Tracking Juvenile Summer Flounder

Materials

For the leader:

Whiteboard

Markers (different colors)

For each group:

Copies of student group packets

Copies of student worksheet

Overview

Scientists studying ecology ask broad questions about how the patterns and behaviors of animals change through space and time and the environmental factors that influence the distribution and abundance of individuals. For fish ecologists, major questions when understanding a population of fish are: where do juvenile fish live and how do they interact with their environment. These data provide ecologists with an understanding of how juvenile organisms use nursery habitats and interact with their environments as they are growing over time. Knowing the behaviors and movements of juvenile organisms provides scientists with a better understanding of how to protect the fragile life stage of juveniles.

Estuaries are transitional environments between fresh and salt-water habitats. Having lots of nutrients and supporting a great diversity of life are two components that characterize estuaries. Unfortunately for fish, estuaries also typically are bordered by the majority of human developments, which means they are likely to be highly disturbed and polluted. Regardless, numerous fish species, including many that are important to the recreational and commercial fisheries, use estuaries as spawning grounds, nursery habitats for the juvenile stages of life, or as feeding grounds for adults.

One such fish that is commonly found in estuaries along the east coast in its juvenile stage is the Summer Flounder, *Paralichthys dentatus*. At Rutgers University, scientists tagged and tracked Age-0 Summer Flounder (fish within the first year of being born) at Schooner Creek, a sub-tidal creek located in an estuary in Southern New Jersey. Stationary and mobile hydrophone systems were used to monitor fish movements over a one-month period. In this activity, students will analyze the data and draw conclusions regarding the use of the creeks in the estuary by juvenile Summer Flounder.

Motivating Question: **What do scientists learn about fish from tracking juveniles in an estuary?**

Take Home Message

Scientists use a variety of instruments to track fish and from the tracking data can gather information about the habitat use patterns of fish.

Engage: Students learn background information about estuaries and Summer Flounder through a class discussion and, if desired, individual research.	10 minutes
Explore: Students investigate the methods and data collected from the Summer Flounder experiment.	25 minutes
Make Sense: Students share their observations, ask questions, and discuss what they can learn from the tracking data about juvenile Summer Flounder.	10 minutes
Total:	**45 minutes**

Audience

Middle and high school students (6th-12th grade).

New Jersey Core Curriculum Content Standards - Science

Grade	Content Statement	CPI#
6	The number of organisms and populations an ecosystem can support depends on the biotic resources available and on abiotic factors.	5.3.6.C.2
6	Changes in environmental conditions can affect the survival of individual organisms and entire species.	5.3.6.E.1
8	Mathematics and technology are used to gather, analyze, and communicate results.	5.1.8.B.2
8	Carefully collected evidence is used to construct and defend arguments.	5.1.8.B.3
8	Scientific reasoning is used to support scientific conclusions.	5.1.8.B.4
8 / 12	Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.	5.1.8.B.1 / 5.1.12.B.1
12	Mathematical tools and technology are used to gather, analyze, and communicate results	5.1.12.B.2
12	Empirical evidence is used to construct and defend arguments.	5.1.12.B.3
12	Scientific reasoning is used to evaluate and interpret data patterns and scientific conclusions.	5.1.12.B.4
12	Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.	5.3.12.C.1

Preparation (20 minutes)

1. Write the motivating question on the board:

   What do scientists learn about fish from tracking juveniles in an estuary?

2. Make group copies of the student group packets, one copy of each: JCNERR_RUMFS_map.pdf, FlounderStudySite.pdf, timebylocation.pdf.
3. Make copies of the student worksheets for each student (last page of this write-up).

Engage (10 minutes)

1. Lead the students in a discussion about estuaries and what they know about fish that use estuaries as spawning, nursery, and feeding grounds.

Q. What is an estuary? What are characteristics of an estuary that make it a great place to live?

Q. Many fish use estuaries at different parts of their lives, why is that? Why do they use the estuary?

2. Ask the students what they know about tracking techniques. Be accepting of all responses from the students. If they are stuck, ask them what kinds of things would they use to learn about the movement patterns of people or other animals (GPS units in cellphones).

Q. What kind of fish use the estuary as a nursery ground? How do they use the estuary?

Q. Why do scientists track an animal? What questions are scientists trying to answer when they collect information from the movements of an animal?

Q. Why would scientists be interested in understanding the movement patterns of fish?

3. After a minute or two and depending on what the students already know, share some information with them that you feel they need to know to understand the activity of the day.

Or, if you would prefer have the students conduct their own research about estuaries, fish that use estuaries as nursery grounds, and fish tagging/tracking methods. If you are interested in showing your students about the estuary they will be working with in the activity, look at the "Barnegat Bay Watershed and Estuary Tour" (http://www.crssa.rutgers.edu/projects/runj/habitat/habitat.html).

Explore (25 minutes)

1. Explain to the students that they will be taking a closer look at fish tagging/tracking techniques, in fact they will be analyzing data of Age-0 tagged Summer Flounder to determine what tracking data can tell us about juvenile fish movements.
2. Have the students conduct research, or share the information, about Summer Flounder. A good place to start is FishBase, which is an international database of information about fish. Students can explore the Summer Flounder webpage (http://www.fishbase.org/summary/Paralichthys-dentatus.html) to learn about the size/weight/age of flounder, the environment and climate they live in, their distribution, the biology, human uses of the flounder, etc. Encourage students to click on the links under "More Information," especially Spawning, Food Items, Larvae, and Pictures.
3. Pass out the student group packets to each group. Orient the students to the area using the Tuckerton-Little Egg Harbor Aerial Photography map. Point out to the students where the Rutgers University Marine Field Station (RUMFS) is located.
4. Explain the Summer Flounder experiment to the students. Encourage the students to mark up their copies of the zoomed in map (FlounderStudySite.pdf) with key features as you explain the study:

Where the study was done and why

Schooner Creek is a salty tidal creek that runs along side the RUMFS field station in the estuary. It was chosen as the site for this study because in a past tagging study at this site, large gaps of time left several unanswered questions regarding when the fish left the creek and the extent of their creek use. The creek was divided into five sections based on depth and width; we will be looking at three:

- Mouth: the first 50 meters from the creek mouth (0-50 m from the mouth)
- Flat: a shallow flat area just inside the creek mouth (less than 0.2 meters deep at low tide, 50-150 m from the mouth)
- Upper creek: the creek area above the stationary hydrophone (150+ m from the mouth)

Other points of interest in the study area are the stationary hydrophone (150 m from the mouth, on land) and the tide station (350 m from the mouth).

Tagging

Five Summer Flounder were captured using a funnel type net (fyke) approximately 150 meters up the from the creek mouth (Fish A-E). Four were captured using hook and line near the tide station (Fish F-I). All fish were determined to be less than one year old based on information about size and age.

The fish were tagged and released at different times. Each fish was temporarily put to sleep with an anesthesia and an ultrasonic transmitter was attached to the fish with a strong thread

by sewing through the muscle just below the dorsal fin. The transmitters were manufactured by Sonotronics, Tucson, AZ, weighed 4 grams in the air and had a 40-day life expectancy. So, there were 40 days, or about a month and 10 days to collect the data.

Since it wasn't known how the fish would recover from the tagging procedure, they were kept for observation in a flow-through seawater tank for about 1-48 hours. The release site was approximately 530 meters up the creek from the mouth. The tagging-release procedure began August 9 and the last fish was tagged and released on August 27th. Fish movements were tracked until the last signal was lost on Sept. 27, 1990.

Tracking

A 150-meter coaxial cable connected the hydrophone to a continuously scanning receiver. After a signal is detected from a tagged fish, the tag number, time, and date were stored in a computer. After some testing, it was determined that the stationary hydrophone was good for approximately 130 meters directly in front of it. Sometimes a fish would swim back and forth in front of it making multiple detections, so multiple detections within 5 minutes were counted as one. The other way fish were tracked was by using a portable directional hydrophone from a small boat or kayak.

If a fish had not been detected for a while, a search was conducted by using 1 km transects or grids from the last known location. Transect searches were repeated three time before the signal was considered lost.

A "missing" category accounted for the time it was known the fish was in the creek but could not specifically be located. For example, if a particular fish was located at the mouth at 6:00 am and in the upper creek at 12:00 pm, but the receiver did not detect the fish moving up the creek, 6 hours were placed in the "missing" category.

5. Ensure that the students have marked the three regions of the creek, the tide station, the hydrophone location, and the capture and release points of the fish (refer to the AnswerKey_FlounderStudySite.pdf if needed).
6. Ask if the students have any questions about the experimental set-up. Also ask the students:

Q. Why do you think the scientists only tagged nine fish?

Q. Do you think the creek was a large enough study area?

Q. What do you think are some challenges in choosing this tagging and tracking method?

Q. When did the scientists track using the portable method? Why?

7. Have the students look at the histograms (bar charts) of the fish movements by time. Make sure the students are looking at both the "Total time in each location (hrs)" and the "Movement of Age-0 Summer Flounder between high and low tides in Schooner Creek." If the students have questions about the graphs, assist them in understanding what information is included in each graph.
8. Once the students are oriented to the graphs, ask them:

Q. What information does each graph provide about the movements of juvenile flounder?

Q. What part of the creek did the fish spend most of their time? Why do you think that is?

Q. What do you think happened to fish A, C, F, H, and I? Why do they have less data? *Note you might want to discourage the students from looking at data from these fish going forward when trying to find patterns, because the scientists were not able to collect a lot of data from them.

9. As the students finish analyzing the graphs, ask them to write a written response to:

Q. What patterns can you observe in the data? Is there a relationship between location in the creek or tides and movements of Summer Flounder? If so, what is the relationship?

Make Sense (10 minutes)

1. After a few minutes of writing their responses, tell the students that we are going pool the information from the different data sources together to determine, as a class, patterns in the movements of juvenile Summer Flounder in the creek.
2. Have the students report out what patterns and/or relationships they observe about different fish and all of the fish combined when they take all of the information into account at the same time. Make sure to have the students support their statements of the patterns and/or relationships by stating what evidence they are using.
    a. Help the students see that:
        i. Most of the fish spent the majority of their time in the mouth of the creek, though some (E and G) also spent a large amount of time in the upper creek as well as the mouth. Even though all of the fish were caught farther up the creek than the mouth and were released very far from the creek mouth.
        ii. When the fish moved, they moved much more with the tide than against the tide.
3. Once the discussion slows down, point to the motivating question and ask:
   Q. What do scientists learn about fish from tracking juveniles in an estuary?
   Ask students to share their ideas about the question with a partner. After a minute, ask volunteers to share the ideas they discussed with the entire class. Be accepting of all responses from the students. This is your opportunity to make sure the students understand the "take home message" that you identified.
4. Ask if the students have any questions about the activity or the graphing.

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* This lesson was adapted from "Tracking Summer Flounder in an Estuary Creek: A WebQuest for 5-8th Grade (Biology)" Designed by Mary Olswang (http://marine.rutgers.edu/striper/education/lp-webquest-p.html)

Tracking Juvenile Summer Flounder Worksheet

Name: _____

Date: _____

Research on Summer Flounder (*Paralichthys dentatus*)

1. What parts of the estuary do juvenile Summer Flounder frequent? Why?

2. What are two adaptations juvenile Summer Flounder have to survive in an estuary?

3. What are some challenges that juvenile Summer Flounder face in an estuary?

Study Site and Experimental Methods

1. Why do you think the scientists only tagged nine fish?

2. Do you think the creek was a large enough study area?

3. What do you think are some challenges in choosing this tagging and tracking method?

4. When did the scientists track using the portable method? Why?

Analyze the Data

1. What information does each graph provide about the movements of juvenile flounder?

2. What part of the creek did the fish spend most of their time? Why do you think that is?

3. What do you think happened to fish A, C, F, H, and I? Why do they have less data?

Writing Prompt:

What patterns can you observe in the data? Is there a relationship between location in the creek or tides and movements of Summer Flounder? If so, what is the relationship?

Vocabulary Terms:

Age-0

Continental Shelf

Dorsal Fin

Ecosystem

Estuary

Habitat

Hydrophone

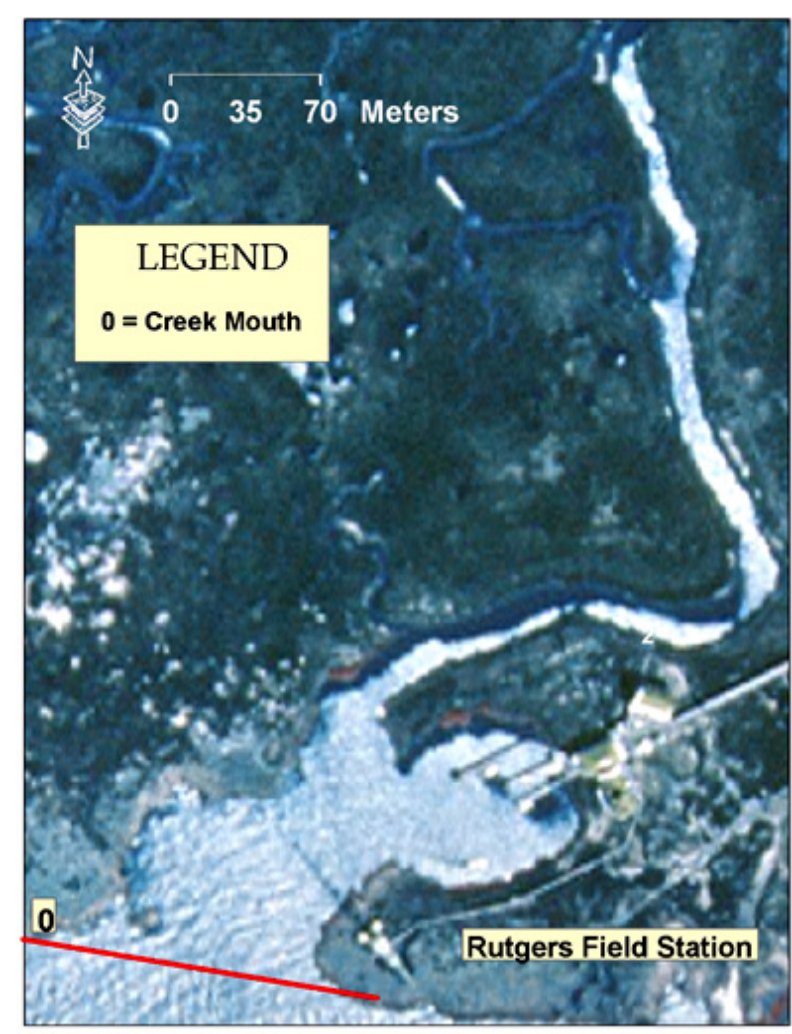
Juvenile

Migration

Tide

Transect

Ultrasonic Transmitter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LEGEND
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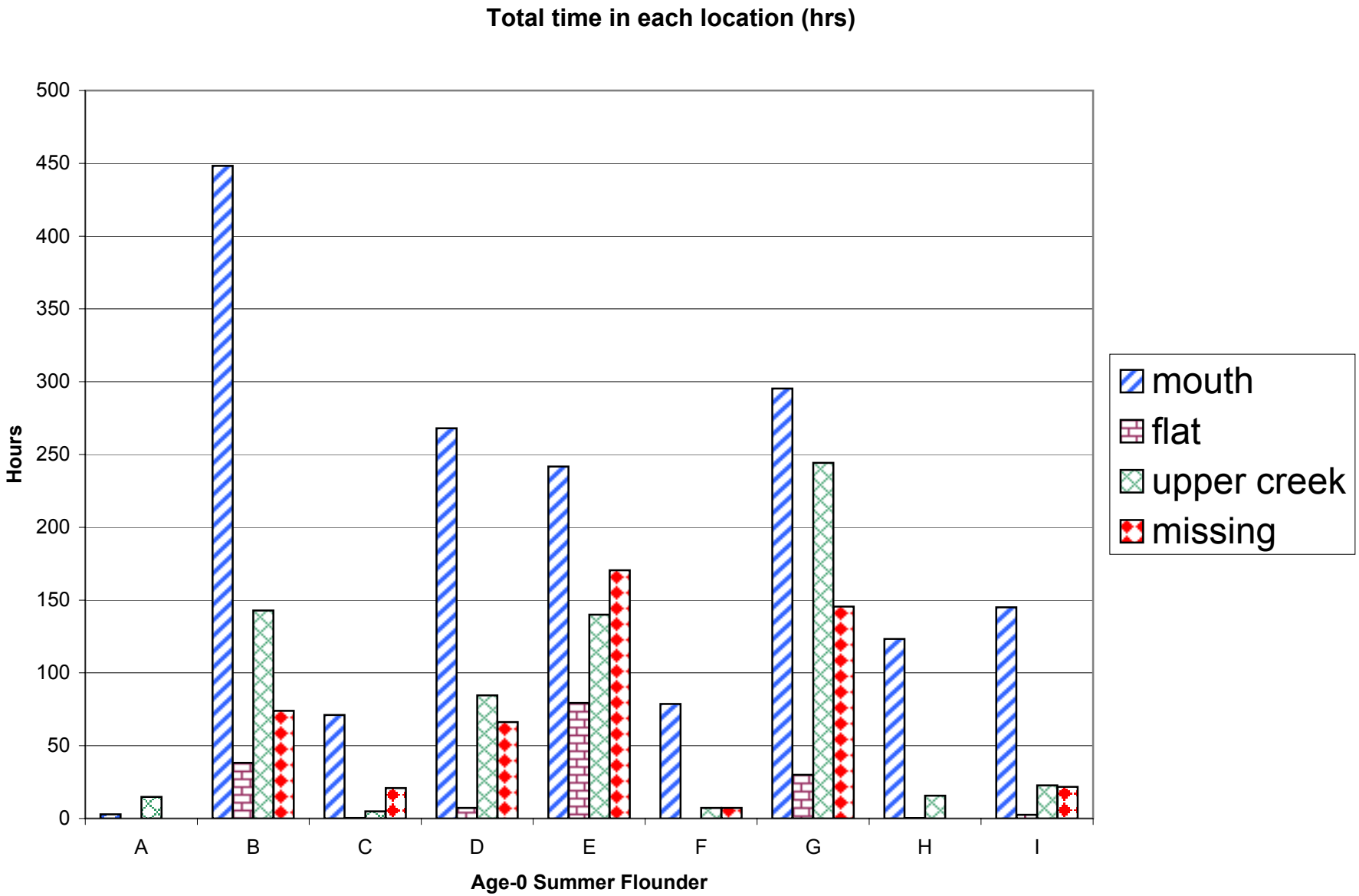
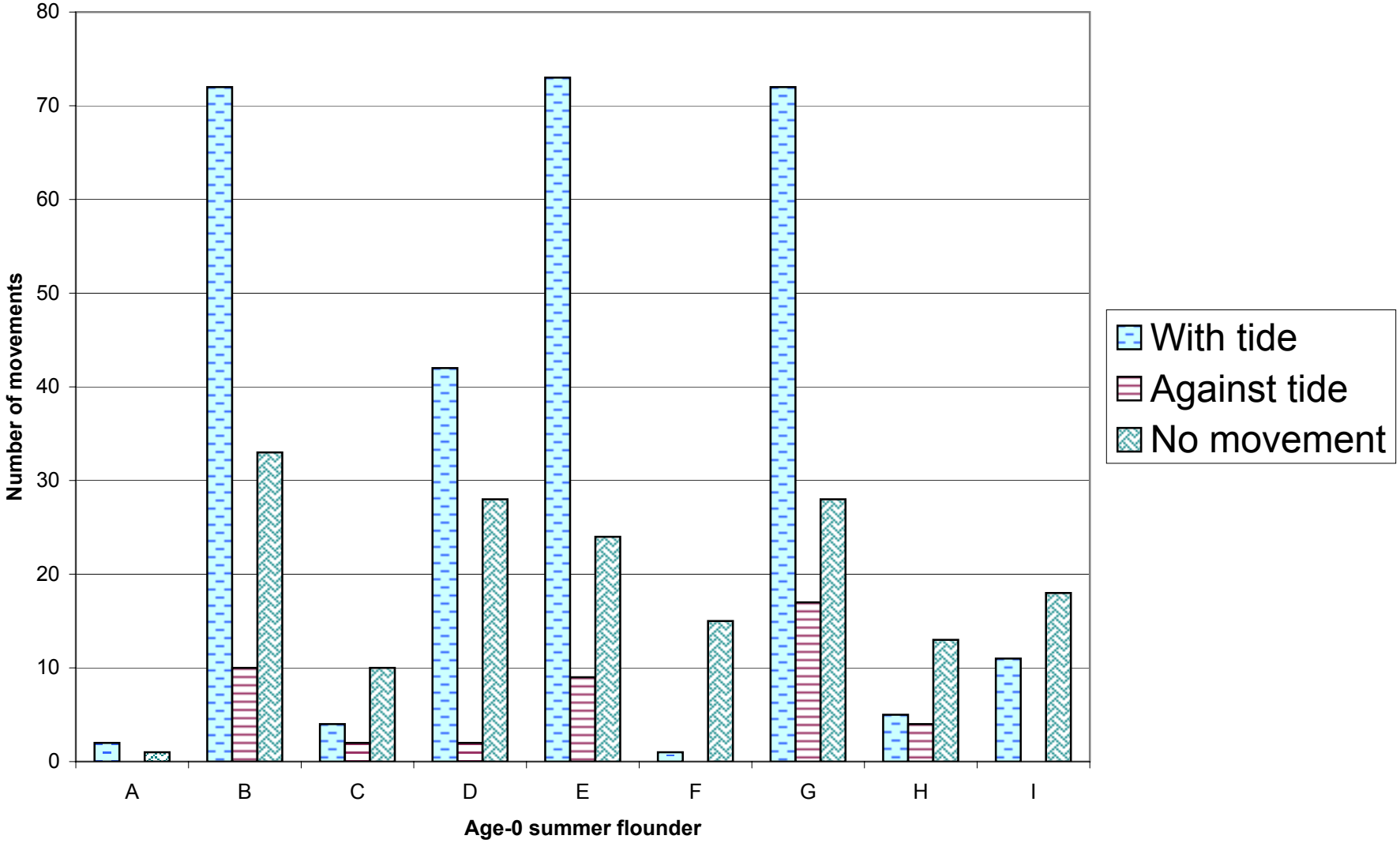
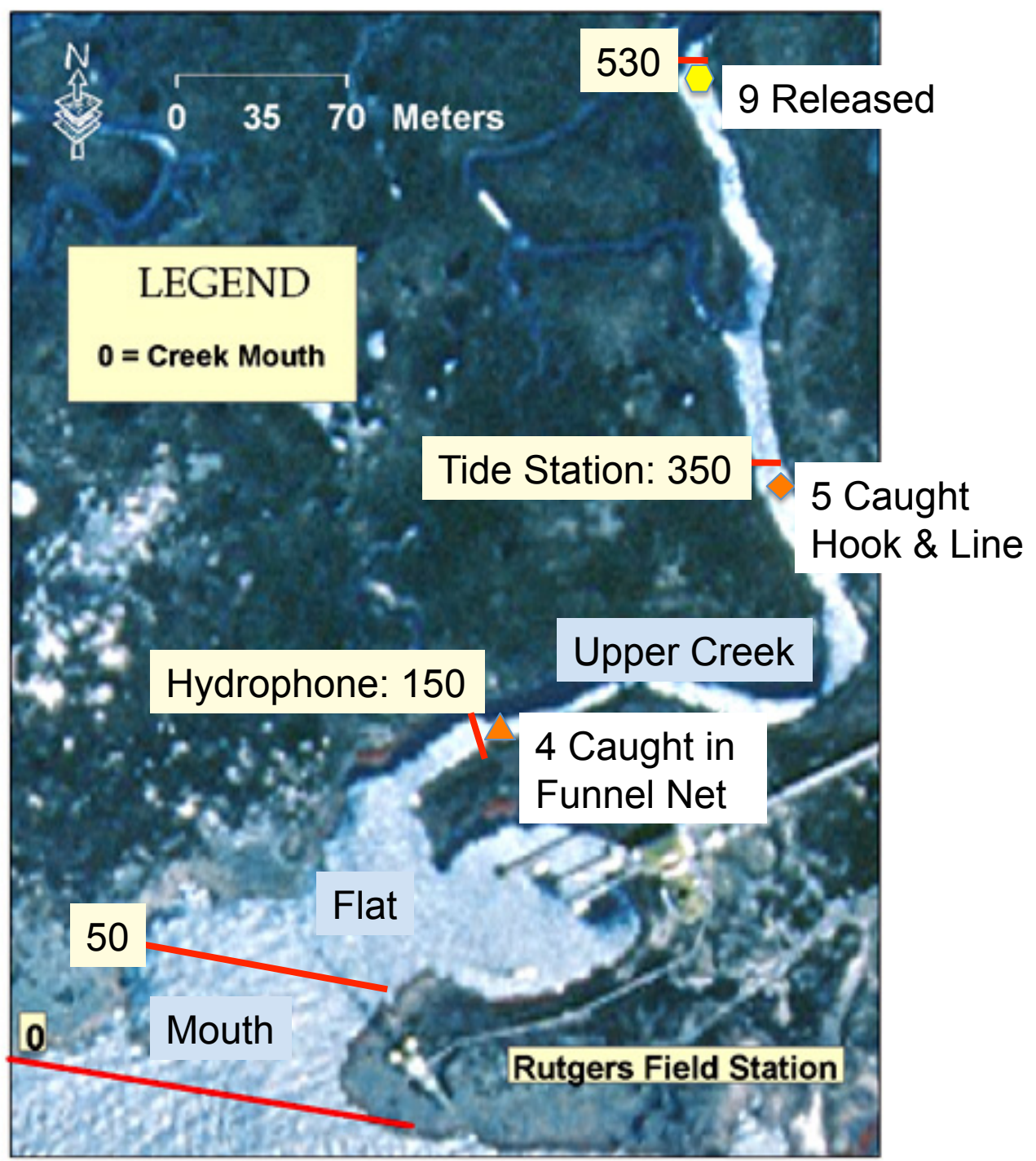
Rutgers Field Station


Total time in each location (hrs)
500
450
400
350
300
250
200
150
100
50
0
Hours
A
B
C
D
E
F
G
H
I
Age-0 Summer Flounder
mouth
flat
upper creek
missing

Movement of Age-0 summer flounder between high and low tides in Schooner Creek




N
0 35 70 Meters
LEGEND
0 = Creek Mouth
530
9 Released
Tide Station: 350
5 Caught
Hook & Line
Upper Creek
Hydrophone: 150
4 Caught in
Funnel Net
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