**DATA SUMMARY**

說明：

使用的獼猴資料皆符合**6分鐘內且100m內且調查日在調查季(約53~188)內**之標準，也刪掉距離過近的猴群資料。

**\*\*\*包括非森林內的資料**

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 | 2 | 3 | 3 | 4 | 2 | 1 | 3 | 2 | 6 | 2 | 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 | 1 | - | 2 | 1 | 1 | 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 | 12 | 9 | 9 | 4 | 7 | 8 | 14 | 15 | 9 | 11 | 11 |
| 台東縣 | 2 | 1 | 1 | 13 | 16 | 2 | 1 | 1 | 6 | 9 | 2 | 1 | 1 | 12 | 13 |
| 合計 | 45 | 37 | 36 | 61 | 56 | 29 | 25 | 18 | 36 | 34 | 42 | 35 | 33 | 56 | 49 |

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 | 3 | - | - | 2 | - | 2 | - | - | 1 | - | 3 | - | - | 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 | - | 4 | 1 | - | 1 | - | 4 | 1 | - | 1 | - | 4 | 1 |
| 合計 | 23 | 13 | 12 | 26 | 14 | 13 | 11 | 8 | 21 | 11 | 21 | 13 | 12 | 26 | 12 |

**\*\*\*only 森林 (用來統計分析的data)**

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 | 2 | 2 | 3 | 4 | 2 | 1 | 2 | 2 | 6 | 2 | 2 | 2 | 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 | 1 | - | 2 | 1 | 1 | 1 | - | 1 | 1 | 1 | 1 | - | 2 | 1 |
| 台南市 | - | - | 2 | 3 | 1 | - | - | 1 | 1 | 1 | - | - | 2 | 2 | 1 |
| 高雄市 | 2 | 3 | 4 | 5 | 2 | 2 | 3 | 1 | 2 | 1 | 2 | 3 | 4 | 5 | 2 |
| 屏東縣 | 3 | 3 | 6 | 2 | 1 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 5 | 2 | 1 |
| 花蓮縣 | 14 | 16 | 10 | 11 | 12 | 8 | 9 | 4 | 6 | 8 | 13 | 15 | 9 | 10 | 11 |
| 台東縣 | 2 | 1 | 1 | 12 | 14 | 2 | 1 | 1 | 6 | 8 | 2 | 1 | 1 | 11 | 11 |
| 合計 | 44 | 37 | 35 | 58 | 54 | 28 | 25 | 17 | 34 | 33 | 41 | 35 | 32 | 53 | 47 |

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 | 3 | - | - | 2 | - | 2 | - | - | 1 | - | 3 | - | - | 2 | - |
| 台南市 | - | - | - | - | 2 | - | - | - | - | 1 | - | - | - | - | 1 |
| 高雄市 | 4 | 3 | - | - | 2 | 1 | 2 | - | - | 2 | 4 | 3 | - | - | 2 |
| 屏東縣 | - | 3 | 2 | 1 | 1 | - | 2 | 1 | 1 | 1 | - | 3 | 2 | 1 | 1 |
| 花蓮縣 | 7 | 3 | 1 | 10 | 3 | 3 | 3 | 1 | 6 | 2 | 5 | 3 | 1 | 10 | 3 |
| 台東縣 | - | - | - | 4 | 1 | - | - | - | 4 | 1 | - | - | - | 4 | 1 |
| 合計 | 22 | 12 | 10 | 24 | 14 | 12 | 10 | 6 | 19 | 11 | 20 | 12 | 10 | 24 | 12 |

2015~2019年各分區的猴群數及樣點數

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 分區 | 面積(km2) |  | 2015\_1 | 2015\_2 | 2016\_1 | 2016\_2 | 2017\_1 | 2017\_2 | 2018\_1 | 2018\_2 | 2019\_1 | 2019\_2 | 總計 | 相對密度  ± SD  (群/樣點數) | 絕對密度  ± SD  (群/km2) |
| 北部 | 9254.960 | 猴群 | 4 | 2 | 0 | 1 | 0 | 0 | 2 | 3 | 1 | 2 | 42 | ± | ± |
| 樣點 | 704 | 636 | 668 | 560 | 516 | 501 | 603 | 502 | 495 | 448 | 4756 |
| 中彰投 | 7582.089 | 猴群 | 4 | 4 | 4 | 3 | 1 | 4 | 5 | 4 | 5 | 8 | 47 | 0.00879±0.00348 | ± |
| 樣點 | 439 | 432 | 471 | 460 | 473 | 466 | 518 | 503 | 503 | 491 | 1746 |
| 雲嘉南 | 5670.880 | 猴群 | 4 | 5 | 1 | 5 | 3 | 6 | 6 | 8 | 4 | 5 | 63 | ± | ± |
| 樣點 | 201 | 198 | 187 | 182 | 184 | 184 | 156 | 150 | 153 | 151 | 1611 |
| 高屏 | 5803.515 | 猴群 | 2 | 3 | 2 | 4 | 4 | 6 | 3 | 4 | 3 | 0 | 30 | ± | ± |
| 樣點 | 144 | 144 | 159 | 156 | 129 | 129 | 164 | 157 | 175 | 168 | 635 |
| 花蓮 | 4605.321 | 猴群 | 5 | 9 | 6 | 10 | 6 | 4 | 7 | 4 | 9 | 3 | 15 | ± | ± |
| 樣點 | 170 | 170 | 162 | 140 | 169 | 161 | 154 | 153 | 166 | 166 | 5633 |
| 台東 | 3582.207 | 猴群 | 2 | 0 | 1 | 0 | 1 | 0 | 4 | 8 | 8 | 6 | 31 | ± | ± |
| 樣點 | 59 | 59 | 59 | 59 | 55 | 45 | 75 | 75 | 75 | 74 | 1525 |
| 總計  (台灣本島) | 36498.973 | 猴群 | 21 | 23 | 14 | 23 | 15 | 20 | 27 | 31 | 30 | 24 | 228 | ± | ± |
| 樣點 | 1717 | 1639 | 1706 | 1557 | 1526 | 1486 | 1670 | 1540 | 1567 | 1498 | 15906 |

面積資料來源：政府開放平台的縣市GIS圖層(資料公佈日期：2019/11/26)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 年 | 旅次 |  | 分區 | | | | | | 總計  (台灣本島) |
| 北部 | 中彰投 | 雲嘉南 | 高屏 | 花蓮 | 台東 |
| 2015 | 1 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 2 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 2016 | 1 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 2 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 2017 | 1 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 2 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 2018 | 1 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 2 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 2019 | 1 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 2 | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 總計 | | 猴群 |  |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |  |
| 相對密度± SD (群/樣點數) | | |  |  |  |  |  |  |  |
| 絕對密度± SD (群/km2) | | |  |  |  |  |  |  |  |

面積資料來源：政府開放平台的縣市GIS圖層(資料公佈日期：2019/11/26)

2015~2019年各森林類型內的猴群數及樣點數

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 年 | 旅次 | 總調查  樣點數 |  | 森林 | | | | | 非森林 |
| 闊葉林 | 針葉林 | 混淆林 | 竹林 | 合計 |
| 2015 | 1 | 2789 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 2 | 2696 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 2016 | 1 | 2913 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 2 | 2694 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 2017 | 1 | 2637 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 2 | 2526 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 2018 | 1 | 2800 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 2 | 2631 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 2019 | 1 | 2671 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 2 | 2663 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 總計 | | 27020 | 猴群 |  |  |  |  |  |  |
| 樣點 |  |  |  |  |  |  |
| 相對密度± SD (群/樣點數) | | | |  |  |  |  |  |  |
| 絕對密度± SD (群/km2) | | | |  |  |  |  |  |  |

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 | 10847 | 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 | | 15647 | 224 |

2015~2019被Julian Day所移除掉的資料

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Julian Day** | Year | Survey | 猴群 | 樣點 |
| **199** | 2019 | 2 | 0筆 | 7筆 |

2015~2019年Data Summary之boxplot (都是10個點畫出來的)

**  **

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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：2015~2019 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. 花蓮縣；
6. 臺東縣。

6. 樣區為隨機變數。

7. 分析總筆數：15647筆；猴群224群。

PS1. 調查日：在平年，3/1第60天，6/30為第181天。

PS2. 調查季：有前後1星期的緩衝。

PS3. 如果不限制Julian day，在glmm分析結果中，Julian day也是不顯著。

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 |

**\*\*\*因為森林類型在AIC中的結果顯示不重要，所以接下來的GLMM都不納入分析**

Analysis of Deviance Table (Type II Wald chisquare tests)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Chisq | Df | P-value(>Chisq) |  |
| 海拔 | 4.8435 | 1 | 0.0278 | \*\* |
| 年 | 3.1494 | 1 | 0.0760 |  |
| 調查日 | 1.1986 | 1 | 0.2736 |  |
| 分區 | 41.5214 | 5 | < 0.001 | \*\*\* |

AIC = 1960.694

> 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 | 0.5683 | 0.5723 | 0.9930 | 0.9183 |  |
| 花蓮 - 中彰投 == 0 | 1.8650 | 0.5238 | 3.5600 | 0.0048 | \*\* |
| 臺東 - 中彰投 == 0 | 2.9229 | 0.7126 | 4.1020 | < 0.001 | \*\*\* |
| 北部 - 中彰投 == 0 | -0.7675 | 0.5033 | -1.5250 | 0.6422 |  |
| 高屏 - 中彰投 == 0 | 0.8296 | 0.6010 | 1.3800 | 0.7338 |  |
| 花蓮 - 雲嘉南 == 0 | 1.2967 | 0.5978 | 2.1690 | 0.2471 |  |
| 臺東 - 雲嘉南 == 0 | 2.3547 | 0.7746 | 3.0400 | 0.0276 | \* |
| 北部 - 雲嘉南 == 0 | -1.3357 | 0.5775 | -2.3130 | 0.1842 |  |
| 高屏 - 雲嘉南 == 0 | 0.2613 | 0.6577 | 0.3970 | 0.9987 |  |
| 臺東 - 花蓮 == 0 | 1.0580 | 0.7166 | 1.4760 | 0.6737 |  |
| 北部 - 花蓮 == 0 | -2.6324 | 0.5257 | -5.0080 | < 0.001 | \*\*\* |
| 高屏 - 花蓮 == 0 | -1.0354 | 0.6114 | -1.6930 | 0.5295 |  |
| 北部 - 臺東 == 0 | -3.6904 | 0.7163 | -5.1520 | < 0.001 | \*\*\* |
| 高屏 - 臺東 == 0 | -2.0934 | 0.7799 | -2.6840 | 0.0758 |  |
| 高屏 - 北部 == 0 | 1.5971 | 0.5943 | 2.6870 | 0.0755 |  |



從猴群在海拔分布上呈現峰型，並且發現相對密度較高的區段在500~1250公尺。

**Estimate**

森林總面積=21536.41(km2)

方法：bootstrap

重複抽樣：5000次

|  |  |
| --- | --- |
| 單位面積的半徑 | 100m |
| 絕對密度(群/ km2) | 0.4557 |
| 絕對密度(95% CI) | 0.0125 ~ 0.0162 |
| **群** | **9813群** |
| **猴群數(95% CI)** | **8543 ~ 11128群** |

**Rtrim**

Region:分為北部、中彰投、雲嘉南、高屏、花蓮、台東，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)

Goodness of fit:

Chi-square = 500.14, df=518, p=0.7056

Likelihood Ratio = 432.55, df=518, p=0.9974

AIC (up to a constant) = -603.45

> wald(m1)

Wald test for significance of covariates

Covariate W df p

Region2 30.93178 15 0.008971353

Wald test for significance of changes in slope

Changepoint Wald\_test df p

2015 8.603741 6 0.19712015

2017 11.505695 6 0.07394943

2018 11.297556 6 0.07960409

> overall(m1,"imputed")

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

2015 2019 0.6702825 0.4533896 1.954789 0.8862813 0.2358378 Uncertain

