

EVE 105: Coral Reef Fish Body Shapes Project
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Project introduction

The exceptional diversity of coral reef fishes is a hallmark of teleost diversity, but the ecological factors underlying this spectacular array remain unclear. Feeding is a strong candidate feature, as it affects many different parts of a fish's life, from how rapidly it must swim to capture its prey, to the parts of the environment in which it spends its time. As a group, we will be asking the question: ***Does planktivory affect body shapes of reef fishes?***

We will measure the body shapes of 81 species of reef fishes spanning eight families. Each family contains both planktivorous and non-planktivorous taxa. We are interested in comparing planktivorous species and non-planktivorous species.

We will measure body shape from photographs of fish specimens taken by Jack Randall using landmark morphometrics. Landmark morphometrics is a method of shape analysis using photographs. We place landmarks on homologous anatomical features of the specimens. Then, we are able to analyze the shape that those landmarks create. We can scale the landmark configurations so that our analyses of shape are independent of the size of the organism. Then, we will compare the body shapes of the two groups.

As a class, you will landmark the images using the package StereoMorph in R. You will each landmark 3 species, with a single specimen per species. I will compile your shape data into a single document and share it with the class. You will each be responsible for statistical analysis on your own of the dataset to compare the two groups and writing a report.

On June 1, you will turn in a brief lab report formatted like a scientific paper with an introduction, methods, results with any data you collected (in table or graphical form), and a discussion about what you found. Be sure to include your hypothesis(es) and prediction(s) in the introduction. The lab report should be between 3-5 pages double-spaced and include literature references where appropriate. This report will be worth 20 points and will be graded according to the attached rubric.

The grading scheme for this project has two parts:

- 1) **5 points:** your contribution to the class' dataset, due May 24. You will each digitize 3 images of fishes. If you do not turn this in you will forfeit the 5 points.
- 2) **20 points:** your written report on the project, due June 1.

I will be holding two extra office hours to help you with R and StereoMorph: Thursday, May 20 2:30-4pm and Friday, May 21 1-2:30pm.

Schedule of events

Tuesday, May 18: Lab session. We will introduce the project and ensure that everyone is comfortable with the basics of R.

- Your assignment: Practice placing landmarks on provided practice fishes (on Canvas). Check yourself by comparing your landmark placements to those in the provided key!

Thursday, May 20: Lab session. We will learn how to place landmarks on fishes using *StereoMorph* in R.

- Your assignment: Landmark your fish photos and upload them to canvas.

Monday, May 24 11:59pm: Your landmarked photos are due.

Tuesday, May 25: Lab session. We will discuss statistical methods with discrete trait data.

- Your assignment: Analyze the data and write up your report.

Tuesday, June 1, 11:59 pm: Your lab report is due to me as an upload on Canvas.

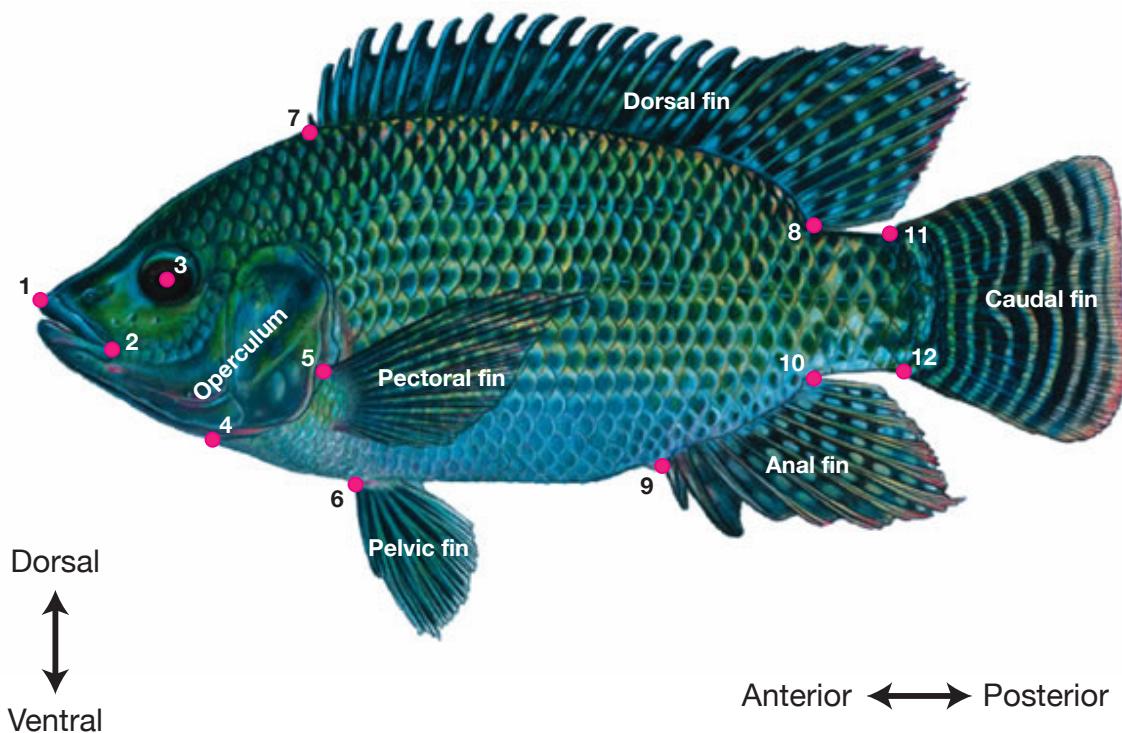
Landmarks and fish anatomy

We will place 12 landmarks on each fish to capture their body shapes. Please do your best to place accurate landmarks as your data will contribute to the quality of the data for everyone else in the class! There are blank fish photos with keys attached on Canvas, intended for you to use as practice to check your landmark placing skills. Please take advantage of these!

An “insertion” is where a fin meets the body. Look for where the fin rays contact the body.

The landmarks are as follows:

1. Anterior tip of the upper jaw
2. Posterior tip of the upper jaw (posterior edge of the lips)
3. Center of the eye
4. Posterior tip of the operculum along the base of the body (where the operculum curves upwards along the body and the operculum and ventral side of the body meet)
5. Dorsal insertion of the pectoral fin
6. Insertion of the pelvic fin
7. Anterior insertion of the dorsal fin into the body
8. Posterior insertion of the dorsal fin into the body
9. Anterior insertion of the anal fin into the body
10. Posterior insertion of the anal fin into the body
11. Dorsal insertion of the caudal fin
12. Ventral insertion of the caudal fin



Using StereoMorph

1. Download your 3 images to digitize

You have been assigned 3 species to digitize as part of the class dataset! There is a list of species assignments on Canvas in the “Coral Reef Fishes” project folder. Go to the list, write down your 3 species, and then search in the family folders for your species. Your species may not all be in the same family!

2. Prepare your folder for digitizing

Make a folder specifically for StereoMorph on your computer.

Add:

1. A new folder named “my_images” containing your 3 images to digitize
2. A new folder named “my_data”, where StereoMorph will save your landmark data (leave blank for now)
3. 105_coral_reef_fishes_lms_ids.txt, a document that tells R how to name the landmarks
4. 105_coral_reef_fishes_shape_digitizing.R, an R script that you will use to run StereoMorph

3. Open R and run script

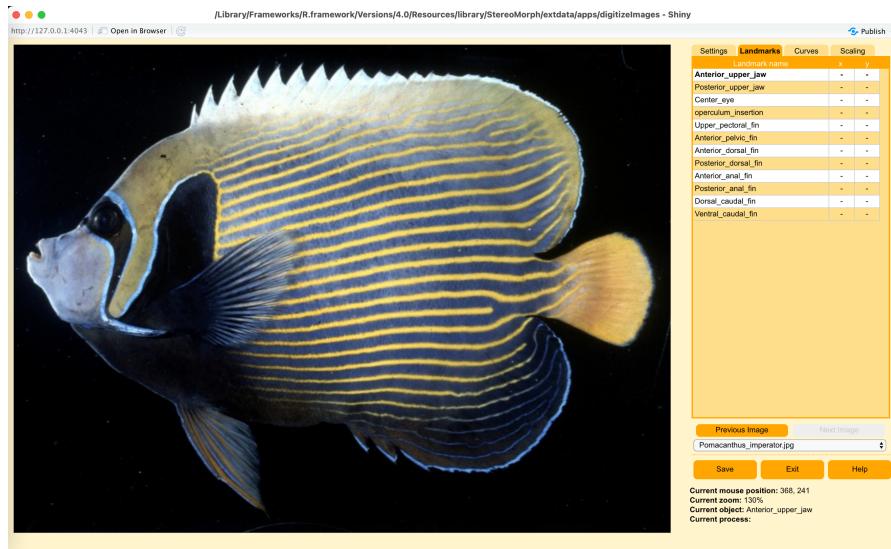
The script I have sent you is nearly entirely set up for you to use, but you will need to update the line “setwd” with the path to your working directory—the path to the folder where you have saved your images.

Once you have set the working directory to your StereoMorph folder, you need to install and load the package *StereoMorph*.

If you have **never run StereoMorph before**, you will need to install the package using *install.package(StereoMorph)*. It will take a moment to download. Once you have installed the package, move on to loading the package (next line down).

If you have **run StereoMorph before or just installed the package successfully**, then you are ready to load the package and get digitizing! Run the line *library(StereoMorph)*. Then, run all the remaining lines starting with *digitizeImage*.

A window will pop up that looks like this:



from the list on the right, hover over the anatomy on the left, and double click. **Try to place the center of the circle over the exact spot that you are trying to mark.** Note how when you place a landmark, its x and y coordinates will automatically appear next to its name on the right!

The landmark you just placed or have currently selected will be green, and all other landmarks will show up as a blue circle. You can move a landmark that you've already placed by selecting its name on the right column, then clicking on the landmark on the left and dragging it to your desired location. Once you've placed a landmark to your satisfaction, go back to the list and click on the next one that you want to move. You can click along the list to switch between landmarks, so you can place them in any order that you'd like.

Mark each of your landmarks one by one. You can navigate between images using the “Next image” or “Previous image” buttons in the lower right.

5. Save and upload .txt files

When you are done with each image, make sure you save [bottom right button]! Your landmarks will save in a text file in the folder “my_data”, with one file for each image that you digitize. These 3 text files are what you will upload on Canvas by **Monday, May 24, 11:59 pm.**

When you are done in StereoMorph, hit “Exit” in the lower right!

You can also save and exit at any time and return to your landmarking in StereoMorph. Just close the window and then when you are ready to come back, reload the package using `library()`, and rerun the lines starting with `digitizeImages`.

Great job!

4. Digitize landmarks!

On the left will be your image to digitize. You will mark landmarks by hovering your mouse over the relevant anatomy on the image of the fish.

On the right, under the “Landmarks” tab, is your list of landmarks! To select a landmark to digitize, select its name