**Supplementary Materials**

**Table S1.** Description of the infrastructure, licenses, and staff required during the drone-monitoring operation.

|  |  |
| --- | --- |
| **Description** | |
| **Equipment** | Thermal Camera EVO II Dual (640) 640\*512, Aircraft EVO II Dual, Remote Controller, 5 batteries (mAh) 7100mAh, Charger Voltage 13.2 ± 0.1 V,mobile phone with iOS Autel Explorer app, 1 computer, 2 x 128 GB memory cards, 1 x 5TB hard drive. |
| **Team** | One remote pilot, one co-pilot, and two video reviewers (experienced and not experienced) |
| **License** | RPAS-1354-CR (Costa Rica) |

**Table S2.**

Database of transects (Tran: transects codes) detections, number of detections with identification to group or species level (idsp), proportion of detections identified to group or species level (propid), detection of primates (idmonkes), number of detections with individuals moving (nmov), number of bats, birds and kinkajou/olingo detections (bat, bird, lapa, toucan,owl and ident kink/olin), and proportion of detections with individuals moving (pmov) with a thermal camera during drone flights at 10 and 18 km/h at 5 different times 11 pm (23hs) , 1 am (1hs), 3 am (3hs), 5 am (5hs), and 7 am (7hs).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tran | Speed | time | detections | nind | idsp | monkeys | nmov | propid | bat | bird | lapa | toucan | owl | Kink/olin | pmov |
| FE | 10kmh | 11pm | 6 | 7 | 0 | 0 | 1 | 0.000 | 0 | 0 | 0 | 0 | 0 | 0 | 0.167 |
| FE | 10kmh | 1am | 5 | 8 | 0 | 0 | 1 | 0.000 | 0 | 0 | 0 | 0 | 0 | 0 | 0.200 |
| FE | 10kmh | 3am | 13 | 14 | 4 | 0 | 6 | 0.308 | 3 | 0 | 0 | 0 | 1 | 0 | 0.462 |
| FE | 10kmh | 5am | 22 | 29 | 9 | 2 | 12 | 0.409 | 0 | 7 | 0 | 0 | 0 | 0 | 0.545 |
| FE | 10kmh | 7am | 9 | 17 | 7 | 0 | 7 | 0.778 | 0 | 7 | 0 | 0 | 0 | 0 | 0.778 |
| FW | 10kmh | 11pm | 13 | 20 | 8 | 1 | 7 | 0.615 | 0 | 7 | 0 | 0 | 0 | 0 | 0.538 |
| FW | 10kmh | 1am | 24 | 32 | 14 | 1 | 14 | 0.583 | 13 | 0 | 0 | 0 | 0 | 0 | 0.583 |
| FW | 10kmh | 3am | 18 | 23 | 10 | 2 | 10 | 0.556 | 8 | 0 | 0 | 0 | 0 | 0 | 0.556 |
| FW | 10kmh | 5am | 14 | 22 | 6 | 3 | 7 | 0.429 | 0 | 2 | 0 | 1 | 0 | 0 | 0.500 |
| FW | 10kmh | 7am | 13 | 18 | 13 | 0 | 13 | 1.000 | 0 | 12 | 1 | 0 | 0 | 0 | 1.000 |
| RE | 10kmh | 11pm | 9 | 18 | 3 | 0 | 1 | 0.333 | 2 | 1 | 0 | 0 | 0 | 0 | 0.111 |
| RE | 10kmh | 1am | 16 | 24 | 2 | 0 | 2 | 0.125 | 2 | 0 | 0 | 0 | 0 | 0 | 0.125 |
| RE | 10kmh | 3am | 21 | 32 | 5 | 0 | 5 | 0.238 | 5 | 0 | 0 | 0 | 0 | 0 | 0.238 |
| RE | 10kmh | 5am | 11 | 29 | 6 | 3 | 6 | 0.545 | 0 | 3 | 0 | 0 | 0 | 0 | 0.545 |
| RE | 10kmh | 7am | 10 | 12 | 7 | 1 | 7 | 0.700 | 0 | 6 | 0 | 0 | 0 | 0 | 0.700 |
| RW | 10kmh | 11pm | 24 | 26 | 6 | 0 | 6 | 0.250 | 4 | 0 | 0 | 0 | 0 | 2 | 0.250 |
| RW | 10kmh | 1am | 22 | 25 | 6 | 0 | 8 | 0.273 | 6 | 0 | 0 | 0 | 0 | 0 | 0.364 |
| RW | 10kmh | 3am | 18 | 20 | 2 | 0 | 6 | 0.111 | 2 | 0 | 0 | 0 | 0 | 0 | 0.333 |
| RW | 10kmh | 5am | 21 | 49 | 8 | 1 | 8 | 0.381 | 0 | 7 | 0 | 0 | 0 | 0 | 0.381 |
| RW | 10kmh | 7am | 5 | 5 | 3 | 2 | 2 | 0.600 | 0 | 1 | 0 | 0 | 0 | 0 | 0.400 |
| FE | 18kmh | 11pm | 8 | 9 | 2 | 0 | 2 | 0.250 | 1 | 0 | 0 | 0 | 0 | 1 | 0.250 |
| FE | 18kmh | 1am | 10 | 14 | 2 | 0 | 2 | 0.200 | 2 | 0 | 0 | 0 | 0 | 0 | 0.200 |
| FE | 18kmh | 3am | 13 | 14 | 2 | 0 | 2 | 0.154 | 2 | 0 | 0 | 0 | 0 | 0 | 0.154 |
| FE | 18kmh | 5am | 10 | 14 | 3 | 3 | 3 | 0.300 | 0 | 0 | 0 | 0 | 0 | 0 | 0.300 |
| FE | 18kmh | 7am | 15 | 21 | 12 | 8 | 12 | 0.800 | 0 | 4 | 0 | 0 | 0 | 0 | 0.800 |
| FW | 18kmh | 11pm | 20 | 44 | 5 | 2 | 3 | 0.250 | 3 | 0 | 0 | 0 | 0 | 0 | 0.150 |
| FW | 18kmh | 1am | 15 | 35 | 7 | 2 | 6 | 0.467 | 2 | 0 | 0 | 0 | 0 | 3 | 0.400 |
| FW | 18kmh | 3am | 14 | 36 | 2 | 0 | 4 | 0.143 | 2 | 0 | 0 | 0 | 0 | 0 | 0.286 |
| FW | 18kmh | 5am | 11 | 21 | 2 | 1 | 4 | 0.182 | 1 | 0 | 0 | 0 | 0 | 0 | 0.364 |
| FW | 18kmh | 7am | 6 | 9 | 5 | 2 | 5 | 0.833 | 0 | 3 | 0 | 0 | 0 | 0 | 0.833 |
| RE | 18kmh | 11pm | 7 | 10 | 0 | 0 | 0 | 0.000 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| RE | 18kmh | 1am | 7 | 9 | 1 | 0 | 1 | 0.143 | 1 | 0 | 0 | 0 | 0 | 0 | 0.143 |
| RE | 18kmh | 3am | 11 | 15 | 1 | 0 | 1 | 0.091 | 1 | 0 | 0 | 0 | 0 | 0 | 0.091 |
| RE | 18kmh | 5am | 8 | 9 | 0 | 0 | 0 | 0.000 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| RE | 18kmh | 7am | 9 | 13 | 3 | 2 | 4 | 0.333 | 0 | 1 | 0 | 0 | 0 | 0 | 0.444 |
| RW | 18kmh | 11pm | 10 | 12 | 1 | 0 | 1 | 0.100 | 1 | 0 | 0 | 0 | 0 | 0 | 0.100 |
| RW | 18kmh | 1am | 12 | 14 | 0 | 0 | 0 | 0.000 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| RW | 18kmh | 3am | 14 | 17 | 0 | 0 | 0 | 0.000 | 0 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| RW | 18kmh | 5am | 11 | 13 | 4 | 3 | 4 | 0.364 | 0 | 1 | 0 | 0 | 0 | 0 | 0.364 |
| RW | 18kmh | 7am | 6 | 10 | 5 | 4 | 5 | 0.833 | 0 | 1 | 0 | 0 | 0 | 0 | 0.833 |

**Table S3.**

Mean values and standard error of individuals recorded with the thermal camera of the Autel Robotics EVO II Dual 8K Drone flying at 5 different times: 11 pm, 1 am, 3 am, 5 am, and 7 am on the left side of the table. On the right side you can the detailed the contrast analysis done between flight times.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Detections/flight* | | | | | | | |
| *Predictors* | *Mean* | *SE* | *contrast* | *ratio* | *SE* | *z.ratio* | *p.value* |
| time [11pm] | 11.92 | 1.38 | 11pm / 1am | 0.874 | 0.121 | -0.971 | 0.869 |
| time [1am] | 13.64 | 1.5 | 11pm / 3am | 0.795 | 0.108 | -1.687 | 0.442 |
| time [3am] | 14.99 | 1.59 | 11pm / 5am | 0.898 | 0.126 | -0.768 | 0.940 |
| time [5am] | 13.27 | 1.47 | 11pm / 7am | 1.329 | 0.206 | 1.836 | 0.353 |
| time [7am] | 8.97 | 1.16 | 1am / 3am | 0.91 | 0.119 | -0.721 | 0.952 |
| **Random Effects** | | | 1am / 5am | 1.028 | 0.139 | 0.203 | 1 |
| σ2 | 0.08 | | **1am / 7am** | **1.521** | **0.229** | **2.783** | **0.043** |
| τ00 Tran | 0.01 | | 3am / 5am | 1.13 | 0.149 | 0.923 | 0.888 |
| ICC | 0.13 | | **3am / 7am** | **1.671** | **0.247** | **3.473** | **0.005** |
| N Tran | 4 | | 5am / 7am | 1.479 | 0.224 | 2.587 | 0.073 |
| *Number of detections with identification* | | | | | | | |
| *Predictors* | *Mean* | *SE* | *contrast* | *ratio* | *SE* | *t.ratio* | *p.value* |
| time [11pm] | 3.12 | 1.32 | 11pm / 1am | -0.875 | 1.42 | -0.617 | 0.972 |
| time [1am] | 4 | 1.32 | 11pm / 3am | -0.125 | 1.42 | -0.088 | 1 |
| time [3am] | 3.25 | 1.32 | 11pm / 5am | -1.625 | 1.42 | -1.145 | 0.781 |
| time [5am] | 4.75 | 1.32 | 11pm / 7am | -3.75 | 1.42 | -2.643 | 0.087 |
| time [7am] | 6.88 | 1.32 | 1am / 3am | 0.75 | 1.42 | 0.529 | 0.984 |
| **Random Effects** | | | 1am / 5am | -0.75 | 1.42 | -0.529 | 0.984 |
| σ2 | 8.05 | | 1am / 7am | -2.875 | 1.42 | -2.026 | 0.278 |
| τ00 Tran | 2.96 | | 3am / 5am | -1.5 | 1.42 | -1.057 | 0.827 |
| ICC | 0.27 | | 3am / 7am | -3.625 | 1.42 | -2.555 | 0.104 |
| N Tran | 4 | | 5am / 7am | -2.125 | 1.42 | -1.498 | 0.572 |
| *Proportion of detections with identification* | | | | | | | |
| *Predictors* | *Mean* | *SE* | *contrast* | *estimate* | *SE* | *t.ratio* | *p.value* |
| time [11pm] | 0.225 | 0.074 | 11pm / 1am | 0.001 | 0.075 | 0.012 | 1 |
| time [1am] | 0.224 | 0.074 | 11pm / 3am | 0.025 | 0.075 | 0.330 | 0.997 |
| time [3am] | 0.2 | 0.074 | 11pm / 5am | -0.102 | 0.075 | -1.358 | 0.658 |
| time [5am] | 0.326 | 0.074 | **11pm / 7am** | **-0.510** | **0.075** | **-6.823** | **<.0001** |
| time [7am] | 0.735 | 0.074 | 1am / 3am | 0.023 | 0.075 | 0.318 | 0.998 |
| **Random Effects** | | | 1am / 5am | -0.102 | 0.075 | -1.370 | 0.651 |
| σ2 | 0.02 | | **1am / 7am** | **-0.510** | **0.075** | **-6.835** | **<.0001** |
| τ00 Tran | 0.01 | | 3am / 5am | -0.126 | 0.075 | -1.688 | 0.456 |
| ICC | 0.32 | | **3am / 7am** | **-0.534** | **0.075** | **-7.153** | **<.0001** |
| N Tran | 4 | | **5am / 7am** | **-0.408** | **0.075** | **-5.465** | **0.0001** |
| *Primates* | | | | | | | |
| *Predictors* | *Mean* | *SE* | *contrast* | *ratio* | *SE* | *z.ratio* | *p.value* |
| time [11pm] | 0.363 | 0.21 | 11pm / 1am | 1 | 0.816 | 0 | 10 |
| time [1am] | 0.363 | 0.21 | 11pm / 3am | 1.5 | 13.693 | 0.444 | 0.992 |
| time [3am] | 0.242 | 0.171 | 11pm / 5am | 0.188 | 0.118 | -2.661 | 0.06 |
| time [5am] | 1.933 | 0.49 | **11pm / 7am** | **0.158** | **0.098** | **-2.971** | **0.024** |
| time [7am] | 2.296 | 0.535 | 1am / 3am | 1.5 | 13.693 | 0.444 | 0.992 |
| **Random Effects** | | | 1am / 5am | 0.188 | 0.118 | -2.661 | 0.06 |
| σ2 | 0.66 | | **1am / 7am** | **0.158** | **0.098** | **-2.971** | **0.025** |
| τ00 Tran | 0 | | **3am / 5am** | **0.125** | **0.094** | **-2.773** | **0.044** |
| N Tran | 4 | | **3am / 7am** | **0.105** | **0.078** | **-3.028** | **0.021** |
|  |  | | 5am / 7am | 0.842 | 0.286 | -0.506 | 0.987 |
| *Proportion of detections with moving animals* | | | | | | | |
| *Predictors* | *Mean* | *SE* | *contrast* | *estimate* | *SE* | *t.ratio* | *p.value* |
| time [11pm] | 0.196 | 0.073 | 11pm / 1am | -0.056 | 0.063 | -0.886 | 0.900 |
| time [1am] | 0.252 | 0.073 | 11pm / 3am | -0.069 | 0.063 | -1.093 | 0.809 |
| time [3am] | 0.265 | 0.073 | 11pm / 5am | -0.179 | 0.063 | -2.826 | 0.058 |
| time [5am] | 0.375 | 0.073 | **11pm / 7am** | **-0.528** | **0.063** | **-8.327** | **<.0001** |
| time [7am] | 0.724 | 0.073 | 1am / 3am | -0.013 | 0.063 | -0.207 | 1.000 |
| **Random Effects** | | | 1am / 5am | -0.123 | 0.063 | -1.941 | 0.318 |
| σ2 | 0.02 | | **1am / 7am** | **-0.472** | **0.063** | **-7.441** | **<.0001** |
| τ00 Tran | 0.01 | | 3am / 5am | -0.110 | 0.063 | -1.734 | 0.429 |
| ICC | 0.45 | | **3am / 7am** | **-0.459** | **0.063** | **-7.234** | **<.0001** |
| N Tran | 4 | | **5am / 7am** | **-0.349** | **0.063** | **-5.500** | **<.0001** |
| *Bats* | | | | | | | |
| *Predictors* | *Mean* | *SE* | *contrast* | *ratio* | *SE* | *z.ratio* | *p.value* |
| time [11pm] | 1.099 | 0.417 | 11pm / 1am | 0.0 | 0.0 | -2.384 | 0.120 |
| time [1am] | 2.598 | 0.785 | 11pm / 3am | 0.0 | 0.0 | -2.006 | 0.263 |
| time [3am] | 2.299 | 0.714 | 11pm / 5am | 11.0 | 12.0 | 2.288 | 0.148 |
| time [5am] | 0.100 | 0.103 | 11pm / 7am | 87200000 | 246000000000 | 0.006 | 10 |
| time [7am] | 0 | 0.000 | 1am / 3am | 1.0 | 0.0 | 0.427 | 0.993 |
| **Random Effects** | | | **1am / 5am** | **26.0** | **27.0** | **3.187** | **0.012** |
| σ2 | 0.54 | | 1am / 7am | 206000000 | 582000000000 | 0.007 | 10 |
| τ00 Tran | 0.18 | | **3am / 5am** | **23.0** | **24.0** | **3.06** | **0.019** |
| ICC | 0.25 | | 3am / 7am | 182000000 | 515000000000 | 0.007 | 10 |
| N Tran | 4 | | 5am / 7am | 7930000 | 22400000000 | 0.006 | 10 |
| *Birds* | | | | | | | |
| *Predictors* | *Mean* | *SE* | *contrast* | *ratio* | *SE* | *z.ratio* | *p.value* |
| time [11pm] | 0.707 | 0.280 | 11pm / 1am | 263000000 | 1510000000000 | 0.003 | 10 |
| time [1am] | 0 | 0.000 | 11pm / 3am | 210000000 | 1080000000000.0 | 0.004 | 10 |
| time [3am] | 0 | 0.000 | 11pm / 5am | 0.00 | 0.00 | -2.182 | 0.187 |
| time [5am] | 1.768 | 0.503 | **11pm / 7am** | **0.00** | **0.00** | **-3.751** | **0.002** |
| time [7am] | 3.094 | 0.755 | 1am / 3am | 1.00 | 6170.00 | 0 | 10 |
| **Random Effects** | | | 1am / 5am | 0.00 | 0.00 | -0.004 | 10 |
| σ2 | 0.5 | | 1am / 7am | 0.00 | 0.00 | -0.004 | 10 |
| τ00 Tran | 0.07 | | 3am / 5am | 0.00 | 0.00 | -0.004 | 10 |
| ICC | 0.12 | | 3am / 7am | 0.00 | 0.00 | -0.004 | 10 |
| N Tran | 4 | | 5am / 7am | 1.00 | 0.00 | -1.989 | 0.272 |
| Observations | 40 | |  |  |  |  |  |

**Video S1 – Video examples from the TIR camera.**

[Thermal drone detecting rainforest canopy wildlife - YouTube](https://www.youtube.com/watch?v=v-qa9joeAZs)