

## **EART101: Role of colony integration in coral reef construction**

Many reef-building corals have high degrees of colony integration but does the fossil record support the argument that colony integration leads to greater reef-building? You will test for a relationship between colony integration and reef-building using the Paleobiology Database ([www.paleobiodb.org](http://www.paleobiodb.org)), a large database of fossil taxonomy, localities, and occurrences. In particular, you will use records of Jurassic scleractinian corals and Permian tabulate corals.

The first main goal of this exercise is to practice making and testing hypotheses. You may find that some of the results are ambiguous, or perhaps even contradictory! It is an important skill to be able to deal with ambiguity and reconcile multiple pieces of information to test and refine hypotheses. The “correct” answer isn’t always known, and science is more about making arguments based on data than memorizing information.

The secondary goal is to practice reading graphs. Graphs are a common way of visualizing data and convey a lot of information in a very concise way, so it is a valuable skill to be proficient at interpreting graphical data.

After performing the analyses listed below, summarize your findings and answer the questions, to be turned in at the end of class.

### **Instructions:**

Open the “Coral photos” file from Canvas. Using the criteria described in the lecture video, categorize each coral family as either “low” or “high” integration. You only have a single example specimen per family, and the degree of integration would have varied among species in some of the families, but this should be sufficient for initial exploration of the hypothesis.

Open RStudio and load the code file `coral_data.R` from Canvas. It should open in RStudio, but if it saves to your computer instead you will need to select “Open file” from the File menu in RStudio and then navigate to the appropriate folder.

Enter your integration results into the upper left panel, next to the family name. The first three have been done as examples. If you determined the family to have low integration, type the number 0 next to the arrow after its name. If you determined that the family has high integration, type the number 1. When done, follow the instructions at the top of the RStudio code.

Next, run this code to get the necessary functions for your analyses:

```
source("https://people.ucsc.edu/~mclapham/eart101/exercises/builder_integration.R")
```

Type the following command at the `>` prompt to request data from the Paleobiology Database:

```
get_data()
```

It will take a few seconds, so wait for it to finish and for the `>` to reappear. Next, type this command at the prompt:

```
integ_time_plot()
```

The x axis of the graph shows the proportion of coral records in the database that belong to families you identified as high-integration (0 means that all belong to low-integration families, 1 means that all belong to high-integration families). The y axis shows the proportion of records

that come from reef environments. Permian data are red points and Jurassic data are blue; each point indicates a different time period within the Permian or Jurassic.

Next, type this command at the prompt:

```
coral_integ_plot()
```

The box-and-whisker plot summarizes the data for the two categories of coral integration (for Jurassic corals only). Each category contains many families, each with a specific proportion of its occurrences in reef environments. The box-and-whisker shows the median (“middle”) value of those proportions as the thick line, the 25%-75% range as the box, and the 2%-98% range as the dashed whiskers. Open circles show outlier points.

### Questions:

1. Use the first graph to compare the proportion of high-integration and proportion of reef-building corals in Permian time periods (tabulate corals) to Jurassic time periods (scleractinian corals). Do time periods with more high-integration corals have more reef-building, less reef-building, or is there no clear relationship? Does this data support the hypothesis that high integration is important for reef-building?
2. Compare the proportion of high-integration and the proportion of reef-building corals just among the blue Jurassic data points. What does this data imply about the relationship between integration and reef-building? Do these values support or contradict your conclusion from question 1?
3. Do the box-and-whisker plots indicate that high-integration corals were significantly more likely than low-integration corals to be found in reefs, significantly less likely, or was there no significant difference between the two groups? What does this suggest about the importance of integration for reef-dwelling?
4. How can you reconcile your conclusion from question 3 with the evidence from the first graph in questions 1 and 2? Synthesize the two pieces of evidence to discuss how coral integration levels may be related to reef-building.

### Optional: other topics to consider if time permits

- A. In the first plot, how much of the variation in the amount of reef-building is explained by variation in the proportion of high-integration corals and how much might just be a difference between Permian tabulate and Jurassic scleractinian corals?
- B. What other biological characteristics might influence reef-building potential in corals? It may help to have prior knowledge about the biology of modern reef-building corals.
- C. What predictions would your answer to B make about the biology of tabulate corals? How could you test those predictions?
- D. The video discusses some benefits of modular growth. All colonial corals have modular growth, yet not all are important reef-builders. What could be some specific benefits of colony integration (beyond the benefits of modularity) that facilitate reef construction in corals?