

lion leopard bear 220425

Code ▼

for the paper “Large predator hunting and their interpretation: Leopards, Bears and Lions in the Archaeological Record of the Southern Levant” by Shimelmitz, Reshef, Nativ & Marom.

Version 3.2: a few specimens added from Hyonim Terrace (bear), Hayonim B (leopard), Qatif Y3 (lion), Megiddo Tombs (lion). Current database version ~/references/daria_table_220425.xlsx

code and statistical mistakes Nimrod Marom (nimrod.arch@gmail.com (mailto:nimrod.arch@gmail.com))

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```
library(vcd)
library(questionr)
library(DescTools)
library(tidyverse)
library(RColorBrewer)

sessionInfo()
```

```

R version 4.1.2 (2021-11-01)
Platform: x86_64-w64-mingw32/x64 (64-bit)
Running under: Windows 10 x64 (build 22598)

Matrix products: default

locale:
[1] LC_COLLATE=English_United Kingdom.1252 LC_CTYPE=English_United Kingdom.1252
[3] LC_MONETARY=English_United Kingdom.1252 LC_NUMERIC=C
[5] LC_TIME=English_United Kingdom.1252
system code page: 65001

attached base packages:
[1] grid      stats      graphics  grDevices  utils      datasets  methods    base

other attached packages:
[1] RColorBrewer_1.1-2 forcats_0.5.1      stringr_1.4.0      dplyr_1.0.8
[5] purrr_0.3.4      readr_2.1.2      tidyr_1.2.0      tibble_3.1.6
[9] ggplot2_3.3.5    tidyverse_1.3.1  DescTools_0.99.44 questionr_0.7.7
[13] vcd_1.4-9

loaded via a namespace (and not attached):
[1] nlme_3.1-153      fs_1.5.2          lubridate_1.8.0   htrr_1.4.2
[5] tools_4.1.2      backports_1.4.1  bslib_0.3.1      utf8_1.2.2
[9] R6_2.5.1         DBI_1.1.2         mgcv_1.8-38      colorspace_2.0-2
[13] withr_2.5.0      tidymodels_1.1.1 Exact_3.1         compiler_4.1.2
[17] cli_3.1.1        rvest_1.0.2      expm_0.999-6     xml2_1.3.3
[21] labeling_0.4.2   sass_0.4.1       scales_1.1.1     lmtest_0.9-40
[25] mvtnorm_1.1-3    proxy_0.4-26     digest_0.6.29    rmarkdown_2.11
[29] pkgconfig_2.0.3  htmltools_0.5.2  labelled_2.9.0   dbplyr_2.1.1
[33] fastmap_1.1.0    highr_0.9        rlang_1.0.1     readxl_1.3.1
[37] rstudioapi_0.13  shiny_1.7.1      farver_2.1.0     jquerylib_0.1.4
[41] generics_0.1.2   zoo_1.8-10       jsonlite_1.7.3   magrittr_2.0.2
[45] Matrix_1.3-4     Rcpp_1.0.8       munsell_0.5.0    fansi_1.0.2
[49] lifecycle_1.0.1  stringi_1.7.6    yaml_2.3.5       MASS_7.3-54
[53] rootSolve_1.8.2.3 promises_1.2.0.1 crayon_1.5.0     lmom_2.8
[57] miniUI_0.1.1.1   lattice_0.20-45  haven_2.4.3     splines_4.1.2
[61] hms_1.1.1        knitr_1.37       pillar_1.7.0     boot_1.3-28
[65] gld_2.6.4        reprex_2.0.1     glue_1.6.1       evaluate_0.15
[69] data.table_1.14.2 modelr_0.1.8     vctrs_0.3.8     tzdb_0.2.0
[73] httpuv_1.6.5     cellranger_1.1.0 gtable_0.3.0     assertthat_0.2.1
[77] xfun_0.29        mime_0.12        xtable_1.8-4     broom_0.7.12
[81] e1071_1.7-9      later_1.3.0      class_7.3-19     ellipsis_0.3.2

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```

#manually feed taxon table for periods 2+
freqs <- c(6,7,1,2,0,1,3,14,1,2,3,12)
tax_table <- matrix(freqs, ncol = 3, nrow = 4, dimnames = list(c("2a","2b","3","4"), c("leopard","lion","bear")))
tax_table

```

```
leopard lion bear
2a      6    0    1
2b      7    1    2
3       1    3    3
4       2   14   12
```

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```
#chi-square + plot residuals of each taxon by period
fisher.test(tax_table)
```

Fisher's Exact Test for Count Data

```
data: tax_table
p-value = 6.043e-05
alternative hypothesis: two.sided
```

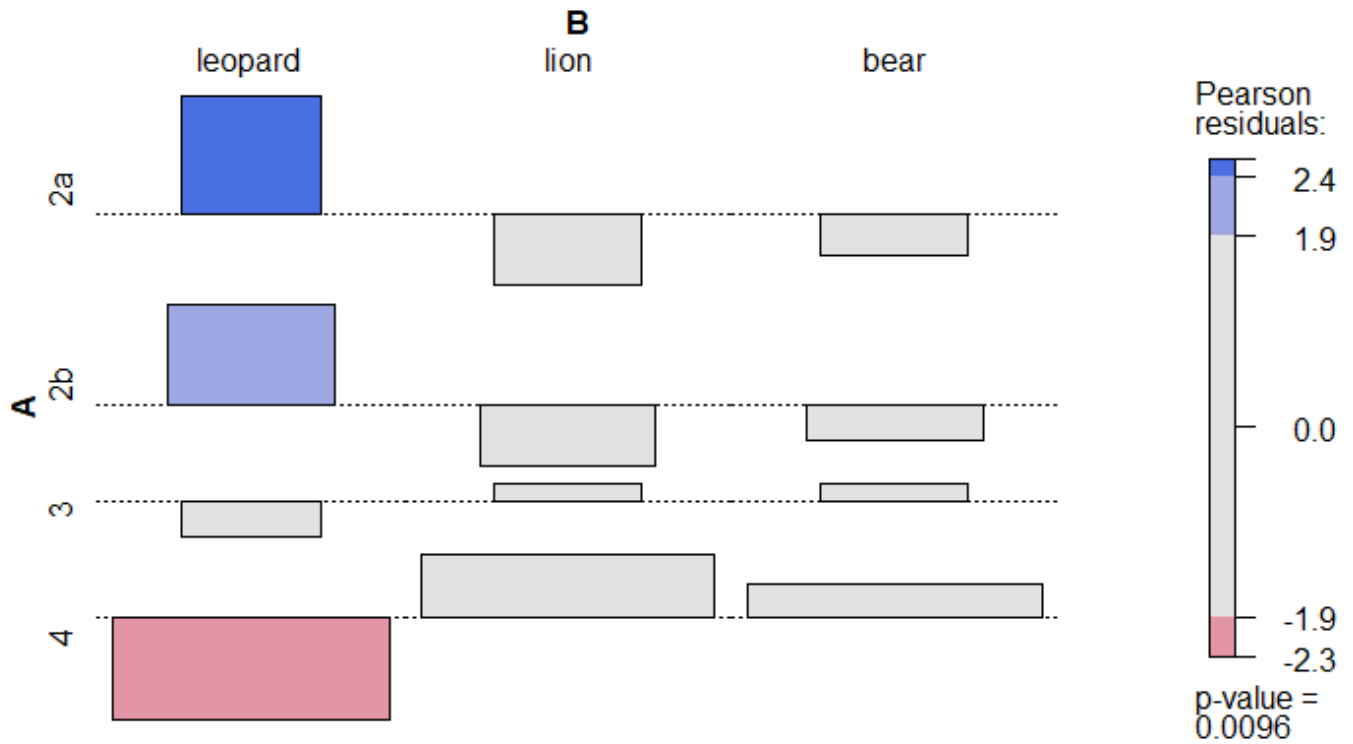
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```
std_res_table <- chisq.residuals(tax_table, std = TRUE)
```

```
Warning in stats::chisq.test(tab) :
  Chi-squared approximation may be incorrect
```

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```
tax_dev_df <- as_tibble(std_res_table)
period <- c("2a", "2b", "3", "4")
tax_dev_df <- cbind(period, tax_dev_df)
tax_dev_df_long <- gather(tax_dev_df, animal, std_res, 2:4)
assoc(tax_table, gp = shading_max, gp_args = list(n = 5000))
```



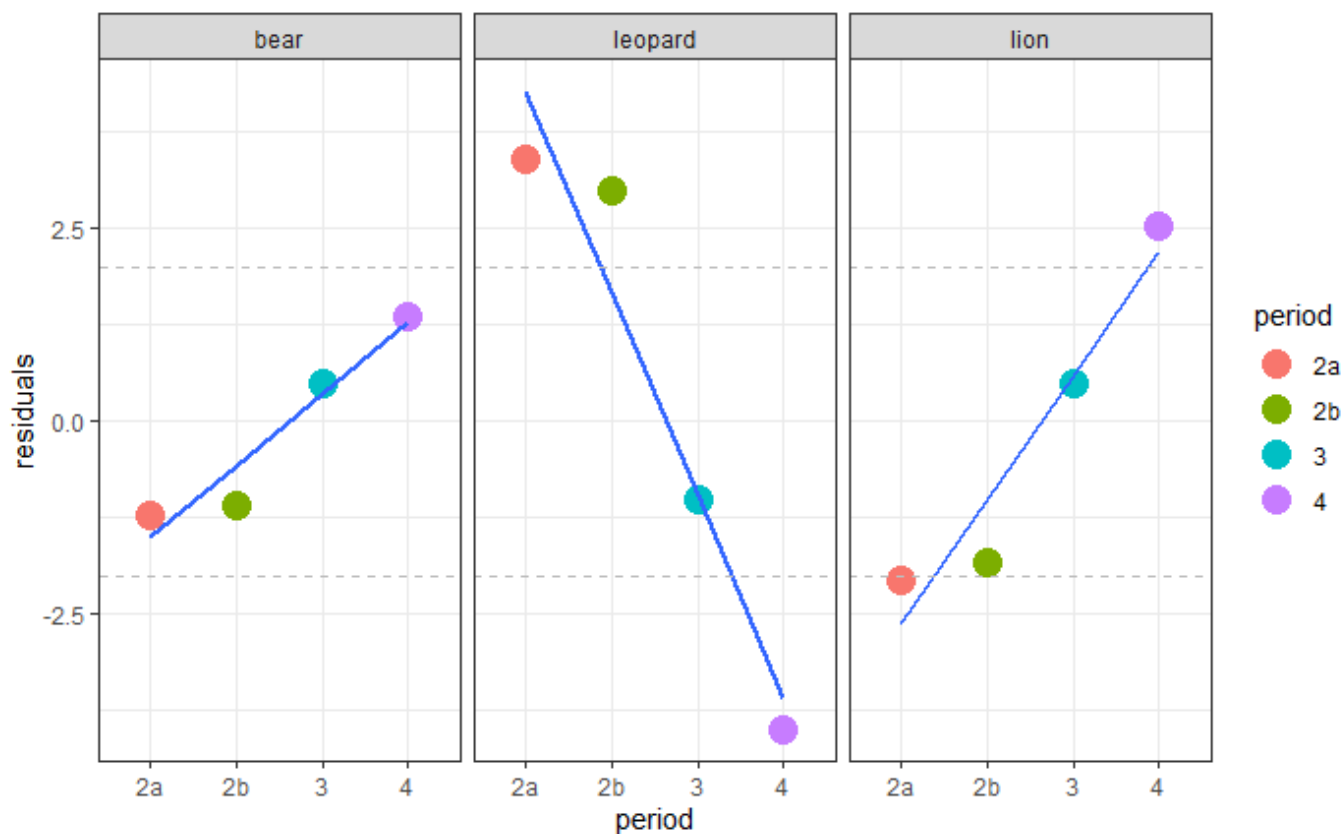
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```
plot_2 <- ggplot(tax_dev_df_long, aes(x= period, y= std_res, group = animal)) + geom_point(aes(col = animal)) + geom_smooth(method = "lm", se = FALSE) + facet_grid(.~animal) + geom_abline(slope = 0, intercept = 2, col = "red", linetype = "dashed") + geom_abline(slope = 0, intercept = -2, col = "red", linetype = "dashed") + theme_bw()
```

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```
#plot residuals by period and correlate the results
std_res_df <- data.frame(std_res_table)
period_temp <- c("2a","2b","3","4")
std_res_df <- cbind.data.frame(period_temp, std_res_df)
colnames(std_res_df)[1] <- "period"
rm(period_temp)
std_res_df_long <- gather(std_res_df, "taxon", "residuals", 2:4)
figure_4 <- ggplot(std_res_df_long, aes(x = period, y = residuals)) +
  geom_point(aes(col = period), size = 5) + facet_grid(.~taxon) +
  geom_smooth(aes(group = taxon),method = 'lm', se = FALSE)+
  theme_bw()+ geom_abline(aes(intercept = 2, slope = 0), col = "gray", linetype = "dashed")+
  geom_abline(aes(intercept = -2, slope = 0), col = "gray", linetype = "dashed")
figure_4
```

```
`geom_smooth()` using formula 'y ~ x'
```



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```
corr_lion_leopard <- cor.test(std_res_table[,1],std_res_table[,2])
corr_lion_bear <- cor.test(std_res_table[,3],std_res_table[,2])
corr_leopard_bear <- cor.test(std_res_table[,3],std_res_table[,1])
corr_leopard_bear
```

Pearson's product-moment correlation

```
data: std_res_table[, 3] and std_res_table[, 1]
t = -20.923, df = 2, p-value = 0.002276
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
-0.9999548 -0.8913801
sample estimates:
cor
-0.9977235
```

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```
corr_lion_bear
```

Pearson's product-moment correlation

```

data: std_res_table[, 3] and std_res_table[, 2]
t = 12.991, df = 2, p-value = 0.005873
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.7414995 0.9998831
sample estimates:
      cor
0.9941266

```

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corr_lion_leopard

Pearson's product-moment correlation

```

data: std_res_table[, 1] and std_res_table[, 2]
t = -34.517, df = 2, p-value = 0.0008383
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
-0.9999834 -0.9586111
sample estimates:
      cor
-0.9991617

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```

#area plot of carnivoran taxa by phase (figure 3)
freqs <- c(2,6,7,1,2,1,0,1,3,14,1,1,2,3,12)
tax_table_2 <- matrix(freqs, ncol = 3, nrow = 5, dimnames = list(c("1","2a","2b","3","4"), c(
"leopard","lion","bear")))
figure_3_df <- data.frame(tax_table_2)
period_temp <- c("1","2a","2b","3","4")
figure_3_df <- cbind.data.frame(period_temp, figure_3_df)
colnames(figure_3_df)[1] <- "period"
figure_3_df$period <- factor(figure_3_df$period)
figure_3_df_long <- gather(figure_3_df, animal, frequency, 2:4)
figure_3_df_long$animal <- factor(figure_3_df_long$animal)
figure_3 <- ggplot(figure_3_df_long, aes(x = period, y = frequency, fill = animal))+ geom_area(
position = 'fill', aes(group = animal), alpha = 0.4) + theme_classic()+ theme(legend.position = "top")+ scale_fill_brewer(palette = "Dark2")
figure_3

```

