Modelling the covariance structure in marginal multivariate count models: Hunting in Bioko Island

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August 15, 2016

1 Selecting the components of the linear and matrix linear predictors

In this Supplementary material we present the stepwise procedure employed to select the components of the linear and matrix linear predictors.

Table S1 shows the step-by-step procedure used to select the components of the linear predictor for both response variables. The selection procedure is simple. We started fitting a model only with the intercept and sequentially including new covariates according to the values of the SIC. For example, in the step 1 for `BD` the smallest SIC value appears for the interaction term between `method` and `alt`. It was the first effect entering (+) in the linear predictor. Since it is an interaction effect the main effects were also included in the model. In the step 2 the SIC indicated that the interaction effect between `sex` and `alt` should be included in the model. We fitted such a model, but in that case the Wald test indicated that the interaction effect was not significant, so we removed (−) this effect from the model. The selection procedure stops when all remaining effects have SIC bigger than zero. In that case 5 steps were enough to reach the final model. The same procedure was used to select the components of the linear predictor for `OT`. It is important to highlight that in the linear predictor selection the covariance structure was fixed assuming independent observations.

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Supplementary Table S1: Step-by-step of the score information criterion for the components of the linear predictor for each response variable.

Effects	Score information criterion				
	Step-1	Step-2	Step-3	Step-4	Step-5
Blue duikers (BD)					
sex	−53.108	−188.770	+	+	+
method	−379.472	+	+	+	+
alt	−2782.852	+	+	+	+
month	−61.316	−1355.822	−1506.486	+	+
sex*method	−721.550	−2132.131	−183.750	−174.565	−
sex*alt	−4570.965	−12094.148	−	−	−
sex*month	−114.691	−761.555	−1586.485	47.173	49.405
method*alt	−5811.822	+	+	+	+
method*month	−456.565	−1525.138	−1698.485	24.419	26.447
alt*month	−3097.580	−2095.673	−2382.826	+	+
Other small animals (OT)					
sex	0.423	−3412.380	+	+	
method	−90.904	+	+	+	
alt	−100.509	+	+	+	
month	6.538	−366.581	−19.981	+	
sex*method	−164.123	−6245.867	2.616	38.664	
sex*alt	−284.136	−7166.742	+	+	
sex*month	9.682	−3212.990	−14.508	68.871	
method*alt	−645.610	+	+	+	
method*mont	−93.846	−385.803	−40.537	51.192	
alt*month	−153.103	−434.920	−81.338	+	

Similarly, Table S2 shows the step-by-step procedure used to select the components of the matrix linear predictor for both response variables. Now, it is important to highlight that for selecting the matrix linear predictor, we fixed the linear predictor as obtained previously. Combining the selected linear and matrix linear predictors the final multivariate model was fitted and the results were presented in Section 5.

Supplementary Table S2: Step-by-step of the score information criterion for the components of the matrix linear predictor for each response variable.

Effects	Score information criterion				
	Step-1	Step-2	Step-3	Step-4	Step-5
Blue duikers (BD)					
Hunter	−65.116	−19.041	9.398	11.953	11.979
Alt-2	140.848	−28.948	−23.213	−	−
Alt-3	−45.291	−5.470	9.611	11.882	11.953
Alt-4	3.308	5.198	7.406	10.048	11.906
Alt-5	4.805	7.946	9.999	11.965	11.899
method	−205.969	−132.659	+	+	+
sex	3.527	7.473	6.048	6.647	9.197
Hunter-Month	−215.736	+	+	+	+
Longitudinal	−19.844	−0.932	−9.306	−10.609	+
Other small animals (OT)					
Hunter	−28.352	−2.866	−1.548	−	
Alt-2	0.509	3.294	4.411	1.450	
Alt-3	4.445	7.826	9.950	9.724	
Alt-4	4.579	6.718	9.063	6.231	
Alt-5	5.759	7.297	9.384	9.362	
method	−2.991	4.455	5.373	8.555	
sex	5.875	6.740	8.055	6.405	
Hunter-Month	−17.950	−7.436	+	+	
Longitudinal	−33.986	+	−	−	

2 Summary of fitted models

Supplementary Table S3: Regression parameter estimates, standard errors (SE) and Z-statistics for the components of the linear predictor for the response variable `BD`.

Effects	Estimates	SE	Z-statistics
`(Intercept)`	0.354	0.107	3.309
`MethodTrampa`	−0.593	0.224	−2.643
`Alt2`	−0.268	0.158	−1.694
`Alt3`	0.365	0.118	3.091
`Alt4`	0.793	0.115	6.926
`Alt5`	0.013	0.146	0.089
`SexM`	−0.623	0.040	−15.743
`poly(Month, 3)1`	−0.232	4.900	−0.047
`poly(Month, 3)2`	−16.397	4.441	−3.692
`poly(Month, 3)3`	−7.220	4.059	−1.779
`MethodTrampa:Alt2`	0.608	0.241	2.522
`MethodTrampa:Alt3`	0.243	0.228	1.068
`MethodTrampa:Alt4`	0.788	0.232	3.391
`MethodTrampa:Alt5`	1.529	0.248	6.170
`Alt2:poly(Month, 3)1`	−17.908	6.344	−2.823
`Alt3:poly(Month, 3)1`	−0.088	5.215	−0.017
`Alt4:poly(Month, 3)1`	−6.556	5.108	−1.284
`Alt5:poly(Month, 3)1`	−3.589	5.250	−0.684
`Alt2:poly(Month, 3)2`	−3.082	5.852	−0.527
`Alt3:poly(Month, 3)2`	7.402	4.677	1.583
`Alt4:poly(Month, 3)2`	6.213	4.648	1.337
`Alt5:poly(Month, 3)2`	9.153	4.820	1.899
`Alt2:poly(Month, 3)3`	−3.555	5.244	−0.678
`Alt3:poly(Month, 3)3`	11.822	4.345	2.721
`Alt4:poly(Month, 3)3`	9.137	4.318	2.116
`Alt5:poly(Month, 3)3`	7.446	4.394	1.695

Supplementary Table S4: Regression parameter estimates, standard errors (SE) and Z-statistics for the components of the linear predictor for the response variable `OT`.

Effects	Estimates	Std.error	Z-statistics
`(Intercept)`	0.037	0.145	0.257
`MethodTrampa`	0.247	0.186	1.329
`Alt2`	−1.252	0.266	−4.711
`Alt3`	−2.681	0.281	−9.544
`Alt4`	−2.097	0.256	−8.203
`Alt5`	−0.633	0.231	−2.739
`SexM`	−0.685	0.172	−3.991
`poly(Month, 4)1`	−3.914	3.922	−0.998
`poly(Month, 4)2`	0.757	3.841	0.197
`poly(Month, 4)3`	4.535	3.658	1.240
`poly(Month, 4)4`	−7.973	3.711	−2.149
`MethodTrampa:Alt2`	0.603	0.306	1.971
`MethodTrampa:Alt3`	0.652	0.321	2.030
`MethodTrampa:Alt4`	−0.140	0.344	−0.405
`MethodTrampa:Alt5`	−0.833	0.287	−2.905
`Alt2:SexM`	−0.158	0.267	−0.591
`Alt3:SexM`	0.505	0.298	1.696
`Alt4:SexM`	0.620	0.302	2.052
`Alt5:SexM`	−0.355	0.278	−1.277
`Alt2:poly(Month, 4)1`	16.677	6.413	2.600
`Alt3:poly(Month, 4)1`	−4.044	7.169	−0.564
`Alt4:poly(Month, 4)1`	17.573	6.502	2.703
`Alt5:poly(Month, 4)1`	4.842	5.774	0.839
`Alt2:poly(Month, 4)2`	−23.686	6.077	−3.898
`Alt3:poly(Month, 4)2`	4.525	6.530	0.693
`Alt4:poly(Month, 4)2`	−4.015	6.421	−0.625
`Alt5:poly(Month, 4)2`	−7.768	5.682	−1.367
`Alt2:poly(Month, 4)3`	−11.150	5.799	−1.923
`Alt3:poly(Month, 4)3`	18.457	6.893	2.678
`Alt4:poly(Month, 4)3`	11.868	6.601	1.798
`Alt5:poly(Month, 4)3`	−14.972	5.541	−2.702
`Alt2:poly(Month, 4)4`	4.565	6.258	0.730
`Alt3:poly(Month, 4)4`	3.505	7.285	0.481
`Alt4:poly(Month, 4)4`	4.194	6.605	0.635
`Alt5:poly(Month, 4)4`	12.866	5.753	2.236

3 Fitted values for alternatives models

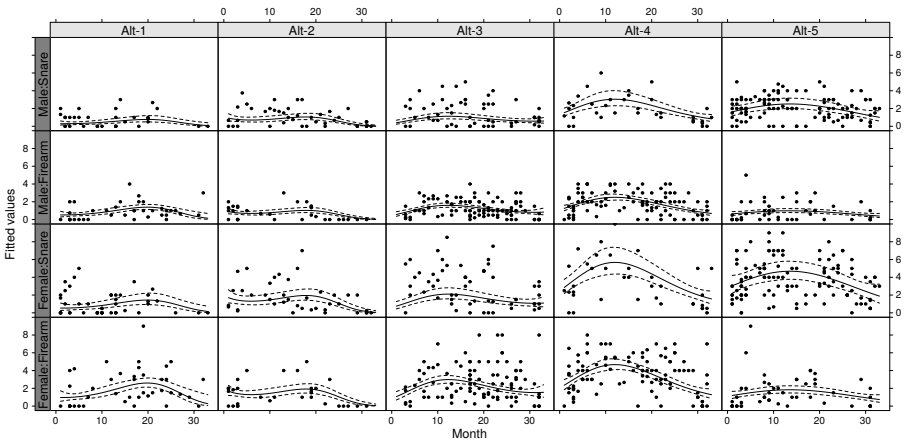

Figure S1: Fitted values and 95% confidence intervals by altitude, method of capture and sex for the response variable `BD` - Splines time trend.

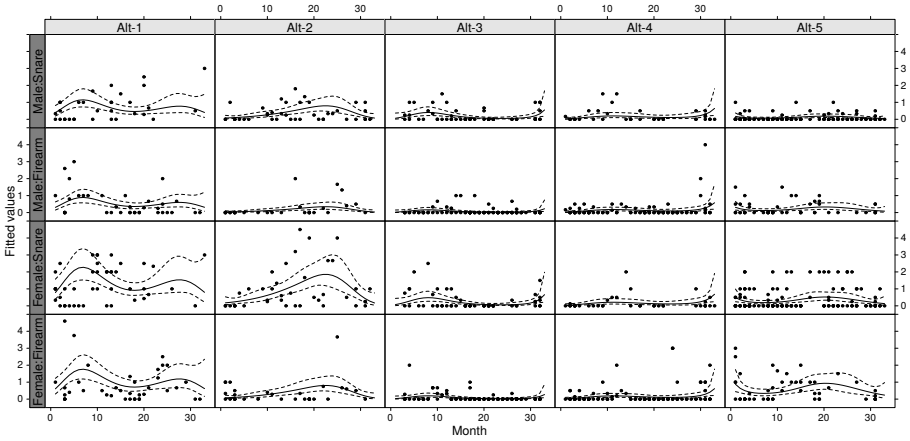

Figure S2: Fitted values and 95% confidence intervals by altitude, method of capture and sex for the response variable `OT` - Splines time trend.

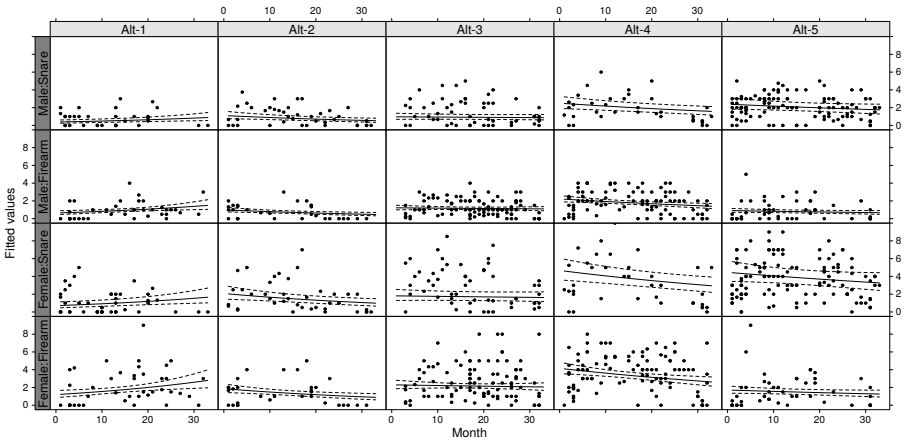

Figure S3: Fitted values and 95% confidence intervals by altitude, method of capture and sex for the response variable `BD` - Linear time trend.

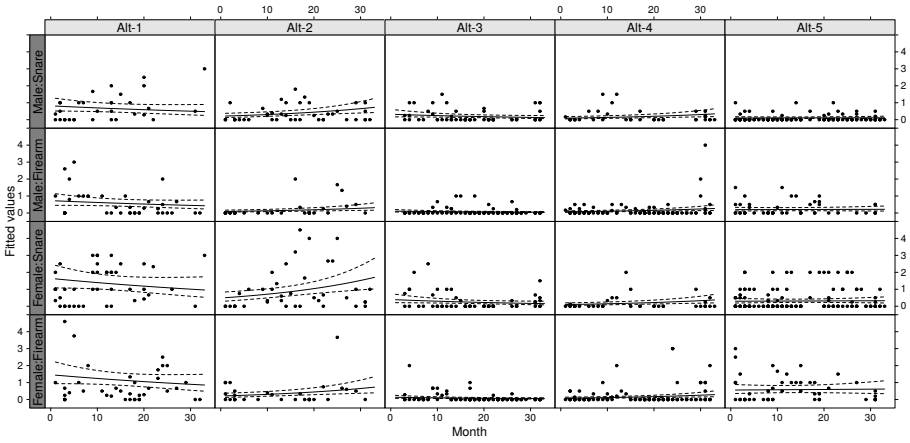

Figure S4: Fitted values and 95% confidence intervals by altitude, method of capture and sex for the response variable `OT` - Linear time trend.