

Homework 15 – Mangroves, zooplankton, and multivariate methods



<https://www.biographic.com/hawaiiis-ancient-aquaculture-revival/>

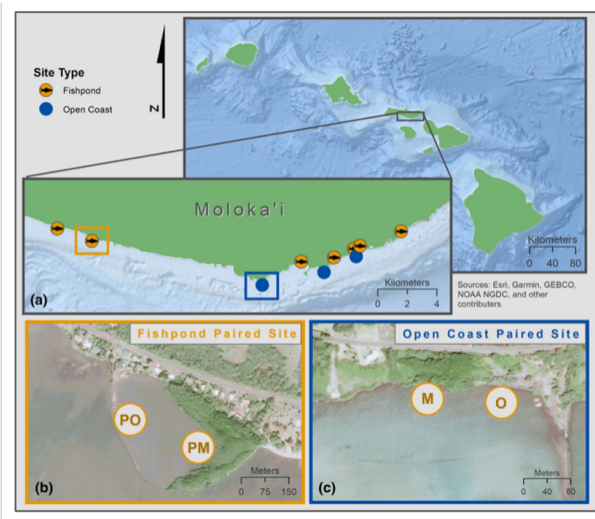


FIGURE 1

[Open in figure viewer](#) | [PowerPoint](#)

(a) The island of Moloka'i and its location in the Hawaiian Islands. Examples of (b) a paired site within a fishpond and (c) a paired open-coast site outside a fishpond. *M* open-coast mangrove, *O* open-coast non-mangrove, *PM* fishpond mangrove, *PO* fishpond non-mangrove

Mangroves are an intertidal foundation species in their native habitats, with wide-ranging effects on biodiversity and ecosystem services. In Hawai'i mangroves are an introduced species that has spread readily into mudflat habitats as well as traditional Hawaiian fishponds (loko i'a), greatly changing the physical and chemical environment. The full impact of introduced mangroves on coastal ecology is not well understood, and Lewis and Granek (2021) investigated how coastal zooplankton are influenced by mangroves as well as traditional fishpond structures.

The attached file contains 28 samples of zooplankton community composition, collected from 20 locations within 10 sites. 7 of the sites were fishponds, while 3 of the sites were open coast. Within each site one sample was taken within a mangrove-dominated portion of the coast, while a paired sample was taken from a non-mangrove location. A few of the 20 locations were sampled twice, leading to 28 total samples. In this assignment we will use the zooplankton sampled using light traps.

The authors compiled a variety of measurements of the environmental context at each of the ten sites. These are stored in columns 37:49 in the attached file, and include the length of mangrove-dominated shoreline, the length of non-mangrove shoreline, the percent mangrove shoreline, the area of the fishpond (this corresponds to the neighboring fishpond for the open coast sites), four measurements of mangrove leaves at the site (d13C, C content, d15N, and N content), and a number of variables characterizing the surrounding watershed (relief in feet, percent mature tree cover, mean annual precipitation, percent impervious substrate, and percent of the land that is developed). Columns 8:35 contain counts of different taxa of zooplankton, including holoplankton and meroplankton. The column names are largely self-explanatory, but noted that crab larvae are divided into multiple stages (three forms of megalopae, zoea, and postlarval), and para.cope = parasitic copepods.

1. Start by characterizing how the environmental variables (columns 37:49) are correlated with each other across the ten sites, using a principal components analysis. Provide an appropriate plot and summary of the PCA results. What are the major patterns of variation across these sites?
2. Next, characterize the major axes of variation in zooplankton community composition (i.e., an unconstrained ordination). Consider how to transform and standardize the community data before the analysis. Provide an appropriate plot and interpret what it means. Finally, use `envfit()` to assess which environmental variables are correlated with the major axes of community composition.
3. Although `envfit()` is a useful tool, it does not directly ask how well community composition can be explained by a set of environmental variables. Use a constrained ordination to ask this question. How much of variation in community composition can be explained by the set of environmental variables? How much can be explained by the first two axes? What do those axes represent (visualizing with a triplot will help)?
4. The authors were interested in whether zooplankton composition is affected by the presence of mangroves, and whether composition is affected by the presence of a fishpond. Use a PERMANOVA to test these questions. Considering all the results together, what have you learned about this system?