**Supplementary Material: Conservation strategies shape stress-related glucocorticoid levels of managed elephant populations more than parasitic infection**

**Table S1.** Variation Inflation Factor (VIF) informing on potential multicollinearity between predictor variables. All VIF were < 3, so no multicollinearity was detected. Please refer to the main text for a description of each variable.

|  |  |  |
| --- | --- | --- |
| **Variables** | **VIF** | **VIF 95% Confidence Interval** |
| EPG | 1,13 | 1,04 – 1,44 |
| Age | 1,15 | 1,05 – 1,45 |
| Sex | 1,16 | 1,06 – 1,45 |
| Density | 1,83 | 1,55 – 2,24 |
| NDVI | 2,30 | 1,92 – 2,84 |
| Area size (log-transformed) | 2,34 | 1,95 – 2,89 |
| Authority | 2.62 | 2,16 – 3,25 |
| Self-drive | 1,70 | 1,45 – 2,08 |



**Figure S1.** Diagnostic plots for full model assumptions validation

**Table S2.** Backward reduced fixed-effect model selection table calculated with Satterthwaite degrees of freedom method. The minimal model retained only the following fixed effects: Log (area size), Self-drive, Density, NDVI and Density in interaction with NDVI. Please refer to the main text for a description of each variable and the details of the modelling approach.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Fixed-effects** | **Eliminated** | **Sum Sq** | **Mean Sq** | **NumDF** | **DenDF** | **F value** | **Pr(>F)** |  |
| Density:Log(area size) | 1 | 0.0111 | 0.0111 | 1 | 60.129 | 0.0596 | 0.807999 |  |
| Age:Sex | 2 | 0.0406 | 0.0406 | 1 | 214.945 | 0.2187 | 0.640499 |  |
| EPG | 3 | 0.3198 | 0.3198 | 1 | 159.904 | 1.7205 | 0.191503 |  |
| Age | 4 | 0.3822 | 0.3822 | 1 | 218.962 | 2.0552 | 0.153117 |  |
| Sex | 5 | 0.1925 | 0.1925 | 1 | 216.602 | 1.0223 | 0.313092 |  |
| Authority | 6 | 0.5069 | 0.5069 | 1 | 39.996 | 2.6753 | 0.10976 |  |
| Log(area size) | 0 | 3.0474 | 3.0474 | 1 | 77.407 | 16.0039 | 0.000144 | \*\*\* |
| Self-drive | 0 | 3.7819 | 3.7819 | 1 | 45.458 | 19.8613 | 5.40E-05 | \*\*\* |
| Density:NDVI | 0 | 2.1602 | 2.1602 | 1 | 60.305 | 11.345 | 0.001323 | \*\* |

Significance codes: 0 ‘\*\*\*’ 0,001 ‘\*\*’ 0,01 ‘\*’ 0,05 ‘.’ 0,1 ‘ ’

**Table S3.** Model selection based on Akaike Information Criterion adjusted for small sample size (AICc). Minimal model is the selected model, full model is the base model and null model account only for the random effect structure (no fixed effect). **K** is the number of independent variables used in the model. LL is the log-likelihood estimate (the likelihood that the model could have produced the observed y-values). Delta AICc, weight and cumulative weight are also provided.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Models** | **K** | **AICc** | **Delta\_AICc** | **AICcWt** | **Cum.Wt** | **LL** |
| Minimal model | 8 | 278.13 | 0.00 | 0.95 | 0.95 | -130.72 |
| Full model | 14 | 284.00 | 5.87 | 0.05 | 1.00 | -126.97 |
| Null model | 3 | 291.78 | 13.66 | 0.00 | 1.00 | -142.84 |

**Table S4.** Description of the selected study sites. The tourist exposure indicates whether the self-drive vehicle by tourists is authorised within the site or not. The area size and the elephant population number are given for the year 2021-2022. The mean annual NDVI, rainfall and maximum temperature are average over the past six years. The name of the sites is not provided to keep anonymity of the data as required by some sites.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** | **Province** | | **Predominant biome** | | **Ownership** | | **Authority Class** | | **Area size (km2)** | | **Elephant population** | | **Elephant density (n.km2)** | | | **Tourist drive modality** | | **Contraception** | **Artificial waterhole\*\*** | |
| 1 | Limpopo | | Savannah | | Private | | Private | | 130 | | 59 | | 0,45 | | | Guided drive | | No | Yes | |
| 2 | Kwa Zulu Natal | | Savanna | | Private | | Private | | 45 | | 29 | | 0,64 | | | Guided drive | | Yes | Yes | |
| 3 | Limpopo | | Savanna | | Private | | Private | | 360 | | 130 | | 0,36 | | | Guided drive | | Yes | Yes | |
| 4 | Limpopo | | Savanna | | Private | | Private | | 500 | | 23 | | 0,05 | | | Guided drive | | Yes | Yes | |
| 5 | Eastern Cape | | Albany Thicket | | Private | | Private | | 200 | | 42 | | 0,21 | | | Guided drive | | Yes | NK | |
| 6 | Eastern Cape | | Albany Thicket | | Private | | Private | | 27 | | 44 | | 1,63 | | | Guided drive | | Yes | Yes | |
| 7 | Eastern Cape | | Albany Thicket | | Private | | Private | | 48 | | 17 | | 0,35 | | | Guided drive | | Yes | Yes | |
| 8 | Eastern Cape | | Albany Thicket | | Private | | Private | | 30 | | 14 | | 0,47 | | | Guided drive | | Yes | NK | |
| 9 | Eastern Cape | | Albany Thicket | | Private | | Private | | 183 | | 96 | | 0,52 | | | Guided drive | | Yes | Yes | |
| 10 | Eastern Cape | | Albany Thicket | | Private | | Private | | 150 | | 23 | | 0,15 | | | Guided drive | | Yes | Yes | |
| 11 | Mpumalanga | | Savanna | | Provincial | | Non-private | | 80 | | 70 | | 0,88 | | | Guided drive | | No | No | |
| 12 | Kwa Zulu Natal | | Savanna | | Communal | | Private | | 120 | | 13 | | 0,11 | | | Guided drive | | Yes | Yes | |
| 13 | Kwa Zulu Natal | | Savanna | | Parastatal | | Non-private | | 300 | | 200 | | 0,67 | | | Self-drive | | Yes | Yes | |
| 14 | North West | | Savanna | | Provincial | | Non-private | | 680 | | 1400 | | 2,06 | | | Guided drive | | No | Yes | |
| 15 | Kwa Zulu Natal | | Savanna | | Parastatal | | Non-private | | 911 | | 1000 | | 1,10 | | | Self-drive | | Yes | Yes | |
| 16 | Eastern Cape | | Albany Thicket | | Parastatal | | Non-private | | 240 | | 500 | | 2,08 | | | Self-drive | | Yes | Yes | |
| 17 | Eastern Cape | | Albany Thicket | | Parastatal | | Non-private | | 120 | | 130 | | 1,08 | | | Guided drive | | Yes | Yes | |
| 18 | Eastern Cape | | Albany Thicket | | Provincial | | Non-private | | 450 | | 2 | | 0,004 | | | Guided drive | | No | No | |
| 19 \* | Limpopo | | Savanna | | Provincial | | Non-private | | 22924 | | 34732 | | 1,51 | | | Guided drive | | No | Yes | |
| 20 \* | | Mpumalanga | | Savanna | | Private | | Private | | 22924 | | 34732 | | 1,51 | Guided drive | | No | | | Yes | |

\* partially fenced (open on Kruger National Park)



**Figure S2.** Faecal glucocorticoid metabolite (FGCM) concentrations per site (anonymised), ordered by median and displayed by fieldwork campaign. Top panels represent samples collected during session 1 (2021-2022, see material & methods), bottom panels represent samples collected during session 2 (2022-2023). The left panels indicate sites in the northern provinces, those on the right indicate the sites in the southern one. The number of samples is indicated for each panel (top left) and for each site (bottom of boxplots). The black points represent the outliers.



**Figure S3.** Strongyle parasite load in number of eggs per gram of faeces (epg) per site (anonymised), ordered by median and displayed by fieldwork campaign. Top panels represent samples collected during session 1 (2021-2022, see material & methods), bottom panels represent samples collected during session 2 (2022-2023). The left panels indicate sites in the northern provinces, those on the right indicate the sites in the southern one. The number of samples is indicated for each panel (top left) and for each site (bottom of boxplots). The black points represent the outliers.