**DATA SUMMARY**

說明：

使用的獼猴資料皆符合**6分鐘內且100m內且調查日在61~180內**之標準，也刪掉距離過近的猴群資料。

猴群於各縣市的分布

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 縣市 | 資料筆數 | | | | | 樣區數 | | | | | 樣點數 | | | | |
| 2015 | 2016 | 2017 | 2018 | 2019 | 2015 | 2016 | 2017 | 2018 | 2019 | 2015 | 2016 | 2017 | 2018 | 2019 |
| 宜蘭縣 | 4 | 1 | - | 2 | 1 | 2 | 1 | - | 2 | 1 | 3 | 1 | - | 2 | 1 |
| 新北市 | 1 | - | - | 2 | - | 1 | - | - | 2 | - | 1 | - | - | 2 | - |
| 桃園市 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 1 |
| 苗栗縣 | 1 | - | - | 1 | 1 | 1 | - | - | 1 | 1 | 1 | - | - | 1 | 1 |
| 台中市 | 6 | 2 | - | 3 | 3 | 4 | 2 | - | 3 | 2 | 6 | 2 | - | 3 | 2 |
| 南投縣 | 2 | 5 | 3 | 7 | 10 | 2 | 5 | 2 | 7 | 6 | 2 | 5 | 2 | 7 | 10 |
| 雲林縣 | 8 | 5 | 7 | 9 | 7 | 3 | 1 | 4 | 2 | 2 | 7 | 5 | 7 | 7 | 5 |
| 嘉義縣 | - | 1 | - | 2 | 1 | - | 1 | - | 1 | 1 | - | 1 | - | 2 | 1 |
| 台南市 | - | - | 2 | 3 | 1 | - | - | 1 | 1 | 1 | - | - | 2 | 2 | 1 |
| 高雄市 | 2 | 3 | 5 | 5 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 3 | 5 | 5 | 2 |
| 屏東縣 | 3 | 3 | 6 | 2 | 1 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 5 | 2 | 1 |
| 花蓮縣 | 15 | 16 | 10 | 12 | 11 | 9 | 9 | 4 | 7 | 7 | 14 | 15 | 9 | 11 | 10 |
| 台東縣 | 2 | 1 | 1 | 13 | 16 | 2 | 1 | 1 | 6 | 9 | 2 | 1 | 1 | 12 | 13 |
| 合計 | 44 | 37 | 34 | 61 | 55 | 28 | 25 | 17 | 36 | 33 | 41 | 35 | 31 | 56 | 48 |

孤猴於各縣市的分布

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 縣市 | 資料筆數 | | | | | 樣區數 | | | | | 樣點數 | | | | |
| 2015 | 2016 | 2017 | 2018 | 2019 | 2015 | 2016 | 2017 | 2018 | 2019 | 2015 | 2016 | 2017 | 2018 | 2019 |
| 宜蘭縣 | - | 1 | - | - | - | - | 1 | - | - | - | - | 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 | 3 | 3 | 1 | 1 | 1 | 3 | 2 | 1 | 1 | 1 | 3 | 2 |
| 雲林縣 | 4 | - | 5 | - | 1 | 2 | - | 2 | - | 1 | 4 | - | 5 | - | 1 |
| 嘉義縣 | 1 | - | - | 2 | - | 1 | - | - | 1 | - | 1 | - | - | 2 | - |
| 台南市 | - | - | - | - | 2 | - | - | - | - | 1 | - | - | - | - | 1 |
| 高雄市 | 4 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 4 | 3 | 1 | 1 | 2 |
| 屏東縣 | - | 3 | 2 | 1 | 1 | - | 2 | 1 | 1 | 1 | - | 3 | 2 | 1 | 1 |
| 花蓮縣 | 8 | 3 | 2 | 11 | 3 | 4 | 3 | 2 | 7 | 2 | 6 | 3 | 2 | 11 | 3 |
| 台東縣 | - | 1 | - | 3 | 1 | - | 1 | - | 3 | 1 | - | 1 | - | 3 | 1 |
| 合計 | 21 | 13 | 12 | 25 | 14 | 12 | 11 | 8 | 20 | 11 | 19 | 13 | 12 | 25 | 12 |

2015~2019年各縣市的調查筆數及猴群數

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 分區 | 縣市 | 縣市面積  (km2) | 資料筆數 | | | | | | 猴群數 | | | | | |
| 2015 | 2016 | 2017 | 2018 | 2019 | 總計 | 2015 | 2016 | 2017 | 2018 | 2019 | 總計 |
| 北部 | 宜蘭縣 | 2201.43 | 174 | 145 | 93 | 73 | 83 | 5554 | 4 | 1 | 0 | 2 | 1 | 15 |
| 基隆市 | 137.57 | 20 | 20 | 12 | 12 | 20 | 0 | 0 | 0 | 0 | 0 |
| 台北市 | 269.85 | 284 | 270 | 262 | 196 | 193 | 0 | 0 | 0 | 0 | 0 |
| 新北市 | 2066.26 | 435 | 306 | 276 | 347 | 252 | 1 | 0 | 0 | 2 | 0 |
| 桃園市 | 1217.22 | 154 | 190 | 164 | 132 | 146 | 0 | 0 | 0 | 0 | 1 |
| 新竹市 | 124.39 | 12 | 12 | 12 | 18 | 24 | 0 | 0 | 0 | 0 | 0 |
| 新竹縣 | 1411.57 | 75 | 82 | 75 | 141 | 54 | 0 | 0 | 0 | 0 | 0 |
| 苗栗縣 | 1826.68 | 156 | 203 | 110 | 174 | 147 | 1 | 0 | 0 | 1 | 1 |
| 中彰投 | 台中市 | 2239.79 | 246 | 260 | 224 | 274 | 229 | 4623 | 6 | 2 | 0 | 2 | 3 | 40 |
| 彰化縣 | 1244.55 | 68 | 68 | 68 | 66 | 68 | 0 | 0 | 0 | 0 | 0 |
| 南投縣 | 4097.75 | 511 | 583 | 605 | 674 | 679 | 2 | 5 | 3 | 7 | 10 |
| 雲嘉南 | 雲林縣 | 1399.57 | 90 | 100 | 104 | 87 | 84 | 1728 | 8 | 5 | 7 | 9 | 7 | 46 |
| 嘉義市 | 59.72 | 34 | 22 | 26 | 26 | 26 | 0 | 0 | 0 | 0 | 0 |
| 嘉義縣 | 1952.77 | 129 | 104 | 88 | 67 | 68 | 0 | 1 | 0 | 2 | 1 |
| 台南市 | 2258.82 | 135 | 143 | 143 | 126 | 126 | 0 | 0 | 2 | 3 | 1 |
| 高屏 | 高雄市 | 2998.50 | 182 | 216 | 170 | 201 | 245 | 1517 | 2 | 3 | 4 | 5 | 2 | 31 |
| 屏東縣 | 2805.02 | 102 | 96 | 88 | 120 | 97 | 3 | 3 | 6 | 2 | 1 |
| 花蓮 | 花蓮縣 | 4605.32 | 340 | 302 | 325 | 307 | 323 | 1597 | 14 | 16 | 10 | 11 | 11 | 62 |
| 台東 | 台東縣 | 3582.21 | 118 | 118 | 100 | 143 | 149 | 628 | 2 | 1 | 1 | 12 | 14 | 30 |
|  |  |  |  |  |  |  |  | 15647 |  |  |  |  |  | 224 |

縣市GIS資料來源：政府開放平台(資料公佈日期：2019/11/26)

樣點與猴群於森林類型之分布

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 年 | 旅次 | 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 | 2789 | 1152 | 164 | 180 | 175 | 1671 | 1118 | 15 | 2 | 2 | 2 | - | 21 |
| 2015 | 2 | 2696 | 1110 | 140 | 176 | 168 | 1594 | 1102 | 17 | - | 4 | 1 | 1 | 22 |
| 2016 | 1 | 2913 | 1195 | 144 | 163 | 201 | 1703 | 1210 | 12 | 1 | 1 | - | - | 14 |
| 2016 | 2 | 2694 | 1060 | 142 | 156 | 179 | 1537 | 1157 | 15 | 2 | 3 | 3 | - | 23 |
| 2017 | 1 | 2637 | 1029 | 140 | 154 | 185 | 1508 | 1129 | 11 | 1 | 2 | 1 | - | 15 |
| 2017 | 2 | 2526 | 989 | 115 | 153 | 180 | 1437 | 1089 | 11 | 1 | 2 | 4 | 1 | 18 |
| 2018 | 1 | 2800 | 1141 | 130 | 169 | 204 | 1644 | 1156 | 18 | 1 | 6 | 2 | 2 | 27 |
| 2018 | 2 | 2631 | 1067 | 125 | 163 | 185 | 1540 | 1091 | 21 | - | 6 | 4 | 1 | 31 |
| 2019 | 1 | 2671 | 1050 | 136 | 158 | 171 | 1515 | 1156 | 22 | 1 | 2 | 4 | 1 | 29 |
| 2019 | 2 | 2663 | 1054 | 120 | 153 | 171 | 1498 | 1165 | 12 | 1 | 1 | 10 | 1 | 24 |

2015~2019年不同森林類型內資料筆數及猴群數

|  |  |  |  |
| --- | --- | --- | --- |
| 本計畫森林類型 | 第4次森林圖層 | 資料筆數 | 猴群數 |
| 闊葉林 | 闊葉樹林型 | 10846 | 154 |
| 針葉林 | 針葉樹林型 | 1356 | 10 |
| 混淆林 | 竹闊混淆林 | 969 | 23 |
| 針闊葉樹混淆林 | 646 | 6 |
| 竹針混淆林 | 10 | 0 |
| 竹林 | 竹林 | 1819 | 31 |
| 總計 | | 15646 | 224 |

2015~2019年不同森林類型內各距離段所記錄的猴群數

|  |  |  |  |
| --- | --- | --- | --- |
|  | A (<25m) | B (25~100) | 合計 |
| 闊葉林 | 87 | 67 | 154 |
| 針葉林 | 4 | 6 | 10 |
| 混淆林 | 12 | 17 | 29 |
| 竹林 | 14 | 17 | 31 |
| 非森林 | 4 | 3 | 7 |
| 合計 | 121 | 110 | 231 |

2015~2019年Data Summary

說明：

獼猴資料皆符合 **6分鐘內**且**100m內**且在**森林內**之標準。(畫圖、GLMM、rtrim的資料都是同一份)

**    **

**GLMM**

Full model:

m1 <- glmer(猴群數 ~ 森林類型 + 年 + 海拔 + 調查日 + 分區 + (1|Site\_N), family = binomial, data = df)

1. 年為連續變數：2015~2019 年。

2. 森林類型為類別變數：分別為闊葉林、針葉林、混淆林、竹林等4 種。

3. 海拔為連續變數：。

4. 調查日為連續變數：調查日期為當年度的第n天，範圍61~180。

5. 分區等為類別變數：分別為北部、中彰投、雲嘉南、高屏、花蓮、臺東等六區；

1. 北部為基隆市、臺北市、新北市、桃園市、新竹縣、苗栗縣、宜蘭縣；
2. 中彰投為臺中市、彰化縣、南投縣；
3. 雲嘉南為雲林縣、嘉義縣、嘉義市、臺南市；
4. 高屏為高雄市、屏東縣；
5. ；
6. 。

6. 樣區為隨機變數。

7. 分析總筆數：15647筆

Model selection table

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (Intercept) | 海拔 | 調查日 | 分區 | 森林類型 | 年 | df | logLik | AICc | delta | weight |
| -6.598 | 0.4154 |  | + |  | 0.0928 | 9 | -970.947 | 1959.9 | 0 | 0.246 |
| -6.595 | 0.3814 | 0.08742 | + |  | 0.0916 | 10 | -970.347 | 1960.7 | 0.8 | 0.165 |
| -6.289 | 0.4075 |  | + |  |  | 8 | -972.566 | 1961.1 | 1.24 | 0.133 |
| -6.289 | 0.3727 | 0.09023 | + |  |  | 9 | -971.927 | 1961.9 | 1.96 | 0.092 |

>importance(d1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 分區 | 海拔 | 年 | 調查日 | 森林類型 |
| Sum of weights: | 1 | 0.87 | 0.64 | 0.42 | 0.25 |
| N containing models: | 16 | 16 | 16 | 16 | 16 |

Analysis of Deviance Table (Type II Wald chisquare tests)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Chisq | Df | P-value(>Chisq) |  |
| 森林類型 | 3.7043 | 3 | 0.2952 |  |
| 年 | 3.1202 | 1 | 0.0773 |  |
| 海拔 | 7.4698 | 1 | 0.0063 | \*\* |
| 調查日 | 1.2249 | 1 | 0.2684 |  |
| 分區 | 41.4099 | 5 | < 0.001 | \*\*\* |

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

Multiple Comparisons of Means: Tukey Contrasts

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Estimate | | Std. Error | | | z value | | P-value(>|z|) | |  |
| 雲嘉南 - 中彰投 == 0 | 0.6274 | | 0.5751 | | | 1.0910 | | 0.8823 | |  |
| 花蓮 - 中彰投 == 0 | 1.8743 | | 0.5253 | | | 3.5680 | | 0.0047 | | \*\* |
| 臺東 - 中彰投 == 0 | 2.9119 | | 0.7106 | | | 4.0980 | | < 0.001 | | \*\*\* |
| 北部 - 中彰投 == 0 | -0.7495 | | 0.5031 | | | -1.4900 | | 0.6650 | |  |
| 高屏 - 中彰投 == 0 | 0.8365 | | 0.6002 | | | 1.3940 | | 0.7257 | |  |
| 花蓮 - 雲嘉南 == 0 | 1.2469 | | 0.6054 | | | 2.0600 | | 0.3028 | |  |
| 臺東 - 雲嘉南 == 0 | 2.2845 | | 0.7782 | | | 2.9360 | | 0.0377 | | \* |
| 北部 - 雲嘉南 == 0 | -1.3769 | | 0.5802 | | | -2.3730 | | 0.1616 | |  |
| 高屏 - 雲嘉南 == 0 | 0.2091 | | 0.6591 | | | 0.3170 | | 0.9996 | |  |
| 臺東 - 花蓮 == 0 | 1.0376 | | 0.7122 | | | 1.4570 | | 0.6862 | |  |
| 北部 - 花蓮 == 0 | -2.6238 | | 0.5239 | | | -5.0080 | | < 0.001 | | \*\*\* |
| 高屏 - 花蓮 == 0 | -1.0379 | | 0.6096 | | | -1.7030 | | 0.5233 | |  |
| 北部 - 臺東 == 0 | -3.6614 | | 0.7127 | | | -5.1380 | | < 0.001 | | \*\*\* |
| 高屏 - 臺東 == 0 | -2.0754 | | 0.7762 | | | -2.6740 | | 0.0786 | |  |
| 高屏 - 北部 == 0 | 1.5860 | | 0.5916 | | | 2.6810 | | 0.0768 | |  |

如果把森林類型從model中拿掉的話…

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Chisq | Df | Pr(>Chisq) |  |
| 海拔 | 4.8424 | 1 | 0.0278 |  |
| 年 | 3.149 | 1 | 0.0760 | . |
| 調查日 | 1.1983 | 1 | 0.2737 | \* |
| 分區 | 41.5147 | 5 | <0.001 | \*\*\* |

**Estimate**

森林總面積=21536.41(km2)

分層：森林類型4層\* 分區4層

|  |  |  |
| --- | --- | --- |
| 單位面積的半徑 | 25m | 100m |
| 密度Mean | 0.0053694 | 0.0163951 |
| SD | 0.0007462 | 0.0105148 |
| 相對密度(80% CI) | 0.004414242 ~ 0.006324642 | 0.00293623 ~ 0.02985399 |
| 相對密度(95% CI) | 0.003906842 ~ 0.006832042 | -0.004213801 ~ 0.03700402 |
| **群** | **58,893.75 群** | **11,239.25 群** |
| **猴群數(80% CI)** | **48,417.19 ~ 69,371.23 群** | **2,012.86 ~ 20,465.66 群** |
| **猴群數(95% CI)** | **42,851.82 ~ 74,936.59 群** | **0 ~ 25,367.19 群** |

**Rtrim**

Region:分為東部、中部、南部、北部，與GLMM同。

最小的scale：樣點

trim(df, count\_col = "number", site\_col = "SP", year\_col = "Year",

weights\_col = "weight", covar\_cols = "Region", model = 2,

changepoints = "all", overdisp = F, serialcor = F, autodelete = T,

stepwise = F)

Model : 2

Method : ML (Convergence reached after 7 iterations)

Coefficients:

covar cat from upto add se\_add mul se\_mul

1 baseline 0 2015 2017 -0.21697733 0.1831711 0.8049482 0.1474433

2 baseline 0 2017 2018 0.49733136 0.3353751 1.6443273 0.5514665

3 Region 2 2015 2017 0.15072668 0.2668305 1.1626788 0.3102382

4 Region 2 2017 2018 -0.02413176 0.463283 0.9761571 0.452237

5 Region 3 2015 2017 -1.6253166 1.0394405 0.1968493 0.2046132

6 Region 3 2017 2018 5.27788419 2.1980012 195.9548327 430.7089573

7 Region 4 2015 2017 0.73049803 0.3303696 2.0761143 0.685885

8 Region 4 2017 2018 -0.72006612 0.5408663 0.4867201 0.2632505

Goodness of fit:

Chi-square = 337.83, df=364, p=0.8339

Likelihood Ratio = 331.94, df=364, p=0.8849

AIC (up to a constant) = -396.06

> wald(m1)

Wald test for significance of covariates

Covariate W df p

Region 12.2644 6 0.05632363

Wald test for significance of changes in slope

Changepoint Wald\_test df p

2015 8.250308 4 0.08282763

2017 11.206205 4 0.02434173

> overall(m1,"imputed")

From upto add se\_add mul se\_mul p meaning

2015 2018 0.5080409 0.3436482 1.662032 0.5711544 0.2773864 Uncertain

