**Supplementary Material 1**

Mammal species list for Nyungwe National Park, Rwanda including all species (excluding small mice and rats) that were detected at least once during the study period. Associated species characteristics and the number of detections of each species using each methodology are also included. Group refers to whether a species is group-living or solitary/lives in pairs. An X refers to a species that is not available for detection by a particular method. Camera trap detection numbers include multiple photos (up to 3) taken each time the camera is triggered.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Order** | **Family** | **Scientific** | **English** | **IUCN Status** | **Active Period** | **Substrate Use** | **Average Adult Body Mass** | **Group** | **Line Transects** | **Ground Cameras** | **Arboreal Cameras** |
| Carnivora | Canidae | *Canis adustus* | Side-striped Jackal | Least Concern | Nocturnal | Terrestrial | 10400 | No | X | 19 | X |
| Carnivora | Felidae | *Leptailurus serval* | Serval | Least Concern | Both | Terrestrial | 11800 | No | X | 45 | X |
| Carnivora | Mustelidae | *Aonyx congicus* | Congo Clawless Otter | Near Threatened | Diurnal | Terrestrial | 21600 | No | 0 | 8 | X |
| Carnivora | Mustelidae | *Mellivora capensis* | Honey Badger | Least Concern | Nocturnal | Terrestrial | 9000 | No | X | 1 | X |
| Carnivora | Nandiniidae | *Nandinia binotata* | African Palm Civet | Least Concern | Nocturnal | Both | 2170 | No | X | 49 | 210 |
| Carnivora | Viverridae | *Civettictis civetta* | African Civet | Least Concern | Nocturnal | Terrestrial | 12100 | No | X | 15 | X |
| Carnivora | Viverridae | *Genetta maculata* | Large-spotted Genet | Least Concern | Nocturnal | Both | 1950 | No | X | 21 | 0 |
| Carnivora | Viverridae | *Genetta servalina* | Servaline Genet | Least Concern | Nocturnal | Both | 1310 | No | X | 42 | 23 |
| Carnivora | Viverridae | *Poiana richardsonii* | Central African Oyan | Least Concern | Nocturnal | Arboreal | 570 | No | X | X | 54 |
| Certartiodactyla | Bovidae | *Cephalophus silvicultor* | Yellow-backed Duiker | Near Threatened | Both | Terrestrial | 61300 | No | 0 | 105 | X |
| Certartiodactyla | Bovidae | *Cephalophus weynsi lestradei* | Lestrade’s Duiker | Not Listed | Both | Terrestrial | 15000 | No | 0 | 69 | X |
| Cetartiodactyla | Bovidae | *Cephalophus nigrifrons* | Black-fronted Duiker | Least Concern | Both | Terrestrial | 14200 | No | 18 | 8749 | X |
| Cetartiodactyla | Bovidae | *Tragelaphus scriptus* | Bushbuck | Least Concern | Both | Terrestrial | 43300 | No | 0 | 42 | X |
| Cetartiodactyla | Suidae | *Potamochoerus larvatus* | Bushpig | Least Concern | Both | Terrestrial | 68600 | Yes | 0 | 504 | X |
| Hyracoidea | Procaviidae | *Dendrohyrax arboreus* | Eastern Tree Hyrax | Least Concern | Nocturnal | Both | 3180 | No | X | 3 | 54 |
| Primates | Cercopithecidae | *Cercopithecus lhoesti* | L'hoest's Monkey | Vulnerable | Diurnal | Both | 5320 | Yes | 22 | 1286 | 3413 |
| Primates | Cercopithecidae | *Cercopithecus mitis* | Blue Monkey | Least Concern | Diurnal | Both | 5040 | Yes | 26 | 106 | 6902 |
| Primates | Cercopithecidae | *Cercopithecus mona* | Mona Monkey | Least Concern | Diurnal | Both | 3980 | Yes | 5 | 0 | 0 |
| Primates | Cercopithecidae | *Colobus angolensis ruwenzorii* | Angolan Colobus | Vulnerable | Diurnal | Both | 8990 | Yes | 39 | 6 | 182 |
| Primates | Cercopithecidae | *Lophocebus albigena* | Grey-cheeked Mangabey | Least Concern | Diurnal | Both | 7360 | Yes | 6 | 0 | 0 |
| Primates | Galagidae | *Galago* spp | Galago or Dwarf Galago species | Least Concern | Nocturnal | Arboreal | 214 | No | X | X | 460 |
| Primates | Hominidae | *Pan troglodytes schweinfurthii* | Eastern Chimpanzee | Endangered | Diurnal | Both | 45100 | Yes | 0 | 422 | 9 |
| Primates | Lorisidae | *Perodicticus potto* | Potto | Least Concern | Nocturnal | Arboreal | 1080 | No | X | X | 21 |
| Rodentia | Anomaluridae | *Anomalurus derbianus* | Lord Derby’s Anomalure | Least Concern | Nocturnal | Arboreal | 665 | No | X | X | 342 |
| Rodentia | Gliridae | *Graphiurus* spp | African Dormouse Species | Least Concern | Nocturnal | Arboreal | 20 | No | X | X | 521 |
| Rodentia | Hystricidae | *Atherurus africanus* | African Brush-tailed Porcupine | Least Concern | Nocturnal | Terrestrial | 2880 | No | X | 818 | X |
| Rodentia | Nesomyidae | *Cricetomys gambianus* | African Giant Pouched Rat | Least Concern | Nocturnal | Terrestrial | 1270 | No | X | 1934 | X |
| Rodentia | Sciuridae | *Funisciurus carruthersi* | Carruther's Mountain Tree Squirrel | Least Concern | Diurnal | Both | 277 | No | 8 | 390 | 1756 |
| Rodentia | Sciuridae | *Funisciurus pyrropus* | Cuvier's Fire-footed Squirrel | Least Concern | Diurnal | Both | 243 | No | 1 | 736 | 0 |
| Rodentia | Sciuridae | *Heliosciurus rufobrachium* | Red-legged Sun Squirrel | Least Concern | Diurnal | Both | 333 | No | 0 | 0 | 32 |
| Rodentia | Sciuridae | *Heliosciurus ruwenzorii* | Montane Sun Squirrel | Least Concern | Diurnal | Both | 291 | No | 8 | 6 | 544 |
| Rodentia | Sciuridae | *Paraxerus alexandri* | Alexander's Squirrel | Least Concern | Diurnal | Both | 70 | No | 10 | 0 | 0 |
| Rodentia | Sciuridae | *Paraxerus boehmi* | Boehm's Squirrel | Least Concern | Diurnal | Both | 51 | No | 17 | 0 | 161 |
| Rodentia | Sciuridae | *Protoxerus stangeri* | African Giant Squirrel | Least Concern | Diurnal | Both | 630 | No | 0 | 62 | 458 |
| Rodentia | Thryonomyidae | *Thryonomys swinderianus* | Greater Cane Rat | Least Concern | Nocturnal | Terrestrial | 3750 | No | X | 2 | X |

**Supplementary Material 2**

Full Model selection table for single-season occupancy models with multi-species data using data from all three field methods combined. Model, Akaike information criterion (AIC) score, negative log likelihood (neg2ll), number of parameters (npar), AIC (change in AIC between the given model and the top model), and model weight are given. Covariates on occupancy (psi) include maxelev (maximum elevation), access (distance to nearest access point), minelev (minimum elevation), and trail (distance to nearest tourist trail). Covariates on detection (p) include mass (average adult body mass), group (0 for group-living, 1 for solitary/lives in pairs), and cat (category based on activity period and location; NA (nocturnal and arboreal), NT (nocturnal and terrestrial), DT (diurnal and terrestrial), DA (diurnal and arboreal), DB (diurnal and both terrestrial and arboreal), NB (nocturnal and both terrestrial and arboreal).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model** | **AIC** | **neg2ll** | **npar** | **DAIC** | **weight** |
| psi()p(mass + group) | 1272.1077 | 1264.1077 | 4 | 0 | 0.1383 |
| psi()p(mass + cat) | 1272.1872 | 1258.1872 | 7 | 0.0795 | 0.1329 |
| psi(maxelev)p(mass + group) | 1272.6544 | 1262.6544 | 5 | 0.5467 | 0.1052 |
| psi(access)p(mass + group) | 1272.7228 | 1262.7228 | 5 | 0.6151 | 0.1017 |
| psi(maxelev)p(mass + cat) | 1272.7569 | 1256.7569 | 8 | 0.6492 | 0.1 |
| psi(minelev)p(mass + group) | 1272.7596 | 1262.7596 | 5 | 0.6519 | 0.0998 |
| psi(access)p(mass + cat) | 1272.8011 | 1256.8011 | 8 | 0.6934 | 0.0978 |
| psi(minelev)p(mass + cat) | 1272.8518 | 1256.8518 | 8 | 0.7441 | 0.0953 |
| psi(trail)p(mass + group) | 1273.8473 | 1263.8473 | 5 | 1.7396 | 0.0579 |
| psi(trail)p(mass + cat) | 1273.8847 | 1257.8847 | 8 | 1.777 | 0.0569 |
| psi()p(mass) | 1279.5372 | 1273.5372 | 3 | 7.4295 | 0.0034 |
| psi(maxelev)p(mass) | 1280.1575 | 1272.1575 | 4 | 8.0498 | 0.0025 |
| psi(access)p(mass) | 1280.181 | 1272.181 | 4 | 8.0733 | 0.0024 |
| psi(minelev)p(mass) | 1280.2822 | 1272.2822 | 4 | 8.1745 | 0.0023 |
| psi(trail)p(mass) | 1281.2748 | 1273.2748 | 4 | 9.1671 | 0.0014 |
| psi()p(cat) | 1282.9194 | 1270.9194 | 6 | 10.8117 | 6.00E-04 |
| psi(maxelev)p(cat) | 1283.4971 | 1269.4971 | 7 | 11.3894 | 5.00E-04 |
| psi(access)p(cat) | 1283.5428 | 1269.5428 | 7 | 11.4351 | 5.00E-04 |
| psi(minelev)p(cat) | 1283.6884 | 1269.6884 | 7 | 11.5807 | 4.00E-04 |
| psi(trail)p(cat) | 1284.6064 | 1270.6064 | 7 | 12.4987 | 3.00E-04 |
| psi(Transect)p(mass + cat) | 1291.2003 | 1243.2003 | 24 | 19.0926 | 0 |
| psi(Transect)p(mass + group) | 1291.2005 | 1249.2005 | 21 | 19.0928 | 0 |
| psi()p() | 1297.681 | 1293.681 | 2 | 25.5733 | 0 |
| psi(access)p() | 1298.381 | 1292.381 | 3 | 26.2733 | 0 |
| psi(maxelev)p() | 1298.5255 | 1292.5255 | 3 | 26.4178 | 0 |
| psi(Transect)p(mass) | 1298.5487 | 1258.5487 | 20 | 26.441 | 0 |
| psi()p(group) | 1298.6938 | 1292.6938 | 3 | 26.5861 | 0 |
| psi(minelev)p() | 1298.7734 | 1292.7734 | 3 | 26.6657 | 0 |
| psi(trail)p() | 1299.3682 | 1293.3682 | 3 | 27.2605 | 0 |
| psi(access)p(group) | 1299.3889 | 1291.3889 | 4 | 27.2812 | 0 |
| psi(maxelev)p(group) | 1299.5358 | 1291.5358 | 4 | 27.4281 | 0 |
| psi(minelev)p(group) | 1299.787 | 1291.787 | 4 | 27.6793 | 0 |
| psi(trail)p(group) | 1300.3805 | 1292.3805 | 4 | 28.2728 | 0 |
| psi(Transect)p(cat) | 1301.6966 | 1255.6966 | 23 | 29.5889 | 0 |
| psi(Transect)p() | 1316.8024 | 1278.8024 | 19 | 44.6947 | 0 |
| psi(Transect)p(group) | 1317.8678 | 1277.8678 | 20 | 45.7601 | 0 |

**Supplementary Material 3**

*Methodological Advantages and Disadvantages*

Researchers will select the most appropriate field method(s) for their needs based on multiple considerations; and line transects, ground cameras and arboreal cameras each have advantages and disadvantages (Table 2). In general, line transects require more fieldwork than what is necessary for camera trap deployment. Line transects also require personnel specialized in animal identification while ground camera trapping requires a basic training in camera deployment; arboreal camera deployment requires personnel also experienced in tree climbing. The quality of line transect data are dependent upon field personnel, but camera trap data are permanent and can be reviewed by multiple people to ensure accuracy. On the other hand, line transect data processing is simple and straightforward whereas the effort needed to process camera images is more labor intensive. Arboreal cameras, in particular, tend to have many blank images from moving branches causing false triggers (Gregory et al., 2014). For example, in our study, 7 arboreal cameras took more than 1000 blank photos due to vegetation moving in the wind. However, ongoing and future advancements in machine learning where algorithms can be trained to identify species, or the use of citizen scientists for species identifications can greatly reduce image processing time, and thus negate this disadvantage (Norouzzadeh et al., 2018; Swanson et al., 2015; Tabak et al., 2018). The risk of data loss is low for line transects as long as datasheets or the devices used to enter data are not lost before the data are backed up. However, there are more opportunities for data loss from cameras. For example, battery depletion, full memory cards, or camera theft, especially for ground cameras, can result in the loss of data. In our study, one ground camera was stolen and one failed after deployment while 3 arboreal cameras stopped collecting data due to battery depletion before the end of the study period.

Table S3.1: Advantages and disadvantages of line transects, ground cameras, and arboreal cameras

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Line Transects** | **Ground Cameras** | **Arboreal Cameras** |
| **Species’ Detected** | Substrate: Arboreal and terrestrial  Activity Pattern: Diurnal or nocturnal (depending on time of survey) | Substrate: Terrestrial  Activity Pattern: Diurnal and nocturnal | Substrate: Arboreal  Activity Pattern: Diurnal and nocturnal |
| **Field Effort** | **High** – each survey takes a partial or whole day | **Low** – after deployment cameras can be left out for the duration of battery life (approx. 30-60 days) | **Low** – after deployment cameras can be left out for the duration of battery life (approx. 30-60 days) |
| **Field Personnel Requirements** | Experienced in animal identification | Trained in camera placement | Experienced in tree climbing and trained in camera placement |
| **Data Quality** | **Low–** based only on observation in the field | **High –** permanent record of animal observations can be verified by multiple people | **High –** permanent record of animal observations can be verified by multiple people |
| **Data Processing Time** | **Low** – manual entry of paper data or transfer of electronic data to computer | **High** – identification of animals from photos (Note: time can potentially be reduced using citizen scientists or machine learning approaches) | **Highest** – identification of animals from photos; high chance of photos with no animals (false triggers) from moving branches or weather (Note: time can potentially be reduced using citizen scientists or machine learning approaches) |
| **Risk of Data Loss** | **Low** – potential loss or damage of paper data or electronic device used for data collection | **Highest** – risk of stolen cameras, depleted batteries, full memory cards, malfunctioning cameras | **High** – risk of depleted batteries, full memory cards, malfunctioning cameras |
| **Weather Conditions** | Requires good visibility | Any, but possibility of camera failure due to harsh weather conditions | Any, but possibility of camera failure due to harsh weather conditions |
| **Expenses** | Field personnel for surveys (staff wages vary depending on location) | Cameras plus accessories;  Field personnel for deployment and retrieval | Cameras plus accessories;  Tree climbing equipment;  Field personnel for deployment and retrieval (including tree climbing) |