

REPORT

DEFAUNATION

The impact of hunting on tropical mammal and bird populations

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Hunting is a major driver of biodiversity loss, but a systematic large-scale estimate of hunting-induced defaunation is lacking. We synthesized 176 studies to quantify hunting-induced declines of mammal and bird populations across the tropics. Bird and mammal abundances declined by 58% (25 to 76%) and by 83% (72 to 90%) in hunted compared with unhunted areas. Bird and mammal populations were depleted within 7 and 40 kilometers from hunters' access points (roads and settlements). Additionally, hunting pressure was higher in areas with better accessibility to major towns where wild meat could be traded. Mammal population densities were lower outside protected areas, particularly because of commercial hunting. Strategies to sustainably manage wild meat hunting in both protected and unprotected tropical ecosystems are urgently needed to avoid further defaunation.

Global biodiversity loss is occurring at an unprecedented rate (1). Few undisturbed areas remain in the tropics (2), but these are threatened by escalating road and infrastructure expansion, which promotes human accessibility to otherwise remote areas and facilitates illegal colonization and hunting (3–5). Hunting exerts a major pressure on wildlife, which can result in large population declines and local extirpations of wildlife populations in forests that appear structurally undisturbed (6). Overhunted “half-empty” or “empty ecosystems” are becoming common across the tropics (7). Indeed, the abundance of wildlife in natural ecosystems is more closely related to patterns of hunting than

to factors such as forest type, habitat area, or habitat protection status (8). A growing body of research is focusing on defaunation and its far-reaching cascading effects, including disruptions in seed dispersal mutualisms and a decline in total biomass (9, 10). However, hunting-induced defaunation is a cryptic phenomenon that is difficult to monitor and, to date, no large-scale estimates of the impact of hunting on wildlife abundances are available.

Here, we analyze the impact of hunting on bird and mammal populations at a pantropical scale, in terms of both magnitude (decline in abundance) and spatial extent (depletion distances). We collated 176 studies, including 384

and 1938 effect sizes for 97 bird and 254 mammal species, respectively (11) (Fig. 1), and estimated the overall reduction in mammal and bird abundance in hunted compared with unhunted sites with a mixed effects meta-analysis. As an effect size, we calculated response ratios (RR) between the abundance of each species in hunted (X_h) and unhunted sites (X_u) within each study [$RR = \log(X_h/X_u)$; (12)]. RR are therefore negative ($RR < 0$) or positive ($RR > 0$) if abundance estimates are lower or higher, respectively, because of hunting pressure. Based on the central-place foraging hypothesis, hunting intensity is generally higher in the proximity of hunters' access points (e.g., settlements and roads) (5, 10), generating gradients of increasing species densities up to a distance where no effect is observed (i.e., species depletion distances). We used single meta-regression models to estimate species-depletion distances and to quantify how the impact of hunting varied depending on accessibility to urban markets for trade [travel time to major towns (13)], region, type of hunting (commercial versus subsistence versus both), protection status (protected versus unprotected area), species body size, and feeding guild. Finally, we tested the relative importance of these moderators using an information-theoretic

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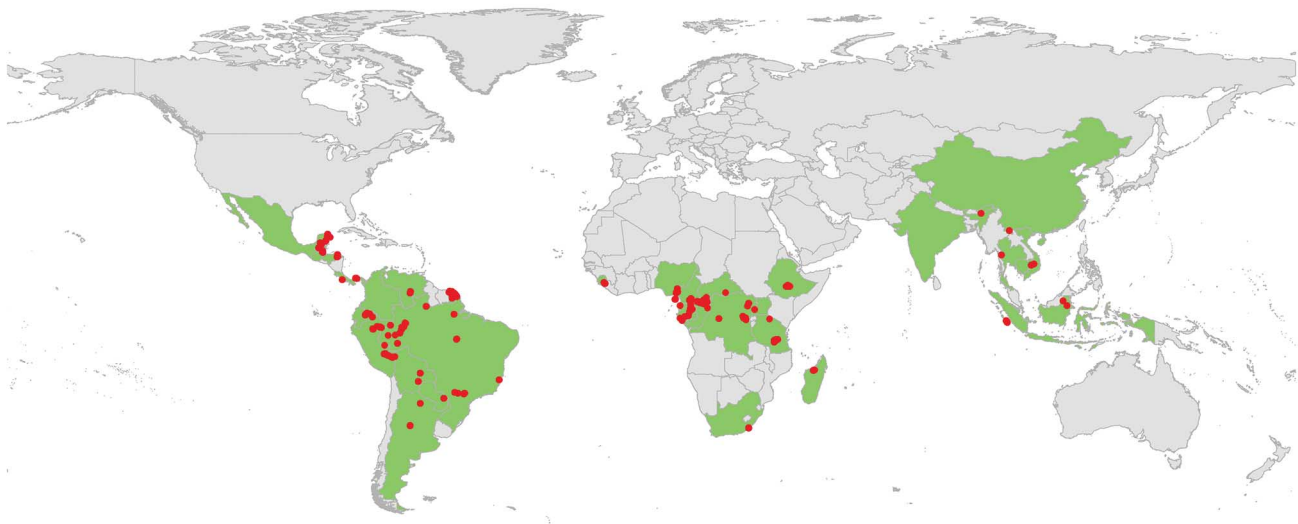


Fig. 1. Geographical location of the 176 studies included in the meta-analysis. Locations as red dots. Countries that contain at least one study are in green color. Red dots may represent multiple effect sizes.

approach of several multiple meta-regression models including first- and second-order interactions.

Overall, bird and mammal abundances were reduced by 58% [95% confidence interval (CI): 25, 76%] and 83% (95% CI: 72, 90%), respectively, in hunted areas (Fig. 2). Hunting pressure had a larger effect on mammals than on birds, probably because hunters preferentially target larger species (6). Results were robust to potential publication bias for mammals and to Geary diagnostic tests and differences in study quality for both groups (figs. S3 and S4). Hunting-induced abundance reductions varied with distance to hunters' access points (distance, hereafter), accessibility to urban markets, protected area status and type of hunting, with distance being the most important moderator (Figs. 3 and 4 and table S5). For birds, effect sizes were the lowest in proximity to hunters' access points ($RR_b = -3.17$, 95% CI = -2.62 , -3.71 , ~95% loss at 500 m) and approximated 0 at a distance of 7 km (Fig. 3A). For mammals, effect sizes first decreased from -0.76 (-1.30 , -0.23) to -2.38 (-2.84 , -1.78) within the first 700 m (~90% loss), and then increased steadily up to 0 at ~40 km from hunters' access points (Fig. 3B). This initial higher RR may reflect the replacement of large-bodied mammals by smaller ones. Indeed, we found evidence of size-differential mammal defauna for frugivores, carnivores, herbivores, and insectivores (tables S6 and S7). Smaller mammals were consistently more abundant at higher hunting pressure than larger species (fig. S5), probably owing to release from predation pressure and competition as a result of (near) extirpation of medium- and large-sized mammals (14). Large-bodied frugivores, herbivores, and insectivores—including chimpanzees (*Pan troglodytes*), Western gorillas (*Gorilla gorilla*), and giant armadillos (*Priodontes maximus*)—are largely hunted for wild meat consumption and trade (15). In turn, large carnivores, such as leopards (*Panthera pardus*) and jaguars (*Panthera onca*), are often persecuted because of livestock-wildlife conflicts, or their populations are reduced because of hunting-induced losses of prey species (16).

Bird and mammal population abundances were lower in hunted areas with higher accessibility to urban markets (Fig. 3, C and D). Effect sizes approached 0 within 1 to 2 days of travel time from the nearest major town. For mammals, this effect remained after controlling for other factors (table S6). Across the tropics, the majority of consumed and traded wild meat and body parts comes from mammals, whereas birds are generally killed for a hunter's own consumption (6, 17). However, for both species groups, the transition from subsistence to commercial hunting is having a massive impact on population densities (Fig. 4). Current prospects of infrastructure expansion in the Amazon, Africa, and Asia will facilitate accessibility to remote areas (3, 18, 19), boosting wild meat harvest and trade to meet urban demands (7) and, thus, increasing pressure on wildlife populations.

Mammal population densities were higher inside than outside protected areas (Fig. 4). However, hunting pressure reduced mammal abundances even within protected areas (Fig. 4). Overhunting

within protected areas is ubiquitous across the Amazon, Africa, and Asia (8, 20). Although our results suggest that the effects within are less detrimental than outside reserves, gazettement of protected areas seems insufficient to safeguard wildlife populations if not accompanied with improved reserve management, effective law enforcement, and on-ground protection efforts (20).

Effect sizes were similar across regions for both taxa, although slightly lower in South America for birds (Fig. 4). This indicates that overhunting is affecting mammal and bird populations similarly across the tropics. However, we found more studies in South America and Africa than Asia or Central America (Fig. 1), which implies that our findings are more generalizable for the former two regions. It also points out an urgent need to focus research efforts in less-studied areas before wildlife populations are completely extirpated. Unfortunately, overhunting has already emptied most Asian forests (7), leaving few unhunted control areas left for pairwise comparisons.

The most important terms retained in our multiple meta-regression models were distance for both groups (tables S6 and S7) and the interactions between guild, body size, and distance for mammals (see fig. S5 and explanations above). Our best models were significant according to omnibus tests (birds: $Q_M = 3157.5$, $P < 0.001$, McFadden pseudo- R^2 : 0.29; mammals: $Q_M = 19207.3$, $P < 0.001$, McFadden pseudo- R^2 : 0.18); however, residual heterogeneity

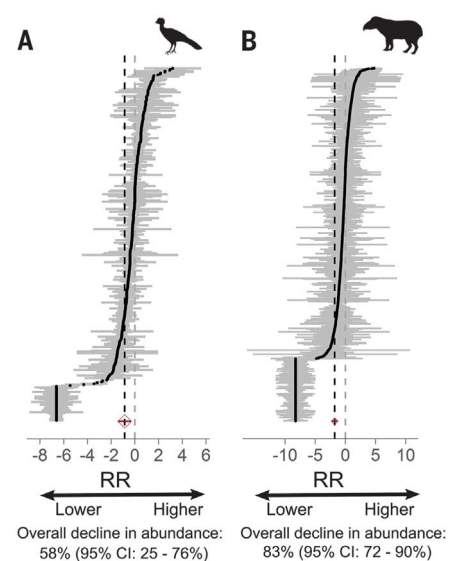


Fig. 2. Forest plots of 384 and 1938 effect size estimates for birds and mammals, respectively. (A) Birds and (B) mammals. RR , response ratios (effect sizes), black dots with 95% confidence intervals (CI) as gray lines. Overall weighted mean effect size estimate, black dashed line and red diamond. 95% CI of weighted mean effect size, red line. $RR = 0$, dashed gray line. Extremely negative effect sizes indicate local extirpations.

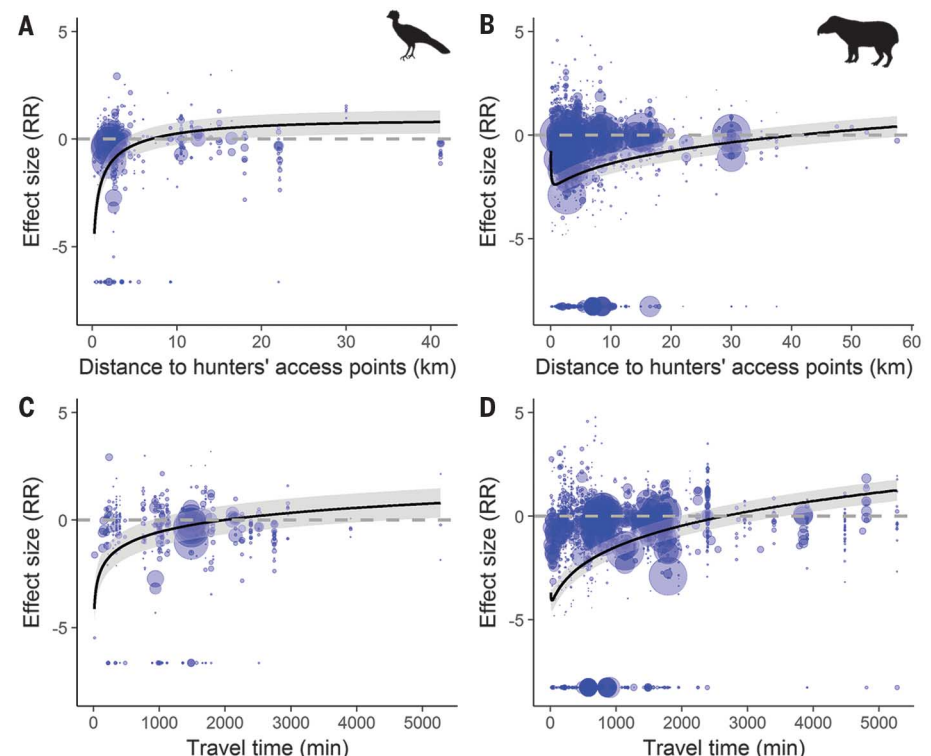


Fig. 3. Change in species abundance with distance to hunters' access points and travel time to major towns. (A and B) Distance to hunter's access points and (C and D) travel time to major towns; for birds (A and C) and mammals (B and D). RR , response ratios. $RR = 0$, dashed gray line; predicted mean effect size (with 95% CI in gray), black lines. Size of data points (in blue) is proportional to the sampling variance. Results obtained with single meta-regressions.

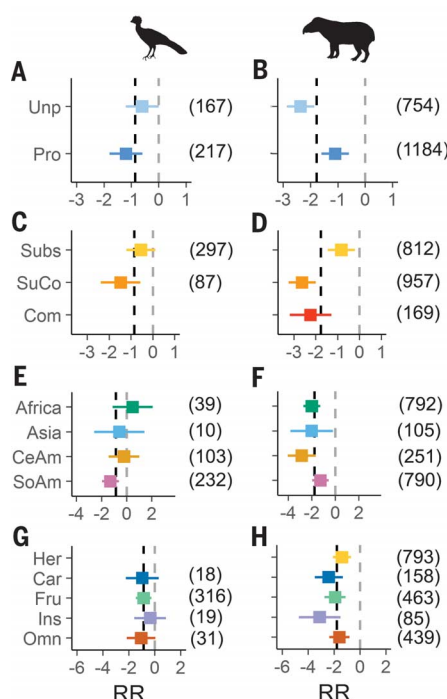


Fig. 4. Change in species abundance for different levels of protection, type of hunting, regions, and feeding guilds. (A to H) Parameters as labeled for birds (left) and mammals (right). Number of effect sizes is shown between brackets. RR, response ratios. Mean weighted effect size, dashed black line; $RR = 0$, dashed gray line; Unp, unprotected areas; Prot, protected areas; Subs, subsistence hunting; SuCo, subsistence and commercial hunting; Com, commercial hunting; CeAm, Central America; SoAm, South America; Her, herbivores; Car, carnivores; Fru, frugivores; Ins, insectivores; and Omn, omnivores. Results obtained with single meta-regressions. None of the studies reported on bird hunting for commercial purposes solely.

was large (table S7), indicating that hunting is a multifaceted phenomenon influenced by additional factors, some of which were not included in our models (e.g., food security). Additionally, confounding variables such as small-scale habitat clearing and road disturbance are correlated with distance to settlements and roads (27). However,

we minimized their influence as much as possible by avoiding pairwise comparisons where disturbances other than hunting were apparent.

Overexploitation is a long-established major driver of wildlife population declines and extinctions in terrestrial ecosystems which, to date, has not been successfully mitigated and rather shows an increasing trajectory in recent decades (22). Pleistocene extinctions were triggered in part by human hunters (23), and ongoing wildlife population declines and (near) extinctions of large-bodied species seem to share similar pathways. Consequently, defaunation is rendering tropical forests, savannahs, and grasslands “empty” (16), with populations so sparse that the strength of species interactions is declining dramatically. The subtle nature of this process makes it undetectable by remote-sensing techniques, which are key to monitor deforestation but prove futile to track on-ground changes in biodiversity and ecological functioning (24). Matching the findings of many regionally specific studies (5, 10), our meta-analysis shows that large vertebrates of various functional groups are depleted in the vicinity of settlements and roads. Our estimated hunting-depletion distances can be used to assess ecosystem degradation as a result of current and future road developments and settlement establishment. Recently, Peres *et al.* (25) estimated that 32.4% of the remaining forest across the Brazilian Amazon (~1 million km²) is affected by hunting on the basis of hunting distances of 6 km from settlements. Our results, however, indicate that the Amazon forest area affected by hunting-induced defaunation might be much larger. By 2050, with millions of kilometers of roads planned in developing countries (26), and human population and associated demand for wild meat increasing steadily, it is likely that the term “remoteness” will be a ghost of the past, with the last remnant half-depleted mammal and bird populations persisting in few protected areas. This can be ameliorated if we undertake coordinated strategies to expand the current network of protected areas, limit human encroachment around them, monitor hunting activities, and control overexploitation via law enforcement, if needed, while implementing alternative livelihood programs for wild meat-dependent communities.

REFERENCES AND NOTES

- Geballos *et al.*, *Sci. Adv.* **1**, e1400253 (2015).
- Gibson *et al.*, *Nature* **478**, 378–381 (2011).

- W. F. Laurance *et al.*, *Curr. Biol.* **25**, R259–R262 (2015).
- W. F. Laurance, A. Balmford, *Nature* **495**, 308–309 (2013).
- C. A. Peres, I. R. Lake, *Conserv. Biol.* **17**, 521–535 (2003).
- K. H. Redford, *Bioscience* **42**, 412–422 (1992).
- E. J. Milner-Gulland, E. L. Bennett, *Trends Ecol. Evol.* **18**, 351–357 (2003).
- R. D. Harrison, *Bioscience* **61**, 919–924 (2011).
- R. Dirzo *et al.*, *Science* **345**, 401–406 (2014).
- K. A. Abernethy, L. Coad, G. Taylor, M. E. Lee, F. Maisels, *Philos. Trans. R. Soc. London B Biol. Sci.* **368**, 20120303 (2013).
- Materials and methods are available as supplementary materials.
- L. V. Hedges, J. Gurevitch, P. S. Curtis, *Ecology* **80**, 1150–1156 (1999).
- A. Nelson, “Travel time to major cities: A global map of accessibility” (Global Environment Monitoring Unit—Joint Research Centre of the European Commission, Ispra, Italy, 2008).
- S. J. Wright, *Perspect. Plant Ecol. Evol. Syst.* **6**, 73–86 (2003).
- W. J. Ripple *et al.*, *R. Soc. Open Sci.* **3**, 160498 (2016).
- W. J. Ripple *et al.*, *Science* **343**, 1241484 (2014).
- J. G. Robinson, E. L. Bennett, *Hunting for Sustainability in Tropical Forests* (Columbia Univ. Press, New York, 2000).
- W. F. Laurance, S. Sloan, L. Weng, J. A. Sayer, *Curr. Biol.* **25**, 3202–3208 (2015).
- G. R. Clements *et al.*, *PLOS ONE* **9**, e115376 (2014).
- W. F. Laurance *et al.*, *Nature* **489**, 290–294 (2012).
- A. Benítez-López, R. Alkemade, P. A. Verweij, *Biol. Conserv.* **143**, 1307–1316 (2010).
- S. L. Maxwell, R. A. Fuller, T. M. Brooks, J. E. Watson, *Nature* **536**, 143–145 (2016).
- C. Sandom, S. Faurby, B. Sandel, J.-C. Svenning, *Proc. Biol. Sci.* **281**, 20133254 (2014).
- C. A. Peres, J. Barlow, W. F. Laurance, *Trends Ecol. Evol.* **21**, 227–229 (2006).
- C. A. Peres, T. Emilio, J. Schietti, S. J. Desmoulière, T. Levi, *Proc. Natl. Acad. Sci. U.S.A.* **113**, 892–897 (2016).
- J. Dulac, “Global land transport infrastructure requirements: Estimating road and railway infrastructure capacity and costs to 2050” (International Energy Agency, Paris, 2013).

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SUPPLEMENTARY MATERIALS

www.sciencemag.org/content/356/6334/180/suppl/DC1
Materials and Methods
Figs. S1 to S6
Tables S1 to S7
References (27–159)

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Supplementary Materials for **The impact of hunting on tropical mammal and bird populations**

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This PDF file includes

Materials and Methods
Figs. S1 to S6
Tables S1 to S7
References

Materials and Methods

Search strategy

The relationship between hunting intensity and species abundance was quantified using data from peer-reviewed literature selected through a systematic literature search. Relevant studies published between 1970 and August 2015 were identified through literature searches in the ISI Web of Science and Google Scholar. The search was performed between July-October 2015 using the following search terms: (*road** OR *settlement** OR *village* OR *infrastructure**) AND (*access** OR *transect* OR *distance* OR **disturb** OR *proximity*) AND (*hunt** OR *bushmeat* OR *poach** OR *game*) AND (**diversity* OR *population* OR *abundan** OR **density* OR *encounter**). We also used ProQuest Dissertations and Theses repository (<http://www.proquest.com/products-services/dissertations/>) to access relevant PhD and MSc dissertations (i.e.: grey literature), and reviewed the references cited in relevant articles. Authors of relevant papers were also contacted for provision of any unpublished material or missing data. Relevant studies in other languages, mostly in Spanish and French, were also identified by cross-reference. Additionally, we obtained bibliographies from the OFFTAKE project (www.offtake.org) to complement our database of studies. No geographical or taxonomic restrictions were applied. A flowchart of the process and outcome of the literature search is provided in Figure S1.

Inclusion and exclusion criteria

We selected relevant studies according to title and abstract, and we finally selected studies that met the following criteria: 1) evaluates effect of hunting on wildlife populations, 2) contains abundance data on species or genus level, 3) reports abundance at increasing distance from access points, or at least at one proximate hunted area and one distant unhunted area (control), which in some cases included light hunting (27). Studies with potential confounding effects due to other disturbances (i.e.: hunted and logged area vs unhunted unlogged area ...) were discarded, unless all compared sites had the same level of disturbance (i.e.: sites with forests logged ca. 20 years ago, but with different hunting pressures and located at different distances from villages). Studies that reported on hunting on managed wild populations (i.e.: with release of farm-reared individuals) used for recreational hunting were not included.

Data extraction

We extracted and stored the following data: the mean abundance of each species at each distance from hunters' access points, the sample size, and, depending on the study, the variance, standard deviation or standard error. These data were extracted from tables or graphs using GetData Graph Digitizer 2.26 (<http://getdata-graph-digitizer.com/>). Data extracted from graphs were plotted and visually inspected to verify that there were no errors during data extraction. Abundance estimates per species were expressed as a variety of metrics, including population density (individuals/km²), group density (groups/km²), encounter rates of groups, subgroups or individuals (e.g., number of encounters per 10 km of census effort) and number of photographs/camera trap-day in case of camera-trap surveys.

When species abundance was reported in distance intervals, we took the middle distance point of the interval as input distance. When only the hunting catchment area around the village was given, we calculated the hunting radius and took the middle of the radius as hunting distance. The effect of hunting on species populations was usually assessed in the core of the hunting catchment areas. In some cases hunting distances were not recorded and we calculated them in ArcGIS 10.2 after georeferencing the study sites (see below).

We also recorded data on the study characteristics: location (continent, country), biome (tropical, subtropical and montane forests, dry and montane grasslands, savannah and xerophilous deciduous forest), geographic coordinates, type of hunters' access points (roads, settlements, river networks, or roads and settlements), protected area status (protected, unprotected) and type of hunting (subsistence, commercial, both) (Table S1). If coordinates were not available we retrieved them by geo-referencing maps in the papers using ArcGIS 10.2 (ESRI, 2011). Additionally, we recorded data on the species' body mass (kg) and diet composition (%) from EltonTraits 1.0 (28), and categorized species as frugivores (> 50 % of diet consists of fruits and seeds), carnivores (> 50 % of diet consists of vertebrates), insectivores (> 50 % of diet consists of invertebrates), herbivores (> 50 % of diet consists of plants and leaves) or omnivores (none of the previous categories apply). Species are defined here as single taxonomic species, or functional groups of ecologically analogous congeners that were not distinguished at species level (e.g., *Psophia* spp., *Dasyprocta* spp., *Saimiri* spp., *Lagothrix* spp., *Aras* spp., *Amazonas* spp.). When abundances were reported for several species aggregated at genus level body mass and diet were averaged for all species included in the abundance estimation. When possible, we averaged trait data for species within the reported Genus known to occur in the area (according to IUCN range maps). Finally, we overlaid all study sites with available global data sets and extracted the following variables: human population density (1 km resolution, year 2000) (29), estimated travel time to the nearest town greater than 50000 inhabitants (as a proxy for accessibility to urban markets, 1 km resolution) (13) and protected area status, from the World Database of Protected Areas (30)(accessed in August 2016). These operations were performed in ArcGIS 10.2 using a Mollweide equal area projection (31). Prior to data analyses, we assessed for collinearity between our explanatory variables. Because human population density was correlated with travel time (Spearman $\rho = -0.38$ and -0.55 , for birds and mammals, respectively) we used only the latter in our models.

Data structure

The data was structured into Data Source, Study, and Species. A Data Source typically represents a single published paper, a technical report published by NGOs or a PhD or MSc thesis. In some cases a Data Source consists of both a published paper and a thesis used to complement the data on the paper (Table S1). A single Data Source may contain one or more Studies, depending on whether data is reported for more than one village, or more than one site. A Study contains one or more Species for which abundance or density is reported at least at one hunted (although there could be more) and one control distance. A single Species may be reported in several Studies. All abundance measurements within a Study and for a Species must have been collected using the same sampling method so that observations within a Study can be reasonably compared and effect sizes calculated. For the same reason, observations among Studies, even for the same Species, should not be compared if there are methodological differences (line transect methods compared to camera traps).

Data availability and selected studies

The search string yielded 461 publications via ISI Web of Knowledge, which were complemented with the 100 first hits from Google Scholar. We also included 2 MSc Theses and 8 PhD theses found through ProQuest, and 55 cross-referenced articles. After removing duplicates, 603 publications were selected for abstract screening, out of which 285 fulfilled the criteria for full text screening. Four authors provided their full database on request (32-35). Additionally, we retrieved two databases from the A.P.E.S. database (36, 37).

Finally we selected 101 data sources (among the peer-reviewed articles, theses and reports), with publication dates ranging between 1984 and 2016 (Fig. S1). Our meta-analysis spanned 38 countries across the main tropical regions. Most data sources were from Africa (49) and South America (32), with the rest being from Asia (8) and Central America (12) (with Mexico included in the Central America category for analyses), with a clear geographical bias towards (sub) tropical regions (22.25 N to 32.27 S, Fig. 1). In total we extracted 176 studies out of the 101 data sources, including 2322 effect sizes for a total of 347 species (Birds: 97 species and 384 effect sizes, Mammals: 250 species and 1938 effect sizes). Body mass of recorded species ranged from 0.06 kg to 3940.3 kg for mammals (median: 7.9 kg), and from 0.035 kg to 111 kg for birds (median: 1.2 kg).

Effect size metrics

We calculated log response ratios (RR , hereafter response ratios) as measure of effect size (12, 38):

$$RR = \ln \left(\frac{\bar{X}_{ikh}}{\bar{X}_{ikc}} \right) \quad (\text{Eq. 1})$$

For each study k , response ratios (RR) were calculated between the mean abundance \bar{X} of any individual species i at hunting distance h from the access point and the mean abundance \bar{X} of individual species i at a control distance c from the access point (unhunted distance) (see (21, 39) for similar approach). The control distance was either reported in the study as unhunted, in some cases after assessing hunting pressure at increasing distances from the access point; or was the most distant data point at which species abundance was estimated. Population densities in unhunted areas were assumed to be in equilibrium and approximate the carrying capacity (40). Response ratios (RR) for any given species are therefore negative ($RR < 0$) if abundance estimates are lower due to hunting pressure (i.e.: closer to hunter's access points) and positive ($RR > 0$) if abundance estimates are higher regardless the distance to hunter's access points. Effect sizes close to zero ($RR \approx 0$) indicate little or no effect of hunting. Some ratios were zero for species completely extirpated in areas close to hunters' access points (mean abundance equals zero), precluding log-transformation. Therefore we transformed our effect sizes using a modification of the transformation $y' = (y * (N-1) + 0.5)/N$ proposed by Smithson & Verkuilen (2006) (41) to shrink $[0,1]$ into $(0,1)$ open intervals avoiding thus zeroes and ones. Since we only wanted to avoid zeroes, we used $y' = (y * N + 0.5)/N$, where y are unlogged ratios ($\bar{X}_{ikh}/\bar{X}_{ikc}$) and N is the number of effect sizes ($N_b = 384$ and $N_m = 1938$ for birds and mammals, respectively) resulting in a distribution of effect sizes slightly displaced towards larger values (mammals: before transformation: $[0.000, 118.246]$, after transformation $[0.00026, 118.24597]$; birds: before transformation $[0.00, 24.25]$, after transformation: $[0.00133, 24.2513]$).

In all meta-analyses and meta-regressions, observed effect sizes (RR s) were weighed by the inverse of the sampling variances, which were calculated as:

$$\hat{\sigma}^2(RR) = \frac{SD_{ikh}^2}{N_{ikh}\bar{X}_{ikh}^2} + \frac{SD_{ikc}^2}{N_{ikc}\bar{X}_{ikc}^2} \quad ; \quad (\text{Eq. 2})$$

where RR represent the log response ratio, SD_{ikc} and SD_{ikh} represent the standard deviations of \bar{X}_{ikc} and \bar{X}_{ikh} , respectively, with N_{ikc} and N_{ikh} as sample sizes (12, 38). Not all studies reported estimates of SD, variances or SE. In such cases, SD_{ikc} and SD_{ikh} could be estimated

by assuming that the data follow a Poisson distribution, in which $\mu = \sigma^2$ and, therefore, $\bar{X}_{ikc} = \sigma_{ikc}^2$ (42). Finally, for studies in which some species had zero densities ($\bar{X}_{ikh} = 0$, and thus $SD_{ikh} = 0$), a continuity correction factor ($k=1/2$) was added to the numerator and denominator resulting in slightly higher variance estimates (43, 44). Alternatively, we used two other methods for imputing missing SD and compared our results to our approach. We used "Bracken1992" approach to impute SD using the coefficient of variation from all complete cases (45). Additionally we used the "HotDeckNN" approach, which applies Rubin and Schenker's (1991) resampling approach to fill gaps of missing SD from the SD's with complete information with means that are similar to missing SD's (46). For the "HotDeckNN" approach we imputed missing SD 100 times and recalculated 100 sampling variances and 100 meta-analytical estimates. These analyses were performed using *metagear* (47). The resulting estimates using these two approaches were similar to those obtained with the "Poisson" approach (Table S2), and therefore we used the latter in all our analyses.

Results are reported as *RR* and as percentage declines in abundance by back-transforming *RR* to unlogged ratios and multiplying by 100 (Percentage decline = $(1 - \exp(RR)) \times 100$).

Data analyses

We ran multilevel mixed effects meta-analyses in *metafor* 1.9-8 (*rma.mv*, (48)) to control for non-independence in the data due to multiple effect sizes per study and species. All analyses were run separately for bird and mammal species. Several candidate random-effects structures were compared using the full candidate fixed-effects structure (see complex multiple meta-regression models below). We specified study identity and species identity as random effects in our models. Given that body mass is phylogenetically conserved at Order level in birds and mammals (49-52), we assessed if model fit would improve by using the following nested random effects structure (Order/Species). Random effects were retained or discarded based on the models' BIC (Bayesian Information Criterion, which is more restrictive than AIC_c) (53). The final retained random effects structure was (1|Study) + (1|Species) for both birds and mammals (Table S4).

Our analyses were separated in three steps: random-effects meta-analysis, single mixed-effects meta-regression models and multiple mixed-effects meta-regression models. With the multilevel random-effects meta-analysis we assessed overall reductions in bird and mammal abundance in hunted vs unhunted sites. For these analyses we assessed heterogeneity by formal Cochran's *Q*-test tests (*Q_E*), which test whether the variability in the observed effect sizes or outcomes is larger than would be expected based on sampling variability alone. As expected for a biological meta-analysis (54), there was significant residual heterogeneity in the random-effects meta-analysis for the birds dataset ($Q = 20256.1$, $P < 0.0001$), and for the mammal dataset ($Q = 441755.2$, $P < 0.0001$), which we tried to explain with different moderators (Table S3).

We ran single mixed-effects meta-regression models to assess the relationship between *RR* and distance to hunters' access points (distance, hereafter), and variations in *RR* according to several categorical (factors) and continuous moderators (Table S3). Continuous variables were log-transformed and fitted as quadratic polynomials to account for non-linear relationships. Models with categorical factors were also run without the intercept to obtain the parameter estimates (mean effect sizes) of each level. The heterogeneity captured by the moderators of each independent meta-regression was assessed with omnibus tests (*Q_M*) (see Table S5). P-values were adjusted for multiple hypothesis testing using Bonferroni corrections.

We also built multiple mixed-effects meta-regression models to examine variations in the relationship between species abundance (*RR*) and distance while controlling for the effect of guild, body mass, type of hunting, travel time and level of protection. Distance, body mass and travel time to major towns were standardized before the analyses. We included first-order and second-order interaction terms to account for variations in the slope of the relationship between effect sizes (*RR*) and distance, for different functional guilds and different body mass (Distance x Guild x BM), for different types of hunting (Distance x TypeHunting) and per level of protection (Distance x Protected). Model selection was done using the Bayesian information criterion (BIC) (53). If the most supported model included interaction terms, we tested them using Q_M and then we removed them to test main effects. We retained all main effects that were part of significant interaction terms regardless of their significance as main effects. Fixed factor estimates were considered statistically significant if the 95% confidence interval (*CI*) did not overlap zero. We checked profile likelihood plots to ensure the identifiability of the variance components in the model (σ_1^2 : study-level variability, σ_2^2 : species-level variability) and to test whether our more complex models were overparameterized (fig. S6)(48). Model fit was assessed with McFadden's adjusted pseudo- R^2 . All parameter estimates are reported for best models run with REML (Restricted maximum likelihood). All analyses were performed in R 3.2.2 software (55).

Exploring potential publication bias and robustness of models

Publication bias was assessed using Funnel plots and Egger tests by including precision (1/SE) as covariate in *rma.mv* function, and using meta-analytic residuals (56). Rosenberg's fail safe-numbers were calculated to assess the robustness of our results to publication bias (57). Egger tests suggest that the overall *RR* for mammals is robust, whereas there is a slight potential publication bias for birds (fig S3). Rosenberg's fail safe-numbers were large enough for both mammals (54983163, $P < 0.0001$) and birds (331975, $P < 0.0001$) to be confident about the reliability of the estimates.

We used Geary diagnostic tests (Eq. 3) to assess the accuracy of our *RR* (58). Effect sizes are deemed valid and accurate approximations when the standardized mean of either the control or treatment group is ≥ 3 .

$$\frac{\bar{X}}{SD} \sqrt{N} \geq 3 \quad (\text{Eq. 3})$$

We performed a sensitivity analysis where the meta-analytic results from the complete dataset were compared to those where problematic cases detected by Geary tests were excluded. Effect sizes were still negative for both taxa even after excluding standardized means < 3 for hunted, control and hunted and control sites (fig. S4).

We used six main criteria to assess study quality:

1) Control area. When the authors reported abundance estimates on a clear unhunted area and/or unhunted distance (score 1). If the control area was unfrequently hunted or was hunted > 5 years ago (score 1). When the control area was under low hunting pressure or lightly hunted (score 0). Else the longest distance from hunters' access points is used as control (score 0).

2) When the authors assessed hunting pressure using metrics such as hunting signs in relation to distance to access points, or in a specific hunted area (score 1). If they specified a

threshold distance up to which hunting occurs, or had evidence of hunting from other studies performed in the same area (score 1). If hunting evidence was not clearly assessed (score 0).

3) When the authors reported clear distance intervals or hunting distances (score 1). If hunting catchments were reported the hunting distance was estimated as the mid-distance of the hunting radius from the access point, or village (score 0). If distances to access points were extracted using GIS after georeferencing transects and villages or roads as access points (score 0).

4) When the authors reported the mean and the variance (or standard deviation, standard error, confidence interval) of the abundance estimates or these could be derived from raw data (score 1). If the variances (or other measure of error/variation around the abundance estimate) were not reported (score 0).

5) If species detectability was calculated and taken into account (e.g.: using DISTANCE software, adjusting the effective strip width via other methods, or using camera traps, for which detectability can be adjusted) (score 1). If detectability was not calculated (score 0).

6) If the effect size can be calculated at species level (score 1). If effect sizes were calculated for 2 or more species aggregated at genus level (due to difficulties of distinguishing between closely related species during surveys, i.e.: indirect signs of red duikers, or brocket deers) (score 0). This last criterion applies to individual effect sizes, not to the study as a whole.

We used the sum of the scores of the six criteria as an overall measure of quality, ranging from 1-2 (“low quality”) to 3-4 (“medium quality”) to 5-6 (“high quality”). Sensitivity analyses were done by rerunning the meta-analysis after subsequently excluding low quality studies, and then low and medium quality studies (i.e.: including only high quality studies). Results of the meta-analyses based on different data subsets were compared to evaluate the robustness of our results to differences in the quality of the studies included. Results were highly robust to differences in data quality, as reflected by similar effect sizes for different data subsets (fig. S4).

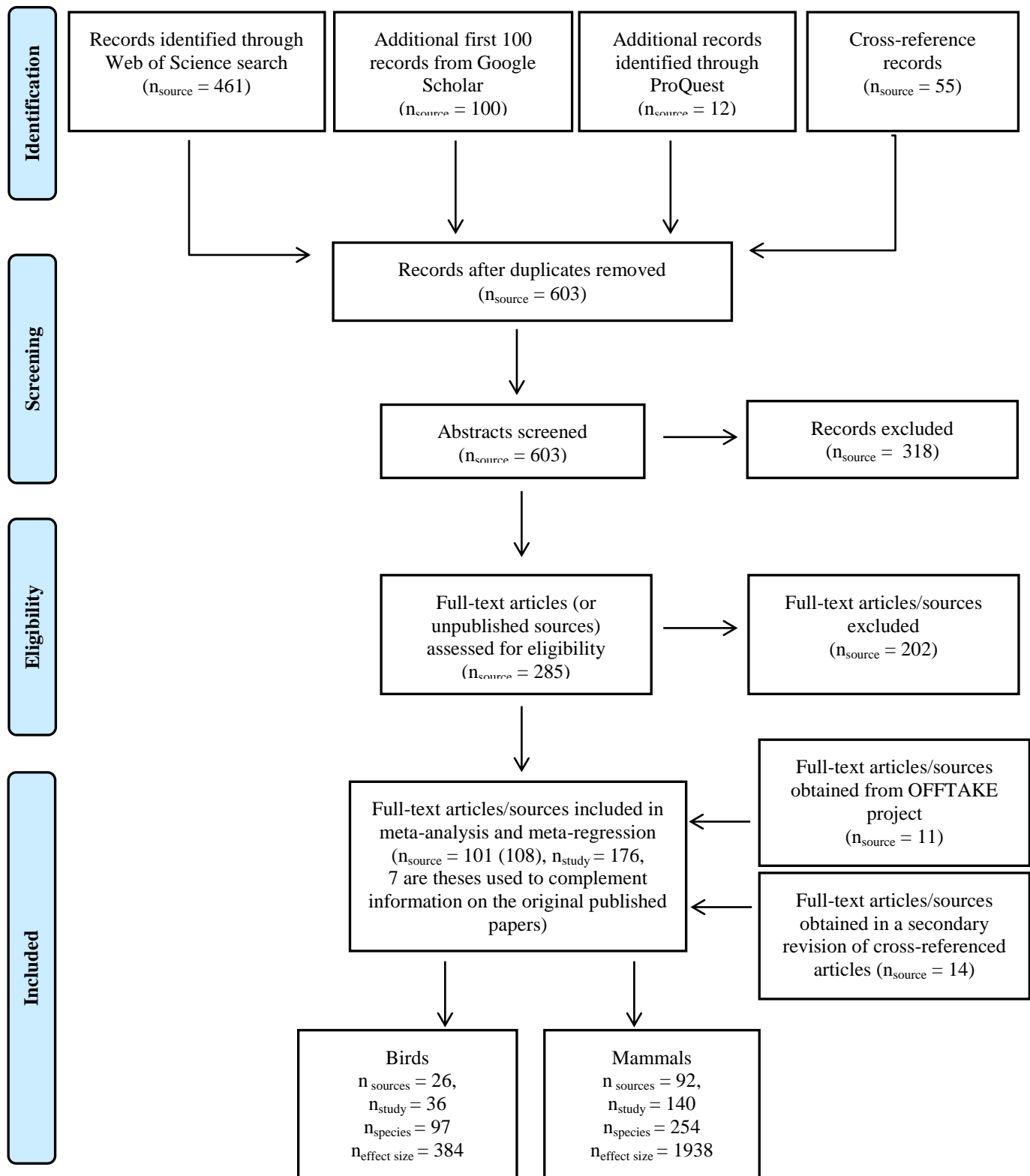


Fig. S1.
PRISMA flow chart showing the procedure of selecting publications.

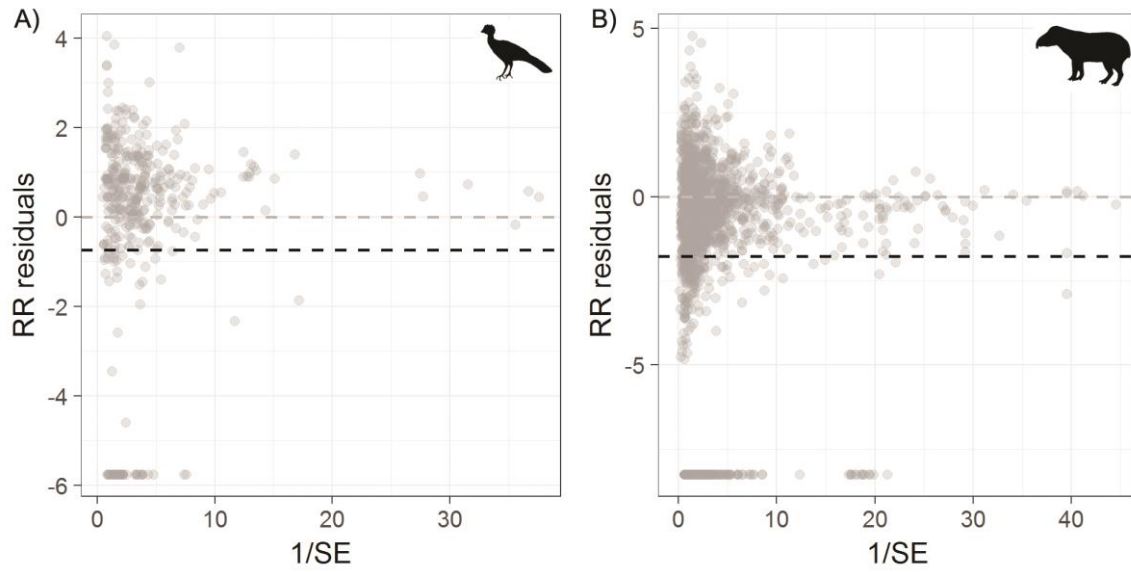


Fig. S3.

Funnel plots for (a) birds and (b) mammals. Funnel plots show the relationship between meta-analytic residuals and precision (1/SE). Dashed lines indicates $RR = 0$ (zero line, black), and weighted mean effect size (gray). Egger test for birds: intercept = -0.74 (95% CI: -1.42, -0.05, $P = 0.0347$). Egger test for mammals: intercept = -0.05 (95% CI: -0.55, 0.44, $P = 0.8374$)

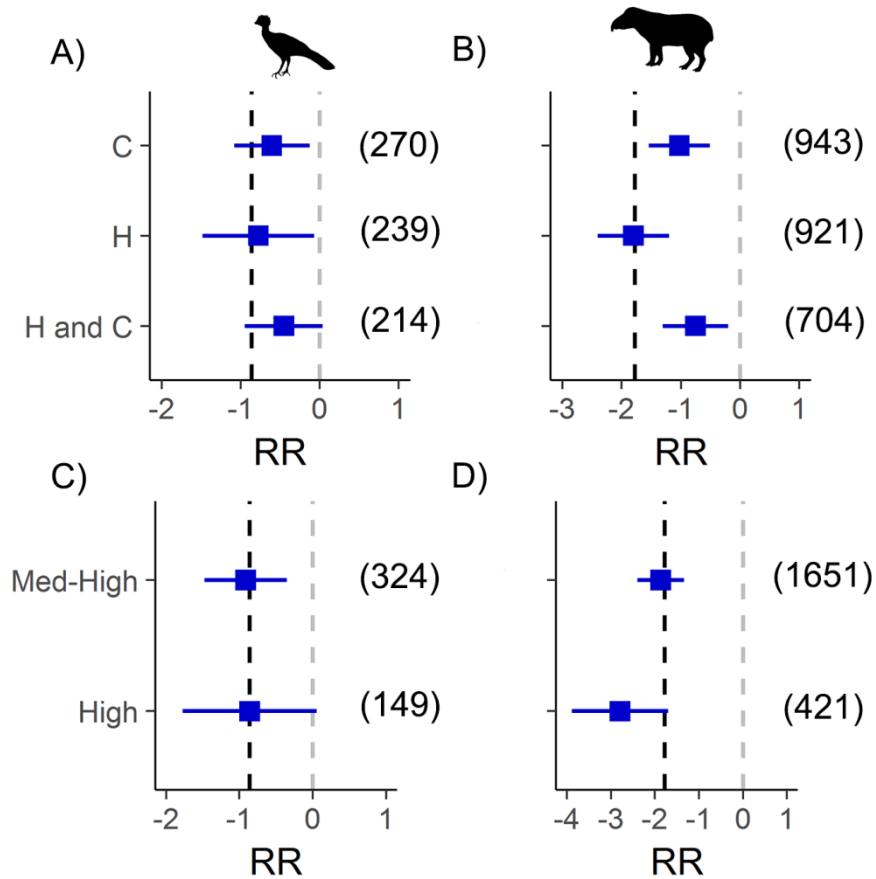


Fig. S4.

Forest plots for (a,c) birds and (b,d) mammals showing mean weighted effect sizes after exclusion of effect sizes with standardized means < 3 , for hunted (H), control (C) and hunted and control means (HC). Forest plots in c) and d) show the robustness of our meta-analytical estimates to exclusion of studies with different quality levels. Med-High: excluding low quality studies; High: excluding low and medium quality studies. Number of effect sizes is shown between brackets. Dashed lines indicates $RR = 0$ (zero line, gray), and weighted mean effect size (black).

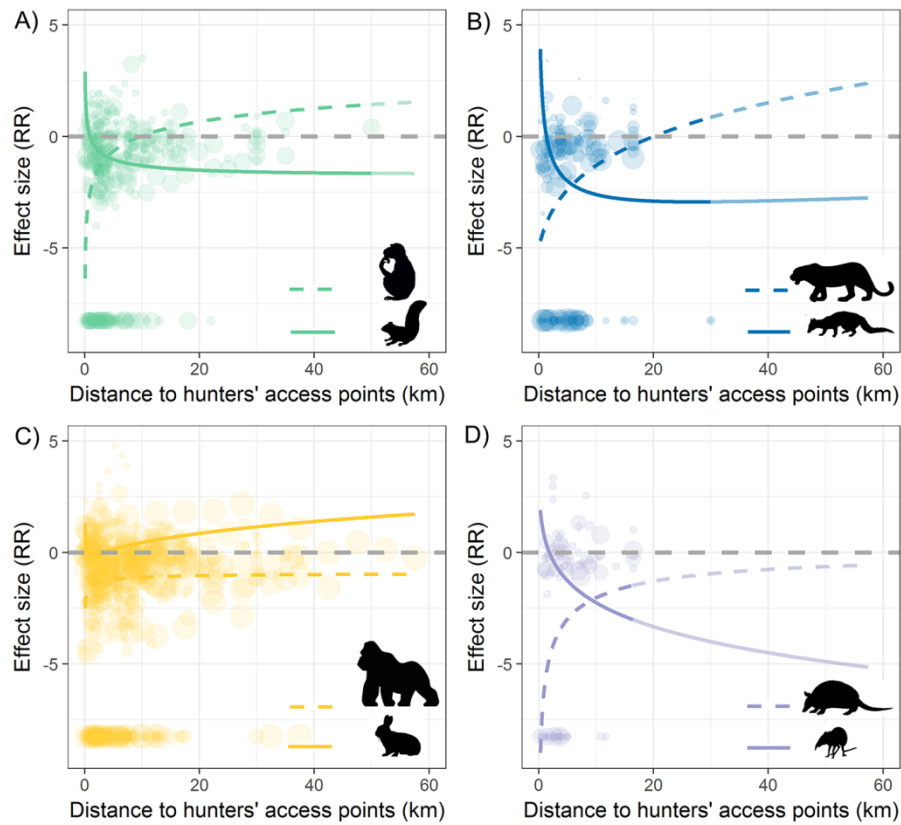


Fig. S5

Relationship between RR and distance to hunters' access points for small and large mammal species representative of each feeding guild (a) frugivores (small: *Sciurus spp.*, ~0.6kg, large: *Pan troglodytes*, 42.5 kg), (b) carnivores (small: *Genetta spp.*, ~1.8 kg, large: *Panthera pardus*, 52 kg), (c) herbivores (small: *Sylvilagus brasiliensis*, 0.95 kg, large: *Gorilla gorilla*, 130 kg), (d) insectivores (small: *Rhynchocyon udzungwensis*, 0.71 kg, large: *Prionomys maximus*, 45 kg). Plots are shown for median travel times (~600 min), and baseline levels of the other factors (subsistence hunting and no protected area, Table S6, S7). Colors as in Fig. 3. Confidence intervals not shown. Point size is proportional to body mass. Predicted lines are extrapolated (faded color) for carnivores and insectivores to allow comparison with the other feeding guilds.

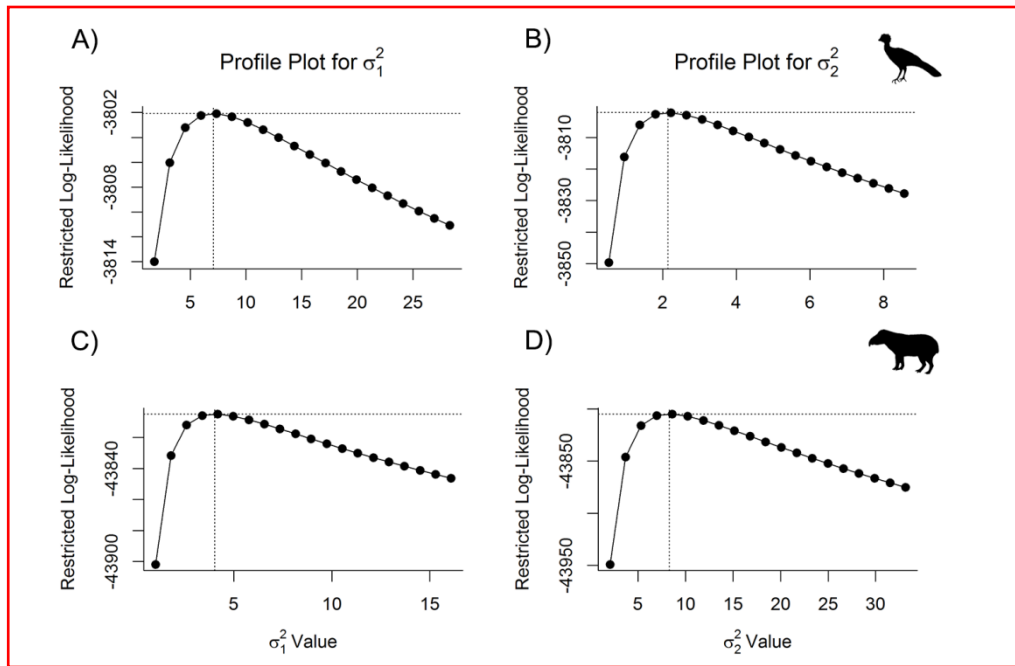


Fig. S6

Profile likelihood plots of the variance components in the model (σ_1^2 : study-level variability, σ_2^2 : species-level variability) for birds (a,b) and mammals (c,d). Plots show a peak at the corresponding REML estimate (Birds: $\sigma_1^2 = 7.08$, $\sigma_2^2 = 2.14$; Mammals: $\sigma_1^2 = 4.02$; $\sigma_2^2 = 8.29$), indicating that our fitted models were not overparameterized. When the profiled likelihood is flat (over the entire parameter space or large portions of it), then this suggests that at least some of the parameters of the model are not identifiable and the parameter estimates obtained are to some extent arbitrary (48).

Table S1.

List of Data sources analyzed in the meta-analysis and meta-regression models, and main characteristics, including author and year, type of source (SP: Scientific publication, MT: master thesis, DT: Doctoral thesis, TR: Technical report), location, habitat, taxa (class), order, type of access point, type of hunting, legality status, number of studies, methods used in the study and study quality (L: Low, ML: Medium-Low, M: Medium, MH: Medium-High, H: High).

Data source	Source type	Location	Habitat	Taxa	Order	Access point	Type of hunting	Legality	Nº studies	Methods	Study quality
Altrichter, 2005	SP (59)	Impenetrable, W Chaco province, N Argentina	semi-arid forest	mammals	Cetartiodactyla (3 spp)	settlement	subsistence	legal	1	Species densities (n/km ²) were estimated using line transects in 3 different sites, 2 hunted sites of 18 and 16 km ² and a national park site of 12 km ² . In each site a total of approximately 400km was walked which includes 2 extra repeats. Transects had various lengths and crossed the entire area. Local hunters never find the species within 1.5km from a settlement, and they never go any further than 5km. Control distance: >5km. Mean and variance given.	M
Aquino et al., 2014	SP (60)	Northeastern Peruvian Amazonia, Peru	tropical forest	mammals	Cetartiodactyla and Perissodactyla (5 spp)	settlement	subsistence & comercial	not specified	1	Species densities (n/km ²) were estimated using line transects in low (Curacay river, N = 8 transects, length: 3-5 km) and high hunting pressure forests (Tigre-Nanay rivers, N = 12 transects, length: 3-5 km) in the northeastern Peruvian Amazonia. Surveys were conducted in Nov-Dec 2012 in Curacay (total transect length: 610 km), and in Feb-Jun and Aug-Oct 2013 in Tigre-Nanay river area (total transect length: 1218 km). Control distance not clear. Mean given. Poisson assumption needed.	L

Atickem et al., 2011	SP (61)	Bale mountains, CS Ethiopia	montane grassland and woodland	mammals	Cetartiodactyla (1 sp)	settlement	commercial	illegal	2	Number of pellets (pellets/plot) counted 1515 times at 10 different sites at varying distances from settlements. Parallel line transects were used to cover the entire area of the different sites. Patrol-controlled sites have higher mountain nyala abundance and are on average closer to settlements (range: 4500- 7500 m) than non-controlled sites (9600-34700), masking the effects of distance to human settlements. Species relative abundance is calculated separately for each of these two datasets. Other potential confounding effects are elevation, forest cover and slope. Control distance: 34.7km. Mean and confidence interval given.	M
Barnes et al., 1991	SP (62)	NE Gabon	tropical rainforest	mammals	Proboscidea (1 spp)	road & settlement	commercial	illegal	2	The number of droppings were counted using 15 transects perpendicular to 3 different roads (5 transects per road with at least 5km distance between the transects). For each dropping encountered, its distance to the starting point was recorded. Settlements are distributed in a narrow band along the road. Control distance: 19-20km. Mean and variance calculated from raw data.	M or H, depending on the study
Barrera-Zambrano et al., 2008	SP (27)	Amacayacu National Park, S Colombia	Campina and Campirana Forest	mammals	Primates (7 spp)	settlement	subsistence	legal	1	Population densities of primates and other diurnal mammal were estimated using line transects. Transects varied in length, with an average of 3.95 ± 1.31 km. Total sample length was 190.3 km in less hunted places (far from settlements, ca. 8 km) and 90.8 km in the site near communities. Transects were walked 9 and 8 days on average, in the sites far and near communities, respectively. Sampling took place between June – September 2003, June –November 2005 and February- March 2006. Mean and CI given, Control distance: 8 km.	L

Baur, 1998	TR (63)	Maya Biosphere Reserve, Aldea Carmelita, Guatemala	subtropical moist forest (1% agriculture + pastures)	mammals & birds	Cetartiodactyla, Carnivores, Perissodactyla (7 spp)	settlement	subsistence and commercial	legal	1	Encounter rates (n/km) were estimated using 10 line transects (2.6 km long) located at different distances from the village. Direct and indirect observations were recorded. Sampling was repeated 27 times per month, during 14 months for a total of 966.5 km. Encounter rates are reported at 4-8, 8-12, 12-16 and 16-20 km from village. Mean given, Poisson assumption was needed for estimating sampling variances. Largest distance assumed control, although the impact could be larger. Control distance: 18 km	L
Begazo and Bodmer, 1998	SP (64)	Pacaya-Samiria National Reserve, Peru	tropical rainforest	birds	Galliformes (4 spp)	settlement	subsistence	legal in the vicinity, illegal in the protected area	1	Densities of cracids (n/km ²) were estimated from censuses carried out in three sites with different hunting pressure (heavy, moderate, light/none) and at different distances from villages (within 5 km, within 20 km and at 43 km from villages). Total transect length was 380 km, 87 km and 402 km in each of the three sites. DISTANCE was used for estimating population densities. Mean and variance given. Control distance: 43 km	H
Begazo, 1999	DT (65)	Tamshiyacu-Tahuayo Communal Reserve (TTCR, upland forest) and Pacaya-Samiria National Reserve (PSNR, varzea forest), Peru	tropical rainforest	birds	Galliformes, Gruiformes, Tinamiformes (21 spp)	settlement	subsistence	legal in the vicinity, illegal in the protected area	4 (2 forest types)	Bird abundance (n/100 km) was estimated with line transects separated 1.5-2 km from each other. Study sites had differing intensities of hunting (none, light, moderate and heavy) and were located at different distances from human settlements. Good experimental design. 28 and 24 line transects (113 and 102 km) were walked in upland and varzea forest, respectively. Average transect length: 4km. Each line transect was surveyed up to 6 times. Control distance: 43.3 km and 135 km. Mean given. Poisson assumption is needed.	M or H, depending on the species

Blake et al., 2007	SP (32)	Congo Basin: Gabon, Cameroon, Congo, Central African Republic and D.R. Congo	tropical rainforest	mammals	Proboscidea (1 spp)	road	commercial	illegal	4	Elephant density (n/km ²) was estimated from dung piles counts in 4 different sites using systematic line-transect distance surveys and reconnaissance walks (total length: > 4000 km between 2003-2005, N transects: 47-147). DISTANCE was used for estimating population densities. Human hunting signs were also recorded. The closest distance to road was recorded at every dung pile. Hunting signs declined at increasing distances from roads overall. Control distance: 42-62 km (depending on site). Mean and variance calculated from raw data.	M or H, depending on the study
Blake et al., 2013	SP (66)	Yasuni National Park, Ecuador	tropical rainforest	mammals & birds	Primates, Rodentia, Cingulata, Cetartiodactyla, Pilosa, Galliformes, Columbiformes, Perissodactyla (15 spp)	road	subsistence & commercial	legal	1	Abundance estimated as n photos/100 trap days using camera traps located at mineral Licks in one hunted site (YRS, 10-550 m to road) and in one non-hunted site (TBS 12-25 km away from any access point). Cameras were active from mid-January to mid-March 2012. Total number of trap-days ranged from 54 to 55 at YRS and from 35 to 66 at TBS. Control distance: 12-25km. Poisson assumption needed.	M
Blom et al., 2004	SP (67)	Dzanga-Ndoki National Park and Dzanga-Sangha Reserve, SW C.A.R.	tropical rainforest	mammals	Proboscidea & Primata (2 spp)	road & settlements	commercial	illegal	1	The direct and indirect signs of species were counted using 8 20km long transects parallel to the same road (and settlements) at different (random) distances from it. Every transect was walked every month from January 1997 to August 1999 (with the exception of 2 transects which were added between March and April 1998 & 2 transects which were skipped during March 1999). Every transect was divided in 500m blocks and the number of blocks with direct and indirect signs of a species was divided by the total amount of blocks to obtain an estimate of abundance. Control distance: 23km. Mean given. Poisson assumption needed.	M

Blom et al., 2005	SP (68)	Dzanga-Ndoki National Park and Dzanga-Sangha Reserve, SW C.A.R.	tropical rainforest	mammals	Primata, Proboscidea & Cetartiodactyla (10 spp)	road & settlements	subsistence	legal & illegal	1	Mean encounter rates per km (n/km) were calculated by walking 7 line transects of 20km long parallel to the closest road in 3 different study sites: 4 in a reserve, 1 on the reserve boundary and 2 outside the reserve (closest to the road). From April to June 1998 every transect was walked once. Every transect was divided in blocks of 500m and all the blocks with direct or indirect signs was divided with the total amount of blocks in that study site, and this has eventually been related to the mean distance of that study site to the nearest road. Control distance: 17.85km. Mean given. Poisson assumption is needed because no variance is given.	M
Bowkett et al., 2008	SP (33)	Mwanihana and Matundu forests, Udzungwa Mountains National Park, E Tanzania	Sub-montane and lowland semideciduous forest	mammals	Cetartiodactyla (3 spp)	road & settlement	subsistence & commercial	illegal	1	Species abundance (camera-trap rate) was calculated as the number of photographs of a species divided by the number of trap-days per site. Camera-trap sites were located at 0.5-km intervals along four 4 km transect routes established for primate and forest antelope surveys. Camera-trap rates were estimated for 60-80 days in 2 different area's in 2 different forests with 8 camera locations at each site. The distance to the nearest village for each camera-trap was calculated using a Garmin e-trex GPS unit. Control distance: 9-10km. Mean and variance calculated from raw data.	M
Brickle, 2002	SP (69)	Dak Lak province, SE Vietnam	tropical rainforest	birds	Galliformes (1 sp)	settlement	subsistence & commercial	illegal	1	Number of call recordings were counted at 161 locations (point-count survey) scattered among several dipterocarp forests (dry deciduous) in Dak Lak province (from February to May 1998). At each point-count location the closest distance to a settlement was recorded. Control distance: >10km. Mean and SE given, calculations for SD required assumptions on an equal number of point-counts per distance interval	M

Cabassu, 2010	MT (70)	Rio Platano Biosphere Reserve, Honduras	tropical rainforest	mammals & birds	Carnivores, Cetartiodactyla, Cingulata, Pilosa, Perissodactyla, Primates, Rodentia(18 spp); Galliformes (2 spp)	settlement	subsistence	legal	1	Direct and indirect signs of 21 species (n/km) were recorded in four six-km long transects around the village (indigenous hunting is concentrated in a six-km radius around settlements) and four 3-km long transects in Río Plátano biosphere reserve (unhunted), 15 km away from settlement. Each of the six km long transects in the hunted ted area were visited 6-8 times (survey effort: 180 km in 30 days). The 4 3-km long transects in the unhunted area were visited 10-12 times (survey effort: 132 km in 44 days). Control distance: 15 km. Mean calculated from raw data. Poisson assumption needed.	M
Carrillo et al., 2000	SP (71)	Osa Peninsula, Costa Rica	tropical forest	mammals	Primates, Rodentia, Cingulata, Didelphimorphia, Carnivores, Cetartiodactyla, Pilosa, Perissodactyla (20 spp)	settlement & roads	subsistence & commercial	legal (illegal in CNP)	1	Species abundance (tracks/km or groups/km) was estimated for two protected areas, one nonhunted (CNP) and one hunted area (GDFR) during September and December 1990. Mammal tracks were recorded along pre-established trails. For primates, monkey troops were located along or near the trail and counted the group as one sighting. Total sampling effort was 65 km (29 km in CNP, N = & trails, and 36 km in GDFR, N = 8 trails). Distances from the midpoint of each trail to the nearest village or road were calculated with GIS and averaged per area. Control distance: 13.5 km. Mean and SE given.	L or M, depending on the species

Chiarello 1999	SP (72)	Linhares Forest Reserve (LFR) and Sooretama Biological Reserve (SBR), Espirito Santo Estate, Brazil	Atlantic tropical rainforest	mammals	Didelphimorphia, Cingulata, Primates, Carnivora, Perissodactyla, Rodentia, Lagomorpha (14 spp)	settlement & roads	subsistence & commercial	illegal	1	Mammal abundances (n/10 km) were estimated in two large reserves (ca. 20000 ha), one with low hunting pressure (LFR) and one with high hunting pressure (SBR), using diurnal and nocturnal line-transect sampling during Oct 1994- Apr 1996. All mammals > 1 kg were censused. The extreme north of LFR is contiguous with the other large reserve (SBR) but the latter is crossed in its eastern part by a highway. Straight trails of 1.5 – 2 km of length and 1.5 m wide were cut in each study site. Number of transects and survey effort were 30 and 80.1 km and 32 and 83.6 km in LFR and SBR, respectively. Distance to nearest settlement or road calculated with GIS. Mean given. Control distance: NA. Poisson assumption needed.	L
Cronin, 2013	DT (73)	Gran Caldera-Southern Highlands Scientific reserve, Bioko Island, Equatorial Guinea	tropical rainforest	mammals	Primates (2,5 and 6 spp, depending on the site)	settlement	subsistence & commercial	illegal	3 (three sites)	Reconnaissance (recce) walk methods were used to collect data on primate abundance, hunting pressure, and habitat structure. 26 recce walk routes distributed across three sites in the GCSH were surveyed in Jan-Jun 2011 and Jan- Feb 2012. Total survey effort: 416.40 km. The three sites: Belebu, Ureca, and Moraka Playa (Moraka), were chosen due to increasing remoteness and decreasing development, respectively. Recce walks originated from points at distance intervals of 100 m, 2 km, 4 km, and 7 - 10 km from southern beaches at Moraka, and the outer village perimeters at Ureca and Belebu. Control distance: 7-10 km. Mean given. Poisson assumption needed.	M

Cullen Jr. et al., 2000, 2001	SP (74, 75)	Mata de Planalto, São Paulo, S Brazil	Atlantic tropical deciduous forest	mammals & birds	Perissodactyla, Cetartiodactyla, Cingulata, Rodentia, Carnivora & Primates (11 spp); Galliformes & Tinamiformes (2 spp)	settlement	subsistence	illegal	4 (one per hunted site)	Species abundance (n/10 km and n/km ²) was estimated with line transect surveys. Four to eight 0.5-0.8 km transects were placed in each of the 5 sites (fragments of remnant forest) each categorized as slightly and heavily hunted according to colonist settled within 5 km of the sites. Each transect was surveyed multiple times between May-Dec 1996 (Total: 2287km, 161 to 618km per fragment, mean: 381km). The protected area Morro do Diabo was used as control area. DISTANCE used for estimating densities. Control distance: >5 km. Mean and SD given.	M or H, depending on the study
Dasgupta and Hilaluddin, 2012	SP (76)	Pakke Tiger Reserve and surrounding forests, Arunachal Pradesh, India	tropical rainforest (semievergreen foothill forests)	birds	Columbiformes, Bucerotiformes (5 spp)	settlement	subsistence & commercial	legal in the hunted sites, illegal in the protected sites	3 (Two hunted and two control sites for pigeons, and 1 extra dataset for hornbills)	Species densities (n/km ²) were determined in a year-long survey (Nov 2007-Nov 2008) of 24 line transects distributed across hunted (2 sites) and unhunted sites (4 sites). Each site had 4 1.2 km transects, the number of replicates varied between 28-33, and the survey effort between 33.6-39.6 km (total: 220.05 km), depending on the site. Densities were estimated with DISTANCE. Mean and SE given. Distances to settlements calculated with GIS. Control distance: 3.7 km	M

Davies et al., 2008	BC (77)	Gola Forest, Sierra Leone	tropical rainforest and farmbush	mammals	Primates (7 spp)	settlement	subsistence & commercial	Illegal in Tiwai sites (control). Legal in the rest.	2 (forest sites and farmbush sites)	Species densities (n/km ²) were estimated in forest and farmbush sites with varying hunting pressure. In the two forest sites (Mogbai and Koyema), a standardized 1 km x 500 m survey grid with parallel transects 100 m apart was used to census primates. The perimeter of the grid was walked slowly (ca. 0.5 km/h) for five consecutive days, in alternating directions each day, in four or five different months and all primate group sightings and calls were mapped. The density of individuals was then determined by multiplying group densities by the average number of individuals per group. In the farmbush sites (Lalehun and Kondebotihun), a rectangular transect was sampled, with all sightings and calls being mapped. Survey effort varied between 50.0 - 71.7 km per site. On Tiwai, primate population densities were estimated during long-term studies using sweep samples in the forest (Whitesides <i>et al.</i> , 1988), and using transect surveys in the farmbush (Fimbel, 1994). Distance calculated using GIS. Mean given. Poisson assumption needed. Control distance: 1.5 km (farmbush), 3 km (forest)	M
De Andrade Melo et al., 2015	SP (78)	Virua National Park and Novo Paraíso Settlement, Roraima State, N Brazil	Campina and Campinara Forest	mammals	Carnivores, Cetartiodactyla, Cingulata, Perissodactyla, Pilosa, Primates, Rodentia (24 spp)	settlement	subsistence	legal	1	Relative abundance (individuals/10 km walked) of medium- and large-sized mammals was estimated using the line transect method in diurnal and nocturnal surveys. At Novo Paraíso (hunted), three parallel trails 3 km apart were opened behind and perpendicular to three inhabited settlement plots. The trails were 5 km, 3.75 km and 4 km long. At Viruá (protected), three 5-km long trails were surveyed. Sampling effort was 420 km at each site. Control distance: 10 km. Mean given. Poisson assumption needed.	M

Demmer et al., 2002	SP (34)	Tawahka Asangni Biosphere Reserve, E Honduras	tropical rainforest	mammals & birds	Carnivora, Rodentia, Cetartiodactyla, Perissodactyla, Cingulata, Primata, (13 and 7 spp); Piciformes, Psittaciformes, Galliformes, Tinamiformes, Columbiformes (9 and 14 spp)	settlement	subsistence	legal & illegal	2 (2 villages)	The number of animal encounters was recorded along 6 different hunting trails (3 from each village) with a total distance of 23km and 137 repetitions (31 times in 1995 and 38 times in 1996 in Yapuwas village and 23 times in 1995 and 45 times in 1996 in Krausirpe village). With each encounter they also recorded the distance from the start of the hunting trail. Control distance: >2.5km. Mean and variance calculated from raw data. Control distance may be too conservative.	L or M, depending on the species
Derby, 2008	DT (79)	Yasuni National Park, Ecuador	tropical forest	mammals	Primates (7 spp)	road & settlement	subsistence & commercial	legal	1	Primate density (n/km ²) was estimated using line transect surveys. 4 km and 3 km transects were established in one hunted and one nonhunted site. The hunted site is located adjacent to the road (see also Suárez et al. 2013). Data were collected 2-3 days per month from Feb-Dec 2005. Control distance: 36 l. Poisson assumption is needed.	L
Dethier, 1995	TR (80)	Dja Reserve, S Cameroon	tropical rainforest	mammals	Cetartiodactyla (7 spp)	settlement	commercial	legal	1	Species abundances (n/km) were estimated by walking 5 different 5km long line transects which lie 5km from each other at varying distances from the settlement (range: 2.5-22.5 km). Every transect was surveyed 6 times. Good experimental design. The last two transects are not hunted. Control distance: 17.5km. Mean given. Poisson assumption is needed because no variance is given.	M

Doherty, 2005	DT (81)	Chiquibul Forest Reserve, Columbia River Forest Reserve and Bladen Nature Reserve, Belize	tropical forest	mammals	Didelphimorphia, Rodentia, Carnivores, Cetartiodactyla, Pilosa (9 spp)	settlement	subsistence	Not specified	1	Obs/hour were recorded using infrared camera traps in three protected areas, one heavily hunted, other moderately hunted, and another non-hunted. Cameras were set at trees that were dropping or about to drop fruit, and that still had ten or more fruits on the tree. Cameras were left at tree sites until there were no longer fruits on the tree or ground, and no recorded animal activity. Sampling effort was 10252 hours of observation, 5693.5 of which were daylight hours. Distances to nearest settlements were calculated in GIS. Control distance: 6.6 km. Poisson assumption needed.	L or M, depending on the species
Effiom et al. 2013	SP (82)	Afi Mt Wildlife Sanctuary, Mbe Mt Community Forest, Okwango division CRNP, Nigeria	tropical forest	mammals	Cetartiodactyla (duikers and red river hog pooled into 1 guild)	settlement	subsistence & commercial	Not specified	1	Mammal abundance (groups/km) was estimated using diurnal standardized line transect censuses during the rainy seasons in May and June 2009 and 2010 in three protected areas with paired sites each (one hunted and one protected, total = 6). Four transects, each of 1 km, were made in all sites. The two sites in a pair were chosen relatively close to be as edaphically and floristically similar as possible to each other. Distances to nearest settlements were calculated in GIS. Mean and SD calculated from raw data. Control distance: > 3.4 km	L
Effiom et al. 2014	SP (83)	Afi Mt Wildlife Sanctuary, Mbe Mt Community Forest, Okwango division CRNP, Nigeria	tropical forest	mammals	Primates, Rodentia, Hyracoidea, (5 spp and 1 pooled)	Settlement	Subsistence & commercial	Not specified	1	Same methods as Effiom et al., (2013) but abundance estimates (n/km) presented by species instead of by guild. Species included in this dataset were not included in Effiom et al. (2013). Distances to nearest settlements were calculated in GIS. Mean given. Poisson assumption needed. Control distance: > 3.4 km	L

Emmons 1984	SP (84)	Madre de Dios, Peru	tropical forest	mammals	Primates, Cingulata, Rodentia, Carnivora, Pilosa, Cetartiodactyla, Didelphimorphia (31 spp)	road & Settlement	subsistence	legal	1	Encounter rates (n/10 km) were determined in several hunted sites and one hunted site. For this study only Tambopata (hunted) and Cocha Cashu (nonhunted) are compared since the other sites belong to other countries. Survey methods were line transects (diurnal and nocturnal) and trapping for small mammals (nocturnal). Nocturnal survey effort was 161.3 h and 116.4 km in Cocha Cashu (2987 trap nights for small mammals) and 21.6 h and 27.3 km in Tambopata (434 trap nights for small mammals). Diurnal survey effort was 65.3 h and 67 km in Cocha Cashu and 29.8 h and 52.3 km in Tambopata. Number of transects or repeats not clear. Distances to nearest settlement and road calculated with GIS. Mean given. Poisson assumption needed. Control distance: 8.7 km	L
Endo et al., 2010	SP (85)	Manu National Park, Peru	tropical forest	mammals & birds	Primates, Cetartiodactyla, Rodentia, Carnivores (16 spp); Tinamiformes, Galliformes (7 spp)	settlement	subsistence	legal	2 (two hunted sites)	Species densities (n/km ²) and encounter rates (group sightings/10km/) were estimated using 20 5-km long line transects (ca. 90 km) at seven locations inside Manu Park. Each transect was surveyed for ca. 10 d within a 21-day period (mean \pm SD = 13.6 \pm 33.9km/site. The two hunted locations corresponded to two settlements, whereas the non-hunted locations were located at 15-70 km from the settlements. DISTANCE used to estimate densities. Control distance: > 43 km. Mean and CV given. Poisson assumption for some estimates with low sample size.	H

Espinosa-Andrade, 2012	DT (86)	Yasuni Biosphere Reserve, Ecuador	tropical forest	birds & mammals	Carnivores, Cetartiodactyla, Cingulata, Didelphimorphia, Galliformes, Gruiformes, Perissodactyla, Pilosa, Rodentia (24 spp)	settlement	subsistence and commercial	legal	1	Camera traps (23-26) were placed in 4 sites with different accessibility (remoteness) and different hunting pressure. Kg/100 trap days of prey were converted into ind/100 trap days using body weights from Elton Traits. Jaguar densities were estimated using program CAPTURE. Mean, SE and CV given for jaguar, for prey species Poisson assumption needed. Distances to settlements were calculated after georeferencing camera traps and villages, and averaging the distance from each camera trap to the closest village. Control distance ~ 12 km.	M or H, depending on the species
Eves, 2006	DT (87)	Boundaries of Nouabale-Ndoki National Park, Congo	tropical forest	mammals	Cetartiodactyla (6 <i>Cephalophus</i> spp. pooled)	settlement	subsistence and/or commercial (depending on the site)	legal	3 (three sites)	The relative abundance of 'hunnable' duikers (<i>Cephalophus</i> spp) was estimated in the vicinity of villages (N=24) in three sites (Forest Management Units) using duiker calls along 25-km transects in 10 km sections each day over a five-day period (Jan-Apr 1996). Data is presented as Potential Rate of Return (PRR), which is an indicator of relative duiker abundance vulnerable to hunting calculated as the kg/hour observed along each 5-km segment of the transect. Regular hunting territories in the area extend to a distance of 15 to 30 km from villages. Mean given, Poisson assumption needed. Kg/hour converted to ind/hour dividing by the pooled weight of the 6 species surveyed. Control distance: 25 km	L

Fay and Agnagna, 1991	SP (88)	N Congo	tropical rainforest	mammals	Proboscidea (1 sp.)	settlement	commercial	illegal	1	Elephant density was estimated by walking 401km of line transects in 4 different study sites (63 to 141.5km per site) from February to April 1989 and in June 1990. Every transect was divided in blocks of 500m and all the blocks with dung piles was divided with the total amount of blocks in that study site. This was eventually related to the mean distance of that study site to the nearest settlement. Control distance: 37.3km. Mean and variance given.	M
Fay, 1991	SP (89)	SW and SE Central African Republic	tropical rainforest	mammals	Proboscidea (1 spp)	settlement	commercial	illegal	1	The elephant density was estimated using dung piles counted at 14 line transects (mean=10.50km and SD=3.79km) distributed over 4 study areas. Each transect was split into 0.5km sectors and for each study area the amount of sectors with dung were divided by the total amount of sectors. This was compared with the average distance of each study site to the nearest settlement. Control distance: 25-34 km. Mean and variance calculated from raw data.	M
Fimbel et al., 2000	BC (90)	Lobeke Forest, SE Cameroon	tropical rainforest	mammals	Cetartiodactyla (5 spp, 4 aggregated in one group: red duikers)	road and settlements	subsistence and commercial	legal and illegal	1	Number of individuals/km2 estimated using line transects at different distance intervals from road and settlements (0-10, 10-20, 20-30, >30 km). 15 5-km transects were surveyed 3 times in each stratified zone. Density estimates were obtained from direct sightings and dungs using DISTANCE. Hunting pressure was reported as number of captures per distance interval. Mean and confidence intervals given. Control distance: 30 km	H

Fragoso, 1991	BC (91)	Belize	tropical rainforest	mammals	Perissodactyla (1 sp)	settlement	subsistence	illegal	1	Numbers of tapirs/10 km of tapirs were estimated for a hunted area 2 km away from closest settlement, and for an unhunted reserve 26 km away from nearest settlement. 10-km long canoe transects were performed along two rivers in each area during the day and night. Each 10-km transect was surveyed 114 times. Mean given. Poisson assumption needed. Control distance: 26 km.	L
Glanz, 1991	BC (92)	Barro Colorado Island and Pipeline Road, Panama	tropical rainforest	mammals	Primates, Pilosa, Rodentia, Carnivora, Perissodactyla (14 spp)	road & settlement	subsistence & comercial	legal	1	Species abundance (sightings/km) was calculated using line transect sampling in several hunted and non-hunted areas. Here only Barro Colorado Island (BCI, control) and Pipeline road (PIP, hunted) areas are used since they have similar habitat characteristics (mature forests). In BCI, nine transects were surveyed at least 5 times (survey effort: 100 km) between 1980-1986. In 1977-1978, six transects were sampled (Total: 314 km). PIP was sampled in 1977-1978 on several transects: 1 2-3 km along Rio Limbo (3 repeats), an adjacent 1-km route (1 repeat) and 6 km in Rio Agua Salud y Frijoles Road areas (2 repeats). Distance to road calculated with GIS. Mean given, Poisson assumption needed. Control distance: 9 km	L or M, depending on the species
Gray and Phan, 2011	SP (35)	E Phnom Prich Wildlife Sanctuary, Mondulkiri province, E Cambodia	tropical rainforest (deciduous and evergreen)	mammals	Cetartiodactyla, Proboscidea, Carnivora, Rodentia & Primata (12 spp)	settlement	subsistence & commercial	illegal	1	Between Dec.2008 and Aug.2009 intensive camera-trapping was conducted in east of Phnom Prich Wildlife Sanctuary, Mondulkiri province, Cambodia. Forty camera-trap locations were set up for >2700 camera-trap nights producing 707 independent encounters of 23 mammal species. Relative abundance index calculated as the number of independent photographs of each species per 100 camera trap nights (average \pm SD: 67.9 \pm 33 nights). For each the camera the distance to the nearest settlement was also recorded. Control distance: 11-15km. Mean and variance given.	M

Hall et al., 1997	SP (93)	Kahuzi-Biega National Park and Kasese region, E D.R. Congo	tropical rainforest	mammals	Proboscidea (1 spp)	road & settlement	commercial	illegal	1	Dung piles per km ² were estimated using line transects with a total length of 480km at 7 different locations (4 within the National Park and 3 just outside it) with 5 to 6 transects per site between January to August 1994 and March to June 1995. For each dung pile found, the distance to the nearest road was recorded. DISTANCE software was used to estimate densities. Human signs were also recorded (snarers, trails, cuts, etc). Distance intervals are large and vary per site. Control distance: 20-35km. Mean and SE given.	H
Hall et al., 1998	SP (94)	Kahuzi-Biega National Park and Kasese region, E D.R. Congo	tropical rainforest	mammals	Primates (1 spp)	road & settlement	commercial	illegal	1	Ape nest densities (n/km) were estimated using variable strip width line transect sampling. Survey effort was 480km at 7 different locations (4 within the National Park and 3 just outside it) with 5 to 6 transects per site between January to August 1994 and March to June 1995. Human signs were also recorded (snarers, trails, cuts, etc). Nest encounter rates were calculated for each sampling site, which were located at different distance intervals from roads and settlements. Distance intervals are large. Control distance: 20-35km. Mean given. Poisson assumption is applied	H
Hart, 2000	BC (95)	Ituri Forest, R.D. Congo	tropical rainforest	mammals	Cetartiodactyla (7 sp but 5 aggregated in a single density estimate)	settlement	subsistence & commercial	legal	1	Duiker densities (n/km ²) were estimated using net drives in hunted and unhunted areas. Survey teams consisted of 49 people. Drive locations for each census period were determined by random placement of the first drive. Drive efficiency was standardized per area. After each drive, all captured animals were recorded. Animal densities were calculated as the total number of animals detected divided by drive area. Mean and SE given. Control distance: 20 km	M or H, depending on the species

Hayward, 2009	SP (96)	Dwesa and Cwebe Nature Reserves, Eastern Cape, SE South Africa	subtropical forest	mammals	Cetartiodactyla, Perissodactyla, Rodents, Carnivores & Primates (11 spp)	road	subsistence & commercial	illegal	2 (2 reserves)	The relative abundance index (RAI, n/100 m transect) of several mammal species was estimated using line transect sampling. Between March-July 2003 83 variable-width transects were walked in two reserves, 47 in Dwesa (mean: 484m ±69) and 37 in Cwebe (mean: 564m ±60). RAI was related to the distance to hunter access points (reserve boundary). Human signs (snares, cartridges) were also recorded. Variable sample size per distance interval (N= 3-15). Control distance: 3 km, probably conservative. Mean and variance calculated from raw data.	M or H, depending on the species
Hegerl et al., 2015	SP (97)	Udzungwa Mountains, Tanzania	lowland deciduous to submontane and montane evergreen forests	mammals	Carnivores, Cetartiodactyla, Primates, Rodents, Hyracoidea, Macroscelidea, Proboscidea, (22 spp)	settlement	subsistence & commercial	illegal	1	Relative abundance index (species-specific number of events/ 100 camera days) were calculated using camera traps in two forest sites (hunted: Uzungwa Scarp Forest Reserve, USFR and non-hunted: Mwanihana Forest, MF). In USFR two grids of 15 digital camera traps were set sequentially at a density of 1 camera/km ² . IN MF 60 camera traps were distributed at a density of camera/2km ² . Sampling effort was 850 (mean per camera 28.3) and 917 (mean per camera 30.6) camera days in USFR (Dec 2013-Jan 2014 and Jan-Feb 2014) and Mwanihana Forest (Jul-Nov 2013), respectively. Species-specific detectabilities (p, probability of detection) and occupancies (ψ, proportion of sites occupied by a species), were modelled using single-species occupancy models. Distances to access points calculated with GIS. Mean given. Poisson assumption needed. Control distance: > 8.2 km	M

Hema et al., 2011	SP (98)	Nazinga Game Ranch, Burkina Faso	savannah woodlands and shrublands	mammals	Proboscidea (1 sp)	settlements	commercial	illegal	3 (3 seasons)	Elephant density (droppings/km) was estimated between 2006 and 2008 using a systematic transect design. A grid of sides 2 km was placed over the study area, and 54 1 km transects were laid at 4 -km intervals (random start). Hunting of other species is regulated in the ranch but illegal in case of elephants. Elephants seem to be attracted to villages and cases of crop-raiding were frequent, but poaching is particularly apparent in areas where law enforcement is lower (distant from guard posts). Control distance: 15-20 km. Mean and variance calculated from raw data in 5 km distance intervals.	M
Henschel et al., 2011; Henschel, 2008	SP; DT (99, 100)	Central Gabon	tropical rainforest	mammals	Carnivora, Proboscidea, Primates, Cetartiodactyla (11spp)	road & settlement	commercial	illegal	1	Using camera-trap data (Henschel, 2008), leopard population density and the relative abundance of prey and of human hunters were compared across four study sites at varying distances from settlements and from roads/railways, used as market access points. 87 camera stations were used: 15, 18, 23 and 31 per site, respectively, resulting in 4060 trap-days. Control distance: 19-29km. Mean and variance given, for leopard data, for the rest of species only mean is given (Poisson assumption is needed).	M or H, depending on the species

Hill et al., 1997	SP (101)	Mbaracayu Reserve, E Paraguay	tropical rainforest	mammals	Primata, Perissodactyla, Cetartiodactyla, Rodentia, Carnivora & Cingulata (4 spp for Ache and 8 spp for Non-Ache hunters)	settlements (around reserve boundary)	subsistence	legal (Ache hunters) and illegal (Paraguayan and Brazilian peasants)	2	Encounter rate for different game species was estimated using over 1400 km of stratified random line transects. The transects (N = 91) generally started at a dirt road that traverse the reserve. All animal signs (direct and indirect) were recorded per 200 m of transect to derive an encounter rate. Hunting signs were also recorded to estimate extent of hunting pressure. Both indexes were related to the distance to the nearest access point for Ache or non-Ache Hunters. Control distance: >18km for Ache hunting, >11 km for Non-Ache hunting. Mean and confidence interval given for Ache hunters, only mean is given for Non-Ache hunters, thus Poisson assumption is applied	M or H, depending on the species
Hurtado-Gonzales and Bodmer, 2004	SP (102)	Tamshiyacu-Tahuayo Communal Reserve, Loreto, NE Peru	tropical rainforest	mammals	Cetartiodactyla (2 spp)	settlement	subsistence	legal	1	Species densities were estimated by walking line transects in 3 different study sites from 1991 to 1999 with different levels of hunting pressure. Densities calculated for Tahuayo/Blanco (heavily hunted, 0-14 km from village), the Lower Yavari-Miri (slightly hunted, 14-20 km), and the Upper Yavari-Miri (non-hunted) sites, which had 923, 889, and 941 km of line, transects censused; respectively, for a total of 2753 km of census. Distance intervals calculated from catchment area, some assumptions about distances made. Censuses were carried out from 1991 to 1999. Control distance: >20km. Mean and variance given.	H

Kano and Asato, 1994	SP (103)	Motaba River area, NE Congo	tropical rainforest	mammals	Primata (2 spp)	settlement	subsistence	illegal	1	The number of ape nests was counted using 12 line transects of various lengths starting from 4 different settlements. Total transect length was 222km. All the transects were repeated once. The location of a nest was recorded using GPS and related to the nearest settlement. All direct sightings and signs of apes, including vocalizations, nests, feeding remnants, dung, and footprints, and all signs of human activities such as hunting camps and honey-collecting sites, were recorded with a GPS. Densities in six equally spaced (5 km) distance intervals. Data was pooled for the 4 villages. Control distance: >25km. Mean given. Poisson assumption is needed because no variance is given	M
Koerner et al. 2016	SP (104)	Makokou (Ogooué-Ivindo province), NE northeastern Gabon	tropical forest	Mammals and birds	Bucerotiformes, Cetartiodactyla, Galliformes, Musophagiformes, Primates, Proboscidea Psittaciformes, Rodentia (28 spp)	settlement	subsistence	Not specified	1	Encounter rates (n/km) and densities (n/km ²) were calculated from direct and indirect observations of large vertebrates. Monthly surveys were conducted from Dec 2013-Dec 2014 line using 24 2.5-km straight-line transects located in a gradient of hunting intensity (distance to villages). Hunting signs were recorded. Densities estimated using DISTANCE software. Mean and SE given. Control distance: >15 km	H
Kosydar et al, 2014	SP (105)	Chiquitano Forest, S Bolivia	tropical dry forest	mammals	Didelphimorpha, Carnivora, Cingulata, Rodentia, Cetartiodactyla, Pilosa, Lagomorpha, Perissodactyla (23 spp)	road	subsistence & commercial	legal & illegal	1	Species relative abundance (n traps/100 trap nights and n photos/100 camera nights) was estimated between 2007-2008 in a hunted area (< 1.5 km from road, N = 6 sites, total trap-nights = 1496), in fragmented-plus-hunted area (7 km from road, N = 5 sites, total trap-nights = 1344) and in a control area (24 km from road, N = 5 sites, total trap-nights = 1279). Control distance: 24 km. Mean given. Poisson assumption needed because no variance is given.	L or M, depending on the species

Kuehl et al., 2009	SP (36)	Moukalaba Doudou National Park, SW Gabon	(secondary) tropical rainforest	mammals	Primata (2 spp)	road & settlement	subsistence & commercial	illegal	1	From April 2004 to July 2005, ape sleeping nest (densities were sampled using point transects (100 m diameter). Each point transect was sampled with decreasing intensity from the center towards the edge. Five observers walked in concentric circles recording ape nests with an integrated GPS and data logging. Hunting intensity is measured as both the Euclidean distance to villages and human population centers (Gamba, Tchibanga, and Mandji) and a cost-weight distance that accounted for variation in travel speed. A total of 540 point transects were walked at 18 (not independent) sites. Control distance: 35.5 km. Mean and variance calculated from raw data.	M
Kümpel et al., 2008	SP (106)	Monte Mitra area, Monte Alén National Park, W Equatorial Guinea	tropical rainforest (mature secondary evergreen humid closed forest)	mammals	Primata (4 spp)	settlement	commercial	illegal	1	Species densities (n/km ²) were estimated using 8 line transects randomly placed at each of the 2 study sites, one close to the settlement and frequently hunted and the other far from the nearest settlement not (or lightly) hunted). Minimum distance between the transects was 300m. The transects far away (control) were walked between February to June 2003 (208km total) and the transects close to the settlement between July 2003 and January 2004 (200km total). Hunter movements were tracked by GPS. Densities estimated using DISTANCE software. Control distance: 35km. Mean and variance given.	H
Kun-Rodrigues et al., 2014	SP (107)	Ankarafantsika National Park, N Madagascar	Dry deciduous forests and savannas	mammals	Primata (1 sp)	road	subsistence	illegal	1	Species density (n/km ²) was estimated at different sites located at different distances from a national road that crosses through a National Park. At each site, three to six line transects were surveyed four to six times during 2–3 days (Aug-Sep 2009). Control distance: Mean and variance given (but not for all estimates).	M

Lahm, 1993	DT (108)	NE Gabon	tropical rainforest	mammals	Proboscidea, Primates, Cetartiodactyla, Carnivores, Rodentia (18 datapoints per distance interval, Carnivores, 11 spp, Prosimians: 4 spp, represented by 1 datapoint each)	road & settlements	subsistence & commercial	legal and ilegal	1	Species density (ind/km ² or mean number/ 10 km) was estimated using line transect surveys between 1988 and 1991. 16 line transects were established: 6 transects were located near villages (0-5km), 6 transects at intermediate distances (7.5-9.5 km) and 4 transects in remote areas (30-50 km). Each transect was surveyed 6 times. Control distance: 30-50km. Mean given, variance estimated using Poisson.	M
Lahm et al., 1998	SP (109)	NE Gabon	tropical rainforest	mammals	Primata (1 spp)	road & settlements	subsistence	legal	1	Primate species density (ind/km ²) was estimated using line transect surveys. 16 different 5-km long transects were surveyed between 1988 and 1991. The starting points of the transects were randomly selected: 6 of them were close to a road, 6 of them started 5-7km from the road & 4 of them started further away in the forest. From each transect 6 replicate counts were made. Monkey density was related to the mean distance of each transect to a road. Control distance: 50km. Mean densities and SD calculated from raw data	M
Laurance et al., 2006	SP (110)	SW Gabon	tropical rainforest	mammals	Cetartiodactyla & Proboscidea (7 spp)	road	commercial	legal	1	Species abundances were estimated using 5 standardized transects (1 km long and parallel to the road at 5 different distances from it) per site. 12 study sites were selected using a stratified random design and foot surveys. All sites were at least 2.4km apart. In 2004 all the transects were surveyed 2 times in the dry and 2 times in the wet season, with at least 2 weeks' time between the different surveys. Control distance: 1.2km. Mean and variance given.	M

Lin et al.,2008	SP (111)	S China	tropical bamboo and humid conifer forest	mammals	Proboscidea (1 sp)	road and Settlements	commercial	illegal	1	Elephant frequency of signs proportion of plots with elephant presence) was recorded at different levels of human disturbance (< 0.5km, 0.5-2km and >2km from settlements and roads). Thirty transects 20 m wide and 10 to 50 km long were monitored. Plots (20 x 20 m) were sampled at intervals of 2 km along the transects. Authors recorded vegetation type, human disturbance, and presence of fresh elephant signs (footprints, dung piles, grubbing and foraging), among other variables. Poaching suggested as threat. Control distance: < 2 km. Mean given. Poisson assumption needed.	L
Linder (2008), Linder et al. (2011)	DT, SP (112, 113)	Korup National Park, SW Cameroon	tropical forest	mammals	Primates (7 spp)	settlements	subsistence & commercial	illegal	1	Standard line transect methods were used to collect data on primate abundance (encounter rates), habitat characteristics, and hunting pressure in 10 transects located in a gradient of hunting intensity. Transect length varied between 1.825 and 5.180 km. Transects were surveyed monthly between October 2004 through June 2005 (southern transects) and between December 2004 through April 2005 (northern transects). Total survey effort was 320.2 km. Distances from each transect to the nearest village were calculated using GIS. Distance was negatively related to hunting pressure (hunt signs/km). The transect with the lowest hunting pressure and located at largest distance is used as control. Control distance: 10.8 km. Poisson assumption needed	L

Lwanga ,2006	SP (114)	Kibale National Park, Uganda	secondary tropical forest	mammals	Cetartiodactyla, (2 spp)	settlement	subsistence and commercial	illegal	1	Duiker abundance (n/km) was estimated using line transects between July 2002 and August 2004. Two monthly censuses were conducted along three transects, of which, two (colonizing forests 1 and 2) were located in colonizing forests naturally replacing anthropogenic grasslands and one in old growth forest. Only the two colonizing forests are used in this study to avoid confounding effects due to habitat differences. The two colonizing forests had different hunting pressure (high vs low). Mean and SD given. Control distance: ~8.6 km	M
Magige et al, 2009	SP (115)	Serengeti National Park and adjacent areas, N Tanzania	savannah	birds	Struthioniformes (1)	settlement	subsistence	illegal	1	Ostrich density (ind/km2) was estimated using line transects (length: 1km) that were systematically spaced (2km) and superimposed on the existing road system in the study area. Sampling was conducted once a month, a total of 195 transects were recorded (total: 4659 km). Density was estimated inside the SNP (control: 7.5-32.5 km from park boundary and settlements) and in the adjacent partially protected areas outside the SNP (0-7.5 km between settlements and park boundary). DISTANCE was used to estimate densities. Some assumptions about distances were made. Control distance: 7.5-32.5 km. Mean and variance given.	H
Marshall et al., 2005	SP (116)	Uzundwa Mountains (West Kilombero Scarp Forest Reserve and New Dabaga/Ulamba Forest Reserve)	montane forest	mammals	Primates (3 spp)	settlement	subsistence	illegal	1	Monkey sighting frequencies per km transect (n/km) and group size were recorded in two census transect routes, each in a heavily hunted site and in an unhunted/slightly hunted site. Transects were 2.520–3.192 km long and sampled montane forest habitats. Routes were repeated (9-11 times). Distances were calculated using GIS and georeferenced transects (2.5, 3, 9, 14.5 km). Mean and SE given. Control distance: 14.5 km	M

Marshall et al., 2006	SP (117)	East Kalimantan, E Borneo	tropical rainforest	mammals	Primata (1 spp)	settlement	subsistence	illegal	1	Orangutan density per km ² was estimated by counting nests and recording its distance to the nearest settlement at 22 sites (minimum 5km apart) between December 2001 and August 2004. At each site 1-10 midlines of 1km in length and minimum 1km apart from each other were randomly placed with a total of 108 midlines. Perpendicular to these midlines 762 transects were randomly placed with a length 500m each and a minimum distance of 100m towards each other. One distance interval is larger than the rest to balance sample size per distance. Control distance: >60km. Mean and variance calculated from raw data.	M
Martínez-Morales, 1999	SP (118)	Cozumel Island, E Mexico	tropical rainforest	birds	Galliformes (1 spp)	road & settlement	subsistence	legal	1	Curassow density per km ² was estimated by counting each curassow along 10 line transects (2.1 to 5.8km per transect) with a total distance walked of 386km between October 1994 and June 1995. For each detection the location was also recorded in order to relate it with the distance to roads and settlements. Control distance: 9km. Mean and variance given.	M
Mena et al., 2000	BC (119)	Quehueiri-ono community, Napo Province, Ecuador	upland humid tropical forest	mammals & birds	Cetartiodactyla, Primates, Rodentia, Carnivores, Psittaciformes, Galliformes, Gruiformes, Piciformes & Tinamiformes (25 spp)	settlement	subsistence	legal	1	Species densities (n/km ²) were estimated using line transect sampling. Four 2-km transects were located in infrequently hunted areas (16 km away from settlement) and other 4 2-km transects were located in persistently hunted areas (ca. 4 km radius around settlement). Each transect was surveyed for a 2-day period each month during 11 months (N = 60 repeats in each area, total length: 117.2 and 118.6 km in each area). Species density (n/km ²) was estimated using detection distances and areas (detection distance x transect length). Mean given, Poisson assumption used to estimate variance. Control distance: 16 km.	M

Muchaal and Ngandjui, 1999	SP (120)	W Dja Reserve, S Cameroon	tropical rainforest	mammals	Cetartiodactyla, Primata, Carnivora, Rodentia & Pholidota (17 spp)	settlement	subsistence & commercial	legal and illegal	1	Direct and indirect signs of animal species were collected by walking 4 different transects of 5x0.03km in 4 different study area's (with some differences in hunting pressure), each with a different distance to the nearest settlement. Between July 1994 and December 1995 a total of 450km were walked. Transect 1 (1.5km from settlement) was walked 31 times, transect 2 (15.0km) 19 times, transect 3 (30.0km) 27 times and transect 4 (45.0km) 13 times. Control distance: >40km. Mean and variance given.	M or H, depending on the species
Nielsen, 2006	SP (121)	Udzungwa Mountains, Tanzania	montane forest	mammals	Cetartiodactyla, Rodentia (3 spp)	settlement	subsistence	illegal	1	Line transect sampling was used to estimate relative densities. A total of 19.40 and 11.05 km were surveyed, divided on 5 and 4 transects in NDUFR (hunted, surrounded by 6 villages at 1.5-14 km from reserve boundary) and WKSFR (not or low hunting, difficult access), respectively. Indirect signs were counted and DISTANCE was used to estimate relative densities. The surveys were conducted in the dry season from July to late October 2001. Control distance: > 14 km. Mean and variance given.	M
Nijman, 2004	SP (122)	Kayan Mentarang National Park, East Kalimantan, E Borneo	tropical rainforest (primary, old secondary and young secondary forest)	mammals	Primata (1 spp)	settlement	subsistence & commercial	illegal	1	Groups of monkeys were counted using repeated line transect surveys between September and December 1996. Transects were situated in 4 different forest types: primary hill forest (four transects with a total length of 10.75 km repeated 44 times), primary riverine forest (one transect of 4.9 km repeated 6 times), old secondary forest (one transect of 3.3 km repeated 20 times) and young secondary forest (two transects totaling 4.6 km repeated 19 times). Control distance: 5km. Mean given. Poisson assumption is needed because no variance is given.	M

Noss, 2000a	BC (123)	Dzangha-Sangha Special Reserve, CAR	tropical forest	mammals	Cetartiodactyla (4 spp)	road and settlements	Subsistence	legal	1	Species densities (n/km ²) estimated by surveying line transects (total: 97 km). The survey consisted of 4 parallel straight 2-km line transects and 2 1.5-km perpendicular transects connecting the ends of the 4 parallel transects. Areas sampled were located at 0-5, 5-10 and 10-15 km from the road and settlements. Number of hunts per sampled area used as proxy of hunting pressure. Mean given. Poisson assumption needed. Control distance: 10-15km	M
Noss, 2000b	BC (124)	El Chaco, Bolivia	xerophilous forest	mammals	Cetartiodactyla, Cingulata, Perissodactyla (10 spp)	settlements	Subsistence	legal	1	Species densities (n/km ²) and encounter rates (n/km) were estimated in line transects located in two sites, one hunted (20 5-km transects, total survey effort: 6560 km, Aug 97-Aug 99) and one non-hunted (6 2-km transects, total survey effort: 1106 km, Jan-Oct 98). Distances were calculated with GIS. Control distance: 23 km. Mean and range given.	M
Novack, 2003	MT (125)	Maya Biosphere Reserve, Guatemala	lowland tropical rainforest	mammals	Cetartiodactyla, Carnivora and Rodentia (6 spp, 2 spp aggregated in 1 group)	settlement	subsistence	legal	1	Species densities were estimated using line-transect sampling and DISTANCE software. 12 transects with similar habitat characteristics were sampled within the hunted area at 6-10 km from the village of Uaxactun (N=6, total: 1045 km) and in a protected unhunted area 32 km away (N=6, total= 1414 km) between Aug 2000-jul 2001). Mean and variance given. Control distance: >32 km	M or H, depending on the species

Núñez-Iturri , 2007, Núñez-Iturri and Howe, 2007; Núñez-Iturri et al., 2008	DT, SP, SP (126-128)	Madre de Dios State, SE Peru	lowland mature tropical forest	mammals	Rodentia, Cetartiodactyla, Primates and Carnivora (35 sp)	settlement	subsistence & commercial	legal	1	Species densities were estimated to quantify differences in mammal abundance between 3 hunted and 3 protected sites with similar vegetation composition. Diurnal and nocturnal censuses of mammals were performed using a standardized line- transect method. Total transect length was 700 km and 630 km in protected and hunted sites. The three hunted sites were located at 3-8 km from hunting villages, and protected sites were at least 30-40 km away. Hunting with firearms. Mean and variance given. Control distance: 30 km	L or M, depending on the species
Paciulli, 2004	DT (129)	Mentawai Islands, Indonesia	lowland evergreen tropical rainforest (unlogged, logged 10 ya and logged 20 ya)	mammals	Primates (4 spp)	settlement	subsistence	legal	3 (three forest types)	Data on primate species' densities were gathered using line transects in nine forest sites with different hunting pressure and located at different distances from villages. Forest sites were categorized as unlogged forests, forests logged 10 years ago and forests logged 20 years ago. In each of the nine survey areas, three 4 km long independent transects were surveyed. Each transect was walked three times (total line length per site: 36 km). Poisson assumption needed. Control distances: 2, 5 and 7 km depending on forest type.	M
Parry et al., 2009	SP (130)	Jarí region, NE Brazilian Amazon	Landscape matrix of upland primary terra firme forests, secondary forests, and industrial plantation forests	mammals & birds	Primates, Rodentia, Cetartiodactyla (7 spp); Galliformes, Tinamiformes (6 spp)	settlement	subsistence	legal	1	Mammal and bird densities were estimated with standardized line transect surveys at eight unhunted (98 surveys, total effort: 344 km) and six hunted primary forest sites (74 surveys, 225 km). Unhunted sites were in remote parts of the landscape with limited proximity or access to communities or urban areas. Hunting signs were recorded. Distances from each site to nearest village obtained with ArcGIS. Mean distance to nearest village \pm SD for hunted sites: 5.0 ± 1.3 km; for unhunted sites: 16.2 ± 11.3 . Mean and variance given. Control distance: >16 km	M

Perera-Romero et al., 2015	BC (131)	Caura river, Venezuela	tropical rainforest	mammals & birds	Didelphimorphia, Carnivores, Gruiformes, Galliformes, Cetartiodactyla, Perissodactyla, Cingulata, Pilosa, Rodentia (21 spp)	settlement	subsistence	legal	1	Encounter rates (Events/1000 trap nights) were estimated using camera traps in three areas (two hunted and one nonhunted and not inhabited) in March – June 2011, 2013 and 2014. Number of trap stations was 58, 53 and 52 in the nonhunted area (Ka'kada), and the tow hunted areas (Yudiña-Ayawaña and Anadekeña-Juwutuña), respectively. Survey effort was 1933, 2220 and 1508 trap nights. Distances to nearest settlement calculated with GIS. Mean and SE given. Control distance: 24 km.	M
Peres and Lake, 2003	SP (5)	Amazon basin, Brazil	tropical rainforest	mammals	Primata, Cetartiodactyla, Perissodactyla & Rodentia (12 spp)	road & rivers	subsistence	legal	1	Species abundance (n groups/10 km) was estimated using a standardized series of line-transect from 1987 to 2000 at 21 heavily or moderate hunted sites. 45 transects which were walked 13 to 15 times were used, contributing to a total distance of 2753 km over 576 walks. For each sighting the GPS location was recorded and compared to the distance of the closest road (in sections of 500m). Data is pooled for all sites. Control distance: 4.5-5km. Mean given. Poisson assumption is needed because no variance is given.	L or M, depending on the species
Peres and Nascimento, 2006	SP (132)	A 'Ukre village, SE Amazon, Brazil	tropical rainforest	mammals & birds	Primata, Perissodactyla, Cetartiodactyla, Carnivora, Rodentia, Cingulata, Galliformes, Gruiformes & Tinamiformes (18 spp)	settlement	subsistence	legal	1	Species densities (n/km ²) were estimated using line-transect surveys (4-5 km long) in two sites with different hunting pressure. One study site had been unhunted for the last 5 years and is located at 12-18km from the settlement, whereas the other site lies 0-5.5 km from the settlement and is frequently used to hunt. Total sampling effort was 248.5 km in the unhunted site (1994-1997), and 199.4km in the hunted site (1997 – 1999). Control distance: 12-18km. Mean given. Poisson assumption is needed because no variance is given.	M or H, depending on the species

Peres, 1990	SP (133)	Several sites in Brazilian Amazon	tropical rainforest	mammals	Primates (15 spp)	settlement	subsistence	legal	4 (4 hunted sites)	Species density (n/km^2) was estimated using repeated line transects (4-5 km long) at 7 sites with different levels of hunting pressure in Brazilian Amazonia (period: 1987-1988). Transects were repeated 10 times and all encounters with primate groups or individuals were noted. Data collected from additional sources (4 sites) was not used in the analyses of this article. Hunting pressure extended up to 9 km from human settlements. Densities of primates in control sites (4, which were relatively close to each other) were averaged per species and used as control density. Control distance: > 9 km	L or M, depending on the species
Peres, 1996	SP (134)	CW and E Brazil	tropical rainforest	mammals	Cetartiodactyla (1 spp)	settlement & rivers	subsistence	legal	9 (9 hunted sites)	Species density (n/km^2) was estimated using repeated line transects (4-5.6 km long) at 23 sites with different levels of hunting pressure (period: 1987-1994). Total sampling effort was 44-359 km per site (mean=103km, SD=65). Hunting pressure extended up to 12 km from the settlement or nearest river according to interviews with hunters. This hunting distance interval was used in each hunted site. Densities of peccaries in control sites (4, which were relatively close to each other) ranged 8.8-11.7 (mean: 10; SD: 1.38). This value was used as control density (approximate carrying capacity). Control distance: >12km. Mean given, Poisson assumption needed.	M

Pia, 2011; Pia et al., 2013	DT, SP (135, 136)	Quebrada del Condorito National Park, C Argentina	high tussock grasslands and shrublands, with granite outcrops	mammals	Carnivores (2 spp)	settlement	subsistence	illegal	2 (outside and inside the National Park)	Number of signs (tracks, faeces, or direct sightings) of culpeo foxes and pumas were counted in 14 transects inside the National park (limited or no poaching), and 13 transects outside the park (higher hunting pressure) in 2007 and 2008. Transects (5 m x 1000 m) were set up on natural sandbanks along riversides, and were located at a wide range of distances to human settlements. Mean and variance calculated from Figure 2 by grouping 4-6 transects in 3 distance intervals for each species, outside and inside the park. Control distances: > 1600 m outside the NP, > 3000 m inside the NP.	L
Poulsen et al., 2011	SP (137)	Kabo Forest Reserve, D. R. Congo	tropical forest	mammals & birds	Bucerotiformes, Cetartiodactyla, Primates, Musophagiformes, Rodentia, Proboscidea, Psittaciformes, (19 spp)	settlement	subsistence & commercial	legal	s1	Species densities (n/km2) were calculated using line transects in three forest types: logged and hunted forest, logged and unhunted forest, and unlogged and unhunted forest. On the first two are considered in the meta-analysis as hunted and unhunted areas. In each forest type 10 2.5-km transects were randomly located and surveyed during two years. The transects follow a gradient of hunting intensity from the town of Kabo. DISTANCE was used to estimate densities. Distances were calculated with GIS. Control distance: 33 km. Mean and CI given.	M or MH, depending on the species

Remis, 2000	SP (138)	Dzanga-Sangha Forest Reserve (DSFR), Central African Republic	tropical rainforest	mammals	Cetartiodactyla, Primates, Proboscidea (3 species and 2 pooled)	settlement	subsistence & commercial	legal and illegal	1	Species abundances (signs/km, calls/km, dungs/km, nests/km) were estimated using line transect sampling in three 30-sq-km sample blocks located at varying distances (10, 30 and 35 km) from the population centre of Bayanga. Three trained research teams surveyed six variable width and length (4-5 km) line transects in each block for wildlife and human sign (survey effort: 81.2 km). Gorilla and chimpanzee tracks, food remains or dung, elephant and ungulate dung, and monkey sightings and calls were recorded on each transect. All indications of human activity, hunting signs and presence were noted. DISTANCE was used to calculate gorilla density estimates. Mean given, Poisson assumption needed. Control distance: 30 km (the site with lowest hunting signs/km)	M or H, depending on the species
Remis and Kpanou 2010	SP (139)	Dzanga-Sangha Reserve, Central African Republic	tropical rainforest	mammals	Cetartiodactyla, Primates, Proboscidea (12 spp, 4 duiker spp. pooled in one)	road & Settlement	subsistence & commercial	legal and illegal, depending on the site	1	Encounter rates (signs/5 km) were calculated using line transects in 4 areas with different levels of hunting pressure and at varying distances from the main town. At each site 5-km linear transects were placed perpendicular to the primary logging roads and the drainage patterns to sample a range of vegetation gradients (Core Park, three sites 20 km each = 60 km, Core Reserve, three sites 20 km each = 60 km, Remote Park, one site, two 5 km transects = 10 km, Remote Reserve, one site, five 5 km transects = 25 km). Hunting signs were recorded per site, and the core park area is used as control due to low hunting pressure. Distances to roads and settlements calculated using GIS. Control distance: 6.35 km. Mean and SE given.	L or M, depending on the species

Reyna-Hurtado, 2002; Reyna-Hurtado and Tanner, 2007	MT, SP (140, 141)	Calakmul Biosphere Reserve and buffer areas, Mexico	tropical rainforest	mammals	Cetartiodactyla, Perissodactyla (5 spp)	settlement	subsistence	legal	1	Straight line transects were cut in the forest and used to estimate the relative abundance of ungulate species (track encounter rate, n/km) between Feb- Jul 2001. Transects were randomly located in three ejidos previously identified as hunting areas (N = 24, 20, 18 transects) and in a non-hunted area (CBR, N =28 transects). Transects started 3-5 km away from the villages to avoid censusing in fragmented areas due to agriculture. Abundance data is pooled for the three hunted sites and compared to the abundance in the control area. Control distance > 20 km from the nearest hunted site and 10 km from road.	M
Rosin and Swamy, 2013	SP (142)	Madre de Dios river basin, Peru	tropical rainforest	mammals	Primates (5 spp)	settlement	subsistence	legal	1	Encounter rates (n/10 km) were estimated using line transects of varying length in three sites (RA: 4 transects, 100.15 km; LA: 3 transects, 102.3 km; TRC: 3 transects, 102.5 km) under varying degrees of protection from hunting pressure. Transects were surveyed in the morning and in the afternoon. The size of the focal protected area and straight-line distance to the nearest human settlement were used as proxies for hunting pressure. The sites were selected to minimize potentially confounding natural variation and other effects of such as logging and agriculture. Mean given, Poisson assumption needed to estimate variance. Control distance > 50 km.	M

Rovero et al., 2012	SP (143)	Udzungwa Mountains, South-Central Tanzania	lowland deciduous forest and evergreen moist montane forest	mammals	Primates (6 spp)	settlement	subsistence & commercial	illegal	1	Primate encounter rates (groups/km) were estimated using line-transects between Feb 2004 and Oct 2009 in a hunted (USFR) and unhunted (MW) forest in the Udzungwa Mountains. Three 3.1–4 km long transects were laid out in each forest and 180 and 134 transect repetitions were conducted in MW and USFR, totalling 702 and 479 km of transect, respectively. Hunting signs were recorded and hunters were interviewed. Mean and SD given. Hunting villages located at 2.5-5 km from hunted forest. Control distance: 150 km	M
Schmid and Rasoloarison, 2002	BC (144)	Ankarafantsika National Park, N Madagascar	xerophytic forests and scrubs	mammals	Primates (5 spp)	road	subsistence	illegal	1	Species abundance (sightings/km) was estimated at different sites located at different distances from a national road. The most remote site was relatively intact. Distance to roads was obtained from (Kun-Rodrigues et al., 2014). At each site, 2-3 line transects were surveyed 2-10 times using nocturnal and diurnal censuses, depending on species activity. Local people were questioned to collect information about the presence of lemur species and about the hunting pressure on the primate fauna. Control distance: 17.6 km Mean and variance derived from data.	M

Stokes et al., 2010	SP (37)	N Congo	tropical rainforest	mammals	Primates & Proboscidea (3 spp)	road & settlement	commercial	illegal	1	Line transect distance sampling was used to estimate densities (ind/km ²) of elephants, gorillas and chimpanzees from counts of elephant dung piles and great ape sleeping nests respectively. 10 different teams performed the counts from February to August 2006 in the dry season. Every transect was walked by 2 to 3 different teams and all were done as fast as possible before moving to the next one in order to minimize seasonal variation. In total 166 transects were walked with a total distance of 329.7km. The GPS location of every observation was recorded in order to relate this with distance to roads and settlements. Control distance: 22-33km. Mean and variance calculated from raw data.	M
Suarez et al., 2013	SP (145)	Yasuní Biosphere Reserve, Ecuador	tropical rainforest (terra firme)	mammals & birds	Primates, Cetartiodactyla, Rodentia, Galliformes, Gruiformes, Piciformes (21 spp)	road & settlement	subsistence and commercial	legal and illegal	1	Species density was estimated from bi-monthly surveys of large birds (several cracid species, toucans, and the grey-winged trumpeter), and medium-sized and large mammals between April 2005 to July 2006. Surveys were performed using distance sampling techniques along six line transects (2 km each) in each of three sampling sites (1 control and two hunted sites). Each transect originated and continued perpendicularly from the roads (Taracoa and Yasuní Research Station) or from the river (Control site). Each transect was surveyed during eight time periods. Sample size per site: 6 x 8 = 48. Hunted distances: up to 2 km, but could expand further into the forest. Mean and CI given (Control distance: 89 (Taracoa) and 40 km (Yasuni))	M or H, depending on the species

Thiollay, 1984	SP (146)	French Guiana	tropical rainforest	birds	Accipitridae, Cathartiformes, Falconidae (16 spp)	settlement	subsistence	legal	1	Species abundance (mean number of individuals seen per 2-hr period) was estimated using 100 m width strip transects and 2-hour long counts from natural openings in one hunted and one unhunted area (50 km from the hunted area). Sampling took place in Nov-Jan (1983-1984) over 100 km ² in the hunted area and 10 km ² in the control area. Mean given, Poisson assumption needed. Control distance: 50 km.	L
Thiollay, 2005	SP (147)	French Guiana	tropical rainforest	birds	Galliformes, Psittaciformes, Tinamiformes, Gruiformes (15 sp, 5 individual spp, 4 sp groups)	settlement	subsistence & commercial	legal	1	Species abundances (mean frequency of occurrence, n/10 h) was estimated using 100 m width strip transects in six hunted and disturbed areas (5-40 km of a small town and accessible by car), seven non-hunted and pristine areas and eight intermediate areas, undisturbed and not currently hunted, but formerly hunted or close to current hunting areas. Sampling took place in Aug-Dec and March-May (1983-2001). The total area covered per site was ≥ 2000 ha, and 997 h, 921 h and 1107 h in each of the three group of sites. Control distance: >30km. Mean and variance given.	M
de Thoisy et al., 2005	SP (148)	N French Guiana	tropical rainforest	mammals	Primata (6 spp)	settlement	subsistence & commercial	illegal	1	Study performed in 17 sites spread all over the country. The sighting rates (indiv/km) of 6 monkey species were estimated using 1 line transect of 4-5km at every of the 13 hunted sites and 4 unhunted sites. 1 site was recently logged (<5 years ago). Every transect was walked 20-38 times. Most hunting occurs within 2.5 km of access points (settlements, tracks and rivers). Maximum distance in hunting trip is 5 km. Values of unhunted sites used as control densities (sighting rates). Control distance: 5 km. Mean given, Poisson assumption needed.	M

Topp-Jørgensen et al. 2009	SP (149)	Uzungwa mountains, Tanzania	montane forest	mammals	Primates, Cetartiodactyla, Proboscidea, Tubulidentata, Rodentia (11 spp)	settlement	subsistence	illegal	1	Relative densities (groups/km, animal trails/km and number burrows/ha) were estimated using line transects, line intersect methods and fixed area searches, depending on the surveyed species. Surveyed line transects were 4.42 km, 4.26 km, and 6.00 km in WKSFR (22 repetitions), USFR (19 repetitions) and NDUFR (10 repetitions). For the line intersect method, transects were 4.26, 4.09 and 4.65 km long. Trails were attributed to a species based on footprints and dung. In the fixed area searches, the number of burrows within five meters to either side of the transect was recorded. Only active burrows were recorded based on uncovered trails and holes. A distance of 25 m between entrance holes was applied to discern between den systems to avoid overestimation. Mean and 95% CI given for some species. Distances were calculated with GIS. Control distance: > 7.5 km	L or M, depending on the species
Urquiza-Haas et al. 2011	SP (150)	Yucatán Peninsula, Mexico	tropical forest	birds & mammals	Galliformes, Tinamiformes, Piciformes, Primates, Rodentia, Cetartiodactyla, Carnivores, Pilosa (17 spp)	settlement	subsistence	Not specified	2 (2 control sites according to forest cover)	Diurnal vertebrate surveys were conducted using standardized line-transect census. Species were identified by direct sightings and/or acoustic cues, particularly alarm calls. Two or three transects of 3–4.5km in length were walked once a day at each site. Cumulative effort was 93.3–147.4km per survey site, and a total of 927.2km walked across all eight sites. Distance intervals not clear, but hunters reported exploiting catchment areas between 2.5 and 9 km of their settlements, and typically within 3–4 km. Hunting activities were evaluated qualitatively via semi-structured interviews. Control distance > 9 km. Mean given, Poisson assumption needed.	L or M, depending on the species

Van Vliet and Nasi, 2008	SP (151)	SW Gabon	tropical rainforest	mammals	Primates, Cetartiodactyla & Proboscidea (12 spp)	road	subsistence	legal	1	Species observations were recorded during a routine forest inventory between 2001 and 2003. 159 parallel line transects of the same distance were used with 5711 survey units centered on the transect lines of 20m by 200m each. Hunting signs were recorded as well. The distance of each survey unit to the nearest road was recorded. Almost no sign of hunting traces over 7 km. Data aggregated over 0-3, 3-7, 7-10 and >10 km distance intervals. Mean and variance calculated from raw data. Control distance: >10 km.	M
Vinitpornsawan, 2013	DT (152)	Thung Yai Naresuan Wildlife Sanctuary, Thailand	tropical rainforest	mammals	Carnivora, Proboscidea, Perissodactyla, Cetartiodactyla (8 spp)	settlement	subsistence & commercial	illegal	2 (sign survey and camera trap survey)	Mean relative abundance of mammal species was estimated in a sign survey covering 10 16x16 km grid cells (Nov. 2010-Feb 2012). Length of survey routes within grid cells were proportional to the amount of forest cover (max= 60 km per 256 km ²). Tracks, pellet/dung piles/scat, scratch marks, direct sight, etc. were recorded only the first encounter of each type of sign/evidence within each 100 m segment. Mean relative abundance (n 100m segments with sign/total number) is calculated for 1 km grid cells at varying distances to settlements. Human disturbance index is also recorded. Camera trap was used for tiger and leopard (50 cameras, 99 camera trap locations, 1689 trap nights). No sign of tiger or leopards within 10 km from villages. Mean density estimates for these two species were obtained using Bayesian approaches. Assumptions about control distance (longest). Control distance: 10 km and >10 km. Mean and variance are given.	M or H, depending on the species

Wang et al., 2007	SP (153)	Dja Reserve and Kompia Community forest, S Cameroon	tropical rainforest (44% mature semi-deciduous lowland forest, abandoned fields/secondary forests (20%), swamps (26%) and active crop plots (10%))	mammals	Primates (6 spp)	settlement	subsistence & commercial	legal	1	Arboreal frugivores were censused using modified line transects in 1999 and 2004. At the hunted forest site (16.3 km ² centered around Kompia village), frugivores were surveyed on four routes (4.4-5.8 km long). At the protected forest site (25 km ²), surveys were conducted on seven routes (6.4 -7.9 km long). All routes were surveyed three times per month. Total length: 640 km in the hunted (N= 4 routes x 3 repeats = 12 repeats per month) and 1727 km in protected forest sites (N= 7 routes x 3 repeats = 21 repeats per month). Mean monthly relative abundance estimates and confidence intervals were obtained for each primate species at each site. Monthly estimates were pooled to obtain a unique estimate per species per site. Control distance: 23 km	M
Wang, 2008	DT (154)	Dja Reserve and Kompia Community forest, S Cameroon	tropical rainforest (44% mature semi-deciduous lowland forest, abandoned fields/secondary forests (20%), swamps (26%) and active crop plots (10%))	birds	Bucerotiformes (6spp)	settlement	subsistence	legal	1	Hornbills were surveyed in 1999 using modified line-transects. See Wang et al 2007 for methods. DISTANCE software was used to estimate densities. Mean and confidence intervals given. Control distance: 23 km	M

Weber, 2005	DT (155)	Calakmul Biosphere Reserve and buffer area, Mexico	tropical rainforest	mammals	Cetartiodactyla (3 spp)	settlement	subsistence	legal	1	Deer density estimates (tracks/km) were obtained using line transect sampling on 6 permanent transects and 23 temporary transects in areas with no hunting, moderate and heavy hunting pressure. Mean hunting distance: 13.5 km. Mean and SE given. Control distance located in reserve in isolated area: 60 km (although 10 km from other nearest village).	M
Wilkie et al., 1987, 1990	DT, SP (156, 157)	Ituri Forest, E D.R. Congo	tropical rainforest	mammals	Cetartiodactyla, Proboscidea, Carnivora, Primata, Pholidota & Rodentia (17 spp)	road & settlements	subsistence	legal	1	Using line transects, the average number of tracks was calculated in 3 5-ha sites within mature forest (unhunted, located 6km from the nearest road) and 3 5-ha sites in secondary forest (hunting occurs between 1.5 and 3km from the road). In each study site five track recording stations were equally placed along each of five 100m transects. Data was collected from June 1982 to January 1983 and during April 1983. Every station was checked every 7 to 11 days. Control distance: 6km. Mean given. Poisson assumption is needed because no variance is given.	L or M, depending on the species
Wright et al., 2000	SP (158)	Several sites, Panama	Secondary lowland tropical rainforests (evergreen and wet, age: 80-150 y)	mammals	Cetartiodactyla, Didelphimorphia, Carnivores, Primates, Pilosa, Rodentia (11 spp)	settlements	subsistence & commercial (not clearly reported)	illegal	1	Abundance is reported as number individuals/km ² , as number of groups/km (primates) and as number animal captured/100 trapping nights. 5-km transects were established in eight study sites with different hunting pressures and different levels of protection. Transect counts were conducted weekly between 18 Aug – 11 Dec 1997 (total 634 km transects; 60-89 km per site). Additionally two rounds of small mammal trapping were conducted at each site using Sherman traps. Poaching intensity was estimated by recording hunting signs in each site and by interviews with national park guards. Distances were calculated with GIS and georeferenced transects. Mean given, Poisson assumption needed. Control distance: 9 km	L or M, depending on the species

Yasuoka 2006	SP (159)	Site adjacent to Nki and Boumba-Bek National Parks, Cameroon	tropical rainforest	mammals	Cetartiodactyla, Proboscidea (5 spp, red duikers pooled)	settlement (along logging road)	subsistence	legal	1	Species density (n/km ²) and relative abundance (number of dungs/plot) was estimated in February and March 2005 at varying distances from a hunting village (Zoualabot), after the bushmeat trade boom during 2002-2004. Two 20×500-m belt transects were established in five plots at 13, 17, 22, 28 and 33 km from the village. When animal dung was found in the belt transect, the distance along the transect, the perpendicular distance from the centerline, the name of the animal, and the date of defecation estimated by the Baka, were recorded. Dung density was calculated based on the assumption that all dung in the belt transect was counted, and was not prone to underestimation. Hunting signs (snares) were recorded at each plot. Mean given, Poisson assumption needed. Control distance: 33 km.	M
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Table S2.

Results of the meta-analysis under different SD imputation methods.

Imputation method	Birds			Mammals		
	Weighted mean effect size (<i>RR</i>)	Lower CI	Upper CI	Weighted mean effect size (<i>RR</i>)	Lower CI	Upper CI
Poisson	-0.859	-1.433	-0.285	-1.775	-2.273	-1.278
Bracken 1992	-0.773	-1.292	-0.255	-1.58	-2.062	-1.107
HotDeckNN (100 estimates)	-0.837	-1.410	-0.264	-1.806	-2.312	-1.293
	(median)	(median)	(median)	(median)	(median)	(median)
	-0.835	-1.402	-0.268	-1.808	-2.316	-1.294
	(average)	(average)	(average)	(average)	(average)	(average)

Table S3.

Moderators included in the analyses. For continuous moderators, units and transformations are indicated; for categorical moderators (factors), levels of the factor are indicated.

Moderators		Type of variable	Unit/levels	Transformation	Reason for inclusion in analyses
Species-level moderators	<i>Guild</i>	Factor	4 (birds) 5 (mammals)	NA	Large-scale hunting may affect functional guilds differently, with different consequences for ecosystem functioning. (25)
	Carnivores				
	Frugivores				
	Herbivores				
	Insectivores				
	Omnivores				
	<i>Body mass</i>	Continuous	Kg	Log transf.	Large species are more heavily hunted.
Study site-level moderators	<i>Distance to hunters' access points</i>	Continuous	Km	Log transf.	Species abundance increases with distance to hunters' access points and levels off beyond a certain threshold distance.
	<i>Travel time</i>	Continuous	Min.	Log transf.	Travel time to major towns is used as a <i>proxy</i> of accessibility to urban markets. Hunting pressure is expected to be higher in areas more accessible (with less travel time) to urban markets.
	<i>Region</i>	Factor	4	NA	Hunting-induced defaunation may vary regionally. For example, regions with more human population and historically more hunted (Africa) may be more defaunated (lower effect sizes) than regions with historically less human population (South America). Not included in model selection because it is confounded with "Type of hunting", plus it is not well balanced for birds.
	Africa				
	Asia				
	CAmerica				
	SAmerica				
	<i>Type of hunting</i>	Factor	2 (birds) 3 (mammals)	NA	Commercial or subsistence and commercial hunting (both) may have a larger effect on wildlife populations than subsistence hunting.
	Subsistence				
	Commercial				
	Both				
	<i>Protected areas</i>	Factor	2	NA	Hunting pressure is larger outside of protected areas.
	Unprotected				
	Protected				

Table S4.

Results of model selection for fitting the random effects structure for birds and mammals. Models were run with a full fixed effects structure and compared using the Bayesian Information Criterion (BIC). The final random effects structure used in the meta-analysis is in bold: (1 |Study + 1|Species). k : number of parameters.

	Birds		Mammals	
Random effects	BIC	k	BIC	k
(1 1)	16136.5	16	238433.6	37
(1 Study)	13161.0	17	142938.8	38
(1 Species)	9749.0	17	134129.6	38
(1 Order/Species	9750.2	18	134137.2	39
(1 Study + 1 Species)	7696.4	18	87904.18	39
(1 Study + 1 Order/Species)	7699.3	19	87910.57	40
(1 Study + 1 Order)	11722.9	18	134137.9	39

Table S5.

Effect sizes (categorical moderators) and regression coefficients (continuous moderators) for birds and mammals. Average random-model effect sizes (“Mean Effect size”) and 95% Confidence Intervals (“LCI” and “UCI”) were calculated by Region, Functional Guild, Type of Hunting and Level of Protection, for birds and mammals separately. Average regression coefficients and 95% CI are shown for continuous moderators (Distance: distance to hunters’ access points, Travel Time, Body mass). Models for continuous moderators included quadratic terms (Slope (q)). N: number of effect sizes, *LRT*: Likelihood ratio tests. Q_M : omnibus test (χ^2 distributed). Significant results are highlighted in bold. *P*-values and *P*-values corrected for multiple hypothesis testing using Bonferroni corrections are presented (*P*-adj).

Fixed effects/ Moderators	Mean effect size/ regression coefficient	BIRDS				Mean effect size/ regression coefficient	MAMMALS			
		LCI	UCI	N	Model support based on omnibus tests ($Q_{M,df}$)		LCI	UCI	N	Model support based on omnibus tests ($Q_{M,df}$)
<i>Distance</i>				384					1938	
Intercept	-2.10	-2.63	-1.58		$Q_{M,2} = 1605.5, P = 0.0007$	-2.36	-2.86	-1.87		$Q_{M,2} = 12741.88, P = 0.0007$
Slope	1.43	1.29	1.56			0.10	0.08	0.13		
Slope (q)	-0.17	-0.21	-0.14			0.14	0.14	0.15		
<i>Body Mass</i>				384					1938	
Intercept	-0.90	-1.47	-0.32		$Q_{M,1} = 6.39, P = 0.0805$	-1.54	-2.12	-0.95		$Q_{M,1} = 2.18, P = 0.9744$
Slope	-0.37	-0.65	-0.08			-0.13	-0.32	0.05		
Slope (q)										
<i>Travel time</i>				384					1938	
Intercept	-6.14	-6.98	-5.30		$Q_{M,1} = 395.45, P = 0.0007$	-2.40	-3.02	-1.78		$Q_{M,2} = 3497.42, P = 0.0007$
Slope	0.81	0.73	0.89			-1.08	-1.21	-0.95		
Slope (q)						0.18	0.16	0.19		
<i>Region</i>										
Africa	0.48	-1.13	2.09	39	$Q_{M,3} = 14.89, P = 0.0343$	-2.00	-2.72	-1.29	792	$Q_{M,3} = 57.18, P = 0.0007$
Asia	-0.58	-2.60	1.43	10		-2.02	-3.84	-0.20	105	
CAmerica	-0.21	-1.45	1.03	103		-2.87	-4.05	-1.68	251	
SAmerica	-1.30	-1.98	-0.63	232		-1.27	-1.97	-0.58	790	

Functional Guild										
Carn	-0.98	-2.25	0.29	18	$Q_{M,3} = 9.81, P = 0.3066$	-2.41	-3.49	-1.33	158	$Q_{M,4} = 55.28, P = 0.0007$
Frug	-0.87	-1.47	-0.26	316		-1.91	-2.73	-1.11	463	
Herb						-1.39	-2.08	-0.70	793	
Insect	-0.36	-1.58	0.86	19		-3.11	-4.71	-1.51	85	
Omn	-1.06	-2.17	0.05	31		-1.59	-2.37	-0.81	439	
Type of hunting										
Susistence	-0.55	-1.21	0.11	297	$Q_{M,1} = 11.85, P = 0.0189$	-0.83	-1.45	-0.22	823	$Q_{M,2} = 76.47, P = 0.0007$
Commercial						-2.24	-3.20	-1.29	191	
Both	-1.48	-2.39	-0.57	87		-2.63	-3.25	-2.01	924	
Level of protection										
Unprotected	-0.60	-1.21	-0.001	167	$Q_{M,1} = 103.7, P = 0.0007$	-2.37	-2.87	-1.87	754	$Q_{M,1} = 2836.12, P = 0.0007$
Protected	-1.20	-1.80	-0.59	217		-1.10	-1.60	0.60	1184	

Table S6.

Model selection results for multiple meta-regression models relating *RR* to the following moderators: Distance: Distance to hunters' access point, BM: Body mass, TypeHunt: Type of Hunting, TravTime: Travel Time to the nearest major town, Guild, Prot: Protected area status. The most supported model is the one with the lowest BIC (Bayesian Information Criterion). Results are presented for a) birds and b) mammals. Δ BIC: Difference in BIC from the most supported model; weights: Akaike weights; *k*: number of fitted parameters. Model selection was applied to main effects first, and subsequently we assessed if model fit improved by adding first- and second-order interactions between distance and some of the moderators.

A) Birds

Model	BIC	Δ BIC	weights	<i>k</i>
Distance + Distance ² + BM x Distance + BM x Distance ² + TypeHunt x Distance + TypeHunt x Distance ² + Prot x Distance + Prot x Distance ²	7687.0	0.0	0.900	14
Distance + Distance ² + BM x Distance + BM x Distance ² + TravTime + TypeHunt x Distance + TypeHunt x Distance ² + Prot x Distance + Prot x Distance ²	7691.6	4.6	0.092	15
Distance + Distance ² + BM x Distance + BM x Distance ² + Guild + TravTime + Distance x TypeHunt + Distance ² x TypeHunt + Prot x Distance + Prot x Distance ²	7696.4	9.4	0.008	18
Distance + Distance ² + BM x Distance + BM x Distance ² + TypeHunt x Distance + Prot x Distance + Prot x Distance ²	7779.1	92.1	0.000	13
Distance + Distance ² + BM x Distance + TypeHunt x Distance + Prot x Distance + Prot x Distance ²	7813.1	126.1	0.000	12
Distance + Distance ² + BM x Distance + BM x Distance ² + TypeHunt x Distance + TypeHunt x Distance ² + Prot x Distance	7823.0	135.9	0.000	13
Distance + Distance ² + BM + Distance x BM + BM x Distance ² + TravTime + Guild + TypeHunt + Prot	8173.5	486.5	0.000	14
Distance + Distance ² + BM + Distance x BM + TravTime + Guild + TypeHunt + Prot	8180.8	493.8	0.000	13
Distance + Distance ² + BM + TravTime + Guild + TypeHunt + Prot x Distance + Prot x Distance ²	8465.9	778.9	0.000	14
Distance + Distance ² + BM + TravTime + Guild + TypeHunt + Prot x Distance	8606.6	919.6	0.000	13
Distance + Distance ² + BM + TravTime + Guild + TypeHunt x Distance + TypeHunt x Distance ² + Prot	8972.2	1285.2	0.000	14

Distance + Distance ² + BM + TravTime + TypeHunt + Prot	8979.3	1292.3	0.000	9
Distance + Distance ² + BM + TravTime + TravTime ² + Guild + TypeHunt + Prot	8985.6	1298.6	0.000	12
Distance + Distance ² + BM + TravTime + Guild + TypeHunt x Distance + Prot	8989.1	1302.1	0.000	13
Null	10779.64	3092.6	0.000	3

B) Mammals

Models	BIC	DeltaBIC	weights	k
Distance + Distance ² + BM + BM x Distance + BM x Distance ² + TravTime + TravTime ² + Guild + Guild x Distance + Guild x Distance ² + Guild x BM + Guild x Distance x BM + TypeHunt + TypeHunt x Distance + TypeHunt x Distance ² + Prot + Prot x Distance + Prot x Distance ²	87904.2	0.0	1.000	39
Distance + Distance ² + BM + BM x Distance + TravTime + TravTime ² + Guild + Guild x Distance + Guild x Distance ² + Guild x BM + Guild x Distance x BM + TypeHunt + Prot + Prot x Distance + Prot x Distance ²	88444.2	540.0	0.000	34
Distance + Distance ² + BM + BM x Distance + TravTime + TravTime ² + Guild + Guild x Distance + Guild x Distance ² + Guild x BM + Guild x Distance x BM + TypeHunt + Prot + Prot x Distance	88463.2	559.0	0.000	33
Distance + Distance ² + BM + BM x Distance + TravTime + TravTime ² + Guild + Guild x Distance + Guild x Distance ² + Guild x BM + Guild x Distance x BM + TypeHunt + TypeHunt x Distance + TypeHunt x Distance ² + Prot	89612.5	1708.3	0.000	36
Distance + Distance ² + BM + BM x Distance + TravTime + TravTime ² + Guild + Guild x Distance + Guild x Distance ² + Guild x BM + Guild x Distance x BM + TypeHunt + TypeHunt x Distance + Prot	89691.9	1787.7	0.000	34
Distance + Distance ² + BM + BM x Distance + TravTime + TravTime ² + Guild + Guild x Distance + Guild x Distance ² + Guild x BM + Guild x Distance x BM + TypeHunt + Prot	90218.5	2314.3	0.000	32
Distance + Distance ² + BM + BM x Distance + TravTime + TravTime ² + Guild + Guild x Distance + Guild x BM + Guild x Distance x BM + TypeHunt + Prot	90279.1	2374.9	0.000	28
Distance + Distance ² + BM + TravTime + TravTime ² + Guild + TypeHunt + Prot + Prot x Distance	91689.3	3785.1	0.000	16
Distance + Distance ² + BM + TravTime + TravTime ² + Guild + TypeHunt + Prot + Prot x Distance + Prot x Distance ²	91695.9	3791.7	0.000	17

Distance + Distance ² + BM + TravTime + TravTime ² + Guild + TypeHunt + TypeHunt x Distance + TypeHunt x Distance ² + Prot	92013.8	4109.6	0.000	19
Distance + Distance ² + BM + TravTime + TravTime ² + Guild + TypeHunt + TypeHunt x Distance + Prot	92094.6	4190.4	0.000	17
Distance + Distance ² + BM + Distance x BM + Distance ² x BM + TravTime + TravTime ² + Guild + TypeHunt + Prot	92477.9	4573.7	0.000	17
Distance + Distance ² + BM + Distance x BM + TravTime + TravTime ² + Guild + TypeHunt + Prot	92483.4	4579.2	0.000	16
Distance + Distance ² + BM + TravTime + TravTime ² + Guild + TypeHunt + Prot	92590.2	4686.0	0.000	15
Null	106903.6	18999.4	0.000	3

Table S7.

Standardized coefficients of retained terms in best meta-regression models for a) birds and b) mammals. Distance: Distance to hunters' access point, BM: Body mass, SC: Subsistence and Commercial (both), C: Commercial. McFadden's pseudo R^2 and omnibus tests are indicated for the model, and for each of the moderators. Main effects were tested after dropping interactions.

A) Birds

Fixed effect (moderators)	Estimate	SE	Z	LCI	UCI	P _{estimate}	Q _M (d.f.)	P _Q
Intercept	-0.61	0.58	-1.06	-1.74	0.52	0.2913		
Distance	3.91	0.20	19.49	3.52	4.31	<0.0001	1552.0 (2)	<0.0001
Distance ²	-2.42	0.19	-12.98	-2.78	-2.05	<0.0001		
BM	-0.14	0.16	-0.88	-0.47	0.18	0.3799	0.8 (1)	0.3799
TypeHunt (SC)	-1.63	0.97	-1.68	-3.53	0.27	0.092	2.8 (1)	0.0920
Protected (Yes)	-0.07	0.08	-0.79	-0.23	0.10	0.4271	0.6 (1)	0.4721
Distance x BM	-0.12	0.09	-1.40	-0.30	0.05	0.1608	690.8 (2)	<0.0001
Distance ² x BM	0.77	0.08	9.76	0.62	0.92	<0.0001		
Distance x TypeHunt (SC)	-4.53	0.42	-10.72	-5.36	-3.70	<0.0001	115.4 (2)	<0.0001
Distance ² x TypeHunt (SC)	3.38	0.32	10.68	2.76	3.99	<0.0001		
Distance x Prot (Yes)	-3.24	0.20	-16.09	-3.63	-2.84	<0.0001	465.5 (2)	<0.0001
Distance ² x Prot (Yes)	2.29	0.19	12.37	1.93	2.65	<0.0001		
McFadden's Pseudo $R^2 = 0.29$; $Q_{M,11} = 3157.5$ ($P < 0.0001$), $Q_{E, 372} = 16544.5$ ($P < 0.0001$)								

B) Mammals

Fixed effects (moderators)	Estimate	SE	Z	LCI	UCI	P_{estimate}	Q_M (d.f.)	P_Q
Intercept	-1.06	0.63	-1.69	-2.29	0.17	0.0901		
Distance	0.69	0.03	23.99	0.64	0.75	<0.0001	9123.7 (2)	<0.0001
Distance ²	-0.03	0.02	-1.42	-0.08	0.01	0.155		
BM	-0.13	0.56	-0.23	-1.23	0.98	0.8218	3.8 (1)	0.0522
TravTime	1.34	0.08	16.76	1.18	1.49	<0.0001	399.8 (2)	<0.0001
TravTime ²	-1.25	0.09	-13.68	-1.43	-1.07	<0.0001		
Guild (Carn)	-1.04	0.82	-1.28	-2.65	0.56	0.2019	8.4 (4)	0.0767
Guild (Herb)	0.38	0.67	0.57	-0.93	1.69	0.5699		
Guild (Invert)	-1.93	1.09	-1.77	-4.08	0.21	0.0769		
Guild (Omn)	-0.63	0.87	-0.73	-2.34	1.07	0.4658		
TypeHunt (C)	-1.98	0.57	-3.45	-3.10	-0.86	0.0006	27.1 (2)	<0.0001
TypeHunt (SC)	-1.72	0.39	-4.38	-2.50	-0.95	<0.0001		
Protected (Yes)	0.51	0.03	17.87	0.46	0.57	<0.0001	1004.3 (1)	<0.0001
Distance x BM	1.12	0.03	32.26	1.06	1.19	<0.0001	1352.4 (2)	<0.0001
Distance ² x BM	-0.21	0.02	-12.55	-0.25	-0.18	<0.0001		
Distance x Guild (Carn)	-1.23	0.15	-8.15	-1.52	-0.93	<0.0001	944.8 (8)	<0.0001
Distance x Guild (Herb)	-0.59	0.04	-15.14	-0.67	-0.51	<0.0001		
Distance x Guild (Inver)	0.66	0.28	2.35	0.11	1.21	0.0189		
Distance x Guild (Omn)	-1.17	0.05	-21.51	-1.28	-1.06	<0.0001		
Distance ² x Guild (Carn)	0.81	0.11	7.10	0.59	1.04	<0.0001		
Distance ² x Guild (Herb)	0.17	0.03	5.32	0.11	0.23	<0.0001		
Distance ² x Guild (Inver)	-0.51	0.21	-2.38	-0.93	-0.09	0.0174		
Distance ² x Guild (Omn)	0.26	0.03	7.55	0.19	0.33	<0.0001		
BM x Guild (Carn)	-0.75	1.03	-0.72	-2.78	1.28	0.4696	58.9 (4)	<0.0001
BM x Guild (Herb)	-0.58	0.55	-1.05	-1.66	0.51	0.2953		
BM x Guild (Inver)	-1.39	1.18	-1.18	-3.71	0.93	0.2392		
BM x Guild (Omn)	-0.72	0.79	-0.91	-2.26	0.82	0.3604		

Distance x TypeHunt (C)	-0.29	0.05	-5.22	-0.39	-0.18	<0.0001	566.1	<0.0001
Distance x TypeHunt (SC)	-0.28	0.04	-6.43	-0.37	-0.19	<0.0001		
Distance ² x TypeHunt (C)	0.84	0.05	16.88	0.75	0.94	<0.0001		
Distance ² x TypeHunt (SC)	0.38	0.04	9.58	0.31	0.46	<0.0001		
Distance x Prot (Yes)	0.85	0.04	21.65	0.78	0.93	<0.0001	493.7	<0.0001
Distance ² x Prot (Yes)	-0.18	0.03	-5.70	-0.24	-0.12	<0.0001		
Distance x BM x Guild (Carn)	1.02	0.11	9.51	0.81	1.23	<0.0001	1325.7	<0.0001
Distance x BM x Guild (Herb)	-0.96	0.03	-30.36	-1.02	-0.90	<0.0001		
Distance x BM x Guild (Inver)	0.87	0.24	3.62	0.40	1.34	0.0003		
Distance x BM x Guild (Omn)	-0.79	0.04	-19.49	-0.87	-0.71	<0.0001		
McFadden's Pseudo $R^2 = 0.18$, $Q_{M,36} = 19208.0$ ($P < 0.0001$), $Q_{E, 1391} = 237350.6$ ($P < 0.0001$)								

References and Notes

1. G. Ceballos, P. R. Ehrlich, A. D. Barnosky, A. García, R. M. Pringle, T. M. Palmer, Accelerated modern human-induced species losses: Entering the sixth mass extinction. *Sci. Adv.* **1**, e1400253 (2015). doi:10.1126/sciadv.1400253 [Medline](#)
2. L. Gibson, T. M. Lee, L. P. Koh, B. W. Brook, T. A. Gardner, J. Barlow, C. A. Peres, C. J. A. Bradshaw, W. F. Laurance, T. E. Lovejoy, N. S. Sodhi, Primary forests are irreplaceable for sustaining tropical biodiversity. *Nature* **478**, 378–381 (2011). doi:10.1038/nature10425 [Medline](#)
3. W. F. Laurance, A. Peletier-Jellema, B. Geenen, H. Koster, P. Verweij, P. Van Dijck, T. E. Lovejoy, J. Schleicher, M. Van Kuijk, Reducing the global environmental impacts of rapid infrastructure expansion. *Curr. Biol.* **25**, R259–R262 (2015). doi:10.1016/j.cub.2015.02.050 [Medline](#)
4. W. F. Laurance, A. Balmford, Land use: A global map for road building. *Nature* **495**, 308–309 (2013). doi:10.1038/495308a [Medline](#)
5. C. A. Peres, I. R. Lake, Extent of nontimber resource extraction in tropical forests: Accessibility to game vertebrates by hunters in the Amazon basin. *Conserv. Biol.* **17**, 521–535 (2003). doi:10.1046/j.1523-1739.2003.01413.x
6. K. H. Redford, The empty forest. *Bioscience* **42**, 412–422 (1992). doi:10.2307/1311860
7. E. J. Milner-Gulland, E. L. Bennett, Wild meat: The bigger picture. *Trends Ecol. Evol.* **18**, 351–357 (2003). doi:10.1016/S0169-5347(03)00123-X
8. R. D. Harrison, Emptying the forest: Hunting and the extirpation of wildlife from tropical nature reserves. *Bioscience* **61**, 919–924 (2011). doi:10.1525/bio.2011.61.11.11
9. R. Dirzo, H. S. Young, M. Galetti, G. Ceballos, N. J. B. Isaac, B. Collen, Defaunation in the Anthropocene. *Science* **345**, 401–406 (2014). doi:10.1126/science.1251817 [Medline](#)
10. K. A. Abernethy, L. Coad, G. Taylor, M. E. Lee, F. Maisels, Extent and ecological consequences of hunting in Central African rainforests in the twenty-first century. *Philos. Trans. R. Soc. London B Biol. Sci.* **368**, 20120303 (2013). doi:10.1098/rstb.2012.0303 [Medline](#)
11. Materials and methods are available as supplementary materials.
12. L. V. Hedges, J. Gurevitch, P. S. Curtis, The meta-analysis of response ratios in experimental ecology. *Ecology* **80**, 1150–1156 (1999). doi:10.1890/0012-9658(1999)080[1150:TMAORR]2.0.CO;2
13. A. Nelson, Travel time to major cities: A global map of accessibility (Global Environment Monitoring Unit—Joint Research Centre of the European Commission, Ispra, Italy, 2008).
14. S. J. Wright, The myriad consequences of hunting for vertebrates and plants in tropical forests. *Perspect. Plant Ecol. Evol. Syst.* **6**, 73–86 (2003). doi:10.1078/1433-8319-00043
15. W. J. Ripple, K. Abernethy, M. G. Betts, G. Chapron, R. Dirzo, M. Galetti, T. Levi, P. A. Lindsey, D. W. Macdonald, B. Machovina, T. M. Newsome, C. A. Peres, A. D. Wallach,

- C. Wolf, H. Young, Bushmeat hunting and extinction risk to the world's mammals. *R. Soc. Open Sci.* **3**, 160498 (2016). doi:10.1098/rsos.160498 [Medline](#)
16. W. J. Ripple, J. A. Estes, R. L. Beschta, C. C. Wilmers, E. G. Ritchie, M. Hebblewhite, J. Berger, B. Elmhagen, M. Letnic, M. P. Nelson, O. J. Schmitz, D. W. Smith, A. D. Wallach, A. J. Wirsing, Status and ecological effects of the world's largest carnivores. *Science* **343**, 1241484 (2014). doi:10.1126/science.1241484 [Medline](#)
 17. J. G. Robinson, E. L. Bennett, *Hunting for Sustainability in Tropical Forests* (Columbia Univ. Press, New York, 2000).
 18. W. F. Laurance, S. Sloan, L. Weng, J. A. Sayer, Estimating the Environmental Costs of Africa's Massive "Development Corridors". *Curr. Biol.* **25**, 3202–3208 (2015). doi:10.1016/j.cub.2015.10.046 [Medline](#)
 19. G. R. Clements, A. J. Lynam, D. Gaveau, W. L. Yap, S. Lhota, M. Goosem, S. Laurance, W. F. Laurance, Where and how are roads endangering mammals in Southeast Asia's forests? *PLOS ONE* **9**, e115376 (2014). doi:10.1371/journal.pone.0115376 [Medline](#)
 20. W. F. Laurance, D. C. Useche, J. Rendeiro, M. Kalka, C. J. A. Bradshaw, S. P. Sloan, S. G. Laurance, M. Campbell, K. Abernethy, P. Alvarez, V. Arroyo-Rodriguez, P. Ashton, J. Benítez-Malvido, A. Blom, K. S. Bobo, C. H. Cannon, M. Cao, R. Carroll, C. Chapman, R. Coates, M. Cords, F. Danielsen, B. De Dijn, E. Dinerstein, M. A. Donnelly, D. Edwards, F. Edwards, N. Farwig, P. Fashing, P.-M. Forget, M. Foster, G. Gale, D. Harris, R. Harrison, J. Hart, S. Karpanty, W. J. Kress, J. Krishnaswamy, W. Logsdon, J. Lovett, W. Magnusson, F. Maisels, A. R. Marshall, D. McClearn, D. Mudappa, M. R. Nielsen, R. Pearson, N. Pitman, J. van der Ploeg, A. Plumptre, J. Poulsen, M. Quesada, H. Rainey, D. Robinson, C. Roetgers, F. Rovero, F. Scatena, C. Schulze, D. Sheil, T. Struhsaker, J. Terborgh, D. Thomas, R. Timm, J. N. Urbina-Cardona, K. Vasudevan, S. J. Wright, J. C. Arias-G, L. Arroyo, M. Ashton, P. Auzel, D. Babaasa, F. Babweteera, P. Baker, O. Banki, M. Bass, I. Bila-Isia, S. Blake, W. Brockelman, N. Brokaw, C. A. Brühl, S. Bunyavejchewin, J.-T. Chao, J. Chave, R. Chellam, C. J. Clark, J. Clavijo, R. Congdon, R. Corlett, H. S. Dattaraja, C. Dave, G. Davies, Bde. M. Beisiegel, Rde. N. da Silva, A. Di Fiore, A. Diesmos, R. Dirzo, D. Doran-Sheehy, M. Eaton, L. Emmons, A. Estrada, C. Ewango, L. Fedigan, F. Feer, B. Fruth, J. G. Willis, U. Goodale, S. Goodman, J. C. Guix, P. Guthiga, W. Haber, K. Hamer, I. Herbinger, J. Hill, Z. Huang, I. F. Sun, K. Ickes, A. Itoh, N. Ivanauskas, B. Jackes, J. Janovec, D. Janzen, M. Jiangming, C. Jin, T. Jones, H. Justiniano, E. Kalko, A. Kasangaki, T. Killeen, H. B. King, E. Klop, C. Knott, I. Koné, E. Kudavidanage, J. L. Ribeiro, J. Lattke, R. Laval, R. Lawton, M. Leal, M. Leighton, M. Lentino, C. Leonel, J. Lindsell, L. Ling-Ling, K. E. Linsenmair, E. Losos, A. Lugo, J. Lwanga, A. L. Mack, M. Martins, W. S. McGraw, R. McNab, L. Montag, J. M. Thompson, J. Nabe-Nielsen, M. Nakagawa, S. Nepal, M. Norconk, V. Novotny, S. O'Donnell, M. Opiang, P. Ouboter, K. Parker, N. Parthasarathy, K. Pisciotto, D. Prawiradilaga, C. Pringle, S. Rajathurai, U. Reichard, G. Reinartz, K. Renton, G. Reynolds, V. Reynolds, E. Riley, M.-O. Rödel, J. Rothman, P. Round, S. Sakai, T. Sanaiotti, T. Savini, G. Schaab, J. Seidensticker, A. Siaka, M. R. Silman, T. B. Smith, S. S. de Almeida, N. Sodhi, C. Stanford, K. Stewart, E. Stokes, K. E. Stoner, R. Sukumar, M. Surbeck, M. Tobler, T. Tschardt, A. Turkalo, G. Umapathy, M. van Weerd, J. V. Rivera, M. Venkataraman, L. Venn, C. Vereza, C. V. de Castilho, M. Waltert, B. Wang,

- D. Watts, W. Weber, P. West, D. Whitacre, K. Whitney, D. Wilkie, S. Williams, D. D. Wright, P. Wright, L. Xiankai, P. Yonzon, F. Zamzani, Averting biodiversity collapse in tropical forest protected areas. *Nature* **489**, 290–294 (2012). [doi:10.1038/nature11318](https://doi.org/10.1038/nature11318) [Medline](#)
21. A. Benítez-López, R. Alkemade, P. A. Verweij, The impacts of roads and other infrastructure on mammal and bird populations: A meta-analysis. *Biol. Conserv.* **143**, 1307–1316 (2010). [doi:10.1016/j.biocon.2010.02.009](https://doi.org/10.1016/j.biocon.2010.02.009)
 22. S. L. Maxwell, R. A. Fuller, T. M. Brooks, J. E. Watson, Biodiversity: The ravages of guns, nets and bulldozers. *Nature* **536**, 143–145 (2016). [doi:10.1038/536143a](https://doi.org/10.1038/536143a) [Medline](#)
 23. C. Sandom, S. Faurby, B. Sandel, J.-C. Svenning, Global late Quaternary megafauna extinctions linked to humans, not climate change. *Proc. Biol. Sci.* **281**, 20133254 (2014). [doi:10.1098/rspb.2013.3254](https://doi.org/10.1098/rspb.2013.3254) [Medline](#)
 24. C. A. Peres, J. Barlow, W. F. Laurance, Detecting anthropogenic disturbance in tropical forests. *Trends Ecol. Evol.* **21**, 227–229 (2006). [doi:10.1016/j.tree.2006.03.007](https://doi.org/10.1016/j.tree.2006.03.007) [Medline](#)
 25. C. A. Peres, T. Emilio, J. Schiatti, S. J. Desmoulière, T. Levi, Dispersal limitation induces long-term biomass collapse in overhunted Amazonian forests. *Proc. Natl. Acad. Sci. U.S.A.* **113**, 892–897 (2016). [doi:10.1073/pnas.1516525113](https://doi.org/10.1073/pnas.1516525113) [Medline](#)
 26. J. Dulac, “Global land transport infrastructure requirements: Estimating road and railway infrastructure capacity and costs to 2050” (International Energy Agency, Paris, 2013).
 27. V. A. Barrera Zambrano, J. Zambrano Moncada, P. R. Stevenson, Diversity of regenerating plants and seed dispersal in two canopy trees from Colombian Amazon forests with different hunting pressure. *Rev. Biol. Trop.* **56**, 1531–1542 (2008). [Medline](#)
 28. H. Wilman, J. Belmaker, J. Simpson, C. de la Rosa, M. M. Rivadeneira, W. Jetz, EltonTraits 1.0: Species-level foraging attributes of the world’s birds and mammals. *Ecology* **95**, 2027 (2014). [doi:10.1890/13-1917.1](https://doi.org/10.1890/13-1917.1)
 29. Center for International Earth Science Information Network - CIESIN - Columbia University, International Food Policy Research Institute - IFPRI, The World Bank, Centro Internacional de Agricultura Tropical - CIAT, "Global Rural-Urban Mapping Project (GRUMP), version 1 : Population Density Grid [NASA Socioeconomic Data and Applications Center (SEDAC), Palisades, NY, 2011]; <http://dx.doi.org/10.7927/H4R20Z93>.
 30. IUCN, UNEP-WCMC, The World Database on Protected Areas (WDPA) (UNEP-WCMC, Cambridge, 2016); <https://www.iucn.org/theme/protected-areas/our-work/world-database-protected-areas>.
 31. Environmental Systems Research Institute, ArcGIS Desktop, Release 10.2 (ESRI, Redlands, CA, 2011).
 32. S. Blake, S. Strindberg, P. Boudjan, C. Makombo, I. Bila-Isia, O. Ilambu, F. Grossmann, L. Bene-Bene, B. de Semboli, V. Mbenzo, D. S’hwa, R. Bayogo, L. Williamson, M. Fay, J. Hart, F. Maisels, Forest elephant crisis in the Congo Basin. *PLOS Biol.* **5**, e111 (2007). [doi:10.1371/journal.pbio.0050111](https://doi.org/10.1371/journal.pbio.0050111) [Medline](#)

33. A. E. Bowkett, F. Rovero, A. R. Marshall, The use of camera-trap data to model habitat use by antelope species in the Udzungwa Mountain forests, Tanzania. *Afr. J. Ecol.* **46**, 479–487 (2008). doi:10.1111/j.1365-2028.2007.00881.x
34. J. Demmer, R. Godoy, D. Wilkie, H. Overman, M. Taimur, K. Fernando, R. Gupta, K. McSweeney, N. Brokaw, S. Sriram, T. Price, Do levels of income explain differences in game abundance? An empirical test in two Honduran villages. *Biodivers. Conserv.* **11**, 1845–1868 (2002). doi:10.1023/A:1020305903156
35. T. N. E. Gray, C. Phan, Habitat preferences and activity patterns of the larger mammal community in Phnom Prich Wildlife Sanctuary, Cambodia. *Raffles Bull. Zool.* **59**, 311–318 (2011).
36. H. S. Kuehl, C. Nzeingui, S. L. D. Yeno, B. Huijbregts, C. Boesch, P. D. Walsh, Discriminating between village and commercial hunting of apes. *Biol. Conserv.* **142**, 1500–1506 (2009). doi:10.1016/j.biocon.2009.02.032
37. E. J. Stokes, S. Strindberg, P. C. Bakabana, P. W. Elkan, F. C. Iyenguet, B. Madzoké, G. A. F. Malanda, B. S. Mowawa, C. Moukoubou, F. K. Ouakabadio, H. J. Rainey, Monitoring great ape and elephant abundance at large spatial scales: Measuring effectiveness of a conservation landscape. *PLOS ONE* **5**, e10294 (2010). doi:10.1371/journal.pone.0010294 [Medline](#)
38. M. J. Lajeunesse, On the meta-analysis of response ratios for studies with correlated and multi-group designs. *Ecology* **92**, 2049–2055 (2011). doi:10.1890/11-0423.1 [Medline](#)
39. R. Alkemade, R. S. Reid, M. van den Berg, J. de Leeuw, M. Jeuken, Assessing the impacts of livestock production on biodiversity in rangeland ecosystems. *Proc. Natl. Acad. Sci. U.S.A.* **110**, 20900–20905 (2013). doi:10.1073/pnas.1011013108 [Medline](#)
40. E. J. Milner-Gulland, in *Hunting and Bushmeat Utilization in the African Rain Forest: Perspectives Toward a Blueprint for Conservation Action*, M. I. Bakarr, G. A. B. d. Fonseca, R. Mittermeier, A. B. Rylands, K. W. Painemilla, Eds. (Center for Applied Biodiversity Science, Washington, DC, 2001), chap. 10.
41. M. Smithson, J. Verkuilen, A better lemon squeezer? Maximum-likelihood regression with beta-distributed dependent variables. *Psychol. Methods* **11**, 54–71 (2006). doi:10.1037/1082-989X.11.1.54 [Medline](#)
42. R. R. Sokal, F. J. Rohlf, *Biometry: The Principles and Practice of Statistics in Biological Research* (Freeman, San Francisco, ed. 2, 1981).
43. M. J. Sweeting, A. J. Sutton, P. C. Lambert, What to add to nothing? Use and avoidance of continuity corrections in meta-analysis of sparse data. *Stat. Med.* **23**, 1351–1375 (2004). doi:10.1002/sim.1761 [Medline](#)
44. D. R. Cox, E. J. Snell, *Analysis of Binary Data* (Methuen, London, 1970).
45. M. B. Bracken, in *Effective Care of the Newborn Infant*, J. C. Sinclair, M. B. Bracken, Eds. (Oxford Univ. Press, Oxford, 1992), pp. 13–20.
46. D. B. Rubin, N. Schenker, Multiple imputation in health-care databases: An overview and some applications. *Stat. Med.* **10**, 585–598 (1991). doi:10.1002/sim.4780100410 [Medline](#)

47. M. J. Lajeunesse, Facilitating systematic reviews, data extraction and meta-analysis with the METAGEAR package for R. *Methods Ecol. Evol.* **7**, 323–330 (2016). [doi:10.1111/2041-210X.12472](https://doi.org/10.1111/2041-210X.12472)
48. W. Viechtbauer, Conducting meta-analyses in R with the metafor package. *J. Stat. Softw.* **36**, 1–48 (2010). [doi:10.18637/jss.v036.i03](https://doi.org/10.18637/jss.v036.i03)
49. F. A. Smith, J. H. Brown, J. P. Haskell, S. K. Lyons, J. Alroy, E. L. Charnov, T. Dayan, B. J. Enquist, S. K. Ernest, E. A. Hadly, K. E. Jones, D. M. Kaufman, P. A. Marquet, B. A. Maurer, K. J. Niklas, W. P. Porter, B. Tiffney, M. R. Willig, Similarity of mammalian body size across the taxonomic hierarchy and across space and time. *Am. Nat.* **163**, 672–691 (2004). [doi:10.1086/382898](https://doi.org/10.1086/382898) [Medline](#)
50. F. A. Smith, S. K. Lyons, How big should a mammal be? A macroecological look at mammalian body size over space and time. *Philos. Trans. R. Soc. London B Biol. Sci.* **366**, 2364–2378 (2011). [doi:10.1098/rstb.2011.0067](https://doi.org/10.1098/rstb.2011.0067) [Medline](#)
51. B. J. McGill, Exploring predictions of abundance from body mass using hierarchical comparative approaches. *Am. Nat.* **172**, 88–101 (2008). [doi:10.1086/588044](https://doi.org/10.1086/588044) [Medline](#)
52. P. H. Harvey, M. D. Pagel, *The Comparative Method in Evolutionary Biology* (Oxford Univ. Press, Oxford, 1991).
53. K. P. Burnham, D. R. Anderson, *Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach* (Springer Science & Business Media, 2003).
54. S. Nakagawa, E. S. A. Santos, Methodological issues and advances in biological meta-analysis. *Evol. Ecol.* **26**, 1253–1274 (2012). [doi:10.1007/s10682-012-9555-5](https://doi.org/10.1007/s10682-012-9555-5)
55. R Core Team, *R: A Language and Environment for Statistical Computing* (R Foundation for Statistical Computing, Vienna, 2015).
56. M. Egger, G. Davey Smith, M. Schneider, C. Minder, Bias in meta-analysis detected by a simple, graphical test. *BMJ* **315**, 629–634 (1997). [doi:10.1136/bmj.315.7109.629](https://doi.org/10.1136/bmj.315.7109.629) [Medline](#)
57. M. S. Rosenberg, The file-drawer problem revisited: A general weighted method for calculating fail-safe numbers in meta-analysis. *Evolution* **59**, 464–468 (2005). [doi:10.1111/j.0014-3820.2005.tb01004.x](https://doi.org/10.1111/j.0014-3820.2005.tb01004.x) [Medline](#)
58. M. J. Lajeunesse, Bias and correction for the log response ratio in ecological meta-analysis. *Ecology* **96**, 2056–2063 (2015). [doi:10.1890/14-2402.1](https://doi.org/10.1890/14-2402.1) [Medline](#)
59. M. Altrichter, The sustainability of subsistence hunting of peccaries in the Argentine Chaco. *Biol. Conserv.* **126**, 351–362 (2005). [doi:10.1016/j.biocon.2005.06.024](https://doi.org/10.1016/j.biocon.2005.06.024)
60. R. Aquino, L. López, I. Arévalo, G. García, E. Charpentier, Densidad de ungulados en bosques de baja y alta presión de caza en el nororiente de la Amazonía peruana. *Cienc. Amazónica (Iquitos)* **4**, 128–137 (2014). [doi:10.22386/ca.v4i2.78](https://doi.org/10.22386/ca.v4i2.78)
61. A. Atickem, L. E. Loe, Ø. Langangen, E. K. Rueness, A. Bekele, N. C. Stenseth, Estimating population size and habitat suitability for mountain nyala in areas with different protection status. *Anim. Conserv.* **14**, 409–418 (2011). [doi:10.1111/j.1469-1795.2011.00437.x](https://doi.org/10.1111/j.1469-1795.2011.00437.x)

62. R. F. W. Barnes, K. L. Barnes, M. P. T. Alers, A. Blom, Man determines the distribution of elephants in the rain forests of northeastern Gabon. *Afr. J. Ecol.* **29**, 54–63 (1991). [doi:10.1111/j.1365-2028.1991.tb00820.x](https://doi.org/10.1111/j.1365-2028.1991.tb00820.x)
63. E. H. Baur, “Estudio de la cacería de subsistencia en la Concesión Forestal de Carmelita, San Andrés, Petén” (ProPetén/Conservation International, Flores Péten, Peten, Guatemala, 1999).
64. A. J. Begazo, R. E. Bodmer, Use and conservation of Cracidae (Aves: Galliformes) in the Peruvian Amazon. *Oryx* **32**, 301–309 (1998). [doi:10.1017/S0030605300030106](https://doi.org/10.1017/S0030605300030106)
65. A. J. Begazo, thesis, University of Florida, Gainesville, FL (1999).
66. J. Blake, D. Mosquera, J. Salvador, Use of mineral licks by mammals and birds in hunted and non-hunted areas of Yasuní National Park, Ecuador. *Anim. Conserv.* **16**, 430–437 (2013). [doi:10.1111/acv.12012](https://doi.org/10.1111/acv.12012)
67. A. Blom, R. Van Zalinge, E. Mbea, I. Heitkönig, H. H. Prins, Human impact on wildlife populations within a protected Central African forest. *Afr. J. Ecol.* **42**, 23–31 (2004). [doi:10.1111/j.0141-6707.2004.00441.x](https://doi.org/10.1111/j.0141-6707.2004.00441.x)
68. A. Blom, R. van Zalinge, I. M. A. Heitkonig, H. H. T. Prins, Factors influencing the distribution of large mammals within a protected central African forest. *Oryx* **39**, 381–388 (2005). [doi:10.1017/S0030605305001080](https://doi.org/10.1017/S0030605305001080)
69. N. W. Brickley, Habitat use, predicted distribution and conservation of green peafowl (*Pavo muticus*) in Dak Lak Province, Vietnam. *Biol. Conserv.* **105**, 189–197 (2002). [doi:10.1016/S0006-3207\(01\)00182-3](https://doi.org/10.1016/S0006-3207(01)00182-3)
70. Y. Cabassu, thesis, Carleton University, Ottawa, Ontario, Canada (2010).
71. E. Carrillo, G. Wong, A. D. Cuarón, Monitoring mammal populations in Costa Rican protected areas under different hunting restrictions. *Conserv. Biol.* **14**, 1580–1591 (2000). [doi:10.1046/j.1523-1739.2000.99103.x](https://doi.org/10.1046/j.1523-1739.2000.99103.x)
72. A. G. Chiarello, Effects of fragmentation of the Atlantic forest on mammal communities in south-eastern Brazil. *Biol. Conserv.* **89**, 71–82 (1999). [doi:10.1016/S0006-3207\(98\)00130-X](https://doi.org/10.1016/S0006-3207(98)00130-X)
73. D. T. Cronin, thesis, Drexel University, Philadelphia, PA (2013).
74. L. Cullen Jr., R. E. Bodmer, C. Valladares-Pádua, Effects of hunting in habitat fragments of the Atlantic forests, Brazil. *Biol. Conserv.* **95**, 49–56 (2000). [doi:10.1016/S0006-3207\(00\)00011-2](https://doi.org/10.1016/S0006-3207(00)00011-2)
75. L. Cullen, E. Bodmer, C. Valladares-Pádua, Ecological consequences of hunting in Atlantic forest patches, São Paulo, Brazil. *Oryx* **35**, 137–144 (2001).
76. E. K. D. Seijusa, A. Pradesh, Differential effects of hunting on populations of hornbills and imperial pigeons in the rainforests of the Eastern Indian Himalaya. *Indian For.* **138**, 902–909 (2012).
77. A. Davies, B. Schulte-Herbrüggen, N. F. Kümpel, S. Mendelson, Hunting and trapping in Gola Forests, south-eastern Sierra Leone: Bushmeat from farm, fallow and forest.in

- Bushmeat and Livelihoods: Wildlife Management and Poverty Reduction* (Blackwell, Oxford, 2007), pp. 15–29.
78. É. R. A. Melo, J. R. Gadelha, M. N. D. da Silva, A. P. da Silva Jr., A. R. M. Pontes, Diversity, abundance and the impact of hunting on large mammals in two contrasting forest sites in northern amazon. *Wildl. Biol.* **21**, 234–245 (2015). [doi:10.2981/wlb.00095](https://doi.org/10.2981/wlb.00095)
 79. A. M. Derby, thesis, Stony Brook University, Stony Brook, NY (2008).
 80. M. Dethier, “Étude chasse” (ECOFAC, Yaounde, Cameroon, 1995).
 81. D. A. Doherty, thesis, University of California Davis, Davis, CA (2005).
 82. E. O. Effiom, G. Nuñez-Iturri, H. G. Smith, U. Ottosson, O. Olsson, Bushmeat hunting changes regeneration of African rainforests. *Proc. Biol. Sci.* **280**, 20130246 (2013). [doi:10.1098/rspb.2013.0246](https://doi.org/10.1098/rspb.2013.0246) [Medline](#)
 83. E. O. Effiom, K. Birkhofer, H. G. Smith, O. Olsson, Changes of community composition at multiple trophic levels due to hunting in Nigerian tropical forests. *Ecography* **37**, 367–377 (2014). [doi:10.1111/j.1600-0587.2013.00359.x](https://doi.org/10.1111/j.1600-0587.2013.00359.x)
 84. L. H. Emmons, Geographic variation in densities and diversities of non-flying mammals in Amazonia. *Biotropica* **16**, 210–222 (1984). [doi:10.2307/2388054](https://doi.org/10.2307/2388054)
 85. W. Endo, C. A. Peres, E. Salas, S. Mori, J.-L. Sanchez-Vega, G. H. Shepard, V. Pacheco, D. W. Yu, Game vertebrate densities in hunted and nonhunted forest sites in Manu National Park, Peru. *Biotropica* **42**, 251–261 (2010). [doi:10.1111/j.1744-7429.2009.00546.x](https://doi.org/10.1111/j.1744-7429.2009.00546.x)
 86. S. R. Espinosa-Andrade, thesis, University of Florida, Gainesville, FL (2012).
 87. H. E. Eves, thesis, Yale University, New Haven, CT (2006).
 88. J. M. Fay, M. Agnagna, A population survey of forest elephants (*Loxodonta africana cyclotis*) in Northern Congo. *Afr. J. Ecol.* **29**, 177–187 (1991). [doi:10.1111/j.1365-2028.1991.tb01000.x](https://doi.org/10.1111/j.1365-2028.1991.tb01000.x)
 89. J. M. Fay, An elephant (*Loxodonta africana*) survey using dung counts in the forests of the Central African Republic. *J. Trop. Ecol.* **7**, 25–36 (1991). [doi:10.1017/S0266467400005022](https://doi.org/10.1017/S0266467400005022)
 90. C. Fimbel, B. Curran, L. Usongo, in *Hunting for Sustainability in Tropical Forests*, J. G. Robinson, E. L. Bennett, Eds. (Columbia Univ. Press, New York, 2000), pp. 356–374.
 91. J. M. Fragoso, in *Neotropical Wildlife Use and Conservation*, J. G. Robinson, K. H. Redford, Eds. (Chicago Univ. Press, Chicago, IL, 1991), pp. 154–162.
 92. W. E. Glanz, in *Neotropical Wildlife Use and Conservation*, J. G. Robinson, K. H. Redford, Eds. (Chicago Univ. Press, Chicago, IL, 1991), pp. 163–173.
 93. J. S. Hall, B.-I. Inogwabini, E. Williamson, I. Omari, C. Sikubwabo, L. White, A survey of elephants (*Loxodonta africana*) in the Kahuzi-Biega National Park lowland sector and adjacent forest in eastern Zaire. *Afr. J. Ecol.* **35**, 213–223 (1997). [doi:10.1111/j.1365-2028.1997.088-89088.x](https://doi.org/10.1111/j.1365-2028.1997.088-89088.x)
 94. J. S. Hall, L. J. T. White, B.-I. Inogwabini, I. Omari, H. S. Morland, E. A. Williamson, K. Saltonstall, P. Walsh, C. Sikubwabo, D. Bonny, K. P. Kiswele, A. Vedder, K. Freeman,

- Survey of Grauer's gorillas (*Gorilla gorilla graueri*) and eastern chimpanzees (*Pan troglodytes schweinfurthi*) in the Kahuzi-Biega National Park lowland sector and adjacent forest in eastern Democratic Republic of Congo. *Int. J. Primatol.* **19**, 207–235 (1998). doi:10.1023/A:1020375430965
95. J. Hart, in *Hunting for Sustainability in Tropical Forests*, J. G. Robinson, E. L. Bennett, Eds. (Columbia Univ. Press, New York, 2000), pp. 106–153.
 96. M. W. Hayward, Bushmeat hunting in Dwesa and Cwebe Nature Reserves, Eastern Cape, South Africa. *S. Afr. J. Wildl. Res* **39**, 70–84 (2009). doi:10.3957/056.039.0108
 97. C. Hegerl, N. D. Burgess, M. R. Nielsen, E. Martin, M. Ciolli, F. Rovero, Using camera trap data to assess the impact of bushmeat hunting on forest mammals in Tanzania. *Oryx* **51**, 87–97 (2015). doi:10.1017/S0030605315000836
 98. E. M. Hema, R. F. W. Barnes, W. Guenda, Distribution of savannah elephants (*Loxodonta africana africana* Blumenbach 1797) within Nazinga game ranch, Southern Burkina Faso. *Afr. J. Ecol.* **49**, 141–149 (2011). doi:10.1111/j.1365-2028.2010.01239.x
 99. P. Henschel, L. T. B. Hunter, L. Coad, K. A. Abernethy, M. Muehlenberg, Leopard prey choice in the Congo Basin rainforest suggests exploitative competition with human bushmeat hunters. *J. Zool. (London)* **285**, 11–20 (2011).
 100. P. Henschel, thesis, University of Göttingen, Göttingen, Germany (2008).
 101. K. Hill, J. Padwe, C. Bejyvagi, A. Bepurangi, F. Jakugi, R. Tykuarangi, T. Tykuarangi, Impact of hunting on large vertebrates in the Mbaracayu Reserve, Paraguay. *Conserv. Biol.* **11**, 1339–1353 (1997). doi:10.1046/j.1523-1739.1997.96048.x
 102. J. L. Hurtado-Gonzales, R. E. Bodmer, Assessing the sustainability of brocket deer hunting in the Tamshiyacu-Tahuayo Communal Reserve, northeastern Peru. *Biol. Conserv.* **116**, 1–7 (2004). doi:10.1016/S0006-3207(03)00167-8
 103. T. Kano, R. Asato, Hunting pressure on chimpanzees and gorillas in the Motaba River Area, Northeastern Congo. *Afr. Study Monogr.* **15**, 143–162 (1994).
 104. S. E. Koerner, J. R. Poulsen, E. J. Blanchard, J. Okouyi, C. J. Clark, Vertebrate community composition and diversity declines along a defaunation gradient radiating from rural villages in Gabon. *J. Appl. Ecol.* 10.1111/1365-2664.12798 (2016). doi:10.1111/1365-2664.12798
 105. A. J. Kosydar, D. I. Rumiz, L. L. Conquest, J. J. Tewksbury, Effects of hunting and fragmentation on terrestrial mammals in the Chiquitano forests of Bolivia. *Trop. Conserv. Sci.* **7**, 288–307 (2014). doi:10.1177/194008291400700209
 106. N. F. Kümpel, E. J. Milner-Gulland, J. M. Rowcliffe, G. Cowlshaw, Impact of gun-hunting on diurnal primates in continental Equatorial Guinea. *Int. J. Primatol.* **29**, 1065–1082 (2008). doi:10.1007/s10764-008-9254-9
 107. C. Kun-Rodrigues, J. Salmons, A. Besolo, E. Rasolondraibe, C. Rabarivola, T. A. Marques, L. Chikhi, New density estimates of a threatened sifaka species (*Propithecus coquereli*) in Ankarafantsika National Park. *Am. J. Primatol.* **76**, 515–528 (2014). doi:10.1002/ajp.22243 [Medline](#)

108. S. A. Lahm, thesis, New York University, New York (1993).
109. S. Lahm, R. Barnes, K. Beardsley, P. Cervinka, A method for censusing the greater white-nosed monkey in northeastern Gabon using the population density gradient in relation to roads. *J. Trop. Ecol.* **14**, 629–643 (1998). [doi:10.1017/S0266467498000443](https://doi.org/10.1017/S0266467498000443)
110. W. E. Laurance, B. M. Croes, L. Tchignoumba, S. A. Lahm, A. Alonso, M. E. Lee, P. Campbell, C. Ondzeano, Impacts of roads and hunting on central African rainforest mammals. *Conserv. Biol.* **20**, 1251–1261 (2006). [doi:10.1111/j.1523-1739.2006.00420.x](https://doi.org/10.1111/j.1523-1739.2006.00420.x)
[Medline](#)
111. L. Lin, L. Feng, W. Pan, X. Guo, J. Zhao, A. Luo, L. Zhang, Habitat selection and the change in distribution of Asian elephants in Mengyang Protected Area, Yunnan, China. *Acta Theriol. (Warsaw)* **53**, 365–374 (2008). [doi:10.1007/BF03195197](https://doi.org/10.1007/BF03195197)
112. J. M. Linder, J. F. Oates, Differential impact of bushmeat hunting on monkey species and implications for primate conservation in Korup National Park, Cameroon. *Biol. Conserv.* **144**, 738–745 (2011). [doi:10.1016/j.biocon.2010.10.023](https://doi.org/10.1016/j.biocon.2010.10.023)
113. J. M. Linder, thesis, City University of New York, New York, NY (2008).
114. J. S. Lwanga, The influence of forest variation and possible effects of poaching on duiker abundance at Ngogo, Kibale National Park, Uganda. *Afr. J. Ecol.* **44**, 209–218 (2006). [doi:10.1111/j.1365-2028.2006.00629.x](https://doi.org/10.1111/j.1365-2028.2006.00629.x)
115. F. J. Magige, T. Holmern, S. Stokke, C. Mlingwa, E. Roskaft, Does illegal hunting affect density and behaviour of African grassland birds? A case study on ostrich (*Struthio camelus*). *Biodivers. Conserv.* **18**, 1361–1373 (2009). [doi:10.1007/s10531-008-9481-6](https://doi.org/10.1007/s10531-008-9481-6)
116. A. R. Marshall, J. E. Topp-Jørgensen, H. Brink, E. Fanning, Monkey abundance and social structure in two high-elevation forest reserves in the Udzungwa Mountains of Tanzania. *Int. J. Primatol.* **26**, 127–145 (2005). [doi:10.1007/s10764-005-0011-z](https://doi.org/10.1007/s10764-005-0011-z)
117. A. J. Marshall, Nardiyono, L. M. Engström, B. Pamungkas, J. Palapa, E. Meijaard, S. A. Stanley, The blowgun is mightier than the chainsaw in determining population density of Bornean orangutans (*Pongo pygmaeus morio*) in the forests of East Kalimantan. *Biol. Conserv.* **129**, 566–578 (2006). [doi:10.1016/j.biocon.2005.11.025](https://doi.org/10.1016/j.biocon.2005.11.025)
118. M. A. Martinez-Morales, Conservation status and habitat preferences of the Cozumel Curassow. *Condor* **101**, 14–20 (1999). [doi:10.2307/1370441](https://doi.org/10.2307/1370441)
119. V. Mena, J. Stallings, J. Regalado, R. Cueva, in *Hunting for Sustainability in Tropical Forests*, J. G. Robinson, E. L. Bennett, Eds. (Columbia Univ. Press, New York, 2000), pp. 57–78.
120. P. K. Muchaal, G. Ngandjui, Impact of village hunting on wildlife populations in the western Dia Reserve, Cameroon. *Conserv. Biol.* **13**, 385–396 (1999). [doi:10.1046/j.1523-1739.1999.013002385.x](https://doi.org/10.1046/j.1523-1739.1999.013002385.x)
121. M. R. Nielsen, Importance, cause and effect of bushmeat hunting in the Udzungwa Mountains, Tanzania: Implications for community based wildlife management. *Biol. Conserv.* **128**, 509–516 (2006). [doi:10.1016/j.biocon.2005.10.017](https://doi.org/10.1016/j.biocon.2005.10.017)

122. V. Nijman, Effects of habitat disturbance and hunting on the density and the biomass of the endemic Hose's leaf monkey *Presbytis hosei* (Thomas, 1889) (Mammalia: Primates: Cercopithecidae) in east Borneo. *Contrib. Zool.* **73**, 283–291 (2004).
123. A. J. Noss, in *Hunting for Sustainability in Tropical Forests* (Columbia Univ. Press, New York, 2000), pp. 282–304.
124. A. Noss, in *Manejo de Fauna Silvestre en Amazonía y Latinoamérica*, E. Cabrera, C. Mercolli, R. Resquin, Eds. (CITES (Convención sobre el Comercio Internacional), 2000), pp. 535–544.
125. A. J. Novack, thesis, University of Florida, Gainesville, FL (2003).
126. G. Nuñez-Iturri, O. Olsson, H. F. Howe, Hunting reduces recruitment of primate-dispersed trees in Amazonian Peru. *Biol. Conserv.* **141**, 1536–1546 (2008).
[doi:10.1016/j.biocon.2008.03.020](https://doi.org/10.1016/j.biocon.2008.03.020)
127. G. Nuñez-Iturri, H. F. Howe, Bushmeat and the fate of trees with seeds dispersed by large primates in a lowland rain forest in western Amazonia. *Biotropica* **39**, 348–354 (2007).
[doi:10.1111/j.1744-7429.2007.00276.x](https://doi.org/10.1111/j.1744-7429.2007.00276.x)
128. G. Nuñez-Iturri, thesis, University of Illinois, Champaign, IL (2007).
129. L. M. Paciulli, thesis, Stony Brook University, Stony Brook, NY (2004).
130. L. Parry, J. Barlow, C. A. Peres, Hunting for sustainability in tropical secondary forests. *Conserv. Biol.* **23**, 1270–1280 (2009). [doi:10.1111/j.1523-1739.2009.01224.x](https://doi.org/10.1111/j.1523-1739.2009.01224.x) [Medline](#)
131. L. Perera-Romero, J. Polisar, L. Maffei, in *I. Conservación de Grandes Vertebrados en Áreas No Protegidas de Colombia, Venezuela y Brasil*, E. Payán, C. A. Lasso, C. Castaño-Urbe, Eds. [Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAvH), Bogotá, DC, Colombia, 2015].
132. C. A. Peres, H. S. Nascimento, Impact of game hunting by the Kayapo of south-eastern Amazonia: Implications for wildlife conservation in tropical forest indigenous reserves. *Biodivers. Conserv.* **15**, 2627–2653 (2006). [doi:10.1007/s10531-005-5406-9](https://doi.org/10.1007/s10531-005-5406-9)
133. C. A. Peres, Effects of hunting on western Amazonian primate communities. *Biol. Conserv.* **54**, 47–59 (1990). [doi:10.1016/0006-3207\(90\)90041-M](https://doi.org/10.1016/0006-3207(90)90041-M)
134. C. A. Peres, Population status of white-lipped *Tayassu pecari* and collared peccaries *T. tajacu* in hunted and unhunted Amazonian forests. *Biol. Conserv.* **77**, 115–123 (1996).
[doi:10.1016/0006-3207\(96\)00010-9](https://doi.org/10.1016/0006-3207(96)00010-9)
135. M. V. Pia, thesis, Universidad Nacional de Córdoba, Córdoba, Argentina (2011).
136. M. V. Pia, D. Renison, A. Mangeaud, C. De Angelo, J. G. Haro, Occurrence of top carnivores in relation to land protection status, human settlements and rock outcrops in the high mountains of central Argentina. *J. Arid Environ.* **91**, 31–37 (2013).
[doi:10.1016/j.jaridenv.2012.11.004](https://doi.org/10.1016/j.jaridenv.2012.11.004)
137. J. R. Poulsen, C. J. Clark, B. M. Bolker, Decoupling the effects of logging and hunting on an afrotropical animal community. *Ecol. Appl.* **21**, 1819–1836 (2011). [doi:10.1890/10-1083.1](https://doi.org/10.1890/10-1083.1) [Medline](#)

138. M. J. Remis, Preliminary assessment of the impacts of human activities on gorillas *Gorilla gorilla gorilla* and other wildlife at Dzanga-Sangha Reserve, Central African Republic. *Oryx* **34**, 56–65 (2000). [doi:10.1017/S0030605300030908](https://doi.org/10.1017/S0030605300030908)
139. M. J. Remis, J. B. Kpanou, Primate and ungulate abundance in response to multi-use zoning and human extractive activities in a Central African Reserve. *Afr. J. Ecol.* **49**, 70–80 (2011). [doi:10.1111/j.1365-2028.2010.01229.x](https://doi.org/10.1111/j.1365-2028.2010.01229.x)
140. R. Reyna-Hurtado, G. W. Tanner, Ungulate relative abundance in hunted and non-hunted sites in Calakmul Forest (Southern Mexico). *Biodivers. Conserv.* **16**, 743–756 (2007). [doi:10.1007/s10531-005-6198-7](https://doi.org/10.1007/s10531-005-6198-7)
141. R. Á. Reyna-Hurtado, thesis, University of Florida, Gainesville, FL (2002).
142. C. Rosin, V. Swamy, Variable density responses of primate communities to hunting pressure in a western Amazonian River Basin. *Neotrop. Primates* **20**, 25–31 (2013). [doi:10.1896/044.020.0105](https://doi.org/10.1896/044.020.0105)
143. F. Rovero, A. S. Mtui, A. S. Kitegile, M. R. Nielsen, Hunting or habitat degradation? Decline of primate populations in Udzungwa Mountains, Tanzania: An analysis of threats. *Biol. Conserv.* **146**, 89–96 (2012). [doi:10.1016/j.biocon.2011.09.017](https://doi.org/10.1016/j.biocon.2011.09.017)
144. J. Schmid, M. R. Rasoloarison, in *A Biological Assessment of the Réserve Naturelle Intégrale d'Ankarafantsika, Madagascar, RAP Bull. Biol. Assess.* no. 23, L. E. Alonso, T. S. Schulenberg, S. Radilofe, O. Missa, Eds. (Conservation International, Washington, DC, 2002), pp. 73–82.
145. E. Suárez, G. Zapata-Rios, V. Utreras, S. Strindberg, J. Vargas, Controlling access to oil roads protects forest cover, but not wildlife communities: A case study from the rainforest of Yasuni Biosphere Reserve (Ecuador). *Anim. Conserv.* **16**, 265–274 (2013). [doi:10.1111/j.1469-1795.2012.00592.x](https://doi.org/10.1111/j.1469-1795.2012.00592.x)
146. J.-M. Thiollay, Raptor community structure of a primary rain forest in French Guiana and effect of human hunting pressure. *Raptor Res.* **18**, 117–122 (1984).
147. J.-M. Thiollay, Effects of hunting on guianan forest game birds. *Biodivers. Conserv.* **14**, 1121–1135 (2005). [doi:10.1007/s10531-004-8412-4](https://doi.org/10.1007/s10531-004-8412-4)
148. B. de Thoisy, F. Renoux, C. Julliot, Hunting in northern French Guiana and its impact on primate communities. *Oryx* **39**, 149–157 (2005). [doi:10.1017/S0030605305000384](https://doi.org/10.1017/S0030605305000384)
149. E. Topp-Jørgensen, M. R. Nielsen, A. R. Marshall, U. Pedersen, Relative densities of mammals in response to different levels of bushmeat hunting in the Udzungwa Mountains, Tanzania. *Trop. Conserv. Sci.* **2**, 70–87 (2009). [doi:10.1177/194008290900200108](https://doi.org/10.1177/194008290900200108)
150. T. Urquiza-Haas, C. A. Peres, P. M. Dolman, Large vertebrate responses to forest cover and hunting pressure in communal landholdings and protected areas of the Yucatan Peninsula, Mexico. *Anim. Conserv.* **14**, 271–282 (2011). [doi:10.1111/j.1469-1795.2010.00426.x](https://doi.org/10.1111/j.1469-1795.2010.00426.x)
151. N. Van Vliet, R. Nasi, Mammal distribution in a Central African logging concession area. *Biodivers. Conserv.* **17**, 1241–1249 (2008). [doi:10.1007/s10531-007-9300-5](https://doi.org/10.1007/s10531-007-9300-5)

152. S. Vinitpornsawan, thesis, University of Massachusetts Amherst, Amherst, MA (2013).
153. B. C. Wang, V. L. Sork, M. T. Leong, T. B. Smith, Hunting of mammals reduces seed removal and dispersal of the afrotropical tree *Antrocaryon klaineianum* (Anacardiaceae). *Biotropica* **39**, 340–347 (2007). doi:10.1111/j.1744-7429.2007.00275.x
154. B. C. Wang, thesis, University of California, Los Angeles, CA (2008).
155. M. Weber, thesis, Durham University, Durham, UK (2005).
156. D. S. Wilkie, J. T. Finn, Slash-burn cultivation and mammal abundance in the Ituri Forest, Zaire. *Biotropica* **22**, 90–99 (1990). doi:10.2307/2388723
157. D. S. Wilkie, thesis, University of Massachusetts (1987).
158. S. J. Wright, H. Zeballos, I. Domínguez, M. M. Gallardo, M. C. Moreno, R. Ibáñez, Poachers alter mammal abundance, seed dispersal, and seed predation in a neotropical forest. *Conserv. Biol.* **14**, 227–239 (2000). doi:10.1046/j.1523-1739.2000.98333.x
159. H. Yasuoka, The sustainability of duiker (*Cephalophus* spp.) hunting for the Baka hunter-gatherers in southeastern Cameroon. *Afr. Study Monogr. Suppl.* **33**, 95–120 (2006).doi:10.14989/68473