**DATA SUMMARY**

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 | 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 | - | - | 2 | 1 | 1 | - | - | 1 | 1 | 1 | - | - | 2 | 1 |
| 台中市 | 7 | 2 | 2 | 4 | 5 | 5 | 2 | 1 | 4 | 4 | 7 | 2 | 2 | 4 | 4 |
| 南投縣 | 2 | 5 | 3 | 7 | 12 | 2 | 5 | 2 | 7 | 8 | 2 | 5 | 2 | 7 | 12 |
| 雲林縣 | 8 | 6 | 8 | 9 | 7 | 3 | 2 | 4 | 2 | 1 | 7 | 6 | 7 | 7 | 4 |
| 嘉義縣 | 2 | 1 | - | 3 | 3 | 2 | 1 | - | 1 | 3 | 2 | 1 | - | 3 | 3 |
| 台南市 | - | - | 2 | 3 | 2 | - | - | 1 | 1 | 1 | - | - | 2 | 2 | 2 |
| 高雄市 | 2 | 3 | 6 | 5 | 4 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 6 | 5 | 4 |
| 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 | 17 | 2 | 1 | 1 | 6 | 9 | 2 | 1 | 2 | 12 | 14 |
| 合計 | 49 | 39 | 39 | 66 | 67 | 33 | 26 | 18 | 38 | 43 | 46 | 37 | 35 | 60 | 59 |

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 | - | 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 |

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 | 2876 | 1266 | 164 | 98 | 189 | 1717 | 1159 | 15 | 3 | 3 | 2 | 23 | 0 |
| 2015 | 2 | 2746 | 1202 | 162 | 97 | 178 | 1639 | 1107 | 20 | 1 | 3 | 1 | 25 | 1 |
| 2016 | 1 | 2903 | 1256 | 144 | 104 | 201 | 1705 | 1198 | 13 | 2 | 0 | 0 | 15 | 0 |
| 2016 | 2 | 2704 | 1138 | 142 | 98 | 179 | 1557 | 1147 | 16 | 2 | 3 | 3 | 24 | 0 |
| 2017 | 1 | 2659 | 1097 | 141 | 102 | 186 | 1526 | 1133 | 12 | 1 | 2 | 1 | 16 | 0 |
| 2017 | 2 | 2583 | 1069 | 133 | 100 | 184 | 1486 | 1097 | 13 | 1 | 3 | 4 | 21 | 2 |
| 2018 | 1 | 2853 | 1233 | 131 | 102 | 204 | 1670 | 1183 | 20 | 1 | 6 | 2 | 29 | 2 |
| 2018 | 2 | 2631 | 1133 | 125 | 97 | 185 | 1540 | 1091 | 26 | 0 | 4 | 4 | 34 | 1 |
| 2019 | 1 | - | - | - | - | - | - | - | 25 | 2 | 3 | 6 | 36 | 1 |
| 2019 | 2 | - | - | - | - | - | - | - | 17 | 1 | 0 | 9 | 27 | 3 |

2019年樣點資料回收尚未完全。

2015~2018年猴群出現的樣點與森林圖層的距離



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 |

2015~2018年Data Summary

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**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：2015~2018 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。

5. 分區等為類別變數：分別為東部、中部、南部、北部等四區。

(1)東部為花蓮縣、臺東縣；

(2)中部為臺中市、彰化縣、南投縣、雲林縣、嘉義縣；

(3)南部為臺南市、高雄市、屏東縣；

(4)北部為基隆市、臺北市、新北市、桃園市、新竹縣、苗栗縣、宜蘭縣。

6. 樣區為隨機變數。

Analysis of Deviance Table (Type II Wald chisquare tests)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Chisq | Df | P-value(>Chisq) |  |
| 年 | 3.0298 | 1 | 0.0818 |  |
| 森林類型 | 4.4189 | 3 | 0.2196 |  |
| 海拔 | 3.7078 | 1 | 0.0542 |  |
| 調查日 | 4.1065 | 1 | 0.0427 | \* |
| 分區 | 27.2269 | 3 | < 0.001 | \*\*\* |

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

Multiple Comparisons of Means: Tukey Contrasts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Estimate | Std. Error | z value | P-value(>|z|) |  |
| East - Center == 0 | 1.8312 | 0.5184 | 3.5320 | 0.0023 | \*\* |
| North - Center == 0 | -0.9372 | 0.5185 | -1.8070 | 0.2685 |  |
| South - Center == 0 | 0.4778 | 0.5897 | 0.8100 | 0.8489 |  |
| North - East == 0 | -2.7684 | 0.5422 | -5.1060 | < 0.001 | \*\*\* |
| South - East == 0 | -1.3534 | 0.6034 | -2.2430 | 0.1114 |  |
| South - North == 0 | 1.4150 | 0.6043 | 2.3410 | 0.0883 |  |

Model selection table

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (Intercept) | 海拔 | 調查日 | 分區 | 森林類型 | 年 | df | logLik | AICc | delta | weight |
| -6.667 | 0.308 | 0.183 | + |  | 0.125 | 8 | -812.208 | 1640.4 | 0 | 0.199 |
| -6.482 |  | 0.209 | + |  | 0.122 | 7 | -813.492 | 1641 | 0.56 | 0.150 |
| -6.320 | 0.299 | 0.184 | + |  |  | 7 | -813.748 | 1641.5 | 1.08 | 0.116 |
| -7.094 | 0.398 | 0.184 | + | + | 0.124 | 11 | -809.883 | 1641.8 | 1.36 | 0.101 |
| -6.144 |  | 0.210 | + |  |  | 6 | -814.971 | 1641.9 | 1.52 | 0.093 |
| -6.667 | 0.308 | 0.183 | + |  | 0.125 | 8 | -812.208 | 1640.4 | 0 | 0.199 |

>importance(d1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 分區 | 調查日 | 年 | 海拔 | 森林類型 |
| Sum of weights: | 1 | 0.79 | 0.64 | 0.63 | 0.29 |
| N containing models: | 16 | 16 | 16 | 16 | 16 |

如果把森林類型從model中拿掉的話…

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Chisq | Df | Pr(>Chisq) |  |
| 海拔 | 2.5041 | 1 | 0.11355 |  |
| 年 | 3.0631 | 1 | 0.08009 | . |
| 調查日 | 4.0596 | 1 | 0.04392 | \* |
| 分區 | 28.7665 | 3 | 2.51E-06 | \*\*\* |

**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** | **58893.75 群** | **11239.25 群** |
| **猴群數(80% CI)** | **48417.19 ~ 69371.23 群** | **2012.86 ~ 20465.66 群** |
| **猴群數(95% CI)** | **42851.82 ~ 74936.59 群** | **0 ~ 25367.19 群** |

**Rtrim**

Region: 四個分區與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

