猴群於各縣市的分布

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 資料筆數 | | | | | 樣區數 | | | | | 樣點數 | | | | |
| County | 2015 | 2016 | 2017 | 2018 | 2019 | 2015 | 2016 | 2017 | 2018 | 2019 | 2015 | 2016 | 2017 | 2018 | 2019 |
| 宜蘭縣 | 5 | 1 | - | 2 | 1 | 3 | 1 | - | 2 | 1 | 4 | 1 | - | 2 | 1 |
| 新北市 | 1 | - | - | 3 | 1 | 1 | - | - | 2 | 1 | 1 | - | - | 2 | 1 |
| 桃園市 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 1 |
| 新竹縣 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 1 |
| 苗栗縣 | 1 | - | - | 3 | 1 | 1 | - | - | 1 | 1 | 1 | - | - | 3 | 1 |
| 台中市 | 8 | 2 | 2 | 4 | 6 | 5 | 2 | 1 | 4 | 4 | 8 | 2 | 2 | 4 | 5 |
| 南投縣 | 2 | 5 | 3 | 7 | 13 | 2 | 5 | 2 | 7 | 8 | 2 | 5 | 2 | 7 | 13 |
| 雲林縣 | 9 | 7 | 8 | 9 | 7 | 3 | 2 | 4 | 2 | 1 | 8 | 7 | 7 | 7 | 4 |
| 嘉義縣 | 2 | 1 | - | 3 | 3 | 2 | 1 | - | 1 | 3 | 2 | 1 | - | 3 | 3 |
| 台南市 | - | - | 2 | 4 | 2 | - | - | 1 | 1 | 1 | - | - | 2 | 3 | 2 |
| 高雄市 | 2 | 3 | 7 | 5 | 5 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 7 | 5 | 5 |
| 屏東縣 | 3 | 3 | 6 | 2 | - | 2 | 2 | 3 | 2 | - | 3 | 2 | 5 | 2 | - |
| 花蓮縣 | 16 | 17 | 10 | 13 | 12 | 10 | 9 | 4 | 8 | 9 | 15 | 16 | 9 | 12 | 11 |
| 台東縣 | 2 | 1 | 2 | 13 | 18 | 2 | 1 | 1 | 6 | 9 | 2 | 1 | 2 | 12 | 14 |
| 合計 | 51 | 40 | 40 | 68 | 71 | 33 | 26 | 18 | 38 | 43 | 48 | 38 | 36 | 62 | 62 |

孤猴於各縣市的分布

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 資料筆數 | | | | | 樣區數 | | | | | 樣點數 | | | | |
| County | 2015 | 2016 | 2017 | 2018 | 2019 | 2015 | 2016 | 2017 | 2018 | 2019 | 2015 | 2016 | 2017 | 2018 | 2019 |
| 宜蘭縣 | - | 3 | - | - | 1 | - | 2 | - | - | 1 | - | 3 | - | - | 1 |
| 新北市 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 1 |
| 苗栗縣 | 1 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - |
| 台中市 | 2 | 1 | 1 | 4 | - | 2 | 1 | 1 | 4 | - | 2 | 1 | 1 | 4 | - |
| 南投縣 | 1 | 1 | 1 | 4 | 4 | 1 | 1 | 1 | 4 | 3 | 1 | 1 | 1 | 4 | 3 |
| 雲林縣 | 4 | - | 5 | 1 | 1 | 2 | - | 2 | 1 | 1 | 4 | - | 5 | 1 | 1 |
| 嘉義縣 | 3 | - | - | 2 | - | 2 | - | - | 1 | - | 3 | - | - | 2 | - |
| 台南市 | - | - | - | - | 2 | - | - | - | - | 1 | - | - | - | - | 1 |
| 高雄市 | 6 | 4 | 3 | 1 | 4 | 2 | 3 | 2 | 1 | 4 | 6 | 4 | 3 | 1 | 4 |
| 屏東縣 | - | 3 | 2 | 1 | - | - | 2 | 1 | 1 | - | - | 3 | 2 | 1 | - |
| 花蓮縣 | 8 | 4 | 2 | 11 | 4 | 4 | 4 | 2 | 7 | 3 | 6 | 4 | 2 | 11 | 4 |
| 台東縣 | - | 1 | - | 4 | 1 | - | 1 | - | 4 | 1 | - | 1 | - | 4 | 1 |
| 合計 | 25 | 17 | 14 | 28 | 18 | 14 | 14 | 9 | 23 | 15 | 23 | 17 | 14 | 28 | 16 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Survey | 總調查樣點數 | 樣點 | | | | | | 猴群 | | | | | |
| 森林 | | | | | 非森林 | 森林 | | | | | 非森林 |
| 闊葉林 | 針葉林 | 混淆林 | 竹林 | 合計 | 闊葉林 | 針葉林 | 混淆林 | 竹林 | 合計 |
| 2015 | 1 | 2846 | 1254 | 164 | 98 | 181 | 1697 | 1149 | 15 | 3 | 3 | 2 | 23 | 0 |
| 2015 | 2 | 2776 | 1214 | 162 | 97 | 186 | 1659 | 1117 | 21 | 1 | 4 | 1 | 27 | 1 |
| 2016 | 1 | 2870 | 1235 | 143 | 104 | 198 | 1680 | 1190 | 13 | 3 | 0 | 0 | 16 | 0 |
| 2016 | 2 | 2737 | 1159 | 143 | 98 | 182 | 1582 | 1155 | 16 | 2 | 3 | 3 | 24 | 0 |
| 2017 | 1 | 2659 | 1097 | 141 | 102 | 186 | 1526 | 1133 | 13 | 1 | 2 | 1 | 17 | 0 |
| 2017 | 2 | 2583 | 1069 | 133 | 100 | 184 | 1486 | 1097 | 13 | 1 | 3 | 4 | 21 | 2 |
| 2018 | 1 | 2778 | 1178 | 122 | 102 | 202 | 1604 | 1174 | 20 | 1 | 7 | 2 | 30 | 2 |
| 2018 | 2 | 2565 | 1098 | 116 | 97 | 183 | 1494 | 1071 | 27 | 0 | 4 | 4 | 35 | 1 |
| 2019 | 1 | 2614 | 1106 | 154 | 86 | 166 | 1512 | 1102 | 27 | 2 | 3 | 6 | 38 | 1 |
| 2019 | 2 | 2534 | 1077 | 138 | 84 | 164 | 1463 | 1071 | 18 | 1 | 0 | 10 | 29 | 3 |

Data Summary



2015~2018年不同森林類型內各距離段所記錄的猴群數

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | A (<25m) | B (25~100) | C (>100m) | 合計 |
| 闊葉林 | 70 | 57 | 8 | 135 |
| 針葉林 | 3 | 6 | 2 | 11 |
| 混淆林 | 8 | 13 | 3 | 24 |
| 竹林 | 6 | 11 | 0 | 17 |
| 非森林 | 2 | 3 | 1 | 6 |
| 合計 | 89 | 90 | 14 | 193 |



**#Include Macaca distance >100m**

Full model:

m1 <- glmer(Macaca\_sur ~ TypeName.1 + Year.re + Altitude + julian.D + Region + (1|Site\_N),

family = binomial, data = df)

summary(m1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | z value | Pr(>|z|) |  |
| (Intercept) | -7.05069 | 0.60382 | -11.677 | < 2e-16 | \*\*\* |
| Year.re | 0.12735 | 0.07125 | 1.787 | 0.073875 | . |
| TypeName.1broad-leaved | 0.58434 | 0.41226 | 1.417 | 0.156357 |  |
| TypeName.1coniferous | -0.1522 | 0.5936 | -0.256 | 0.797646 |  |
| TypeName.1mixed | 0.57216 | 0.40047 | 1.429 | 0.153088 |  |
| Altitude | 0.39741 | 0.2039 | 1.949 | 0.051287 | . |
| julian.D | 0.18325 | 0.0905 | 2.025 | 0.042897 | \* |
| RegionEast | 1.8046 | 0.51082 | 3.533 | 0.000411 | \*\*\* |
| RegionNorth | -0.95519 | 0.51278 | -1.863 | 0.062498 | . |
| RegionSouth | 0.46196 | 0.58192 | 0.794 | 0.427278 |  |

Anova(m1)

Analysis of Deviance Table (Type II Wald chisquare tests)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Chisq | Df | Pr(>Chisq) |  |
| Year.re | 3.1948 | 1 | 0.07387 | . |
| TypeName.1 | 4.4844 | 3 | 0.21368 |  |
| Altitude | 3.7989 | 1 | 0.05129 | . |
| julian.D | 4.0995 | 1 | 0.0429 | \* |
| Region | 27.6756 | 3 | 4.25E-06 | \*\*\* |

summary(glht(m1, linfct = mcp(Region = "Tukey")))

Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | z value | Pr(>|z|) |  |
| East - Center == 0 | 1.8046 | 0.5108 | 3.533 | 0.00233 | \*\* |
| North - Center == 0 | -0.9552 | 0.5128 | -1.863 | 0.2431 |  |
| South - Center == 0 | 0.462 | 0.5819 | 0.794 | 0.85663 |  |
| North - East == 0 | -2.7598 | 0.5354 | -5.154 | < 0.001 | \*\*\* |
| South - East == 0 | -1.3426 | 0.5946 | -2.258 | 0.10759 |  |
| South - North == 0 | 1.4171 | 0.5975 | 2.372 | 0.08214 | . |

Model selection table

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (Int) | Alt | jln.D | Rgn | TyN.1 | Yer.re | df | logLik | AICc | delta | weight |
| -6.487 | 0.2787 | 0.1804 | + |  | 0.1228 | 8 | -811.866 | 1639.7 | 0 | 0.192 |
| -6.452 |  | 0.2093 | + |  | 0.1251 | 7 | -813.057 | 1640.1 | 0.38 | 0.159 |
| -6.274 | 0.2975 | 0.1834 | + |  |  | 7 | -813.397 | 1640.8 | 1.06 | 0.113 |
| -6.794 | 0.3788 | 0.1833 | + | + | 0.1239 | 11 | -809.592 | 1641.2 | 1.46 | 0.093 |
| -6.113 |  | 0.2098 | + |  |  | 6 | -814.608 | 1641.2 | 1.48 | 0.092 |
| -6.626 | 0.3802 |  | + |  | 0.1291 | 7 | -813.791 | 1641.6 | 1.85 | 0.076 |

> importance(d1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Region | julian.D | Year.re | Altitude | TypeName.1 |
| Sum of weights: | 1 | 0.78 | 0.63 | 0.63 | 0.29 |
| N containing models: | 16 | 16 | 16 | 16 | 16 |

**#exclude Macaca distance >100m**

Full model:

m1 <- glmer(Macaca\_sur ~ TypeName.1 + Year.re + Altitude + julian.D + Region + (1|Site\_N),

family = binomial, data = df)

> Anova(m1)

Analysis of Deviance Table (Type II Wald chisquare tests)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Chisq | Df | Pr(>Chisq) |  |
| Year.re | 3.1948 | 1 | 0.07387 | . |
| TypeName.1 | 4.4844 | 3 | 0.21368 |  |
| Altitude | 3.7989 | 1 | 0.05129 | . |
| julian.D | 4.0995 | 1 | 0.0429 | \* |
| Region | 27.6756 | 3 | 4.25E-06 | \*\*\* |

> summary(glht(m1, linfct = mcp(Region = "Tukey")))

Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | z value | Pr(>|z|) |  |
| East - Center == 0 | 1.8046 | 0.5108 | 3.533 | 0.00241 | \*\* |
| North - Center == 0 | -0.9552 | 0.5128 | -1.863 | 0.24308 |  |
| South - Center == 0 | 0.462 | 0.5819 | 0.794 | 0.85663 |  |
| North - East == 0 | -2.7598 | 0.5354 | -5.154 | < 0.001 | \*\*\* |
| South - East == 0 | -1.3426 | 0.5946 | -2.258 | 0.10737 |  |
| South - North == 0 | 1.4171 | 0.5975 | 2.372 | 0.08216 | . |

Model selection table

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (Int) | Alt | jln.D | Rgn | TyN.1 | Yer.re | df | logLik | AICc | delta | weight |
| -6.487 | 0.2787 | 0.1804 | + |  | 0.1228 | 8 | -811.866 | 1639.7 | 0 | 0.192 |
| -6.452 |  | 0.2093 | + |  | 0.1251 | 7 | -813.057 | 1640.1 | 0.38 | 0.159 |
| -6.274 | 0.2975 | 0.1834 | + |  |  | 7 | -813.397 | 1640.8 | 1.06 | 0.113 |
| -6.794 | 0.3788 | 0.1833 | + | + | 0.1239 | 11 | -809.592 | 1641.2 | 1.46 | 0.093 |
| -6.113 |  | 0.2098 | + |  |  | 6 | -814.608 | 1641.2 | 1.48 | 0.092 |
| -6.626 | 0.3802 |  | + |  | 0.1291 | 7 | -813.791 | 1641.6 | 1.85 | 0.076 |

importance(d1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Region | julian.D | Year.re | Altitude | TypeName.1 |
| Sum of weights: | 1 | 0.78 | 0.63 | 0.63 | 0.29 |
| N containing models: | 16 | 16 | 16 | 16 | 16 |

**#Estimate**

森林總面積=21536.41(km2)

分層：森林類型4層\* Julian Day 10層

|  |  |  |
| --- | --- | --- |
| 單位面積的半徑 | 25m | 100m |
| 密度Mean | 0.004338623 | 0.0140073 |
| SD | 0.000531627 | 0.05473798 |
| 相對密度(80% CI) | -0.02517439 ~ 0.03385163 | -0.2854634 ~ 0.313478 |
| 相對密度(95% CI) | -0.04085317 ~ 0.04953042 | -0.4445572 ~ 0.4725718 |
| **群** | **47,612** | **9,607** |
| **猴群數(80% CI)** | **0 ~ 371,487** | **0 ~215,006** |
| **猴群數(95% CI)** | **0 ~ 543,545** | **0 ~ 324,124** |

**#Rtrim**

Region: 四個分區中，海拔1,000公尺以下有三區，分別為

北部地區（包含新竹、桃園、北北基以及宜蘭）；

東部地區（包含花蓮、臺東以及恆春半島東半部）；

西部地區（包含苗栗、臺中、彰化、南投、雲林、嘉義、臺南、高雄、屏東以及恆春半島的西半部）。

海拔高於1,000公尺的樣區則合併歸為中高海拔山區。

|  |
| --- |
| **>trim(bird.data, count\_col = "Macaca\_sur", site\_col = "Site\_N",**  **year\_col = "Year", weights\_col = "weight", covar\_cols = "Region",**  **model = 2, overdisp = T, serialcor = F, autodelete = T, stepwise = F)**  Model : 2  Method : GEE (Convergence reached after 6 iterations)  Coefficients:  covar cat from upto add se\_add mul se\_mul  1 baseline 0 2015 2018 0.5285990 0.4830606 1.6965537 0.8195383  2 Region 2 2015 2018 -0.4224405 0.4959588 0.6554453 0.3250738  3 Region 3 2015 2018 -0.3975320 0.4999194 0.6719764 0.3359340  4 Region 4 2015 2018 -0.4071457 0.5077487 0.6655472 0.3379307  Overdispersion : 1.1270  Goodness of fit:  Chi-square = 174.68, df=155, p=0.1332  Likelihood Ratio = 190.49, df=155, p=0.0276  AIC (up to a constant) = -119.51 |

**> wald(m1)**

|  |
| --- |
| Wald test for significance of covariates  Covariate W df p  Region 0.7277765 3 0.866652  Wald test for significance of changes in slope  Changepoint Wald\_test df p  2015 3.729534 4 0.443845 |

|  |
| --- |
| **> overall(m1,"imputed")**  from upto add se\_add mul se\_mul p meaning  2015 2018 0.01108377 0.07908815 1.011145 0.07996962 0.9013859 Uncertain |

