Nowhere to run, nowhere to hide: carnivoran extinction in the Holocene

INTRO:

Methods:

Sample:

We collated a sample of 114 species of carnivorans from the ecoregister - 19 species or 16.7% extinct, and 95 species or 83.3% extant. They cover X sites and a were dated from Xya to Xya. The ecoregister is….

Covering X% of carnivorans from X% of the landmass.

All variables used in the analyses, despite brain size, pc, longevity...?! were sourced from Ecoregister. (see Table for sources) PC was derived as a composite score of the first PC from the XXX list vars from Noonan describing WHAT % of the variance. Longevity was obtained from Noonan.

Table X – data sources and detailed description of variables, including histograms of the distribution of the original dataset, and density plots of the 20 imputed datasets (red lines) and the observed original data (blue line).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable | Units | Description | Distribution | Imputation | Source | NM |
|  |  |  |  |  |  |  |
| Body mass | kg | Body mass |  |  | Ecoregister | 10 |
| Home Range | km2 | ? |  |  | Ecoregister | 45 |
| Brain | mm3 | Endocranial volume |  |  | Michaud | 28 |
| EQ | index | Derived using CEQ formula |  |  | Heldstab | 49 |
| PC | PC score | See methods for details |  |  | Noonan | 46 |
| BMR | ml O2 hr-1 |  |  | NA | Ecoregister | 0 |
| Litter size | number | Number of offspring per litter |  |  | Noonan | 34 |
| Shannon index of diet | Index |  |  |  |  | 46 |
| Simpson index of diet | Index |  |  |  |  | 46 |
| Abundance | Frequency of camera trap observation | See methods for details |  |  |  | 34 |
| Longevity | years |  |  |  | Noonan | 49 |
|  |  |  |  |  |  |  |
| **CATEGORICAL** |  |  |  |  |  |  |
| Extinct or Extant | 0 – extinct, 1 - extant |  |  |  | Ecoregister | 0 |
| Locomotor mode | 6 categoris | A – arboreal  R – semiarboreal  SA – semiaquatic  SC – scansorial  SF – semifossorial  T - terrestrial |  |  | Galvez-Lopez | 0 |
| Diet | 6 Categories | Based on k-means clustering of scat data |  |  | Ecoregister | 46 |
|  |  |  |  |  |  |  |

Michaud

Helbstad

Noonan

Ecoregister

Variable processing:

Diet was categorized using data from scat samples, obtained from the ecoregister.

Scat categories in the Ecoregister include: vertebrates, invertebrates, fruit, plant, aquatic, fungus

and were subsequently recategorized in 6 different categories using k-means clustering and XXX:

Cat 1:

Cat 2:

Cat 3:

Cat 4:

Cat 5:

Cat 6:

Shannon and Simpson indices of diet were calculated using …..

All variables (despite Shannon index) were log scaled (Shannon was Yeo-Johnson transformed) and min-max normalised before imputation.

Imputation:

We imputed 20 datasets as the original dataset contained ~20% missing data (REF!). DESCRIBE MISSINGLNESS IN SHORT – CHECK PHY SIGNAL IN MISSINGNESS (detailed description of the missingness pattern and imputation analyses in Supplement). All continuous variables were imputed using Predictive Means Matching (PMM), and all categorical variables with Polytomous logistic regression (polyreg).

Phylogeny:

We used the latest Phylacine phylogeny (REF!) which (describe) providing 1000 trees.

We added 3 missing species as follows: *Martes caurina* as sister species to *Martes americana*, *Conepatus robustus* as sister to both *Conepatus chinga* *and Conepatus leuconotus*, and *Felis lybica* as sister to *Felis silvestris*.

Statistical analysis:

All analyses were conducted on the 20 imputed datasets and all phylogenetically corrected tests used 1000 trees. MCMCglmm data was pooled used Rubin’s rule (REF).

PCA – over 20 datasets

Phyloglm – comparison with mcmcglmm (supplement) – 1000 trees and test runs

mcMCMCglmm – running final models

Lavaan – causality on \*random\* models

We used packages: [generate] mice, lavaan, psych, phylolm, phytol, ggplot, MulTree, psych, easystats

RESULTS:

DISC: