



Zooplankton Migration Patterns at Scotton Landing: Behavioral Adaptations

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Summary: Zooplankton have evolved specific migration patterns that increase their chances of survival. These migration patterns are behavioral adaptations. Students will determine how zooplankton migrate and how these adaptations increase their chances of survival.

Activity Use: This activity can be used as a part of any unit on biology, adaptations, ecology, graphing, and more.

Target Grade Level: Elementary School

Standards Addressed:

LS1.A: Structure and Function
LS1.B: Growth and Development of Organisms
LS1.C: Organization for Matter and Energy Flow in Organism
LS1.D: Information Processing
LS2.A: Interdependent Relationships in Ecosystems
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
LS2.C: Ecosystem Dynamics, Functioning, and Resilience
LS2.D: Interactions and Group Behavior

Lesson Time: 45 minutes

Essential Question: How do behavioral adaptations in zooplankton increase their chances of survival?

SMART Objectives:

After completing this activity, students will be able to:

1. Name one zooplankton species in the Delaware Bay.
2. Give an example of a behavioral adaptation.
3. Explain why some zooplankton migrate to the surface of the water column at night.

Vocabulary/Key Terms: Behavioral Adaptation, Zooplankton, Phytoplankton, Vertical Migration, *Acartia tonsa*, Predator, Prey

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Introduction (Teacher Reading Material):

Zooplankton

Zooplankton are aquatic organisms that live in the water column and drift with the currents. Zooplankton are weak swimmers that are found throughout the Delaware Bay. They are an important component in the food web and are preyed upon by many species of small fish. Zooplankton consume phytoplankton which also live in the water column and drift with the currents. Phytoplankton utilize sunlight to photosynthesize and produce their own food. Therefore, phytoplankton are found at the surface of the water column where sunlight can penetrate. To feed on phytoplankton, zooplankton must migrate to the surface water. However, zooplankton are also an important food source for many local species, such as fish, that use eyes and vision to find food. Therefore, zooplankton must migrate to the surface water while avoiding predation.

Zooplankton Migrations: Behavioral Adaptations

To survive, organisms including zooplankton must adapt to their environment.

Behavioral adaptations are actions that organisms perform to increase their chances of survival. Behavioral adaptations include migration and hibernation. For example, bears hibernate to escape the cold and conserve energy when food is scarce; this behavioral adaptation increases their chance of survival. Zooplankton migrations are an example of behavioral adaptations that increase survival.

One common zooplankton migration pattern is known as **diel vertical migration**. Zooplankton that are **vertical migrators** routinely migrate in the water column during certain times of the day. They are deep in the water column during the day and migrate to the surface water at night. Vertical migrators migrate to the surface of the water to feed on phytoplankton at night. In the darkness, they cannot be seen by their predators. During the daytime when light begins to penetrate the water column, vertical migrators sink deeper into the water where it is dark. This cycle is repeated daily to avoid predation. This migration pattern is a behavioral adaptation that increases zooplankton survival.

Acartia tonsa

Acartia tonsa is one of the most common species of zooplankton sampled in the St. Jones River at Scotton Landing near Dover, Delaware (see provided map). *Acartia tonsa* is a copepod. Copepods are crustaceans with large antennae and an exoskeleton. The adult life cycle stage of *Acartia tonsa* is a **vertical migrator**. *Acartia tonsa* comes to the surface of the water at night and sinks deeper in the water during the day. *Acartia tonsa* must migrate to the surface to feed on phytoplankton. By migrating to the surface at night, predators won't be able to see *Acartia tonsa*.

In research funded by the Delaware National Estuarine Research Reserve in 2016, scientists at the University of Delaware sampled water from the St. Jones River at Scotton Landing to determine the number of species and abundance of zooplankton present. In the activity, we will use water samples taken over the course of one day during that study. Every three hours, water samples were taken from Scotton Landing. The surface water was sampled; this is where phytoplankton are located and where zooplankton migrate to feed on phytoplankton. The total number of *Acartia tonsa* in each water sample was counted and recorded. The data are shown in the table below and on the student worksheet. The data describe how many *Acartia tonsa* are present in one cubic meter of water (enough water to fill two large bathtubs). The data show that the number of *Acartia tonsa* in the surface water increases dramatically during the night and is reduced during the day. This clearly shows *Acartia tonsa*'s diel vertical migration pattern: a behavioral adaptation used to avoid predation.

Learning Activity: Students will be introduced to zooplankton and behavioral adaptations in the student worksheet provided. Students will be given the abundance data of *Acartia tonsa* sampled at the St. Jones river over the course of one day. They will then construct a bar graph to see the vertical migration pattern of *Acartia tonsa*.

Solutions to Graphing Activity and Discussion Questions:

Let's get to know our zooplankton, *Acartia tonsa*. Answer the following questions.

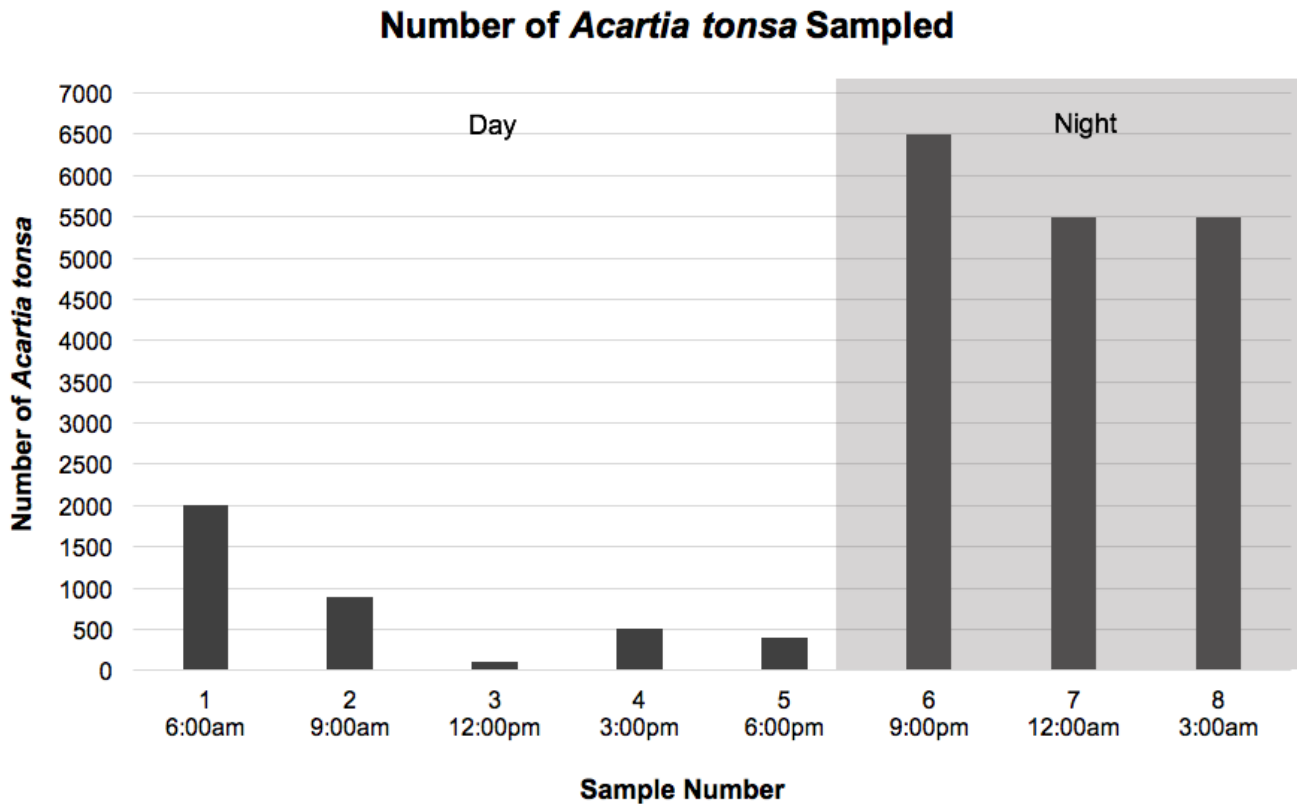
1. *Acartia tonsa*, a type of zooplankton, eats
phytoplankton.
2. To make food, phytoplankton need
sunlight.
3. To survive and make food, should phytoplankton be found at the surface of the water or deeper down?
Phytoplankton are found at the surface of the water where the sunlight can penetrate.
4. Where in the water column do zooplankton need to migrate to eat phytoplankton?
Phytoplankton are at the surface of the water where sunlight is available. Zooplankton need to migrate to the water surface to feed on phytoplankton.

Below is the information and data provided to students to construct the bar graph:

Every three hours, water samples were taken from the surface of the St. Jones River at Scotton Landing. The amount of water collected in each water sample is enough to fill two large bathtubs! The total number of *Acartia tonsa* in each water sample was counted. Using the table below, plot a bar graph that shows the total number of *Acartia tonsa* in each water sample throughout the day. The first bar has been plotted for you. The shaded region of the graph represents nighttime while the unshaded region represents daytime

Sample Number	Time of Sample	Number of <i>Acartia tonsa</i>
1	6:00 am	2,000
2	9:00 am	900
3	12:00 pm	100
4	3:00 pm	500
5	6:00 pm	400
6	9:00 pm	6,500
7	12:00 am	5,500
8	3:00 am	5,500

Completed Bar Graph of *Acartia tonsa* Abundance:



Look at your bar graph and answer the following questions.

5. Are there more *Acartia tonsa* at the surface of the water in the St. Jones River at night or during the day?
Acartia tonsa are more abundant in the surface water at night. They come to the surface water during the night to feed on phytoplankton while they are protected by the darkness from the eyes of predators.
6. Small fish eat *Acartia tonsa*. If *Acartia tonsa* wanted to avoid getting eaten by other marine animals, should it come to the surface in the daytime, when it can be seen by predators like fish?
No. *Acartia tonsa* should come to the surface of the water at night when it is dark so they cannot be seen by predators.
7. *Acartia tonsa*'s migration pattern is an example of a behavioral adaptation. They migrate to the surface of the water at a certain time of day to increase their chances of survival. Why do *Acartia tonsa* come to the surface at night?
Acartia tonsa migrate to the surface of the water at night to increase their chances of survival by avoiding predators. *Acartia tonsa* must migrate to the surface of the water to eat phytoplankton. *Acartia tonsa* migrate to the surface while it is dark so that predators will not be able to see them.

8. If *Acartia tonsa* migrated to the surface of the water during the day instead of during the night, would *Acartia tonsa* be preyed upon more? Would *Acartia tonsa*'s chance of survival increase or decrease?

Acartia tonsa would be preyed upon more frequently if they migrated to the surface water during the day because they would be seen by predators. Since more predators can see *Acartia tonsa* during the day, *Acartia tonsa*'s chance of survival would decrease.

Assessment

Performance: Was the student engaged during the activity? Did the student actively participate in the lesson and discussion?

Product: Did the student complete the graphing activity? Did the student provide evidence and explanations in their answers to the provided questions?

Extensions:

1. Explore the website: www.underthescope.udel.edu. Click on the "Magnify it" tab and discover *Acartia tonsa* up close under the "Copepods" tab.

SCOTTON LANDING, ST. JONES RIVER



The St. Jones River is located at the red star.



The sampling site, Scotton Landing, is located along the St. Jones River at the red arrow.