

# Test of garden hunting hypothesis for mammals in La Gran Sabana, Venezuela using occupancy models

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## Methods

### Model definition

### Covariates of probability of detection

### Covariates of probability of occupancy - frequency of use

For the location of each camera, we downloaded the time series of Terra Moderate Resolution Imaging Spectroradiometer (MODIS) Vegetation Indices (MOD13Q1) Version 6 with a temporal resolution of 16 days and a spatial resolution of 250 meter (Data source: <https://lpdaac.usgs.gov/products/mod13q1v006/>).

We used the Normalized Difference Vegetation Index (NDVI) measurements from 2010 to 2019. The time series have n=215 total measurements per camera, but we considered only those with good reliability and production quality of the observations (see product user manual in [https://lpdaac.usgs.gov/documents/103/MOD13\\_User\\_Guide\\_V6.pdf](https://lpdaac.usgs.gov/documents/103/MOD13_User_Guide_V6.pdf)).

### Habitat classification

## Results

### Goodness of fit

MacKenzie and Bailey Goodness-of-fit Test for Royle-Nichols Occupancy Models.

These species show one or more signs of lack of fit, probably due to the low number of detections:

##	spp	n.detect	chi.square	p.value	c.hat.est	large.coefs	large.SE
## 1	T.major	18	259.79464	0.9089	0.1627314	1.997841	0.9496989
## 2	P.maximus	6	57.77727	0.6702	0.2781694	6.314187	3.8660475
## 3	O.virginianus	4	69.79056	0.1638	1.2168687	13.116899	7.0882253
## 4	C.olivaceus	7	215.06256	0.1288	1.4806293	9.358572	2.2896328
## 5	L.pardalis	15	1328.96760	0.1476	1.5787944	2.595576	1.1826112
## 6	L.wiedii	2	36.77011	0.1267	2.1384643	17.999527	28.6721375
## 7	P.concolor	9	187.81866	0.0669	2.1389520	63.557464	38.3550939
## 8	C.unicinctus	2	169.06990	0.0318	5.0234796	6.666408	3.6873545
## 9	H.hydrochaeris	2	68.95269	0.0315	7.2047951	3.690178	6.7769076
## 10	P.tajacu	2	58.39312	0.0151	9.5490141	55.961881	68.7921296

These species appear to have a good fit but the model has over-dispersion ( $c - \hat{c} > 1$ ), and might have problems with large coefficients and standard errors

```
##          spp n.detect chi.square p.value c.hat.est large.coefs large.SE
## 1      T.pecari      2  10.142795  0.3629  1.033483   17.11700 19.380774
## 2  O.virginianus      4  69.790557  0.1638  1.216869   13.11690  7.088225
## 3  D.marsupialis      2   9.727674  0.2237  1.443056   76.02648 51.909755
```

For this species, the over-dispersion might be accounted for by using quasi-AICc

```
##          spp n.detect chi.square p.value c.hat.est large.coefs large.SE
## 1  P.onca      12  440.9212  0.2154  1.086351    2.381425  1.18029
```

These species appear to have a good fit and no signs of over-dispersion, but could have problems with large coefficients or standard errors:

```
##          spp n.detect chi.square p.value c.hat.est large.coefs large.SE
## 1      M.americana     17  237.93467  0.6900  0.3385060   7.204168 2.472669
## 2  T.tetradactyla      6   82.14154  0.4461  0.4139622   6.584425 2.163541
## 3      E.barbara     16  309.85514  0.4835  0.5318033   5.231910 1.280346
## 4      T.terrestris      8  127.78052  0.4680  0.5492710   7.463467 3.023464
## 5      D.imperfecta     11  336.36679  0.3657  0.5671526   4.794876 1.644272
## 6  M.gouazoubira     33  940.58630  0.5254  0.6932379   5.468643 1.090774
## 7      N.nasua        5  139.96839  0.3327  0.8382985   6.180975 2.531680
## 8      M.tridactyla     13  397.71195  0.2259  0.9766572   6.440562 1.919368
```

These species seem to have a good fit and no signs of over-dispersion:

```
##          spp n.detect chi.square p.value c.hat.est large.coefs large.SE
## 1      L.rufaxilla     33  644.7614  0.6387  0.3538287   3.611257 1.0718646
## 2      C.paca       71  975.2095  0.8211  0.4558315   2.325624 0.5896220
## 3      D.leporina     66  991.3192  0.7988  0.4665773   2.619642 0.5969287
## 4      C.thous       24  961.8610  0.5635  0.5191312   1.712018 1.0551831
## 5      D.kappleri     25  777.6629  0.5718  0.5210131   3.569831 1.1148144
## 6      C.alector     31 1152.7708  0.4004  0.8499629   3.749929 0.9350088
## 7  D.novemcinctus     18  740.8384  0.1884  0.9089265   3.490498 1.5360376
```

## Model averaging

### L. rufaxilla

Sum of AICc weights indicate a clear effect of p(sfrz) and large support for lam(evi.mu). wcon has AICcw=0.29

```
##          p(sfrz) lam(evi.mu) lam(I(evi.mu^2)) p(date) lam(wcon)
## Sum of weights:    1.00    0.84    0.66    0.33    0.29
## N containing models:  24    32    16    24    24
##          p(dras)
## Sum of weights:    0.23
## N containing models:  24
```

Significant conditional coefficients for p(sfrz). Positive (“attracted”) but non-significant effect of conucos

```
##          2.5 %    97.5 %
## lam(Int)    -0.59433423 -1.7050647  0.5163962
## lam(evi.mu)  0.77366678 -0.2594941  1.8068277
## lam(I(evi.mu^2)) -1.21655959 -2.4202055 -0.0129137
## p(Int)      -3.59874879 -5.5460808 -1.6514168
## p(sfrz)      3.32758385  1.2630970  5.3920707
```

```
## p(date)          0.37209565 -0.3594232  1.1036145
## lam(wcon)        0.20611793 -0.3522697  0.7645055
## p(dras)          0.03004662 -0.6707541  0.7308474
```

### C. paca

Very strong support for  $p(\text{sfrz}) + \text{lam}(\text{evi.mu}) + \text{lam}(I(\text{evi.mu}^2))$ , and strong support for  $p(\text{dras})$ , but only 0.23 for  $wcon$ .

```
##               lam(evi.mu) p(sfrz) lam(I(evi.mu^2)) p(dras) p(date)
## Sum of weights:    0.99      0.98    0.95          0.86    0.25
## N containing models: 32      24     16          24     24
##               lam(wcon)
## Sum of weights:    0.23
## N containing models: 24
```

Significant conditional coefficients for those parameters. Very weak and non-significative effect of  $wcon$

```
##
## Call:
## model.avg(object = oms, subset = delta < 10)
##
## Component model call:
## occuRN(formula = ~<14 unique rhs>, data = UMF, K = 30)
##
## Component models:
##      df logLik   AICc delta weight
## 2345   6 -111.36 236.30  0.00   0.48
## 12345   7 -111.23 238.62  2.31   0.15
## 23456   7 -111.35 238.85  2.55   0.13
## 345     5 -114.44 239.98  3.68   0.08
## 123456  8 -111.23 241.27  4.97   0.04
## 1345    6 -114.07 241.73  5.43   0.03
## 3456    6 -114.43 242.45  6.15   0.02
## 234     5 -115.73 242.57  6.27   0.02
## 2346    6 -115.16 243.90  7.60   0.01
## 245     5 -116.49 244.10  7.80   0.01
## 13456    7 -114.07 244.30  8.00   0.01
## 1234     6 -115.47 244.52  8.22   0.01
## 1245     6 -116.21 246.00  9.70   0.00
## 12346    7 -114.96 246.07  9.77   0.00
##
## Term codes:
##      p(date)          p(dras)          p(sfrz)      lam(evi.mu)
##           1              2              3              4
## lam(I(evi.mu^2))      lam(wcon)
##           5              6
##
## Model-averaged coefficients:
## (full average)
##      Estimate Std. Error z value Pr(>|z|)
## lam(Int)      0.41285    0.40517   1.019  0.3082
## lam(evi.mu)    1.03782    0.42734   2.429  0.0152 *
## lam(I(evi.mu^2)) -1.15566    0.51588   2.240  0.0251 *
## p(Int)        -2.44067    0.60056   4.064 4.82e-05 ***
```

```
## p(dras)          0.66561    0.40894    1.628    0.1036
## p(sfrz)          1.75520    0.61625    2.848    0.0044 **
## p(date)         -0.02973    0.11777    0.252    0.8007
## lam(wcon)        0.00756    0.09581    0.079    0.9371
##
## (conditional average)
##               Estimate Std. Error z value Pr(>|z|)
## lam(Int)        0.41285    0.40517    1.019    0.30823
## lam(evi.mu)     1.03782    0.42734    2.429    0.01516 *
## lam(I(evi.mu^2)) -1.20774    0.46394    2.603    0.00923 **
## p(Int)         -2.44067    0.60056    4.064 4.82e-05 ***
## p(dras)         0.77283    0.33363    2.316    0.02054 *
## p(sfrz)         1.77918    0.58506    3.041    0.00236 **
## p(date)        -0.12061    0.21284    0.567    0.57095
## lam(wcon)       0.03447    0.20231    0.170    0.86472
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#### D. leporina

Used linear model for EVI. Most support for p(sfrz)+lam(evi.mu), significant conditional coefficients for those parameters. Weak negative (“avoids”) non-significant effect of conucos

```
##               lam(evi.mu) p(sfrz) p(date) p(dras) lam(wcon)
## Sum of weights:      1.00      0.99    0.33    0.29    0.27
## N containing models:   32      24     24     24     24
##               lam(I(evi.mu^2))
## Sum of weights:      0.23
## N containing models:   16
```

Coefficients with 95% CI

```
##               2.5 %      97.5 %
## lam(Int)      -0.84908521 -1.7196286  0.02145821
## lam(evi.mu)    1.46870590  0.6695390  2.26787281
## p(Int)        -2.50377865 -3.6487959 -1.35876138
## p(sfrz)        1.79478300  0.6417482  2.94781783
## p(date)        0.20664631 -0.2012628  0.61455542
## lam(wcon)     -0.10425326 -0.4222668  0.21376026
## p(dras)        0.27757811 -0.4212358  0.97639206
## lam(I(evi.mu^2)) -0.06030174 -0.9565609  0.83595744
```

#### C.thous

Used linear model for EVI. Most support for p(sfrz)+lam(evi.mu), significant conditional coefficients for lam(evi.mu) (negative association). Weak negative (“avoids”) non-significant effect of conucos

```
##               lam(evi.mu) p(sfrz) p(dras) lam(wcon) p(date)
## Sum of weights:      0.93      0.50    0.27    0.25    0.24
## N containing models:   16      16     16     16     16
```

Coefficients with 95% CI

```
##               2.5 %      97.5 %
## lam(Int)      -1.70114098 -2.5068374 -0.8954445
## lam(evi.mu)   -0.93861161 -1.6728401 -0.2043832
```

```
## p(Int)      -0.79757151 -2.5371444  0.9420014
## p(sfrz)     1.55261933 -0.4746939  3.5799326
## p(dras)     -0.17432610 -0.7669693  0.4183171
## p(date)     -0.13659607 -0.9306621  0.6574699
## lam(wcon)   -0.08351734 -0.9460289  0.7789943
```

#### D. kappleri

Most support for p(sfrz)+lam(evi.mu) but no significant conditional coefficients . Very weak non-significant effect of conucos.

```
##               lam(evi.mu) p(sfrz) p(date) p(dras) lam(I(evi.mu^2))
## Sum of weights:      1.00      0.66   0.38   0.28   0.25
## N containing models:   32      24    24    24    16
##               lam(wcon)
## Sum of weights:      0.23
## N containing models:   24
```

Coefficients with 95% CI

```
##               2.5 %    97.5 %
## lam(Int)      -2.30607775 -4.8643079  0.2521524
## lam(evi.mu)    2.83695546 -1.5071118  7.1810227
## p(Int)        -2.99582423 -5.2306012 -0.7610473
## p(sfrz)        1.58771547 -0.1783192  3.3537501
## p(date)       -0.31944039 -0.8437306  0.2048498
## p(dras)        0.33743479 -0.5897187  1.2645883
## lam(I(evi.mu^2)) -0.86052980 -5.3911924  3.6701328
## lam(wcon)      0.02628049 -0.4452568  0.4978178
```

#### C. alector

Most support for p(dras)+p(sfrz)+lam(evi.mu)+lam(wcon), significant conditional coefficients for those parameters. Strong negative significant effect of conucos.

```
##               lam(evi.mu) lam(wcon) p(dras) p(sfrz) lam(I(evi.mu^2))
## Sum of weights:      1.00      0.99   0.81   0.74   0.26
## N containing models:   32      24    24    24    16
##               p(date)
## Sum of weights:      0.25
## N containing models:   24
```

Coefficients with 95% CI

```
##               2.5 %    97.5 %
## lam(Int)      -1.0654125 -2.5199061  0.3890811
## lam(evi.mu)    1.5507267  0.3668379  2.7346154
## lam(wcon)     -1.2039786 -2.1142263 -0.2937308
## p(Int)        -3.2661567 -5.3733121 -1.1590013
## p(dras)        0.9421430  0.2015449  1.6827412
## p(sfrz)        1.6268736  0.0201853  3.2335620
## lam(I(evi.mu^2)) -0.4842195 -2.0229497  1.0545107
## p(date)       -0.1385168 -0.6665610  0.3895274
```

#### D. novemcinctus

```
##                p(date) lam(evi.mu) p(dras) lam(wcon) p(sfrz)
## Sum of weights:    0.98    0.80        0.25    0.24    0.23
## N containing models: 24      32        24      24      24
##                lam(I(evi.mu^2))
## Sum of weights:    0.22
## N containing models: 16
```

Coefficients with 95% CI

```
##                2.5 %    97.5 %
## lam(Int)        -0.07315150 -2.168549979 2.0222470
## lam(evi.mu)      0.71144760 -0.002901512 1.4257967
## p(Int)          -3.33804353 -5.759116792 -0.9169703
## p(date)         -1.03326082 -1.712955459 -0.3535662
## lam(I(evi.mu^2)) 0.35538806 -0.572638593 1.2834147
## p(dras)         -0.13662314 -0.880722575 0.6074763
## lam(wcon)       -0.06670767 -0.582224649 0.4488093
## p(sfrz)         -0.05884151 -1.754745240 1.6370622
```

#### M. americana

Best model is p(date) p(sfrz) lam(evi.mu) but very large coefficients for p(Int) and p(sfrz)

```
##                p(sfrz) lam(evi.mu) p(date) p(dras) lam(wcon)
## Sum of weights:    1.00    0.98        0.82    0.23    0.23
## N containing models: 16      16        16      16      16
```

Coefficients with 95% CI

```
##                2.5 %    97.5 %
## lam(Int)        -2.46891587 -4.3656878 -0.5721439
## lam(evi.mu)      1.97856015  0.1970717  3.7600486
## p(Int)          -7.04144050 -11.8293132 -2.2535678
## p(date)         -1.07977156 -2.0354868 -0.1240563
## p(sfrz)          6.06339828  1.2305177 10.8962788
## p(dras)         -0.11585434 -1.6132591  1.3815504
## lam(wcon)        0.01234525 -0.5241298  0.5488203
```

#### T.tetradactyla

Null model is best model

```
##                lam(evi.mu) p(dras) p(sfrz) lam(wcon) p(date)
## Sum of weights:    0.43    0.38    0.29    0.27    0.26
## N containing models: 32      24      24      24      24
##                lam(I(evi.mu^2))
## Sum of weights:    0.11
## N containing models: 16
```

Coefficients with 95% CI

```
##                2.5 %    97.5 %
## lam(Int)        2.3240854 -1.3390253  5.9871961
## p(Int)          -6.4770963 -10.4995345 -2.4546582
```

```
## p(dras) -0.6139330 -1.7262816 0.4984155
## lam(evi.mu) 0.5287272 -0.5237742 1.5812287
## p(sfrz) 1.1388104 -2.0033911 4.2810118
## lam(wcon) -0.2380238 -1.0694219 0.5933744
## p(date) -0.2092702 -1.1226259 0.7040854
## lam(I(evi.mu^2)) -0.3544662 -1.8995652 1.1906328
```

#### E.barbara

```
## lam(evi.mu) lam(I(evi.mu^2)) p(sfrz) lam(wcon) p(dras)
## Sum of weights: 0.99 0.56 0.27 0.25 0.23
## N containing models: 32 16 24 24 24
## p(date)
## Sum of weights: 0.23
## N containing models: 24
```

Coefficients with 95% CI

```
## 2.5 % 97.5 %
## lam(Int) 1.23088539 -1.1619442 3.6237150
## lam(evi.mu) 2.38150388 -1.5861455 6.3491532
## lam(I(evi.mu^2)) -1.77768986 -4.7100204 1.1546407
## p(Int) -5.00662541 -7.0106255 -3.0026253
## p(sfrz) 0.57319609 -1.2137929 2.3601851
## p(dras) -0.04841124 -0.8740415 0.7772191
## p(date) 0.01342205 -0.5583690 0.5852131
## lam(wcon) 0.05064999 -0.3930331 0.4943330
```

#### T.terrestris

```
## lam(evi.mu) p(sfrz) lam(wcon) lam(I(evi.mu^2)) p(date)
## Sum of weights: 0.99 0.61 0.29 0.25 0.24
## N containing models: 32 24 24 16 24
## p(dras)
## Sum of weights: 0.23
## N containing models: 24
```

Coefficients with 95% CI

```
## 2.5 % 97.5 %
## lam(Int) -2.90048579 -9.1656562 3.3646846
## lam(evi.mu) 3.94084950 -1.2017906 9.0834896
## p(Int) -6.37039899 -11.4880427 -1.2527552
## p(sfrz) 3.08828979 -1.3409540 7.5175335
## lam(wcon) -0.29440222 -1.0841200 0.4953155
## lam(I(evi.mu^2)) 1.19546241 -2.3517159 4.7426407
## p(date) 0.10124733 -0.7648119 0.9673066
## p(dras) -0.06938722 -1.2311128 1.0923384
```

#### D.imperfecta

```
## p(dras) lam(evi.mu) p(sfrz) p(date) lam(wcon)
## Sum of weights: 0.95 0.61 0.46 0.23 0.23
## N containing models: 24 32 24 24 24
```

```
##                                lam(I(evi.mu^2))
## Sum of weights:                0.14
## N containing models:          16

Coefficients with 95% CI

##                                2.5 %      97.5 %
## lam(Int)                      -1.20149391 -2.8868377  0.4838498
## lam(evi.mu)                   0.93528179 -0.4296045  2.3001681
## p(Int)                        -3.85464501 -6.9467582 -0.7625318
## p(dras)                       1.44440160  0.3911707  2.4976325
## p(sfrz)                       1.90332166 -0.9803374  4.7869808
## lam(wcon)                     -0.04673492 -0.9525704  0.8591006
## lam(I(evi.mu^2))              0.04203208 -1.5165401  1.6006043
## p(date)                       0.02687450 -0.9562547  1.0100037
```

### M.gouazoubira

```
##
## Call:
## model.avg(object = oms, subset = delta < 10)
##
## Component model call:
## occuRN(formula = ~<28 unique rhs>, data = UMF, K = 30)
##
## Component models:
##      df logLik   AICc delta weight
## 345    5 -75.64 162.40  0.00   0.19
## 34     4 -77.00 162.73  0.33   0.16
## 346    5 -76.15 163.42  1.02   0.12
## 3456   6 -75.50 164.58  2.18   0.07
## 2345   6 -75.51 164.60  2.21   0.06
## 234    5 -76.76 164.62  2.23   0.06
## 1345   6 -75.61 164.80  2.41   0.06
## 134    5 -77.00 165.11  2.72   0.05
## 2346   6 -76.10 165.78  3.38   0.04
## 1346   6 -76.14 165.86  3.47   0.03
## 23456  7 -75.42 167.00  4.61   0.02
## 1234   6 -76.74 167.07  4.67   0.02
## 13456  7 -75.46 167.07  4.67   0.02
## 12345  7 -75.50 167.16  4.77   0.02
## 45     4 -79.57 167.87  5.47   0.01
## 4      3 -80.91 168.26  5.86   0.01
## 12346  7 -76.10 168.34  5.95   0.01
## 46     4 -79.82 168.37  5.98   0.01
## 123456 8 -75.41 169.65  7.25   0.01
## 456    5 -79.29 169.70  7.30   0.01
## 245    5 -79.48 170.07  7.68   0.00
## 24     4 -80.76 170.24  7.84   0.00
## 145    5 -79.57 170.25  7.86   0.00
## 14     4 -80.90 170.52  8.13   0.00
## 246    5 -79.81 170.73  8.33   0.00
## 146    5 -79.82 170.76  8.36   0.00
## 2456   6 -79.27 172.12  9.72   0.00
```



```
## 1456    6 -79.29 172.16  9.77   0.00
##
## Term codes:
##           p(date)           p(dras)           p(sfrz)       lam(evi.mu)
##           1           2           3           4
## lam(I(evi.mu^2))       lam(wcon)
##           5           6
##
## Model-averaged coefficients:
## (full average)
##           Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -0.826961   2.182113   0.379   0.7047
## lam(evi.mu)    4.792117   4.782326   1.002   0.3163
## lam(I(evi.mu^2)) -1.548483   2.681864   0.577   0.5637
## p(Int)        -5.423097   1.247316   4.348 1.38e-05 ***
## p(sfrz)        1.860072   0.928820   2.003   0.0452 *
## lam(wcon)       0.049446   0.113726   0.435   0.6637
## p(dras)       -0.039680   0.170850   0.232   0.8163
## p(date)        0.006163   0.109597   0.056   0.9552
##
## (conditional average)
##           Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -0.8270     2.1821   0.379   0.7047
## lam(evi.mu)    4.7921     4.7823   1.002   0.3163
## lam(I(evi.mu^2)) -3.2763     3.0914   1.060   0.2892
## p(Int)        -5.4231     1.2473   4.348 1.38e-05 ***
## p(sfrz)        1.9830     0.8222   2.412   0.0159 *
## lam(wcon)       0.1501     0.1554   0.966   0.3340
## p(dras)       -0.1600     0.3137   0.510   0.6101
## p(date)        0.0274     0.2298   0.119   0.9051
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## N.nasua

```
##
## Call:
## model.avg(object = oms, subset = delta < 10)
##
## Component model call:
## occuRN(formula = ~<42 unique rhs>, data = UMF, K = 30)
##
## Component models:
##           df logLik  AICc delta weight
## 456         5 -17.07 45.25  0.00   0.11
## 46          4 -18.41 45.55  0.30   0.10
## 2456        6 -16.17 45.93  0.68   0.08
## 246         5 -17.52 46.16  0.91   0.07
## 4           3 -19.96 46.35  1.10   0.07
## 3456        6 -16.63 46.84  1.59   0.05
## 346         5 -17.98 47.08  1.83   0.05
## 1456        6 -16.87 47.33  2.08   0.04
## 146         5 -18.32 47.74  2.49   0.03
```

```

## 23456 7 -15.87 47.89 2.64 0.03
## 24 4 -19.59 47.91 2.66 0.03
## 2346 6 -17.17 47.93 2.67 0.03
## 34 4 -19.67 48.06 2.81 0.03
## 26 4 -19.73 48.19 2.94 0.03
## 45 4 -19.78 48.29 3.04 0.03
## 12456 7 -16.20 48.55 3.30 0.02
## 1246 6 -17.52 48.63 3.38 0.02
## 14 4 -19.96 48.64 3.39 0.02
## 13456 7 -16.54 49.24 3.99 0.02
## 1346 6 -17.91 49.41 4.15 0.01
## 245 5 -19.20 49.51 4.26 0.01
## 234 5 -19.34 49.78 4.53 0.01
## 236 5 -19.36 49.82 4.57 0.01
## 345 5 -19.49 50.09 4.84 0.01
## 124 5 -19.57 50.25 5.00 0.01
## 123456 8 -15.81 50.44 5.19 0.01
## 134 5 -19.67 50.44 5.19 0.01
## 12346 7 -17.17 50.49 5.24 0.01
## 126 5 -19.70 50.51 5.26 0.01
## 145 5 -19.75 50.61 5.36 0.01
## 2345 6 -19.03 51.64 6.39 0.00
## 1245 6 -19.25 52.08 6.83 0.00
## 1234 6 -19.30 52.18 6.93 0.00
## 1236 6 -19.31 52.21 6.96 0.00
## 1345 6 -19.47 52.52 7.27 0.00
## 6 3 -23.17 52.76 7.51 0.00
## (Null) 2 -24.64 53.49 8.24 0.00
## 36 4 -22.61 53.94 8.69 0.00
## 12345 7 -18.94 54.04 8.79 0.00
## 2 3 -24.04 54.50 9.25 0.00
## 3 3 -24.21 54.85 9.60 0.00
## 16 4 -23.16 55.04 9.79 0.00
##
## Term codes:
##          p(date)          p(dras)          p(sfrz)          lam(evi.mu)
##              1              2              3              4
## lam(I(evi.mu^2))          lam(wcon)
##              5              6
##
## Model-averaged coefficients:
## (full average)
##          Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -16.02113   32.34991   0.495  0.62043
## lam(evi.mu)    30.54236   61.37791   0.498  0.61876
## lam(I(evi.mu^2)) -13.39091   28.75951   0.466  0.64149
## lam(wcon)      -1.27934    1.21061   1.057  0.29062
## p(Int)         -5.27951    1.71804   3.073  0.00212 **
## p(dras)         0.45102    0.80563   0.560  0.57559
## p(sfrz)         0.43909    1.26162   0.348  0.72781
## p(date)        -0.01997    0.26590   0.075  0.94013
##
## (conditional average)
##          Estimate Std. Error z value Pr(>|z|)

```

```
## lam(Int)          -16.02113   32.34991   0.495   0.62043
## lam(evi.mu)       32.45264   62.77641   0.517   0.60519
## lam(I(evi.mu^2)) -30.69536   36.94291   0.831   0.40604
## lam(wcon)         -1.71367    1.10401   1.552   0.12061
## p(Int)            -5.27951    1.71804   3.073   0.00212 **
## p(dras)           1.11128    0.93030   1.195   0.23227
## p(sfrz)           1.48693    1.95753   0.760   0.44750
## p(date)           -0.08479    0.54284   0.156   0.87588
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## M.tridactyla

```
##
## Call:
## model.avg(object = oms, subset = delta < 10)
##
## Component model call:
## occuRN(formula = ~<48 unique rhs>, data = UMF, K = 30)
##
## Component models:
```

	df	logLik	AICc	delta	weight
## 3	3	-51.02	108.47	0.00	0.08
## 34	4	-50.00	108.73	0.25	0.07
## 45	4	-50.13	108.99	0.51	0.06
## 345	5	-48.97	109.05	0.58	0.06
## 4	3	-51.33	109.09	0.62	0.06
## (Null)	2	-52.49	109.19	0.72	0.06
## 23	4	-50.48	109.69	1.22	0.04
## 2	3	-51.86	110.15	1.67	0.03
## 346	5	-49.65	110.41	1.94	0.03
## 234	5	-49.71	110.53	2.06	0.03
## 245	5	-49.77	110.65	2.18	0.03
## 24	4	-51.00	110.72	2.25	0.03
## 13	4	-51.00	110.73	2.25	0.03
## 36	4	-51.02	110.77	2.30	0.03
## 46	4	-51.03	110.80	2.32	0.02
## 2345	6	-48.66	110.91	2.44	0.02
## 134	5	-49.97	111.05	2.58	0.02
## 456	5	-50.10	111.31	2.84	0.02
## 145	5	-50.12	111.36	2.89	0.02
## 14	4	-51.32	111.38	2.90	0.02
## 3456	6	-48.90	111.39	2.91	0.02
## 1	3	-52.48	111.39	2.92	0.02
## 6	3	-52.49	111.41	2.93	0.02
## 1345	6	-48.97	111.52	3.05	0.02
## 123	5	-50.42	111.95	3.48	0.01
## 236	5	-50.46	112.03	3.56	0.01
## 12	4	-51.83	112.38	3.91	0.01
## 2346	6	-49.41	112.40	3.93	0.01
## 26	4	-51.84	112.41	3.93	0.01
## 246	5	-50.72	112.55	4.08	0.01
## 1346	6	-49.64	112.87	4.40	0.01

```

## 1234      6 -49.64 112.87  4.40   0.01
## 124       5 -50.97 113.04  4.57   0.01
## 2456      6 -49.74 113.06  4.59   0.01
## 136       5 -51.00 113.11  4.64   0.01
## 1245      6 -49.77 113.12  4.65   0.01
## 146       5 -51.03 113.18  4.71   0.01
## 23456     7 -48.60 113.36  4.89   0.01
## 12345     7 -48.65 113.45  4.98   0.01
## 16        4 -52.48 113.69  5.21   0.01
## 1456      6 -50.09 113.77  5.30   0.01
## 13456     7 -48.90 113.95  5.48   0.01
## 1236      6 -50.40 114.39  5.92   0.00
## 126       5 -51.81 114.73  6.25   0.00
## 12346     7 -49.37 114.90  6.42   0.00
## 1246      6 -50.71 115.00  6.52   0.00
## 12456     7 -49.74 115.63  7.15   0.00
## 123456    8 -48.60 116.01  7.54   0.00
##
## Term codes:
##           p(date)           p(dras)           p(sfrz)      lam(evi.mu)
##                1                2                3                4
## lam(I(evi.mu^2))      lam(wcon)
##                5                6
##
## Model-averaged coefficients:
## (full average)
##           Estimate Std. Error z value Pr(>|z|)
## lam(Int)      0.94923    2.42535   0.391   0.6955
## p(Int)      -5.18579    2.67081   1.942   0.0522 .
## p(sfrz)      0.97031    1.29674   0.748   0.4543
## lam(evi.mu)   0.31168    0.35680   0.874   0.3824
## lam(I(evi.mu^2)) 0.20012    0.40765   0.491   0.6235
## p(dras)      0.11298    0.28141   0.401   0.6881
## lam(wcon)    -0.02985    0.16027   0.186   0.8522
## p(date)      0.01200    0.16573   0.072   0.9423
##
## (conditional average)
##           Estimate Std. Error z value Pr(>|z|)
## lam(Int)      0.94923    2.42535   0.391   0.6955
## p(Int)      -5.18579    2.67081   1.942   0.0522 .
## p(sfrz)      1.81432    1.26999   1.429   0.1531
## lam(evi.mu)   0.49597    0.33343   1.487   0.1369
## lam(I(evi.mu^2)) 0.69181    0.48406   1.429   0.1530
## p(dras)      0.35584    0.40374   0.881   0.3781
## lam(wcon)    -0.11658    0.30034   0.388   0.6979
## p(date)      0.05083    0.33822   0.150   0.8805
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

## P. onca

If  $\hat{c} > 1$ , then we use QAICc

```
##
```

```

## Call:
## model.avg(object = oms, subset = delta < 10)
##
## Component model call:
## occuRN(formula = ~<25 unique rhs>, data = UMF, K = 30)
##
## Component models:
##      df logLik QAICc delta weight
## 4      3 -43.99 89.72  0.00  0.32
## 24     4 -43.86 91.86  2.14  0.11
## 45     4 -43.97 92.06  2.35  0.10
## 14     4 -43.97 92.07  2.35  0.10
## 34     4 -43.98 92.08  2.37  0.10
## 234    5 -43.85 94.31  4.60  0.03
## 245    5 -43.86 94.32  4.61  0.03
## 124    5 -43.86 94.33  4.62  0.03
## 145    5 -43.95 94.50  4.78  0.03
## 345    5 -43.96 94.52  4.80  0.03
## 134    5 -43.97 94.53  4.81  0.03
## (Null) 2 -48.29 95.33  5.61  0.02
## 2345    6 -43.84 96.87  7.16  0.01
## 1234    6 -43.85 96.88  7.17  0.01
## 1245    6 -43.85 96.89  7.17  0.01
## 5       3 -47.91 96.94  7.22  0.01
## 1345    6 -43.94 97.05  7.34  0.01
## 2       3 -48.22 97.50  7.79  0.01
## 1       3 -48.23 97.52  7.80  0.01
## 3       3 -48.29 97.62  7.91  0.01
## 15      4 -47.84 99.18  9.47  0.00
## 25      4 -47.90 99.30  9.59  0.00
## 35      4 -47.91 99.32  9.61  0.00
## 12      4 -47.97 99.43  9.72  0.00
## 12345   7 -43.84 99.54  9.83  0.00
##
## Term codes:
##      p(date)      p(dras)      p(sfrz) lam(evi.mu)  lam(wcon)
##           1           2           3           4           5
##
## Model-averaged coefficients:
## (full average)
##      Estimate Std. Error z value Pr(>|z|)
## lam(Int)    -1.59354    1.07772   1.479  0.13924
## lam(evi.mu)  1.39026    0.77441   1.795  0.07261 .
## p(Int)      -2.31653    0.88901   2.606  0.00917 **
## p(dras)     -0.08054    0.38656   0.208  0.83496
## lam(wcon)    0.01456    0.13578   0.107  0.91458
## p(date)      0.01371    0.17344   0.079  0.93701
## p(sfrz)     -0.02989    0.47850   0.062  0.95020
##
## (conditional average)
##      Estimate Std. Error z value Pr(>|z|)
## lam(Int)    -1.59354    1.07772   1.479  0.13924
## lam(evi.mu)  1.47512    0.71494   2.063  0.03908 *
## p(Int)      -2.31653    0.88901   2.606  0.00917 **

```

```

## p(dras)      -0.32823    0.72643    0.452    0.65138
## lam(wcon)     0.06240    0.27569    0.226    0.82094
## p(date)       0.06011    0.35936    0.167    0.86715
## p(sfrz)       -0.13319    1.00329    0.133    0.89439
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sum of QAICc-weights

##               lam(evi.mu) p(dras) lam(wcon) p(date) p(sfrz)
## Sum of weights:    0.94      0.25    0.23      0.23    0.23
## N containing models:  16      16     16      16     16

```