Supporting Information

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Forsyth, D. M., S. Comte, N. E. Davis, A. J. Bengsen, S. D. Côté, D. G. Hewitt, N. Morellet, and A. Mysterud. Methodology matters when estimating deer abundance: a global systematic review and recommendations for improvements. Journal of Wildlife Management

**S1. Selection, Descriptions, and Sources of the Biophysical and Anthropogenic Predictor Variables Used in Analyses**

In addition to deer density and study area size, we considered 3 biophysical and 3 anthropogenic variables for inclusion as explanatory variables in analyses of spatio-temporal trends in the use of deer abundance and density estimation methodologies, and the precision of deer abundance and density estimates (Table S1.1). Including strongly correlated predictor variables in models is undesirable (Dormann et al. 2013); hence, we evaluated the pairwise Pearson correlations between each of these 8 variables using the package Hmisc (version 4.4.0) in R version 4.0.2 (R Core Team 2020). The data and code that support the findings of this study are openly available in figshare at <https://doi.org/10.6084/m9.figshare.18846647.v1> (Forsyth et al. 2022).

These pairwise correlations used data for 3,870 deer abundance and density estimates published during 2004–2018. The only strong correlations were between the 3 anthropogenic variables night light, human density, and Global Human Influence Index (GHII), and all were positive (Table S1.2). We therefore used only 1 anthropogenic variable, GHII, in our analyses, because in our assessment this variable represents the complexity of human influences on the landscape better than night light or human density alone. In particular, GHII includes information on human population density, urban areas, roads, navigable rivers, and agricultural land uses.

**Table S1.1.** Descriptions and sources of the biophysical and anthropogenic predictor variables considered for inclusion in our analysis of spatio-temporal trends in the use of deer abundance and density estimation methodologies, and the precision of deer abundance and density estimates, in articles published during 2004–2018.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable name  (abbreviation) | Units | Description | Resolution | Source and access date | Reference |
| Study area | Hectares (ha) | Study area associated with each deer abundance or density estimate | Log-transformed area (in ha) to accommodate the large range of values | Extracted from the publications | Extracted from all publications included in this review |
| Deer density | deer/km2 | Density of deer within the study area. Abundance estimates were divided by the size of the study area. When estimates were given as a range, the mean value was selected. Deer density was log*e*-transformed to accommodate the large range of values. | Study area | Extracted from the publications | Extracted from all publications included in this review |
| Biophysical variables | |  |  |  |  |
| Elevation | Meters above sea level (m) | Digital Elevation Models based on data collected by the 2000 Shuttle Radar Topography Mission (SRTM); voids in the SRTM data were filled using contours derived from topographical maps. Units are metre above sea level. | 15 arc second resolution (~500 m at the equator) | <http://www.viewfinderpanoramas.org/dem3.html>  [accessed 24 Jan 2020] | Farr, T. G., Rosen, P. A., Caro, E., Crippen, R., Duren, R., and Hensley, S. 2007. The Shuttle Radar Topography Mission. Reviews of Geophysics 45:RG2004. doi:10.1029/2005RG000183. |
| Tree cover | Percentage (%) | Percent Tree Cover represents the density of trees on the ground. The data show the ratio of the area covered with branches and leaves of trees (tree canopy) to the ground surface seen from above (vertical direction). | 15 arc second resolution (~500 m at the equator) | <https://globalmaps.github.io/ptc.html>  [accessed 24 Jan 2020] | Vegetation (Percent Tree Cover) – Global version – Version 2 © Geospatial Information Authority of Japan, Chiba University and Collaborating Organizations |
| Net primary productivity  (NPP) | 109 grams of carbon | Global Patterns in Net Primary Productivity (NPP). Values are stored in 109 grams of carbon per grid cell | 0.25 decimal degrees resolution (~28 km at the equator) | <http://sedac.ciesin.columbia.edu/es/hanpp.html>  [accessed 24 Jan 2020] | Imhoff, M. L., Bounoua, L., Ricketts, T., Loucks, C., Harriss, R., and Lawrence, W. T. 2004. Global patterns in human consumption of net primary production. Nature 429:870–873. |
| Anthropogenic variables | |  |  |  |  |
| Human density | People per km2 | Population estimates for 2015 are created by extrapolating the raw population census. The 2 basic inputs of Gridded Population of the World (GPW) are non-spatial population data (i.e., tabular counts of population listed by administrative area) and spatially explicit administrative boundary data (administrative or enumeration units). | 30 arc second resolution (~1 km at the equator) | <https://sedac.ciesin.columbia.edu/data/collection/gpw-v4/documentation>  [accessed 24 Jan 2020] | Center for International Earth Science Information Network (CIESIN), Columbia University. 2017. Gridded Population of the World, Version 4 (GPWv4): Population Density, Revision 10. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4DZ068D |
| Night light | Values range from 0 (low light) to 63 (intense light). | Records in the data are the mean digital number (DN) values for 2010. | 30 arc second resolution (~1 km at the equator) | <https://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html>  [accessed 24 Jan 2020] | Version 4 DMSP-OLS Nighttime Lights Time Series. Image and Data processing by NOAA’s National Geophysical Data Center. DMSP data collected by the US Air Force Weather Agency |
| Global Human Influence Index  (GHII) | Values range from 1 (low human influence) to 64 (high human influence). | Overlay of human population distribution, urban areas, roads, navigable rivers, and various agricultural land uses. The combined influence of these factors yields the Global Human Influence Index (GHII). | 30 arc second resolution (~1 km at the equator) | <http://sedac.ciesin.columbia.edu/wildareas/>  [accessed 24 Jan 2020] | Last of the Wild Data Version 2, 2005 (LTW-2): Global Human Footprint Dataset (Geographic). Wildlife Conservation (WCS) and Center for International Earth Science Information Network (CIESIN). https://doi.org/10.7927/H46W980H |

**Table S1.2.** Pearson’s *rho* values for the correlation between each pair of biophysical and anthropogenic variables for 3,870 deer abundance and density estimates published during 2004–2018. The 8 variables are explained in Table S1.1.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variablea | Study area | Elevation | Tree cover | NPP | Deer  density | Human density | Night light | GHII |
| Study area | 1 | –0.02 | –0.03 | 0.08 | 0.05 | –0.02 | –0.05 | –0.07 |
| Elevation |  | 1 | –0.23 | –0.11 | –0.13 | –0.08 | –0.26 | –0.33 |
| Tree cover |  |  | 1 | 0.17 | 0.06 | –0.17 | –0.24 | –0.17 |
| NPP |  |  |  | 1 | 0.04 | 0.11 | 0.04 | 0.07 |
| Deer density |  |  |  |  | 1 | 0.06 | 0.09 | 0.16 |
| Human density |  |  |  |  |  | 1 | 0.50 | 0.43 |
| Night light |  |  |  |  |  |  | 1 | 0.84 |
| GHII |  |  |  |  |  |  |  | 1 |

a GHII: Global Human Influence Index. NPP: net primary productivity.

**Literature Cited**

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