CONNECT | ENRICH | TRANSFORM

Periwinkle Abundance Along a Transect

Introduction

Learning more about an ecosystem can be complicated. Especially if you are interested in a very large geographical range. If a scientist wants to learn more about the abundance, distribution, or population size of a certain species within an ecosystem it would be impossible, impractical, and potentially harmful (to the scientist, the organism in question, or the environment) to count and identify every individual. To make the task a bit easier scientist can use transects. Transects are lines placed across a study area that are being investigated. The line will have sampling locations at intervals which can be used to make observations or measurements. This method allows information to be gathered without having to count everything in that environment. Transects can be used anywhere from a coral reef, a rainforest, a cave, or even the surface of Mars. In the diagram below are 14 transects used to study hypoxia (low oxygen) in the Gulf of Mexico. Each transect has several sampling locations (shown by the black dots). Using transects allows the teams of scientists to get an accurate idea of where hypoxia is occurring in the Gulf of Mexico without having to sample the entire water body.

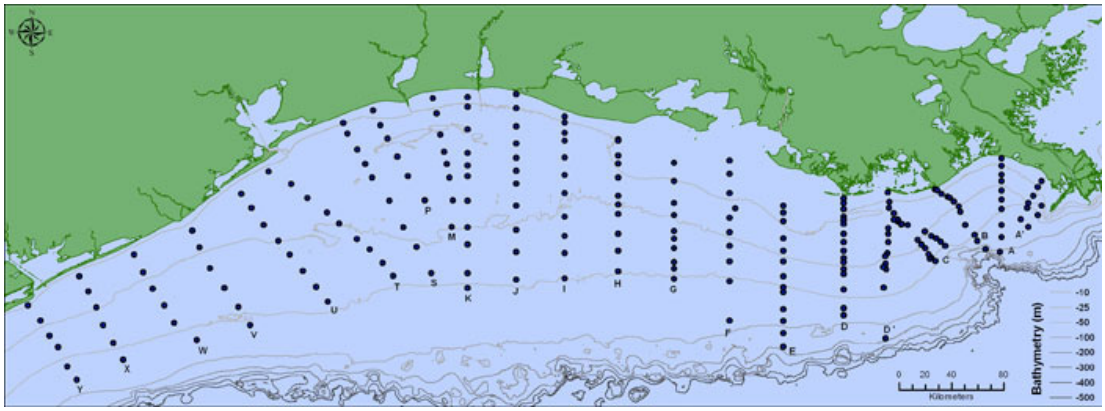


Figure 1: Cruise Station Map. https://gulfhypoxia.net/. Map shows the stations (designated by the black dots) during the annual shelf wide cruise performed by Dr. Nancy Rabalais and her collaborators.

Collecting information or samples along a transect can require the use of a quadrat. A quadrat is a small area of the habitat of interest. Usually, a quadrat is a square area that is 1 meter by 1 meter. However, any size or shape can be used as long as you know the total area of the quadrat. Quadrats can be placed at random along the transect or they can be placed at pre-determined locations along the transect. The method used depends on the research question and goals. Using transect data scientists can better understand the distribution of a species over a large area. They can also use abundance data along a transect to estimate the total number of individuals in a population. This activity focuses on the distribution of a common salt marsh invertebrate. The distribution of an organism is the way in which individuals are

spread over an area. The distribution of organisms can be affected by biotic (living) factors like the presence of a predator. However, distribution patterns can just as easily the result of abiotic (non-living) factors like the availability of food, water, or sunlight.

The data supplied for this activity was collected in Cocodrie, Louisiana near LUMCON's DeFelice Marine Center. The research goal for this data collection was to learn about the distribution of Salt Marsh Periwinkles (*Littorina irrorata)* in salt marsh adjacent to the Marine Center Then you'll be asked to try and explain the distribution of the periwinkles. First, it would be helpful to know a bit more about this species. The next section is a brief summary of information about periwinkles. After looking at the data, if you feel you need more information you should do an internet search to gather more information about periwinkles from trusted sources.

Salt Marsh Periwinkles:
Salt Marsh Periwinkles (*Littorina irrorata)* are small snails with spiraled and grooved shells. Their shells grow up to 2.5 centimeters (~1 inch) in length.

Image 1: A salt marsh periwinkle feeds on fungus on the shoot of S. alternaflora.

This snail originated in Europe and was introduced to the U.S. in the 1800s. Today, they are a common species found in Louisiana salt marshes. Their range in the U.S. extends from New England to the gulf coast of Texas. These snails live in high-marsh areas and low marsh areas where the salinity of the water does not exceed 25 parts per thousand. Because they have gills, periwinkles must stay in areas where the environment is wet enough to allow their gills to remain moist. When the conditions are too dry, they can seal themselves in their shells to hold onto moisture for short periods of time.

Image 2: Shows periwinkles on the grass during high tide.

Periwinkle behavior is fun to observe. Periwinkles spend a large amount of time moving up and down salt marsh grasses. The shoots of cordgrass (*Spartina alternaflora)* seem to be their plant of choice. Their vertical migrations are somehow tied to the tidal flooding of the marsh. At high tide, periwinkles are almost exclusively found above the height of the water high up on the coastal grasses. A sticky mucus they secrete helps them maintain a hold on the grasses. The common thought is they do this to avoid predators that gain access to the marsh while water is high. There are many predators of the periwinkle. The most common ones in the salt marshes of Louisiana are terrapins, blue crabs, birds, and fishes. At low tide, periwinkles move down the stems to access food that can be found on the muddy surface of the marsh.

Periwinkles are herbivores consuming algae, detritus, and diatoms. They also will feast on fungus that lives on the leaves of salt marsh grasses. To do this they have a radula, a file-like

tongue, which helps them scrape fungus off of the leaves. They have been called "fungus farmers" since their behaviors actually encourage new growth of fungus which they can later consume.

Study Area

In January of 2017, a group of students did a transect survey through the salt marsh. The transect ran from the marsh edge into the interior of the marsh. The total transect length was 35 meters. The abundances of periwinkles were counted within 25 cm square quadrats at five-meter intervals starting at the water's edge. See the image below for reference.

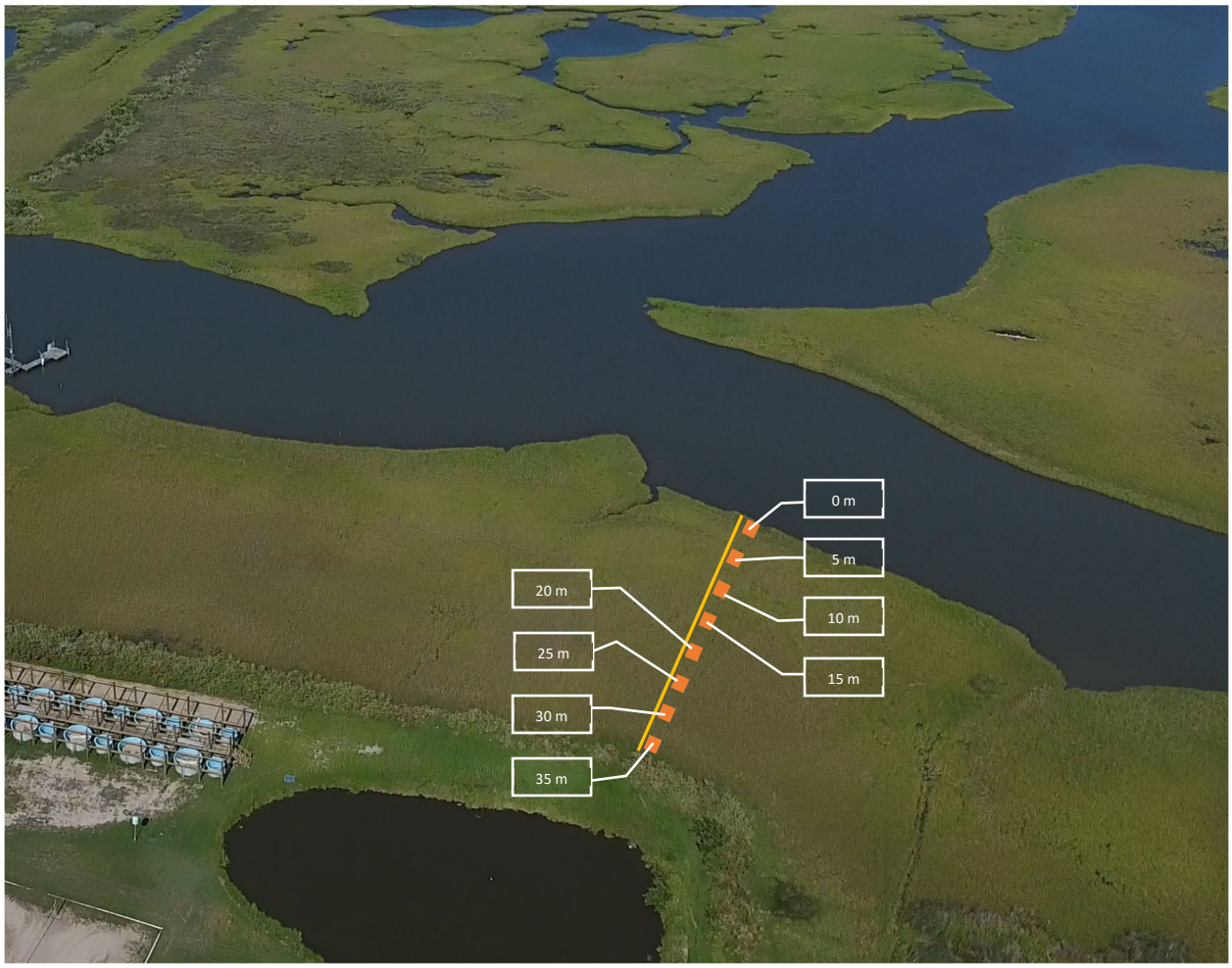


Figure 2: The yellow line shows the location of the transect. The orange squares are the locations of the quadrats along the transect. The distance intervals for each quadrat are indicated. The transect is on the LUMCON property at the DeFelice Marine Center in Cocodrie, LA.

Before moving on, formulate a hypothesis about the distribution of periwinkles at this location. Write in the space below.

Below is a table showing the data collected by the students. At the bottom of the table are field notes that will provide some context about the conditions on the day of the sampling.

Distance from Water	# of Periwinkles	# of Stems/shoots	Notes about Quadrat
0	3	23	Quadrat right on the edge of the marsh. Site inundated with water roughly 2 cm deep. Stems/shoots are all *S. alternaflora*
5	7	58	Quadrate location has a bit of water on the surface. Periwinkles found mostly towards lower half of the plants. All plants are *S. alternaflora*
10	28	47	The sediments are very wet, but not flooded. The marsh is not very stable here, our feet keep sinking in the mud. *S. alternaflora* is the only plant found. Snails found from midway up to near the top of the plants.
15	23	196	Muddy. No water on the surface of the marsh. Plants are *S. Alternaflora* and some *Juncus*. The *Juncus* has no perwinkles or anything else on it.
20	12	60	The marsh is muddy, but not as bad as the ones closest to the water. More types of plants are at this location. Mostly S. alternaflora, but there is one or two S. patens. Also seeing another species of snail called an olive snail.
25	11	38	This location looks like it has been disturbed recently. Almost like someone walked through it a few days ago. The dirt is wet, but it is much drier than down by the water. All of the plants seems to be *S. alternaflora* and *S. patens.*
30	8	213	Still muddy, but able to stand like normal. Lots of stems and shoots in this location. Mostly finding *S. patens* and *Distichlis spicata.* There a few *S. alternaflora.*
35	2	77	The soils is not very wet. There is S*. patens* and *Distichlis spicata* plants. We have a Bullrush plant just outside the quadrat, but did not count it. Saw some empty periwinkle shells on the ground.

Field notes:
Date: January 21, 2017 Time: 9:15am CST
Weather: Cold, breezy with wind from the north, overcast with some breaks in the clouds.
Other: Tide was coming in earlier but may be dropping now. There is a tidal pool about 100 meters down the bayou from this location. Dolphins were sighted in the bayou while data was being collected.

Using the data in the table, draw a bar graph using the grid provided on the next page. Put the distance interval on the X axis and the periwinkle abundances on the Y axis. Be sure that your graph includes the appropriate titles and units. Once your graph is completed answer the following questions. Use a separate piece of paper if you need more space.

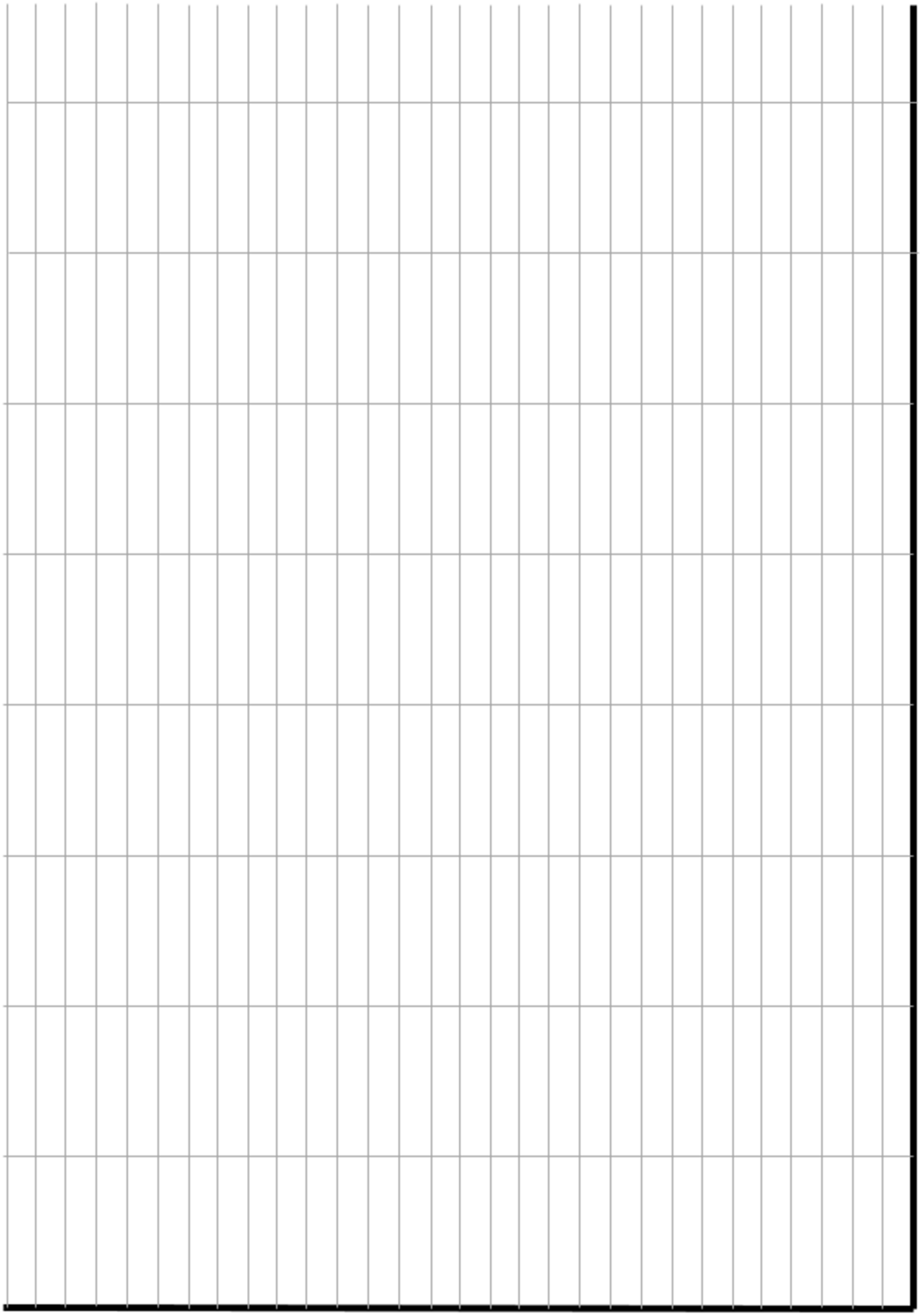
1. **Describe the distribution of the periwinkles based on what you see on your graph.**

2. **Did the data support your hypothesis about the distribution of periwinkles at this site?**

3. **Explain some of the reasons that could be causing this distribution pattern.**

4. **Do you observe any other relationships or patterns by looking at the notes included with the data? Describe them.**

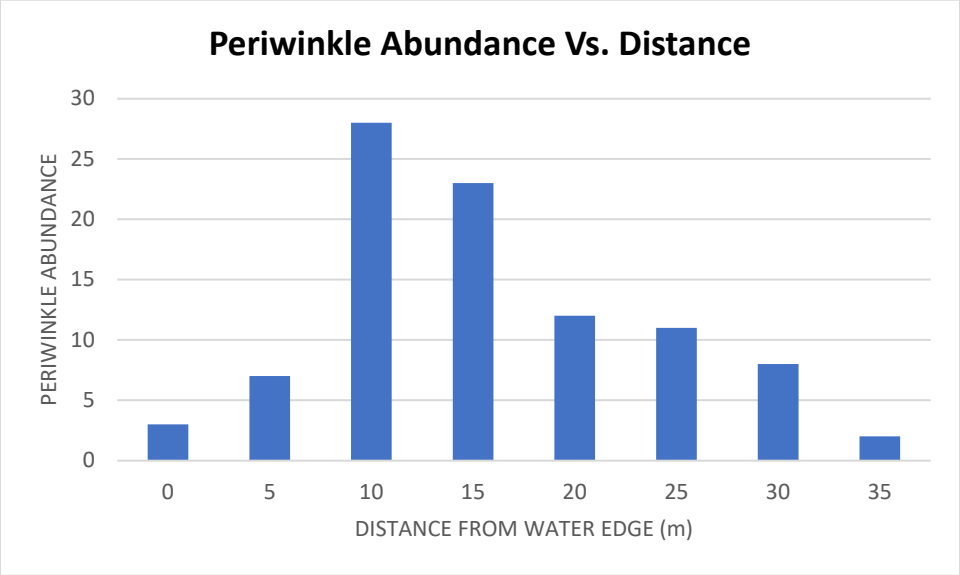
5. **What are some questions that you have for further study about periwinkles?**



Scientific Literature:
Below is a list of scientific papers that students can read to understand Salt Marsh Periwinkle distribution and predator avoidance.

- Rietl, A. J., M. G. Sorrentino, and B. J. Roberts. 2018. Spatial distribution and morphological responses to predation in the salt marsh periwinkle. Ecosphere 9(6):e02316. 10.1002/ecs2.2316
- Carroll JM, Church MB, Finelli CM. 2018. Periwinkle climbing response to water- and airbone predator chemical cues may depend on home-marsh geography. PeerJ 6:e5744 https://doi.org/10.7717/peerj.5744

Answers:



- Describe the distribution of the periwinkles based on what you see on your graph.
  The abundance of periwinkles is low at both ends of the transect and the highest at about 10 meters from the edge.

- Explain some of the reasons that could causing this distribution pattern.
  This is a distribution that has been seen in other locations in Louisiana (see first paper listed under "scientific literature). This seems to be the result of higher predation pressure at the ends on the transect. At the edge, periwinkles would be more suspectable to blue crabs and other aquatic species. At the interior end of the transect they are more vulnerable to predation by birds and less water leaves them more vulnerable to drying out.

- Do you observe any other relationships or patterns by looking at the notes included with the data? Describe them. Learners should be able to pick out a possible relationship between abundance and vegetation type. They may also pick out the vertical distribution and water height at each quadrat location.