Morphometry of the pedipalp patella provides new characters for species-level taxonomy in whip spiders (Arachnida, Amblypygi): A test case with description of a new species of *Phrynus*

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README FILE FOR DATA AND SCRIPTS

27th February, 2022

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Explanation

This file provides a guide for reproducing the analyses of the study “Morphometry of the pedipalp patella provides new characters for species-level taxonomy in whip spiders (Arachnida, Amblypygi): A test case with description of a new species of *Phrynus*”. Each folder in the repository contains the data necessary for the respective analysis. The figures in the paper in which the results of a specific analysis appear are indicated.

1. “Geometric morphometrics” folder

This folder contains the data used in the geometric morphometric analysis.

Results appear in figures 3B, C of the paper.

1.1 “Photos_and_landmark_setting” folder
This folder contains one folder for each *Phrynus* group B species included in the geometric morphometric analysis. Each folder contains the images on which landmarks were set using *tpsDig2 ver. 2.31*, a .csv file containing information about the imaged specimens, and the resulting .tps files. The .tps files refer to the images in the same directory. To see how landmarks were set on the series of specimen photographs belonging to a respective species, .tps files need to be located in the same folder as the photographs they are referring to and opened in *tpsDig2 ver. 2.31*. To see .tps files as text files, they can be opened in ImageJ or a text editor program such as Notepad on Microsoft Windows.

Note that *P. goesii*, *P. tessellatus* and *P. pinarensis* were not imaged in duplicates.

1.2 “Geomorph_analysis” folder
This folder contains the geometric morphometric analyses performed either for females and males simultaneously (folder “all_specimens”), females only (folder “females”) or males only (folder “males”).

Each folder contains:

- *Phrynus_group_B_species_curves_appended.tps*
  Two .tps files containing the replicate landmark data in which curves were appended (note: both files contain the same data for *P. goesii*, *P. tessellatus* and *P. pinarensis* as they were not imaged in duplicates).
- *links.csv*
  A file describing what landmarks should be connected with a line in the mean shapes of the Procrustes-aligned pedipalp patella.
- *specimen_descriptions.csv*
  A file providing information about the sex of a specimen and in which color a species should be plotted in the PCA.
- *results* folder
  An empty folder in which the results from running R scripts will be saved.

To perform the geometric morphometric analysis using geomorph and to plot the mean shapes of the Procrustes-aligned pedipalp patella and the PCA, put the following R scripts (deposited on Zenodo) into the following folders:

“1_2_Phrynus_B_landmark_analysis_all_specimens_replicates.R” into folder “all_specimens”;
“1_2_Phrynus_B_landmark_analysis_females_only.R” into folder “females”;
“1_2_Phrynus_B_landmark_analysis_males_only.R” into folder “males”.

The working directory in R must be set to the location of the respective script before running it.

2. “Linear distance measurements” folder

This folder contains the images from which linear distance measurements were taken.

Results appear in figures 4D, B, C; 5B, C; S2; S3 and tables 2; 4; S1 of the paper.

- *all_measurements_and_ratios.xlsx*
  File containing all measurements (average measurements for specimens measured in duplicates) and ratios calculated thereof.
- *measurements_per_species folder*
  The folder contains one folder for each species of which linear distance measurements were taken. Each folder contains pedipalp patella photos. In the case of *P. calypso*, *P. exsul*, *P. guarionexi*, *P. longipes*, *P. pinarensis* and *P. pulchripes* the folder contains an .xlsx file of replicate measurement from which averages were calculated for the “*all_measurements_and_ratios.xlsx”* file. The *P. tessellatus* folder contains specimens imaged at the British Museum of Natural History (BMNH) in three subfolders:

- “*Images_of_specimens_at_BMNH*”
  Contains folders with imaged material of a specific specimen jar at the BMNH.
- “*photos_for_carapax_measurements*”
  Contains images from which carapax measurements were taken.
- “*photos_for_pedipalp_measurements*”
  Contains images from which pedipalp patella measurements were taken. Images of specimens with broken spines are located in the folder “*measurements_damaged_specimens*”. The pieces of broken spines were individually measured and their length added up.

3. “Box_plots” folder

This folder contains one folder for each linear morphometric ratio. Each folder contains a .csv file containing the ratios.

Results appear in figures 4D; 5B; S1B and tables of the paper.

To generate the boxplots based on the .csv containing the ratios, put the following R scripts (deposited on Zenodo) into the following folders:

“3_P2_P3_ratio_boxplot.R” into folder “P2_P3_ratio_boxplot”;
“3_P3_length_pedipalp_patella_width_ratio_boxplot.R” into folder “P3_length_pedipalp_patella_width_ratio_boxplot”;
“3_P4_P3_ratio_boxplot.R” into folder “P4_P3_ratio_boxplot”;
“3_P5_P3_ratio_boxplot.R” into folder “P5_P3_ratio_boxplot”;
“3_P6_P3_ratio_boxplot.R” into folder “P6_P3_ratio_boxplot”;
“3_relative_legI_length_boxplot.R” into folder “3_relative_legI_length_boxplot”;
“3_relative_pedipalp_patella_length_ratio_boxplot.R” into folder “relative_pedipalp_patella_length_ratio_boxplot”

The working directory in R must be set to the location of the respective script before running it.

4. “Statistical_testing” folder

This folder contains one folder for each linear morphometric ratio. Each folder contains a .csv file containing the ratios.

Results appear in figures 4D; 5B; S1B and tables 3; 5 of the paper.

To perform RankFD, Kruskal-Wallis and Dunn’s tests on the ratios in the .csv files, put the following R scripts (deposited on Zenodo) into the following folders:

“4_stat_tests_P2_P3.R” into folder “P2_P3_ratio”;
“4_stat_tests_P3_length_pedipalp_patella_width_ratio.R” into folder “P3_length_pedipalp_width_ratio”;
“4_stat_tests_P4_P3.R“ into folder “P4_P3_ratio”;
“4_stat_tests_P5_P3.R“ into folder “P5_P3_ratio”;
“4_stat_tests_P6_P3.R” into folder “P6_P3_ratio”;
“4_stat_tests_relative_legI_length.R” into folder “relative_legI_length”;
“4_stat_tests_relative_pedipalp_patella_length.R” into folder “relative_pedipalp_patella_length”

The working directory in R must be set to the location of the respective script before running it.

5. “PCA_spine_length_ratios” folder

This folder contains a .csv data file with pedipalp patella dorsal spine length ratios to perform a Principal Component Analysis.

Results appear in figures 5C of the paper.

To perform the Principal Component Analysis on the dorsal spine length ratios, put the following R Markdown file (deposited on Zenodo) into the following folder:

“5_PCA_pedipalp_Patella_spine_ratios.rmd” into folder “5_PCA_spine_length_ratios”

The working directory in R must be set to the location of the respective script before running it. The results from running the script will be saved in the empty “results” folder.