

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

dras: distance to animal tracks and trails

sfrz: sampling effort (nr. of days camera was active)

date: date of sampling

Covariates of probability of occupancy - frequency of use

buf.fragmen: 1 km buffer of forest cover derived from LandSat time series (Hansen et al. 2013)

dcon: distance to nearest conuco

Results

Goodness of fit

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

Symptoms of lack of fit for most species: Five models with extreme p-value or c-hat values, 18 models with large coefficients or standard errors.

```
##
##          FALSE TRUE
##  FALSE      8   15
##   TRUE       2    3
```

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  C.unicinctus      2  300.31760  0.0094  9.3887144    7.074475   4.7208069
## 2  H.hydrochaeris      2   15.98849  0.0504  4.9832875    3.845704   2.9392481
## 3  O.virginianus      4   64.74000  0.0340  5.6915053   51.400425  32.3157809
## 4    P.tajacu        2   43.35466  0.0225  7.6794165  155.933192 478.6763018
## 5    T.major       18  373.16798  0.8950  0.2079672    1.713872   0.9530671
##  overdispersion coef.problems lack.of.fit
## 1          FALSE          TRUE          TRUE
## 2          FALSE          FALSE          TRUE
## 3          FALSE          TRUE          TRUE
```

```
## 4          FALSE          TRUE          TRUE
## 5          FALSE          FALSE         TRUE
```

These species appear to have a good fit but 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.tetradactyla      6   72.908937  0.6242  0.3044934   5.149190  1.993683
## 2    M.americana     17  214.769141  0.7627  0.3075773   7.133735  2.483416
## 3    P.maximus       6   67.585595  0.6808  0.3312252   7.043249  1.894306
## 4    D.imperfecta    11  266.266673  0.5163  0.3617684   4.788737  1.601210
## 5    T.terrestris     8  158.483963  0.5477  0.3855418   5.623549  2.455302
## 6    E.barbara      16  382.477516  0.5193  0.5365605   5.550178  1.241677
## 7    D.kappleri     25  853.546005  0.5691  0.5583040   4.157502  1.374860
## 8    N.nasua         5  105.475806  0.4402  0.6281102   6.764335  2.802847
## 9  M.gouazoubira    33 1145.153588  0.5182  0.6552944   4.033203  1.092467
##10  D.marsupialis     2    7.579146  0.4145  0.7131915  63.796450 54.413120
##11    T.pecari        2    8.603980  0.3425  0.9464064  22.064771 18.374398
##12  M.tridactyla     13  566.665554  0.1648  1.0452732   6.145284  4.635281
##13  C.olivaceus       7  158.073252  0.1972  1.2748033  10.109364  2.500621
##14    L.wiedii        2   28.383801  0.2544  1.4577179  18.030818 26.721106
##15    P.concolor      9  191.512415  0.1075  1.7406969  86.836067 95.636342
```

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  955.7612   0.154  1.468173   1.894531  1.119389
```

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  649.5341  0.6009  0.3620011   3.606669  1.0752993
## 2      C.paca       71 1012.9643  0.7969  0.4768465   2.306089  0.5964110
## 3    D.leporina     66 1021.2905  0.8584  0.4879682   2.580912  0.5916394
## 4    L.pardalis     15  930.5981  0.2918  0.8206981   2.276073  0.9698528
## 5    C.alector      31 1802.8678  0.3782  0.8634740   3.362759  0.8891477
## 6 D.novemcinctus    18  842.0565  0.1829  0.9523229   2.939231  1.1499196
## 7    C.thous       24 1345.3608  0.3221  0.9782528   1.750597  1.0517824
```

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(buf.fragmen) lam(I(buf.fragmen^2)) lam(dcon)
## Sum of weights:    1.00    0.67                0.53                0.48
## N containing models: 24    32                16                24
##          p(date) p(dras)
## Sum of weights:    0.32    0.23
## N containing models: 24    24
```

Significant conditional coefficients for p(sfrz). Negative relationship with distance to conuco (“attracted”) but non-significant effect of conucos

```
##          2.5 %    97.5 %
## lam(Int)      -0.781648845 -2.0485981  0.4853004
## lam(buf.fragmen)  0.796820709 -0.3136025  1.9072439
## lam(I(buf.fragmen^2)) -1.033250796 -1.9904958 -0.0760058
## p(Int)        -3.583609136 -5.5209367 -1.6462815
```

```
## p(sfrz)          3.309129226  1.2552245  5.3630340
## lam(dcon)        -0.933031922 -2.3750932  0.5090293
## p(date)          0.359224826 -0.3746243  1.0930740
## p(dras)          -0.007977523 -0.7257832  0.7098281
```

C. paca

```
##                p(sfrz) p(dras) lam(dcon) lam(buf.fragmen)
## Sum of weights:  0.97   0.90   0.89     0.47
## N containing models: 24     24     24     32
##                lam(I(buf.fragmen^2)) p(date)
## Sum of weights:  0.31                     0.26
## N containing models: 16                     24
```

Significant conditional coefficients for those parameters. Negative relationship with distance to conuco (“attracted”) of conucos

```
##
## Call:
## model.avg(object = oms, subset = delta < 10)
##
## Component model call:
## occuRN(formula = ~<24 unique rhs>, data = UMF, K = 50)
##
## Component models:
##      df logLik  AICc delta weight
## 236    5 -114.86 240.83  0.00  0.34
## 23456   7 -113.24 242.63  1.80  0.14
## 1236    6 -114.71 243.00  2.16  0.12
## 2346    6 -114.86 243.30  2.47  0.10
## 2345    6 -115.53 244.65  3.82  0.05
## 123456   8 -113.04 244.89  4.06  0.05
## 12346    7 -114.70 245.55  4.72  0.03
## 36       4 -118.59 245.91  5.07  0.03
## 3456     6 -116.26 246.10  5.27  0.02
## 12345    7 -115.30 246.75  5.91  0.02
## 136      5 -118.17 247.45  6.62  0.01
## 23       4 -119.37 247.48  6.64  0.01
## 26       4 -119.42 247.56  6.73  0.01
## 13456    7 -115.74 247.63  6.79  0.01
## 234      5 -118.31 247.73  6.90  0.01
## 346      5 -118.58 248.27  7.44  0.01
## 345      5 -118.76 248.63  7.80  0.01
## 126      5 -119.13 249.36  8.53  0.00
## 123      5 -119.19 249.48  8.65  0.00
## 2456     6 -118.01 249.60  8.77  0.00
## 1234     6 -118.05 249.69  8.86  0.00
## 1346     6 -118.14 249.86  9.03  0.00
## 246      5 -119.40 249.92  9.09  0.00
## 1345     6 -118.17 249.93  9.10  0.00
##
## Term codes:
##                p(date)                p(dras)                p(sfrz)
##                      1                      2                      3
##      lam(buf.fragmen) lam(I(buf.fragmen^2))      lam(dcon)
```

```

##          4          5          6
##
## Model-averaged coefficients:
## (full average)
##          Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -0.46384    0.49987   0.928 0.353453
## lam(dcon)     -1.11378    0.64660   1.723 0.084977 .
## p(Int)        -2.27118    0.60478   3.755 0.000173 ***
## p(dras)        0.75938    0.40417   1.879 0.060263 .
## p(sfrz)        1.67780    0.64127   2.616 0.008887 **
## lam(buf.fragmen) 0.16401    0.31809   0.516 0.606117
## lam(I(buf.fragmen^2)) -0.17809    0.31954   0.557 0.577295
## p(date)       -0.03496    0.12435   0.281 0.778589
##
## (conditional average)
##          Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -0.4638    0.4999   0.928 0.353453
## lam(dcon)     -1.2531    0.5439   2.304 0.021236 *
## p(Int)        -2.2712    0.6048   3.755 0.000173 ***
## p(dras)        0.8423    0.3337   2.524 0.011594 *
## p(sfrz)        1.7201    0.5906   2.913 0.003584 **
## lam(buf.fragmen) 0.3510    0.3885   0.903 0.366277
## lam(I(buf.fragmen^2)) -0.5852    0.3119   1.876 0.060629 .
## p(date)       -0.1364    0.2156   0.632 0.527064
## ---
## 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(buf.fragmen) p(sfrz) p(dras) p(date) lam(dcon)
## Sum of weights:      1.00          0.98   0.39   0.36   0.36
## N containing models:  16          16    16    16    16

```

Coefficients with 95% CI

```

##          2.5 %      97.5 %
## lam(Int)      -0.6426287 -1.3423469 0.05708957
## lam(buf.fragmen) 0.9824139 0.4880842 1.47674366
## p(Int)        -2.4541182 -3.6113765 -1.29686000
## p(sfrz)        1.7526036 0.6060442 2.89916302
## p(dras)        0.4360446 -0.2652325 1.13732177
## lam(dcon)     -0.5151278 -1.4824117 0.45215608
## p(date)       0.2308525 -0.1757137 0.63741870

```

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(buf.fragmen) p(sfrz) p(dras) lam(dcon) p(date)
## Sum of weights:      0.92          0.49   0.27   0.27   0.24
## N containing models:  16          16    16    16    16

```

Coefficients with 95% CI

```
##                                2.5 %    97.5 %
## lam(Int)                    -1.74261691 -2.6056310 -0.8796029
## lam(buf.fragmen)            -1.05889022 -1.9715562 -0.1462242
## p(Int)                      -0.77236536 -2.5115916  0.9668609
## p(sfrz)                     1.54377960 -0.4808521  3.5684113
## p(dras)                    -0.18165120 -0.7670821  0.4037797
## lam(dcon)                   0.15029737 -0.4736274  0.7742221
## p(date)                    -0.09492864 -0.8960877  0.7062304
```

D. kappleri

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

```
##                                lam(buf.fragmen) p(sfrz) lam(dcon) p(dras) p(date)
## Sum of weights:              0.99              0.68    0.43    0.41    0.34
## N containing models:        16              16    16    16    16
```

Coefficients with 95% CI

```
##                                2.5 %    97.5 %
## lam(Int)                    -1.0847212 -2.6230918  0.4536493
## lam(buf.fragmen)            1.1390454  0.4088009  1.8692898
## p(Int)                      -3.2031083 -5.6672864 -0.7389303
## p(sfrz)                     1.5912284 -0.1512081  3.3336649
## lam(dcon)                   -0.9680396 -2.4798483  0.5437690
## p(dras)                     0.5862272 -0.2776336  1.4500880
## p(date)                    -0.2768467 -0.8013681  0.2476748
```

C. alector

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

```
##                                lam(buf.fragmen) p(sfrz) p(dras) lam(dcon) p(date)
## Sum of weights:              0.99              0.73    0.55    0.49    0.24
## N containing models:        16              16    16    16    16
```

Coefficients with 95% CI

```
##                                2.5 %    97.5 %
## lam(Int)                    -1.20815199 -2.25811257 -0.1581914
## lam(buf.fragmen)            1.09987331  0.28986100  1.9098856
## lam(dcon)                   0.94772046 -0.26268557  2.1581265
## p(Int)                      -2.41041732 -4.47284116 -0.3479935
## p(dras)                     0.89484509 -0.08745471  1.8771449
## p(sfrz)                     1.68996734  0.01034336  3.3695913
## p(date)                    -0.05340577 -0.62251309  0.5157016
```

L. pardalis

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

```
##                                lam(buf.fragmen) lam(dcon) p(dras) p(date) p(sfrz)
## Sum of weights:              0.40              0.29    0.25    0.24    0.24
## N containing models:        16              16    16    16    16
```

Coefficients with 95% CI

```
##                                2.5 %    97.5 %
## lam(Int)                      -0.71605009 -1.9637219  0.5316217
## p(Int)                        -2.22102011 -3.7120790 -0.7299613
## lam(buf.fragmen)              0.41501374 -0.2760638  1.1060913
## lam(dcon)                     0.29538224 -0.5089605  1.0997249
## p(dras)                       0.09557729 -0.6234464  0.8146010
## p(sfrz)                       0.09894075 -1.6878000  1.8856815
## p(date)                       -0.03806139 -0.7094956  0.6333728
```

D. novemcinctus

```
##                                p(date) lam(buf.fragmen) lam(I(buf.fragmen^2)) p(dras)
## Sum of weights:              0.97    0.25                0.24                0.24
## N containing models:         32      32                32                32
##                                lam(dcon) p(sfrz)
## Sum of weights:              0.24    0.23
## N containing models:         32      32
```

Coefficients with 95% CI

```
##                                2.5 %    97.5 %
## lam(Int)                      -0.185624898 -1.5940080  1.2227582
## p(Int)                        -2.930405329 -4.6717725 -1.1890382
## p(date)                      -1.013295293 -1.7137654 -0.3128251
## lam(buf.fragmen)              0.126571418 -0.4766315  0.7297744
## lam(I(buf.fragmen^2))         0.104973963 -0.5573100  0.7672579
## lam(dcon)                    -0.066878329 -0.7478050  0.6140484
## p(dras)                       0.087934845 -0.6467919  0.8226616
## p(sfrz)                      -0.003628663 -1.7318782  1.7246209
```

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(buf.fragmen) p(date) lam(dcon) p(dras)
## Sum of weights:              1.00    0.95                0.80    0.31    0.23
## N containing models:         16      16                16      16      16
```

Coefficients with 95% CI

```
##                                2.5 %    97.5 %
## lam(Int)                      -1.9541488  -3.2794138 -0.62888389
## lam(buf.fragmen)              1.1405572   0.2661417  2.01497265
## p(Int)                        -7.0051580 -11.8450308 -2.16528513
## p(date)                      -1.0585761  -2.0191386 -0.09801355
## p(sfrz)                       6.0472298   1.1752708 10.91918892
## lam(dcon)                    -0.8614168  -2.9438129  1.22097935
## p(dras)                       0.1034961  -1.3768811  1.58387323
```

T.tetradactyla

Null model is best model

```
##                                lam(buf.fragmen) lam(dcon) lam(I(buf.fragmen^2)) p(sfrz)
## Sum of weights:              0.95                0.95    0.59                0.29
## N containing models:         32                32      32                32
##                                p(dras) p(date)
## Sum of weights:              0.27    0.25
```

```
## N containing models: 32      32
```

Coefficients with 95% CI

```
##                2.5 %    97.5 %
## lam(Int)        -0.6885369 -4.4207513  3.0436776
## lam(buf.fragmen)  3.1039203 -0.5441203  6.7519609
## lam(I(buf.fragmen^2)) -1.5891669 -3.5384056  0.3600719
## lam(dcon)        1.9170744  0.3824650  3.4516839
## p(Int)          -4.4479497 -7.6851934 -1.2107059
## p(sfrz)          1.2819150 -2.1365232  4.7003531
## p(dras)          -0.2858688 -1.4513495  0.8796120
## p(date)          -0.2279642 -1.1728022  0.7168737
```

E.barbara

```
##                lam(dcon) lam(buf.fragmen) lam(I(buf.fragmen^2)) p(sfrz)
## Sum of weights:    0.94      0.46                0.31      0.27
## N containing models: 32      32                32      32
##                p(date) p(dras)
## Sum of weights:    0.24      0.23
## N containing models: 32      32
```

Coefficients with 95% CI

```
##                2.5 %    97.5 %
## lam(Int)        1.16167371 -1.5285047  3.8518521
## lam(dcon)       -2.13191844 -3.9589072 -0.3049297
## p(Int)          -5.30844363 -7.6294115 -2.9874757
## lam(buf.fragmen)  0.49157145 -0.2886889  1.2718318
## lam(I(buf.fragmen^2)) 0.14209376 -0.5793977  0.8635852
## p(sfrz)          0.57733507 -1.1797508  2.3344209
## p(date)          0.09885260 -0.4899687  0.6876739
## p(dras)          0.02689288 -0.8228646  0.8766503
```

T.terrestris

```
##                lam(buf.fragmen) p(sfrz) lam(I(buf.fragmen^2)) p(date)
## Sum of weights:    0.75      0.67      0.32      0.27
## N containing models: 32      32      32      32
##                lam(dcon) p(dras)
## Sum of weights:    0.26      0.24
## N containing models: 32      32
```

Coefficients with 95% CI

```
##                2.5 %    97.5 %
## lam(Int)        -1.5328043 -4.0012173  0.9356086
## lam(buf.fragmen)  1.3074868 -0.5460617  3.1610354
## p(Int)          -4.6236650 -9.6586465  0.4113166
## p(sfrz)          3.4444216 -1.1859256  8.0747687
## lam(I(buf.fragmen^2)) -0.2394428 -2.0642581  1.5853726
## p(date)          0.3489186 -0.7231632  1.4210005
## p(dras)          0.1339191 -1.3362337  1.6040719
## lam(dcon)        -0.3165804 -2.2772716  1.6441108
```

D.imperfecta

```
##                p(dras) lam(buf.fragmen) lam(I(buf.fragmen^2)) p(sfrz)
## Sum of weights: 0.92    0.77                0.47                0.45
## N containing models: 32      32                32                32
##                lam(dcon) p(date)
## Sum of weights: 0.25    0.23
## N containing models: 32      32
```

Coefficients with 95% CI

```
##                2.5 %      97.5 %
## lam(Int)        -1.27857881 -3.0874479 0.5302903
## lam(buf.fragmen) 2.08389678 -1.6522328 5.8200264
## lam(I(buf.fragmen^2)) -1.41613622 -4.0926940 1.2604215
## p(Int)          -3.76687311 -6.8248872 -0.7088590
## p(dras)          1.41092744 0.3537661 2.4680887
## p(sfrz)          1.88515436 -0.9728824 4.7431912
## lam(dcon)        0.41821791 -1.5118086 2.3482444
## p(date)         -0.03338869 -1.0280154 0.9612381
```

M.gouazoubira

```
##
## Call:
## model.avg(object = oms, subset = delta < 10)
##
## Component model call:
## occuRN(formula = ~<34 unique rhs>, data = UMF, K = 50)
##
## Component models:
##      df logLik  AICc delta weight
## 34      4 -83.94 176.61 0.00 0.21
## 346      5 -82.84 176.79 0.18 0.19
## 345      5 -83.87 178.85 2.24 0.07
## 234      5 -83.93 178.97 2.36 0.06
## 134      5 -83.93 178.98 2.37 0.06
## 1346      6 -82.78 179.15 2.54 0.06
## 3456      6 -82.82 179.22 2.61 0.06
## 2346      6 -82.83 179.24 2.63 0.06
## 356      5 -84.62 180.36 3.75 0.03
## 1345      6 -83.86 181.30 4.69 0.02
## 2345      6 -83.87 181.32 4.71 0.02
## 1234      6 -83.92 181.43 4.82 0.02
## 13456      7 -82.76 181.67 5.07 0.02
## 12346      7 -82.77 181.70 5.09 0.02
## 23456      7 -82.79 181.73 5.12 0.02
## 1356      6 -84.45 182.49 5.88 0.01
## 4         3 -88.07 182.58 5.97 0.01
## 46        4 -86.94 182.61 6.01 0.01
## 2356      6 -84.62 182.83 6.22 0.01
## 36        4 -87.18 183.09 6.49 0.01
## 12345      7 -83.86 183.87 7.26 0.01
## 123456     8 -82.74 184.30 7.69 0.00
## 136       5 -86.80 184.72 8.11 0.00
## 45        4 -88.00 184.74 8.13 0.00
```



```

## 24      4 -88.04 184.81  8.21  0.00
## 14      4 -88.07 184.87  8.26  0.00
## 35      4 -88.09 184.92  8.31  0.00
## 456     5 -86.93 184.97  8.36  0.00
## 146     5 -86.94 184.98  8.38  0.00
## 246     5 -86.94 184.99  8.38  0.00
## 12356   7 -84.45 185.05  8.44  0.00
## 236     5 -87.09 185.30  8.69  0.00
## 235     5 -87.43 185.98  9.37  0.00
## 56      4 -88.82 186.37  9.76  0.00
##
## Term codes:
##              p(date)              p(dras)              p(sfrz)
##              1              2              3
##      lam(buf.fragmen) lam(I(buf.fragmen^2))      lam(dcon)
##              4              5              6
##
## Model-averaged coefficients:
## (full average)
##              Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -0.484163   0.854942  0.566 0.571182
## lam(buf.fragmen)  0.853213   0.425140  2.007 0.044760 *
## p(Int)        -3.970463   1.117718  3.552 0.000382 ***
## p(sfrz)        2.015617   0.930457  2.166 0.030291 *
## lam(dcon)      -0.450056   0.628592  0.716 0.474007
## lam(I(buf.fragmen^2)) 0.006714   0.221495  0.030 0.975818
## p(dras)        -0.001025   0.196288  0.005 0.995833
## p(date)        0.014770   0.125820  0.117 0.906550
##
## (conditional average)
##              Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -0.48416   0.85494  0.566 0.571182
## lam(buf.fragmen)  0.92393   0.36109  2.559 0.010505 *
## p(Int)        -3.97046   1.11772  3.552 0.000382 ***
## p(sfrz)        2.10472   0.84646  2.487 0.012901 *
## lam(dcon)      -0.88979   0.62444  1.425 0.154172
## lam(I(buf.fragmen^2)) 0.02436   0.42136  0.058 0.953905
## p(dras)        -0.00457   0.41441  0.011 0.991202
## p(date)        0.06478   0.25728  0.252 0.801203
## ---
## 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 = ~<53 unique rhs>, data = UMF, K = 50)
##
## Component models:
##      df logLik  AICc delta weight
## 246     5 -17.54 46.20  0.00  0.13

```



```
##           p(date)           p(dras)           p(sfrz)
##           1             2             3
##   lam(buf.fragmen) lam(I(buf.fragmen^2))   lam(dcon)
##           4             5             6
##
## Model-averaged coefficients:
## (full average)
##           Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -4.32632    7.59921  0.569  0.5691
## lam(buf.fragmen)  6.24672   10.92703  0.572  0.5675
## lam(dcon)      1.01732    1.42057  0.716  0.4739
## p(Int)        -5.98388    2.39931  2.494  0.0126 *
## p(dras)        1.08728    1.21494  0.895  0.3708
## p(sfrz)        0.37301    1.16620  0.320  0.7491
## lam(I(buf.fragmen^2)) -0.99256    4.16400  0.238  0.8116
## p(date)        0.03297    0.27560  0.120  0.9048
##
## (conditional average)
##           Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -4.3263    7.5992  0.569  0.5691
## lam(buf.fragmen)  7.2575   11.4623  0.633  0.5266
## lam(dcon)      2.0982    1.3763  1.524  0.1274
## p(Int)        -5.9839    2.3993  2.494  0.0126 *
## p(dras)        1.7556    1.1000  1.596  0.1105
## p(sfrz)        1.3166    1.8863  0.698  0.4852
## lam(I(buf.fragmen^2)) -2.5242    6.3426  0.398  0.6906
## p(date)        0.1401    0.5547  0.253  0.8006
## ---
## 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 = ~<64 unique rhs>, data = UMF, K = 50)
##
## Component models:
##           df logLik   AICc delta weight
## 3           3 -51.02 108.47  0.00  0.10
## (Null)      2 -52.49 109.19  0.72  0.07
## 34          4 -50.41 109.55  1.08  0.06
## 23          4 -50.48 109.69  1.22  0.05
## 4           3 -51.74 109.91  1.43  0.05
## 2           3 -51.86 110.15  1.67  0.04
## 36          4 -50.90 110.54  2.06  0.04
## 13          4 -51.00 110.73  2.25  0.03
## 35          4 -51.01 110.75  2.28  0.03
## 6           3 -52.33 111.09  2.62  0.03
## 234         5 -50.01 111.13  2.66  0.03
## 24          4 -51.29 111.30  2.83  0.02
## 5           3 -52.46 111.35  2.87  0.02
```

```

## 1      3 -52.48 111.39 2.92 0.02
## 345    5 -50.15 111.42 2.94 0.02
## 45     4 -51.51 111.75 3.28 0.02
## 346    5 -50.39 111.89 3.42 0.02
## 134    5 -50.40 111.91 3.44 0.02
## 235    5 -50.41 111.94 3.47 0.02
## 123    5 -50.42 111.95 3.48 0.02
## 236    5 -50.47 112.06 3.58 0.02
## 46     4 -51.72 112.16 3.69 0.02
## 14     4 -51.74 112.20 3.73 0.02
## 25     4 -51.75 112.23 3.76 0.02
## 12     4 -51.83 112.38 3.91 0.01
## 26     4 -51.85 112.42 3.95 0.01
## 136    5 -50.87 112.85 4.38 0.01
## 356    5 -50.90 112.91 4.44 0.01
## 135    5 -50.99 113.09 4.62 0.01
## 16     4 -52.32 113.37 4.89 0.01
## 56     4 -52.32 113.37 4.90 0.01
## 2346   6 -49.91 113.40 4.93 0.01
## 246    5 -51.16 113.43 4.95 0.01
## 2345   6 -49.93 113.44 4.97 0.01
## 1234   6 -49.97 113.52 5.05 0.01
## 245    5 -51.23 113.57 5.10 0.01
## 15     4 -52.45 113.64 5.16 0.01
## 124    5 -51.27 113.65 5.17 0.01
## 3456   6 -50.09 113.76 5.28 0.01
## 1345   6 -50.13 113.85 5.38 0.01
## 456    5 -51.45 114.02 5.55 0.01
## 145    5 -51.51 114.13 5.66 0.01
## 1235   6 -50.36 114.31 5.83 0.01
## 1346   6 -50.38 114.35 5.87 0.01
## 1236   6 -50.41 114.40 5.93 0.01
## 2356   6 -50.41 114.41 5.94 0.01
## 146    5 -51.72 114.54 6.07 0.00
## 125    5 -51.72 114.56 6.09 0.00
## 256    5 -51.75 114.61 6.14 0.00
## 126    5 -51.81 114.74 6.26 0.00
## 1356   6 -50.87 115.33 6.85 0.00
## 156    5 -52.31 115.73 7.26 0.00
## 2456   6 -51.09 115.77 7.30 0.00
## 23456  7 -49.82 115.79 7.31 0.00
## 1246   6 -51.14 115.87 7.39 0.00
## 12346  7 -49.87 115.90 7.43 0.00
## 12345  7 -49.88 115.92 7.45 0.00
## 1245   6 -51.21 116.00 7.53 0.00
## 13456  7 -50.07 116.30 7.82 0.00
## 1456   6 -51.45 116.49 8.01 0.00
## 12356  7 -50.36 116.87 8.40 0.00
## 1256   6 -51.72 117.03 8.56 0.00
## 12456  7 -51.08 118.31 9.83 0.00
## 123456 8 -49.78 118.38 9.91 0.00
##

```

Term codes:

```

##          p(date)          p(dras)          p(sfrz)

```

```
##          1          2          3
##      lam(buf.fragmen) lam(I(buf.fragmen^2))      lam(dcon)
##          4          5          6
##
## Model-averaged coefficients:
## (full average)
##      Estimate Std. Error z value Pr(>|z|)
## lam(Int)      0.81658    2.72603  0.300  0.765
## p(Int)      -4.80568    2.97473  1.616  0.106
## p(sfrz)      1.03084    1.32462  0.778  0.436
## lam(buf.fragmen) 0.14838    0.30099  0.493  0.622
## p(dras)      0.13266    0.29928  0.443  0.658
## lam(dcon)    -0.01090    0.26356  0.041  0.967
## p(date)      0.01639    0.16940  0.097  0.923
## lam(I(buf.fragmen^2)) -0.01342    0.21563  0.062  0.950
##
## (conditional average)
##      Estimate Std. Error z value Pr(>|z|)
## lam(Int)      0.81658    2.72603  0.300  0.765
## p(Int)      -4.80568    2.97473  1.616  0.106
## p(sfrz)      1.85951    1.27445  1.459  0.145
## lam(buf.fragmen) 0.40015    0.37891  1.056  0.291
## p(dras)      0.39099    0.40372  0.968  0.333
## lam(dcon)    -0.04374    0.52663  0.083  0.934
## p(date)      0.06861    0.34143  0.201  0.841
## lam(I(buf.fragmen^2)) -0.05304    0.42615  0.124  0.901
```

P. onca

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

```
##
## Call:
## model.avg(object = oms, subset = delta < 10)
##
## Component model call:
## occuRN(formula = ~<31 unique rhs>, data = UMF, K = 50)
##
## Component models:
##      df logLik QAICc delta weight
## 4      3 -45.15 70.23  0.00  0.24
## (Null) 2 -48.29 72.21  1.98  0.09
## 45     4 -45.04 72.47  2.24  0.08
## 14     4 -45.14 72.60  2.37  0.07
## 34     4 -45.14 72.61  2.38  0.07
## 24     4 -45.15 72.61  2.38  0.07
## 5      3 -47.95 74.04  3.82  0.04
## 245    5 -44.58 74.31  4.09  0.03
## 2      3 -48.22 74.42  4.19  0.03
## 1      3 -48.23 74.43  4.20  0.03
## 3      3 -48.29 74.50  4.28  0.03
## 124    5 -44.90 74.75  4.52  0.02
## 145    5 -45.03 74.93  4.70  0.02
## 345    5 -45.04 74.94  4.71  0.02
## 134    5 -45.13 75.07  4.84  0.02
```

```

## 234      5 -45.14 75.08  4.85  0.02
## 15       4 -47.88 76.33  6.10  0.01
## 25       4 -47.93 76.40  6.17  0.01
## 1245     6 -44.23 76.40  6.18  0.01
## 35       4 -47.95 76.43  6.20  0.01
## 12       4 -47.97 76.46  6.24  0.01
## 23       4 -48.22 76.80  6.57  0.01
## 13       4 -48.23 76.81  6.58  0.01
## 2345     6 -44.58 76.88  6.65  0.01
## 1345     6 -45.03 77.50  7.27  0.01
## 1234     6 -45.13 77.63  7.40  0.01
## 135      5 -47.87 78.80  8.57  0.00
## 235      5 -47.93 78.88  8.65  0.00
## 123      5 -47.96 78.92  8.70  0.00
## 125      5 -47.97 78.94  8.71  0.00
## 12345    7 -44.22 79.07  8.84  0.00
##
## Term codes:
##          p(date)          p(dras)          p(sfrz) lam(buf.fragmen)
##              1              2              3              4
##          lam(dcon)
##              5
##
## Model-averaged coefficients:
## (full average)
##          Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -1.188333   0.866838   1.371   0.1704
## lam(buf.fragmen) 0.670684   0.562960   1.191   0.2335
## p(Int)        -2.228814   0.873544   2.551   0.0107 *
## lam(dcon)      0.053867   0.405930   0.133   0.8944
## p(date)       0.032859   0.202404   0.162   0.8710
## p(sfrz)       -0.008201   0.480643   0.017   0.9864
## p(dras)       0.164494   0.681499   0.241   0.8093
##
## (conditional average)
##          Estimate Std. Error z value Pr(>|z|)
## lam(Int)      -1.18833   0.86684   1.371   0.1704
## lam(buf.fragmen) 0.93870   0.43816   2.142   0.0322 *
## p(Int)        -2.22881   0.87354   2.551   0.0107 *
## lam(dcon)      0.20619   0.77416   0.266   0.7900
## p(date)       0.13819   0.39716   0.348   0.7279
## p(sfrz)       -0.03597   1.00607   0.036   0.9715
## p(dras)       0.66496   1.24286   0.535   0.5926
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sum of QAICc-weights

##          lam(buf.fragmen) lam(dcon) p(dras) p(date) p(sfrz)
## Sum of weights:      0.71      0.26      0.25      0.24      0.23
## N containing models:   16      16      16      16      16

```