing home range size as jaguars require larger areas to meet metabolic needs [26,27]. These observations are consistent with the relatively large home range sizes predicted by our models, and the relatively low estimated densities or occurrence probabilities, in portions of productive systems with strong anthropogenic impacts including the Atlantic Forest [28–30], Llanos [31], and western Amazon [20].

Within ecoregions, as at the range-wide scale, increasing net primary productivity was associated with smaller home range size and increasing road density with larger home range size. A lack of an effect from forest cover and human population density within ecoregions can be attributed to homogeneity and low variability of both factors within ecoregions where the movement data were collected [28]. Importantly, we illustrated that ecosystem productivity and the presence of roads drive jaguar home range size, both range-wide and among ecoregions, which is consistent with observed behavior of jaguars [12,16,20,32] and other felids [33,34]. We do note, however, that for several ecoregions sample sizes were low and subsequently, despite our efforts to account for this in our modeling, our site-specific results at the ecoregional scale need to be interpreted within the context of the associated uncertainty.

Additionally, apart from determining the covariates at the range-wide and ecoregional scales associated with home range size, we demonstrated a high sensitivity of home range size to increasing net primary productivity at both scales, and to human population density range-wide, at the lower range of the values of those covariates. As expected from previous research [28,29,35], males had larger home ranges than females range-wide and among ecoregions. Male home range size is driven by both food availability and the need to maintain reproductive opportunities by maximizing their contact with females; consequently, their home ranges tend to be larger. In contrast, females have comparatively smaller home ranges to minimize metabolic costs while maximizing food availability and reproductive success [36,37]. Supporting this interpretation, and as indicated by previous research [15,29,35], we found that males moved farther, faster, and more directionally than females which is consistent with male requirements to maintain larger home range areas.

The negative relationship of speed with percent forest cover and mean annual precipitation suggests that forest availability, and potentially forest structure from increased precipitation, as well as a greater availability of water, results in more homogenous, high quality habitat which consequently does not force jaguars to avoid sub-optimal habitats [11,14,16]. Since daily speed was negatively related with forest cover, a positive relationship in home range crossing time with percent forest cover is logical, as it would be expected that when individuals move slower, they take a longer time to cross their home ranges.

The increase in the autocorrelation timescale with increasing precipitation range-wide suggests that, as with speed, habitat homogeneity and water availability lead to more directional movements [11,14]. Autocorrelation timescale and home range crossing time exhibited a lack of relationship with landscape covariates within ecoregions. This likely indicates that factors different from those that we considered drive jaguar movement behaviors within ecoregions, or may potentially be due to homogeneity in covariates among home ranges within ecoregions. Given individual-level fine scale movement decisions by jaguar [9,15] the lack of clear relationships among movement parameters and the landscape factors we evaluated is not unexpected and points to a need for analyses of localized, fine-scale movement decisions by jaguars across its range.

Our data set and analysis is the largest to date on the movement ecology of the jaguar, or for any large felid, spanning its complete extant range from its southernmost limits in the province of Misiones, Argentina to its northernmost extent in the state of Sonora, Mexico representing the spectrum of habitat types that jaguars inhabit, including dry and humid forest and wetlands, and varying levels of anthropogenic transformation. We corroborated prior research documenting that the anthropogenic and environmental factors affecting jaguar space use and movement at local and regional scales [11,14,15] act similarly across ecoregions, continents, and range-wide to affect jaguar space use and movements, demonstrating that jaguars perceive their environment similarly, regardless of geographic location or habitat type. In doing so, we provide a set of landscape metrics and a mechanism to evaluate jaguar habitat quality throughout the species' range, facilitating transboundary conservation planning among jaguar range states, which is of significance as the range-wide conservation vision for the jaguar is based upon international collaboration and trans-boundary decision making to maintain connectivity among core jaguar populations (Jaguar Conservation Units) [6].

Our analysis is unique in that it is the first to elucidate the range-wide drivers of space use by a terrestrial apex predator, and given the geographic and ecological breadth of our analysis, and its accounting for uncertainty in the data, our inferences not only provide robust generalizations which address key needs for the jaguars' range-wide conservation[6], but also for the conservation of other large cats [38–40], and large terrestrial carnivores in general [2].

Moreover, given the importance of understanding the drivers of space use by large terrestrial carnivores for their conservation, our modeling framework provides a useful tool to identify the environmental and anthropogenic factors associated with large carnivore space use. Our findings, and the framework presented herein, therefore have immediate and direct applications for the range-wide conservation of jaguars, other large cats, and large terrestrial carnivores around the world and the biodiversity for which they are proxy.

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Author contributions

J.J.T., R.G.M., B.S., A.P., J.A.T. conceptualized the analysis, J.J.T., B.S., V.B., J.O., A.E.B. undertook the analysis, J.J.T., R.G.M., B.S. led the writing of the manuscript, J.J.T., R.G.M., B.S., A.P., J.A.T., F.L., R.T.M., R.C.P., L.C., L.S., D.L.Z.K., E.E.R., L.M., M.H., D.A.S., R.A.M., E.C., V.M., O.M., P.C., A.T.J., N.M.T., G.B.A., I.C., R.T., C.S., J.C.C., L.D.A., I.H., M.X.S., A.V., M.F.D.M., S.S.M., D.C.P., G.R.A., L.C.S., L.L., M.M.C., L.R., L.S., H.Q., F.T., R.H., P.G.C., A.L.D., J.A.M., G.V.N.P., M.W.P., S.E.C, E.P., F.C.C.A., H.V.B.C., V.A.Q., S.A.C., J.P.A., E.V., Y.E.D., A.M.C.L., M.C.R provided data. All authors contributed to the writing.

Declaration of interests: The authors claim no competing interests.

STAR METHODS

Detailed methods are provided in the online version of this paper and include the following:

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    - Modeling factors affecting home range size and movement parameters

SUPPLEMENTAL INFORMATION

Supplemental Information can be found online at:

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Data and materials availability: Data used in the analysis are available at

https://datadryad.org/stash/dataset/doi:10.5061/dryad.2dh0223

STAR METHODS

KEY RESOURCES TABLE

REAGENT or RESOURCE	SOURCE	IDENTIFIER
Deposited Data		
Raw data	[9]	https://datadryad.org/stash/dataset/doi:10.5061/dryad.2dh0223
Experimental Models: Organisms/Strains		
Panthera onca	Wild	N/A
Software and Algorithms		
ctmm 0.5.11	[41]	https://cran.r-project.org/web/packages/ctmm/index.html
R 3.6.3	[42]	https://www.r-project.org/
lme4 1.1-23	[43]	https://cran.r-project.org/web/packages/lme4/index.htmlwing

WinBUGS 1.4.3	[44]	https://www.mrc-bsu.cam.ac.uk/software/bugs/the-bugs-project-winbugs/
R2WinBUGS 2.1-21	[45]	https://cran.r-project.org/web/packages/R2WinBUGS/index.html
Other		
Terrestrial ecoregions	[46]	https://ecoregions2017.appspot.com/
Forest cover	[47]	www.globalforestwatch.org
Protected area	[48]	www.protectedplanet.net
Annual precipitation	[49]	http://worldclim.org/
Seasonality in precipitation	[49]	http://worldclim.org/
Net primary productivity	[50]	http://files.ntsg.umt.edu/data/NTSG_Products/MOD17/
Human pop density	[51]	http://sedac.ciesin.columbia.edu/data/set/gpw–v4–population–density–rev10
Human footprint index	[52]	https://wcshumanfootprint.org/
Cattle density	[53]	https://livestock.geo–wiki.org/home–2/
Primary Roads	[54]	http://sedac.ciesin.columbia.edu/data/set/groads–global–roads–open–access–v1

RESOURCES AVAILABILITY

Lead Contact

Further information and requests should be directed to and will be fulfilled by the Lead Contact, Jeffrey J. Thompson (jthompson.py@gmail.com).

Materials Availability

This study did not generate unique reagents.

Data and Code Availability

Original data are deposited to Data Dryad: https://datadryad.org/stash/dataset/doi:10.5061/dryad.2dh0223

EXPERIMENTAL MODEL AND SUBJECT DETAILS

The study subjects were jaguars (*Panthera onca*). All jaguar captures and handling followed the guidelines of the American Society of Mammalogists for the use of wild mammals in research [55].

QUANTIFICATION AND STATISTICAL ANALYSIS

Home range and movement parameter estimation

To estimate home range size we fit continuous-time stochastic movement models to our data to account for autocorrelation structure in the data over time and for variable sampling intervals [10]. We fit models in a maximum likelihood framework using starting values derived from semi-variance functions, ranking model fit using Akaike Information Criteria adjusted for small sample size (AICc) and model weights [10]. We tested three movement models 1) a random search model (Brownian motion) with uncorrelated velocities and no limits to space use, 2) a random search model with constrained space use (Ornstein–Uhlenbeck, OU), and 3) the Ornstein–Uhlenbeck motion with foraging (OUF) which is the OU process with correlated velocities [10]. All these models account for autocorrelation in positions, while the OU and OUF models include range residency (home range), and the OUF model accounts for autocorrelation in velocities. Consequently, the OU and OUF models produce estimates of home range size and home range crossing time, while the OUF model additionally estimates the velocity autocorrelation time scale (time over which movements are correlated) and mean distance traveled per day (speed) [10].

If individuals exhibited range residency, 95% home range areas were estimated using autocorrelated kernel density estimation (AKDE) based upon the best fitting model [56]. Semi-variogram analysis, model selection, and AKDE were undertaken using the *ctmm* package [41] with the software R [42]. Irregular sampling schedules in the data were accounted for using the *dt* argument within the *variogram* function in the *ctmm* package [41].

Modeling factors affecting home range size and movement parameters

Based upon previous research on factors related to jaguar distribution and home range size [12,28,29,35] we hypothesized that nine environmental and four anthropogenic covariates could potentially be determinants of home range size of jaguar across its distribution. For each home range area we derived the 1) mean percent forest cover, 2) mean percent area in forest, 3) mean forest patch area, 4) perimeter:area ratio of forest patches, 5) density of forest edge, 6) percent protected area, 7) mean annual precipitation, 8) mean seasonality in precipitation, 9) mean net primary productivity, 10) mean human population density, 11) mean Human Footprint Index, 12) mean cattle density, and 13) primary road density (see Key Resources Table). Additionally, we included sex as a covariate based upon exploratory analysis of the data and that sex-based differences in jaguar movements have been illustrated [15,29,32,35], while we also considered the effect of body mass as it has been shown to be a factor associated with jaguar distribution [12].

We tested for correlation among covariates using Pearson's Correlation Coefficient, with coefficient values between -0.6–0.6 considered uncorrelated. Of the original covariate set, seven were uncorrelated with other covariates; mean percent forest cover, percent protected area, mean annual precipitation, mean seasonality in precipitation, mean net primary productivity, mean human population density, and road density. Also, body mass was significantly associated with sex (Kruskal-Wallis χ^2 test, p=0.04) and was not included in the models. We examined covariates for normality with Shapiro-Wilk tests and inspection of Q-Q plots and log transformed covariates if necessary, to ensure normality. If not log transformed, covariates were *z*-transformed so that their means value were equal to zero.

We modeled the relationship of the estimates of home range, speed, autocorrelation timescale, and home range crossing time with the covariates using generalized linear mixed models (GLMM) [57] in maximum likelihood and Bayesian frameworks with sex as a random effect to evaluate range-wide factors associated with movement parameters and with ecoregion (as defined by [46]) as a random effect to evaluate relationships among covariates and movement parameters at the ecoregion scale. We chose to employ GLMMs since incorporating random effects allowed for borrowing of information and improved accounting of variability and psuedoreplication in our data, which in turn improved the strength of our inferences given low sample sizes for several sites [57]. We separated our analysis into two components (range-wide and ecoregional) due to a failure of models including sex and ecoregion hierarchies to convergence which we attribute to insufficient sample size.

Using a maximum likelihood framework, we chose a most parsimonious model to explain home range size and each movement parameter by starting with the global model and sequentially eliminating the least informative parameter based upon the value of the estimate divided by its standard error until there was further reduction in AIC or all model parameters were informative at least at the 85% confidence interval [58]. Using the best fit maximum likelihood models at each scale for home range size and movement parameters, we modeled the GLMMs in a Bayesian framework which allowed us to incorporate all uncertainty in our data, estimate the effect size of sex and ecoregion, and quantify the strength of covariate effects as probabilities based upon posterior distributions.

The strength of the covariate effects on home range size and movement parameters was measured by the proportion of the parameter posterior distributions above or below 0 (no effect). To test for differences in home range and movement parameters between sexes and among ecoregions we tested the difference between parameter posterior distributions by randomly selecting 100,000 values with replacement from posterior distributions, comparing the proportion of times that the selected values from a distribution were greater or smaller than the selected values from the distribution being compared. Where these proportions were 0.5 there was no difference between parameters since they had equal probability of being different (50%:50%), while where the proportional difference was 1 the probability of a difference between distributions was 100%.

For modeling maximum likelihood GLMMs we used the lme4 package [43] with the software R [42] and for the development of the Bayesian GLMMs we used WinBUGS [44] and the *R2winBUGS* package [45], running 3 chains for 1 million iterations, a burn-in period of 100,000 iterations, and a thinning rate of 30. For the prior distributions in the modeling we used diffuse uniform distributions for the random effects and normal distributions for the covariate effects, confirming model convergence with a scale reduction factor ≤1.01 and visual inspection of trace plots for lack of autocorrelation [57].

Using the parameter estimates for each covariate from the range-wide best-fit model for home range size and the corresponding spatial covariate values we predicted mean home range size throughout the extant home range of the jaguar. All spatial data and the final map were at a resolution of 0.008 decimal degrees (approximately 1 km). Additionally, using the mean covariate values range-wide and within ecoregions we estimated mean home range size and movement parameter values by sex and ecoregion.

SUPPLEMENTAL MATERIALES

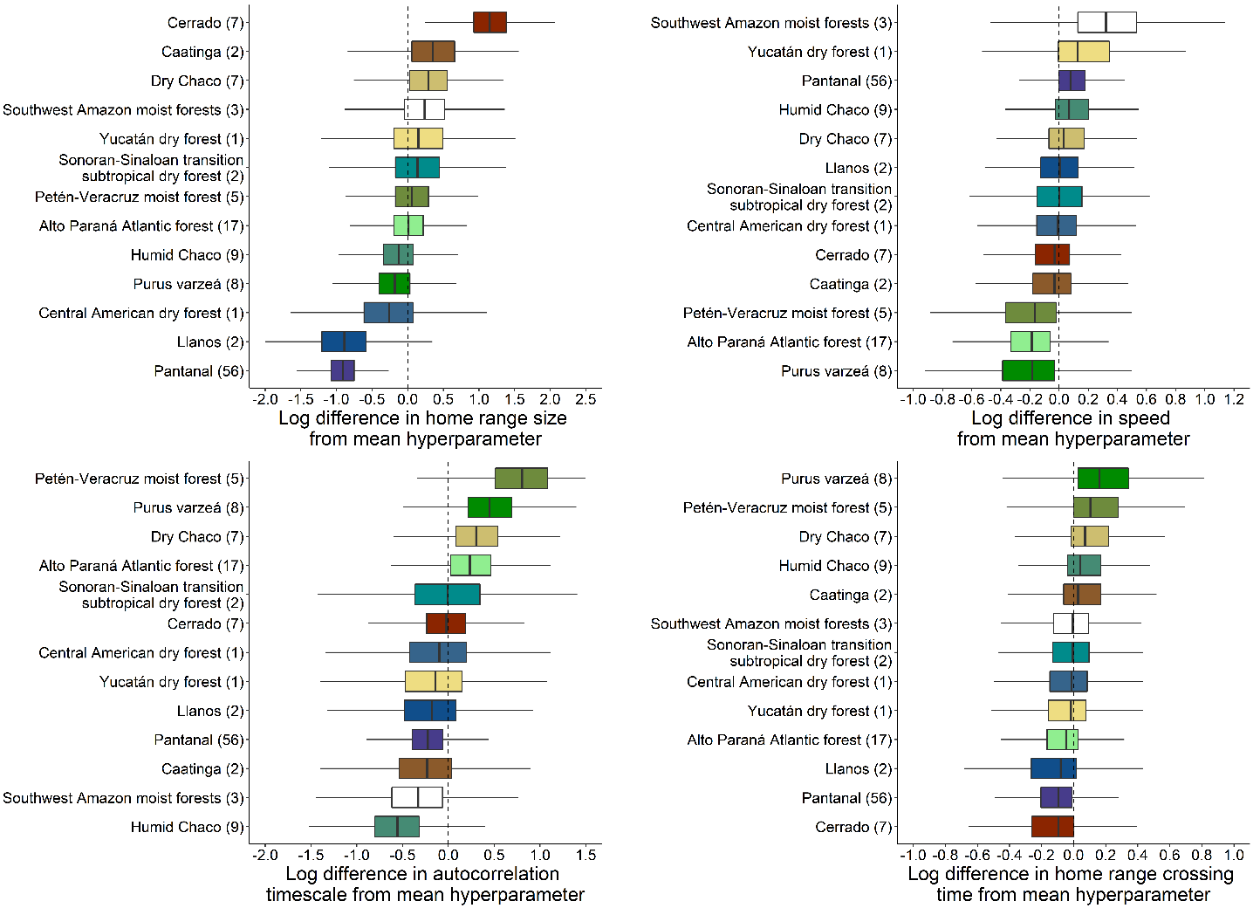

Fig. S1. Estimated ecoregion effect on home range size and movement parameters. Posterior distributions of the effect size of ecoregion compared to the mean effect from the ecoregional generalized linear mixed model with ecoregion as a random effect for home range size, speed, autocorrelation timescale, and home range crossing time. Dashed line represents the mean value of the ecoregion hyper–parameter. Boxplots are ordered by median value and represent the median, 25th and 75th quantiles and whiskers 1.5 times the upper and lower interquartile range. Sample size for each ecoregion is in parentheses.

Table S1. Estimated movement parameters for individual jaguars in the analysis. Autocorrelated kernel density estimated home ranges and movement parameters for jaguars used in the analysis.

Ecoregion	Sex	95% AKDE home range (km^2)	Home crossing time (day)	Autocorrelation timescale (hours)	Speed (km/day)
Alto Paraná Atlantic forest	Female	105.6 (83.5–130.2)	2.4 (1.5–3.9)	3.68 (1.43–9.49)	6.0 (4.6–7.3)
Alto Paraná Atlantic forest	Female	146.0 (107.1–191.0)	6.0 (4.0–8.9))	0.82 (0.07–10.34)	9.3 (5.7–13.0)
Alto Paraná Atlantic forest	Female	51.3 (31.1–76.4)	5.3 (2.5–11.1)	—	—
Alto Paraná Atlantic forest	Female	133.3 (75.8–206.7)	1.0 (0.0–3.0)	1.03 (0.0–2.96)	4.5 (0.86–8.46)
Alto Paraná Atlantic forest	Female	115.8 (77.3–161.9)	4.4 (2.6–7.3)	—	—
Alto Paraná Atlantic forest	Female	260.0 (141.4–414.1)	16.5 (0.0–34.0)	—	—
Alto Paraná Atlantic forest	Female	256.8 (191.1–332.0)	7.3 (5.1–10.6)	—	—
Alto Paraná Atlantic forest	Female	722.8 (296.8–1335.1)	18.5 (4.7–72.6)	—	—
Alto Paraná Atlantic forest	Female	144.4 (97.9–199.8)	2.4 (1.2–4.9)	—	—
Alto Paraná Atlantic forest	Female	235.0 (170.0–310.4)	7.9 (5.4–11.6)	1.56 (1.22–1.98)	7.5 (7.0–8.1)
Alto Paraná Atlantic forest	Female	137.6 (112.2–165.5)	1.6 (1.2–2,1)	2.19 (1.49–3.22)	10.0 (9.0–11.0)
Alto Paraná Atlantic forest	Male	151 (117.8–188.1)	4.5 (3.3–6.1)	0.04 (0.03–0.05)	7.1 (6.6–7.6)
Alto Paraná Atlantic forest	Male	112.6 (88.9–139.1)	1.6 (1.1–2.2)	—	—
Alto Paraná Atlantic forest	Male	702.3 (528.4–900.6)	2.1 (1.4–3.2)	—	—
Alto Paraná Atlantic forest	Male	504.8 (400.4–621.2)	4.6 (3.5–6.1)	0.89 (0.25–3.21)	21.8 (14.9–28.8)
Alto Paraná Atlantic forest	Male	174.8 (69.1–328.7)	10.6 (2.5–43.8)	0.6 (0.45–0.80)	8.5 (7.8–9.2)
Alto Paraná Atlantic forest	Male	685.1 (264.8–1301.7)	6.3 (1.2–31.5)	—	—
Caatinga	Male	2188.7 (795.5–4274.5)	1.9 (0.38–10.1)	0.81 (0.78–0.84)	10.7 (10.6–10.9)
Caatinga	Male	476.0 (86.3–1191.8)	23.8 (20.0–26.6)	0.38 (0.33–0.44)	11.7 (11.2–12.1)
Central America dry forest	Female	84.9 (73.0–97.8)	3.1 (2.6–3.7)	0.73 (0.68–0.78)	11.3 (11.1–11.6)
Cerrado	Female	1141.7 (683.7–1715.2)	14.3 (7.8–26.5)	0.37 (0.28–0.48)	23.4 (21.1–25.7)
Cerrado	Female	1815.7 (368.5–4394.6)	1.2 (0.0–2.7)	1.89 (0.50–7.08)	8.0 (5.7–10.3)
Cerrado	Male	2131.9 (754.4–4212.3)	1.2 (0.2–7.0)	1.07 (0.88–1.30)	10.9 (10.1–11.6)
Cerrado	Male	1003.4 (837.3–1184.2)	3.4 (2.8–4.1)	0.76 (0.66–0.88)	34.6 (32.8–36.4)
Cerrado	Male	2453.5 (1118.4–4304.2)	1.2 (0.4–3.5)	0.71 (0.59–0.86)	15.9 (14.7–17.0)
Cerrado	Male	1278.2 (780.3–1896.8)	6.9 (3.8–12.5)	0.83 (0.76–0.91)	25.9 (25.3–26.6)
Cerrado	Male	1171.3 (835.4–1563.1)	4.5 (3.0–6.7)	1.91 (1.61–2.27)	20.2 (19.3–21.1)
Dry Chaco	Female	504.4 (359.0–673.2)	9.5 (6.4–14.0)	1.72 (1.49–1.99)	9.7 (9.3–10.1)
Dry Chaco	Female	612.8 (425.3–833.8)	11.5 (7.6–17.5)	1.09 (0.89–1.34)	11.9 (11.1–12.6)
Dry Chaco	Male	410.8 (351.5–474.5)	2.7 (2.3–3.2)	1.37 (1.27–1.49)	17.1 (16.7–17.4)
Dry Chaco	Male	2326.7 (1691.6–3061.4)	8.0 (5.6–11.5)	1.15 (0.96–1.37)	28.8 (27.1–30.5)
Dry Chaco	Male	352.2 (240.1–485.4)	11.5 (7.3–18.0)	1.78 (1.51–2.10)	7.9 (7.5–8.3)
Dry Chaco	Male	563.5 (356.8–816.5)	3.5 (2.0–6.2)	1.93 (1.65–2.25)	15.1 (14.8–15.7)
Dry Chaco	Male	1052 (812.9–1321.5)	4.8 (3.6–6.4))	2.15 (1.90–2.43)	19.3 (18.6–20.0)
Humid Chaco	Female	309.7 (214.4– 422.3)	6.2 (3.9–9.9)	1.52 (0.93–2.48)	9.3 (7.9–10.6)
Humid Chaco	Female	96.9 (79.6–115.9)	1.2 (0.91–1.62)	0.47 (0.01–24.29)	21.0 (12.3–29.8)
Humid Chaco	Female	86.3 (41.3–147.8)	5.7 (2.1–15.5)	—	—
Humid Chaco	Female	124.0 (74.4–186.0)	9.9 (5.4–17)	0.16 (0.09–0.28)	14.1 (11.3–16.9)
Humid Chaco	Female	245.1 (172.2–330.8)	9.2 (6.2–13.7)	0.15 (0.09–0.23)	22.6 (18.7–26.4)

Humid Chaco	Female	111.6 (78.4–150.6)	9.4 (6.3–14.1)	0.16 (0.63–0.42)	14.2 (10.1–18.3)
Humid Chaco	Male	1066.7 (594.0–1675.6)	5.9 (2.7–12.7)	—	—
Humid Chaco	Male	430.1 (293.5–592.3)	4.4 (2.9–7.0)	1.42 (1.2–1.67)	15.0 (14.4–15.6)
Humid Chaco	Male	352.2 (227.1–504.4)	5.3 (3.2–9.1)	0.85 (0.60–1.22)	13.5 (12.0–14.9)
Llanos	Female	35.0 (19.9–54.2)	1.7 (0.8–3.7)	0.3 (0.13–0.70)	20.2 (15.4–24.9)
Llanos	Male	100.3 (77.4–134.0)	2.0 (1.3–3.2)	1.31 (0.58–2.97)	11.1 (8.9–13.4)
Pantanal	Female	475.5 (182.9–905.4)	25.6 (5.84–112.1)	0.36 (0.33–0.40)	11.7 (11.3–12.0)
Pantanal	Female	27.5 (20.6–36.2)	20.5 (14.9–28.3)	0.31 (0.26–0.36)	19.7 (18.7–20.6)
Pantanal	Female	37.2 (28.6–46.9)	2.0 (1.5–2.7)	4.3 (3.4–5.4)	26.9 (24.4–29.5)
Pantanal	Female	39.9 (28.3–53.5)	1.3 (0.9–1.9)	5.02 (3.21–7.85)	34.3 (28.7–53.5)
Pantanal	Female	36.2 (27.4–46.3)	3.3 (2.4–4.6)	—	—
Pantanal	Female	30.7 (22.4–40.3)	2.0 (1.3–2.9)	—	—
Pantanal	Female	36.3 (24.5–50.4)	1.6 (0.7–3.5)	2.88 (0.64–12.8)	4.9 (3.7–6.2)
Pantanal	Female	49.0 (40.9–57.9)	2.9 (2.3–3.5)	—	—
Pantanal	Female	30.9 (21.8–41.5)	2.1 (1.2–3.4)	—	—
Pantanal	Female	98.2 (79.7–118.7)	1.2 (0.9–1.7)	—	—
Pantanal	Female	68.3 (46.4–94.5)	2.7 (1.6–4.5)	—	—
Pantanal	Female	19.3 (14.9–24.2)	3.7 (2.8–4.9)	0.33 (0.31–0.36)	7.2 (7.1–7.4)
Pantanal	Female	16.7 (7.9–28.7)	3.0 (1.1–8.4)	0.27 (0.20–0.36)	7.7 (7.0–8.4)
Pantanal	Female	116.6 (89.9–146.7)	3.1 (2.3–4.1)	0.23 (0.21–0.26)	23.9 (22.9–24.9)
Pantanal	Female	64.6 (52.8–77.6)	2.6 (2.0–3.2)	—	—
Pantanal	Female	89.8 (71.2–110.5)	4.3 (3.3–5.6)	1.12 (0.94–1.35)	7.9 (7.4–8.3)
Pantanal	Female	60.1 (43.4–79.6)	3.1 (2.1–4.4)	0.24 (0.21–0.28)	15.2 (14.4–16.0)
Pantanal	Female	61.5 (50.5–73.5)	2.5 (2.0–3.1)	0.19 (0.17–0.22)	19.1 (18.2–19.9)
Pantanal	Female	143.0 (92.4–204.4)	3.7 (2.2–6.1)	0.07 (0.05–0.09)	40.8 (35.7–45.8)
Pantanal	Female	26.1 (17.7–36.0)	19.6 (12.4–31.0)	0.05 (0.3–0.09)	49.5 (40.4–58.6)
Pantanal	Female	52.2 (33.3–75.1)	7.9 (4.7–13.3)	0.01 (0.04–0.20)	25.2 (15.4–35.03)
Pantanal	Female	477.2 (193.1–887.7)	9.8 (2.4–40.2)	1.07 (0.62–1.85)	10.8 (9.0–12.6)
Pantanal	Female	68.8 (59.3–79.1)	2.4 (2.03–2.82)	—	—
Pantanal	Female	55.2 (43.3–68.6)	15.0 (10.7–21.0)	—	—
Pantanal	Female	48.1 (39.5–57.5)	4.5 (3.6–5.5)	—	—
Pantanal	Female	95.6 (50.8–154.6)	6.6 (2.9–14.9)	—	—
Pantanal	Female	36.6 (31.1–42.6)	1.2 (1.0–1.5)	—	—
Pantanal	Female	142.3 (131.4–153.8)	8.8 (7.9–9.9)	—	—
Pantanal	Female	119.9 (92.2–151.1)	3.8 (2.8–5.1)	0.87 (0.66–1.15)	9.9 (9.0–10.8)
Pantanal	Female	37.5 (25.6–51.6)	4.2 (2.7–6.4)	0.39 (0.36–0.43)	8.3 (8.1–8.5)
Pantanal	Male	37.3 (29.3–46.3)	3.3 (2.5–4.3)	0.30 (0.28–0.33)	12.3 (11.9–12.6)
Pantanal	Male	726.9 (57.5–2223.4)	14.7 (0.0–38.0)	0.40 (0.27–0.60)	17.5 (15.4–19.6)
Pantanal	Male	280.8 (173.3–413.8)	3.9 (2.2–6.8)	0.39 (0.35–0.45)	23.5 (22.6–24.4)
Pantanal	Male	107.8 (71.6–151.2)	4.9 (3.06–7.8)	0.33 (0.29–0.37)	13.7 (13.2–14.2)
Pantanal	Male	92.4 (60.3–131.2)	9.4 (5.8–15.4)	0.32 (0.30–0.35)	9.5 (9.2–9.7)
Pantanal	Male	36.0 (12.2–72.3)	6.5 (0.9–44.7)	0.16 (0.08–0.32)	9.1 (7.3–10.8)
Pantanal	Male	561.0 (394.8–756.1)	6.2 (4.2–9.2)	0.54 (0.52–0.56)	21.7 (21.4–21.9)
Pantanal	Male	423.1 (316.4–545.1)	3.4 (2.4–4.8)	1.39 (1.13–1.70)	16.7 (15.7–17.7)

Pantanal	Male	63.5 (45.0–85.2)	1.0 (0.6–1.8)	0.61 (0.0–1.42)	16.4 (7.6–25.2)
Pantanal	Male	200.7 (136.0–278.0)	3.8 (2.3–6.2)	—	—
Pantanal	Male	32.9 (14.3–59.0)	6.2 (1.8–20.9)	—	—
Pantanal	Male	69.8 (50.4–92.2)	1.8 (1.1–2.9)	—	—
Pantanal	Male	58.0 (39.7–79.7)	2.1 (1.1–4.0)	1.42 (0.01–2.3)	8.0 (5.0–11.0)
Pantanal	Male	172.6 (134.4–215.5)	2.2 (1.5–3.0)	2.09 (1.33–3.29)	11.9 (10.2–13.5)
Pantanal	Male	89.4 (72.2–108.4)	21.4 (12.6–36.3)	1.7 (0.08–34.3)	13.4 (8.7–18.2)
Pantanal	Male	76.8 (67.4–86.8)	1.2 (1.0–1.4)	—	—
Pantanal	Male	302.7 (156.5–496.4)	6.0 (2.3–15.9)	2.36 (1.19–4.65)	7.8 (6.4–9.2)
Pantanal	Male	181.7 (99.3–288.6)()	3.9 (1.8–8.3)	0.09 (0.06–0.12)	40.2 (35.7–44.7)
Pantanal	Male	457.7 (214.5–791.6)	2.1 (0.8–5.7)	0.2 (0.18–0.22)	10.7 (10.4–11.0)
Pantanal	Male	248.4 (198.2–304.1)	2.1 (1.5–2.8)	1.2 (0.89–1.61)	17.7 (15.9–19.4)
Pantanal	Male	401.1 (237.8–606.5)	3.1 (1.5–6.2)	0.65 (0.33–1.28)	24.4 (19.3–77.1)
Pantanal	Male	187.5 (140.3–241.3)	22.7 (14.7–35.0)	1.39 (0.84–2.31)	21.1 (18.6–23.6)
Pantanal	Male	98.7 (63.1–142.3)	3.5 (1.9–6.3)	0.79 (0.41–1.52)	10.4 (8.6–12.3)
Pantanal	Male	122.8 (97.0–151.5)	1.3 (0.9–1.7)	0.32 (0.0–0.70)	30.9 (15.4–46.5)
Pantanal	Male	219.5 (166.7–279.5)	1.0 (0.7–1.5)	—	—
Pantanal	Male	209.3 (109.7–340.7)	16.0 (7.1–36.2)	0.4 (0.36–0.43)	10.2 (9.9–10.4)
Petén–Veracruz moist forest	Female	643.1 (360.6–1005.9)	28.9 (13.4–62.2)	—	—
Petén–Veracruz moist forest	Female	45.7 (6.06–124.5)	9.4 (0.0–23.5)	5.40 (2.40–12.14)	1.4 (1.2–1.7)
Petén–Veracruz moist forest	Female	258.7 (190.9–336.7)	5.9 (4.1–8.7)	2.91 (2.24–3.77)	7.0 (6.4–7.5)
Petén–Veracruz moist forest	Male	370.2 (294.0–454.9)	4.5 (3.4–6.0)	4.27 (3.55–5.13)	8.0 (7.6–8.4)
Petén–Veracruz moist forest	Male	718.4 (415.1–1103.5)	4.8 (1.9–12.3)	5.24 (2.93–9.33)	9.6 (8.3–11.0)
Purus várzeá	Female	86.9 (45.8–140.8)	9.8 (4.1–23.2)	2.53 (1.97–3.26)	3.3 (3.05–3.49)
Purus várzeá	Female	49.4 (38.0–62.4)	4.8 (3.5–6.7)	0.88 (0.39–2.0)	6.0 (4.8–7.4)
Purus várzeá	Female	70.2 (52.2–90.7)	7.7 (5.6–10.7)	1.03 (0.96–1.11)	5.5 (5.4–5.6)
Purus várzeá	Female	232.2 (85.4–451.1)	28.7 (0.0–59.1)	2.58 (0.4–16.7)	3.3 (2.4–4.2)
Purus várzeá	Male	207.7 (157.5–264.8)	6.8 (5.0–9.4)	2.61 (2,21–3.09)	6.3 (6.0–6.6)
Purus várzeá	Male	254.9 (171.2–355.0)	5.9 (3.6–9.7)	3.36 (2.72–4.14)	6.5 (6.1–6.9)
Purus várzeá	Male	75.8 (42.0–118.6)	3.4 (1.1–11.1)	1.87 (1.02–3.41)	6.1 (5.1–7.0)
Purus várzeá	Male	312.2 (177.9–483.6)	20.4 (10.1–41.0)	—	—
Sonoran–Sinaloan subtropical dry forest	Female	462.9 (245.5–748.1)	9.8 (4.4–21.9)	—	—
Sonoran–Sinaloan subtropical dry forest	Male	805.3 (698.0–920.2)	1.8 (1.5–2.1)	—	—
Southwest Amazon moist forests	Male	201.9 (149.6–261.9)	23.1 (22.7–23.5)	0.20 (0.19–0.21)	5.6 (4.0–7.8)
Southwest Amazon moist forests	Male	305.9 (167.6–485.1)	11.2 (10.1–12.2)	1.82 (1.24–2.68)	3.7 (1.6–8.6)
Southwest Amazon moist forests	Male	372.6 (278.6–480.1)	26.7 (26.3–27.2)	0.37 (0.35–0.39)	26.7 (26.3-27.2)
Yucatán dry forest	Male	305.2 (239.8–378.3)	2.8 (2.1–3.7)	0.57 (0.45–0.71)	25.5 (23.7–27.3)

Table S2. Best fit models. Range–wide and ecoregion scale best fit generalized linear mixed models for home range size, speed, home range crossing time and autocorrelation timescale with sex and ecoregion, respectively as a random effect.

Range–wide	
Random effect	$\alpha \sim Normal(mean_{sex}, var_{sex})$
Home range	$log(home\ range_i)$ $= \alpha_{sex_i} + \beta_1(forest_i) + \beta_2(net\ primary\ productivity_i)$ $+ \beta_3(human\ population\ density_i) + \beta_4(road\ density_i)$
Speed	$log(speed_i) = \alpha_{sex_i} + \beta_1(forest_i) + \beta_2(mean\ annual\ precipitation_i)$
Home range crossing time	$\log(home\ range\ crossing\ time_i) = \alpha_{sex_i} + \beta_1(forest_i)$
Autocorrelation timescale	$\log(autocorrelation\ timescale_i) = \alpha_{sex_i} + \beta_1(mean\ annual\ precipitation_i)$
Ecoregion	
Random effect	$\alpha \sim Normal\left(mean_{ecoregion}, var_{ecoregion}\right)$
Home range	$log(home\ range_i)$ $= \alpha_{ecoregion_i} + \beta_1(net\ primary\ productivity_i)$ $+ \beta_2(road\ density_i) + \beta_3(sex_i)$
Speed	$log(speed_i) = \alpha_{ecoregion_i} + \beta_1(forest_i) + \beta_2(mean\ annual\ precipitation_i)$ $+ \beta_3(sex_i)$
Home range crossing time	$\log(home\ range\ crossing\ time_i) = \alpha_{ecoregion_i}$
Autocorrelation timescale	$\log(autocorrelation\ timescale_i) = \alpha_{ecoregion_i}$

Table S3. Model estimates of jaguar home range size and movement parameters. Estimated mean movement parameters and 95% credibility intervals (CRI) range-wide and by ecoregion from the Bayesian form of the best fit range-wide and ecoregion-scale generalized linear mixed model with transformed covariates equal to 0.

	Home range (km^2)		**Speed (km/day)**		**Autocorrelation timescale (hours)**		**Home range crossing time (days)**	
Sex	**Mean**	**CRI**	**Mean**	**CRI**	**Mean**	**CRI**	**Mean**	**CRI**
Female	389.3	169.9–888.9	12.2	10.0–13.5	0.93	0.71–1.20	4.9	4.0–6.0
Male	1041.8	461.7–2349.6	14.9	13.5–18.2	0.92	0.70–1.23	4.0	3.3–5.0
Ecoregion								
Alto Paraná Atlantic forest	189.3	37.4–579.4	11.0	7.5–14.8	1.33	0.75–2.23	4.4	3.1–5.8
Caatinga	259.1	62.2–737.3	13.1	7.8–20.4	0.84	0.30–1.77	5.1	3.1–8.9
Central American dry forest	153.7	21.8–531.7	13.5	7.4–22.5	1.01	0.30–2.38	4.6	2.4–7.8
Cerrado	565.5	144.6–1546.9	12.9	8.6–18.0	1.01	0.55–1.72	4.1	2.5–5.8
Dry Chaco	218.1	84.0–466.8	14.4	10.0–21.4	1.43	0.77–2.49	5.3	3.6–8.4
Humid Chaco	147.6	47.2–352.5	14.8	10.7–20.8	0.59	0.30–1.04	5.1	3.5–7.6
Llanos	77.4	13.0–244.5	13.7	8.0–21.5	0.89	0.32–1.89	4.2	2.0–6.4
Pantanal	68.0	20.8–165.0	14.6	12.3–17.4	0.80	0.60–1.05	4.2	3.4–5.0
Peten-Veracruz moist forest	192.1	43.9–545.1	11.0	5.4–16.5	2.66	1.03–5.80	5.6	3.7–9.6
Purus várzeá	150.9	33.5–432.7	10.8	5.2–16.2	1.66	0.88–2.94	5.9	3.9–9.8
Sonoran–Sinaloan subtropical dry forest	199.3	56.8–511.3	14.3	6.2–28.4	1.28	0.24–3.99	4.7	2.7–7.7
Southwest Amazon moist forests	255.7	39.2–870.4	19.7	12.1–34.9	0.76	0.30–1.49	4.7	2.8–7.4
Yucatán dry forest	238.4	34.9–850.6	17.0	9.8–33.5	0.96	0.28–2.24	4.6	2.4–7.7

Table S4. Range–wide scale parameter estimates. Covariate parameter estimates and 95% credibility intervals (CRI) for the Bayesian form of the best fit generalized linear mixed model at the range–wide scale with sex as a random effect.

	Log home range (km^2)		**Log speed (km/day)**		**Log autocorrelation timescale (h)**		**Log home range crossing time (d)**	
Parameter	**mean**	**95% CRI**	**mean**	**95% CRI**	**mean**	**95% CRI**	**mean**	**95% CRI**
Percent forest cover	-0.17	-0.34–0.01	-0.22	-0.34–-0.10	–	–	0.15	0.00–0.30
Net primary productivity	-0.56	-0.93–-0.2	–	–	–	–	–	–
Human population density	0.17	0.08–0.26	–	–	–	–	–	–
Road density	0.30	0.12–0.48	–	–	–	–	–	–
Mean annual precipitation	–	–	-0.23	-0.34–-0.12	0.25	0.06–0.44	–	–
Male (intercept)	6.95	6.13–7.76	2.72	2.56–2.87	-0.08	-0.34–0.18	1.39	1.18–1.60
Female (intercept)	5.96	5.13–6.79	2.47	2.30–2.64	-0.07	-0.36–0.21	1.59	1.38–1.80
Sex hyperparameter	6.44	2.63–10.17	2.58	-0.51–5.61	-0.08	-2.90–2.72	1.48	-1.49–4.38

Table S5. Ecoregional scale parameter estimates. Covariate parameter estimates and 95% credibility intervals (CRI) for the Bayesian form of the best fit generalized linear mixed model with ecoregion as a random effect.

Parameter	Log home range (km^2)		Log speed (km/day)		Log autocorrelation timescale (h)		Log home range crossing time (d)	
	mean	**95% CRI**	**mean**	**95% CRI**	**mean**	**95% CRI**	**mean**	**95% CRI**
Percent forest cover	–	–	-0.23	-0.38–-0.09	–	–	–	–
Net primary productivity	-0.35	-0.82–0.14	–	–	–	–	–	–
Road density	0.31	0.16–0.45	–	–	–	–	–	–
Mean annual precipitation	–	–	-0.16	-0.32–-0.07	–	–	–	–
Sex	0.82	0.55–1.09	0.25	0.02–0.47	–	–	–	–
Ecoregion intercepts								
Alto Paraná Atlantic forest	5.00	3.62–6.36	2.04	1.59–2.48	0.24	-0.30-0.80	1.74	1.36-2.28
Caatinga	5.36	4.13–6.60	2.13	1.55–2.70	-0.27	-1.21-0.57	1.46	1.14-1.76
Central American dry forest	4.71	3.08–6.28	2.22	1.63–2.83	-0.12	-1.20-0.87	1.59	1.11-2.19
Cerrado	6.15	4.97–7.34	2.13	1.60–2.63	-0.03	-0.61-0.54	1.39	0.90-1.76
Dry Chaco	5.29	4.43–6.15	2.24	1.76–2.78	0.31	-0.26-0.91	1.64	1.28-2.12
Humid Chaco	4.86	3.85–5.87	2.33	1.88–2.80	-0.58	-1.22-0.04	1.50	0.89-2.05
Llanos	4.08	2.57–5.50	2.20	1.63–2.77	-0.21	-1.13-0.64	1.60	1.25-2.02
Pantanal	4.08	3.03–5.11	2.30	1.91–2.68	-0.23	-0.51-0.04	1.69	1.30-2.26
Peten–Veracruz moist forest	5.05	3.78–6.30	2.01	1.30–2.56	0.87	0.03-1.75	1.42	1.21-1.62
Purus várzeá	4.81	3.51–6.07	2.00	1.29–2.54	0.46	-0.13-1.08	1.49	0.86-2.03
Sonoran–Sinaloan subtropical dry forest	5.14	4.04–6.24	2.20	1.45–2.97	-0.01	-1.43-1.37	1.52	0.99-2.04
Southwest Amazon moist forests	5.23	3.67–6.77	2.49	1.90–3.20	-0.36	-1.21-0.39	1.39	0.71-1.85
Yucatán dry forest	5.15	3.55–6.75	2.35	1.76–3.13	-0.18	-1.28-0.82	1.51	1.02-2.00
Ecoregion hyperparameter	4.99	3.82–6.14	2.20	1.78–2.62	-0.01	-0.48-0.44	2.20	1.78-2.62