

Leptograpsus crab morphology manuscript

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Introduction

Leptograpsus variegatus is a species of small shore crab found throughout the Southern Pacific, including on the shores of western Australia where the crabs dataset was collected (Campbell and Mahon 1974). These crabs play an important role in the flow of nutrients through mangrove ecosystems, where they break down mangrove leaves and provide particulate organic matter to many species of detritivores (Camilleri 1992). The authors of the study for which the crabs dataset was originally collected intended their analysis to support the differentiation of the two colour morphs into separate species (Campbell and Mahon 1974). However, as far as I can tell, there have been no official subspecies of *Leptograpsus variegatus* described in the 50 years the publication of the original study.

Data and analysis

Data for this project was originally collected and published in Campbell and Mahon (1974). Take a look at the distribution of some of the variables show below in Figure 1. Based on visually examining the distributions, (and reading what the original authors did in their analysis), and since all variables are already in a common unit measure (mm) I decided not to transform the data.

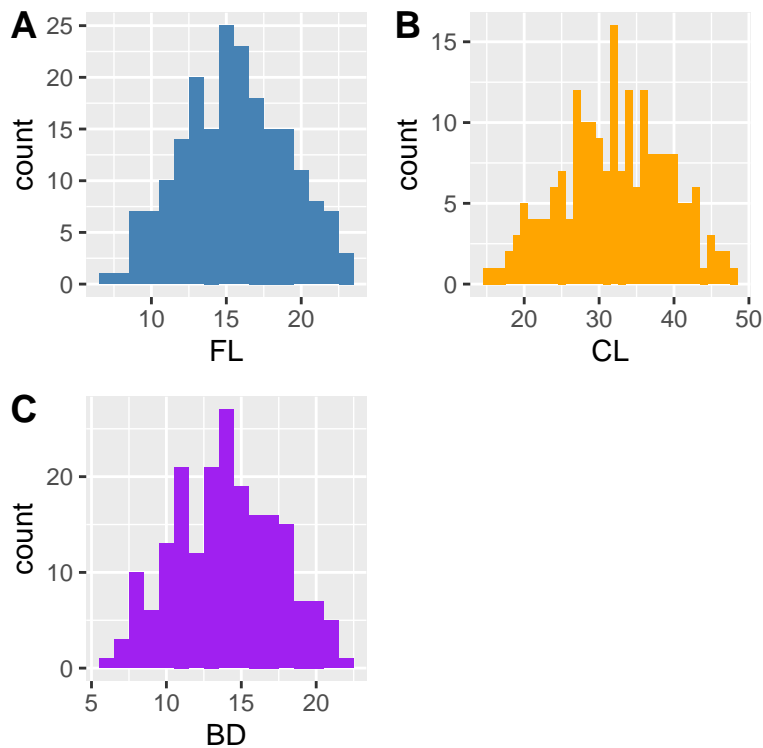


Figure 1: Histograms showing distributions of frontal lobe (FL), carapace length (CL), and body depth (BD).

Analysis and data visualizations were all performed in R.

We used R version 4.4.0 (R Core Team 2024) and the following R packages: ggordiplots v. 0.4.3 (Quensen et al. 2024), prereg v. 0.6.0 (Aust and Spitzer 2022), rmarkdown v. 2.28 (Xie et al. 2018, 2020; Allaire et al. 2024), tidyverse v. 2.0.0 (Wickham et al. 2019), vegan v. 2.6.8 (Oksanen et al. 2024).

Results

Results of the PCA demonstrated some distinction between blue and orange morphs along the first principal component, and a larger distinction between males and females along the second axis of variation as seen in the following code chunk.

```
#we need the vegan stats package, ggplot, and  
#ggordiplots which allows us to create biplots using ggplot  
library(vegan)  
  
## Loading required package: permute  
## Loading required package: lattice  
## This is vegan 2.6-8  
  
library(ggplot2)  
library(ggordiplots)  
  
## Loading required package: glue  
#reading crabs data from the raw data folder  
crabs <- read.csv('../00_rawdata/crabs_measurements.csv')  
#perform pca using vegan's rda function  
pca_crabs <- rda(crabs[5:9])  
#creating a species+sex column for visualization in the plot  
crabs$spsex <- paste0(crabs$sp, crabs$sex)  
#using ggordiplot. Ellipses are 1 standard deviation about the centroid.  
gg_ordiplot(pca_crabs, groups = crabs$spsex, pt.size = 1,  
            kind = 'sd')
```

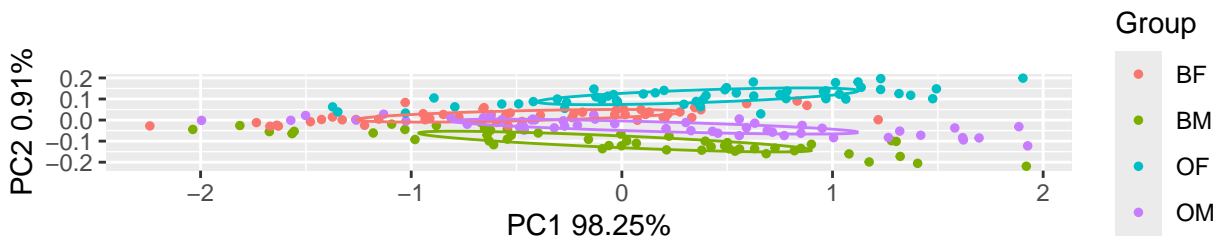


Figure 2: Biplot showing the first and second principal components from the PCA using the crabs morphological data. Point represent individual crabs and are coloured by sex and colour morph

Campbell and Mahon (1974) did not include a figure showing their PCA, however their listed values for their first and second principal components are similar to the ones I obtained using the standard rda function in vegan. Since only one principal component captures over 98% of the total variation in the original variables, there is a consistent relationship between all variables across the dataset. We can see in Figure 2 that there is a very large overlap between the males of both colour morphs, and some minor differentiation between females of between colour morphs in the first dimension (shown along the x-axis). As noted in (Campbell and Mahon 1974) the crabs have a fairly consistent body shape, and much of the variation is in total size across all measured dimensions. Since PCA is not a statistical test, we cannot use it to determine if there is a

significant difference between colour morphs. Unmeasured factors such as crab age may also be contributing to variation within the colour morph and sex groups.

References

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