Title: Where in the Bay?

By Pat Harcourt and Liz Duff

Learning Goals: See overarching Striped Bass Curriculum.

Objectives:
Students will understand these Ocean Literacy Concepts:
5. The ocean supports a great diversity of life and ecosystems.
d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.
f. Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate and circulation, ocean life is not evenly distributed temporally or spatially, i.e., it is "patchy". Some regions of the ocean support more diverse and abundant life than anywhere on Earth, while much of the ocean is considered a desert.

Timeframe: (Prep, implementation)
Initial Prep to print and laminate the sheets might take one hour.
Purchase/accumulate tokens, another hour.
Once that is done, there is little prep involved.
Science journals for each student.

Class 1-3 implementation 45-60 min.

Grade Level(s): Grade 4-12

Class 1 (45 minutes to 1 hour.) Reflection can be done as homework.
Engaging Experience: Powerpoint Slideshow and token activity.

Vocabulary:

Salinity: the concentration of mineral salts dissolved in water.

Concepts:

1. Salinity impacts the distribution of adult fish in an ecosystem.

2. Different fish species are tolerant of different levels of salinity.

Materials:

1. Slideshow "Where in the Bay" Introduction Slides 1-11, Review 13-14.
2. Projector and Pointer
3. Salinity Survival tables. 1 per team of 2-3 students.
4. Salinity maps. 1 per team of 2-3 students.
5. Tokens. Copy of slide 11 for each team to cut up, or this could be play dough of different colors, post it notes, paper, different colored cereal etc. Post it notes will allow you to move things around and hold it up to show others. Play dough is fun to form into fish shapes.

Preparation:

1. Print out the salinity maps (in color) and laminate them. You can do the Chesapeake Bay map back to back with the Plum Island Sound salinity map. Make sure you have enough for 1 per team. (10-12?)
2. Print out the "Salinity Survival" tables for teams to fill out. (This can be done as a whole class.)
3. Find tokens, or make copies of slide 11 for students to cut up.

Facilitation Guidelines:

1. Discuss whether any of them have gone fishing before, and where they go to find fish. Do they like fishing in saltwater or fresh water. Do they find the same or different fish in those locations?
2. Introduce the activity via the slide show. Slides 1-?
3. Fill out individually, or as a class the "Salinity Survival table". Check answers and discuss before proceeding.
4. Pass out the maps and tokens and have students place on the Chesapeake Bay map the location of the different fish species.
5. Review the following instructions with the students.

Instructions:

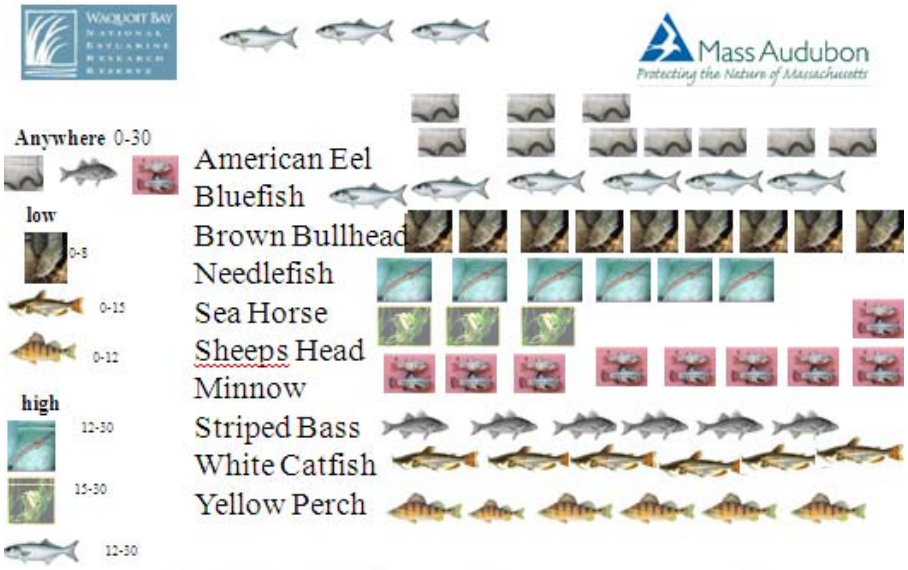
1. Give Explanation: Many fish cannot live where it is too fresh or too salty. Some parts of the Chesapeake Bay are very salty (high salinity) others are nearly fresh (low salinity). In this activity you will be placing a fish in parts of the bay with the right salinity for their survival.
2. Look at the table showing different kinds of fish and the salinity of the water they can live in. Salinity is given in parts per thousand (ppt). On some charts and graphs this is written 0/00. The salinity of the Bay ranges from near 0 to 30 ppt. Divide the fish in the table into three groups: those that can live in High, Low, and Both High and Low. Write each fish's group on the line.
3. Choose tokens, or create a token or symbol to represent different fish species. For example, paper clips might represent low salinity fish. Or yellow play-dough could be used to make a yellow perch. Using the spring salinity map, decide

where to place the fish on your map of the Bay. For fish that can live in both high and low salinity, use tokens of the same color in different areas of the Bay.

You can cut up the fish on slide 11 for tokens.

4. Make a key showing what fish is represented by each token/symbol.
5. Look at the fall salinity maps and move the fish if necessary. What fish had to be moved? How far did they move?
6. Discuss: If you were going fishing, how would the salinity of the water affect your plans?
7. Reflect: Have students write in their science journal reflections about this activity.

3 things they learned. Two questions they have. One comment.

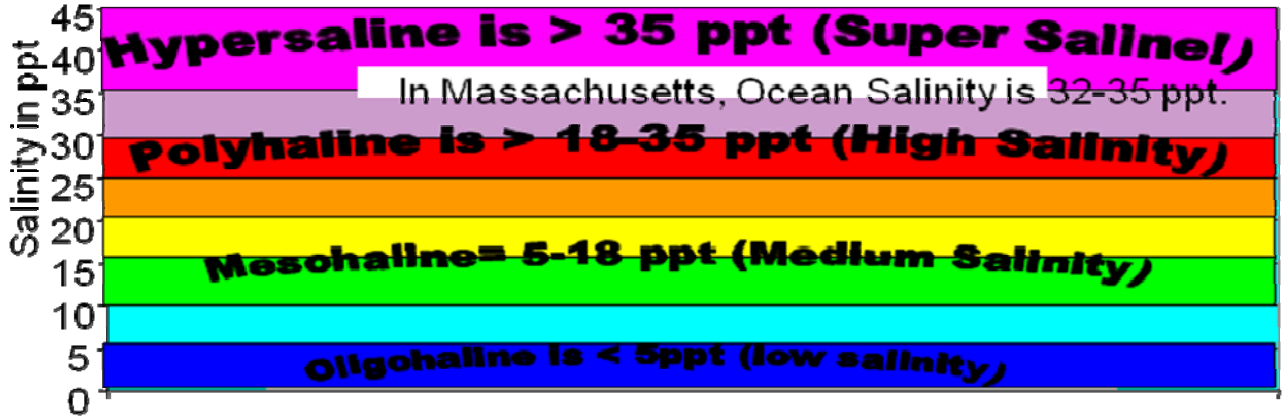


Cut out the fish and place each species on the salinity maps in the areas where they can survive.

Slide 11 can be used for tokens.

Name _____ Date _____

	Salinity Survival Table Fill in the third column. Fish	Salinity	High, Low, or High and Low?
	American Eel	0-30 ppt	
	Bluefish	12-30 ppt	
	Brown bullhead	0-8 ppt	
	Needlefish	12-30 ppt	
	Sea horse	15-30 ppt	
	Sheepshead minnow	0-30 ppt	
	Striped bass	0-30 ppt	
	White catfish	0-15 ppt	
	Yellow perch	0-12 ppt	



Fresh = 0-.5 salinity (no salinity)

Cut out the fish and place each species on the salinity maps in the areas where they can survive.

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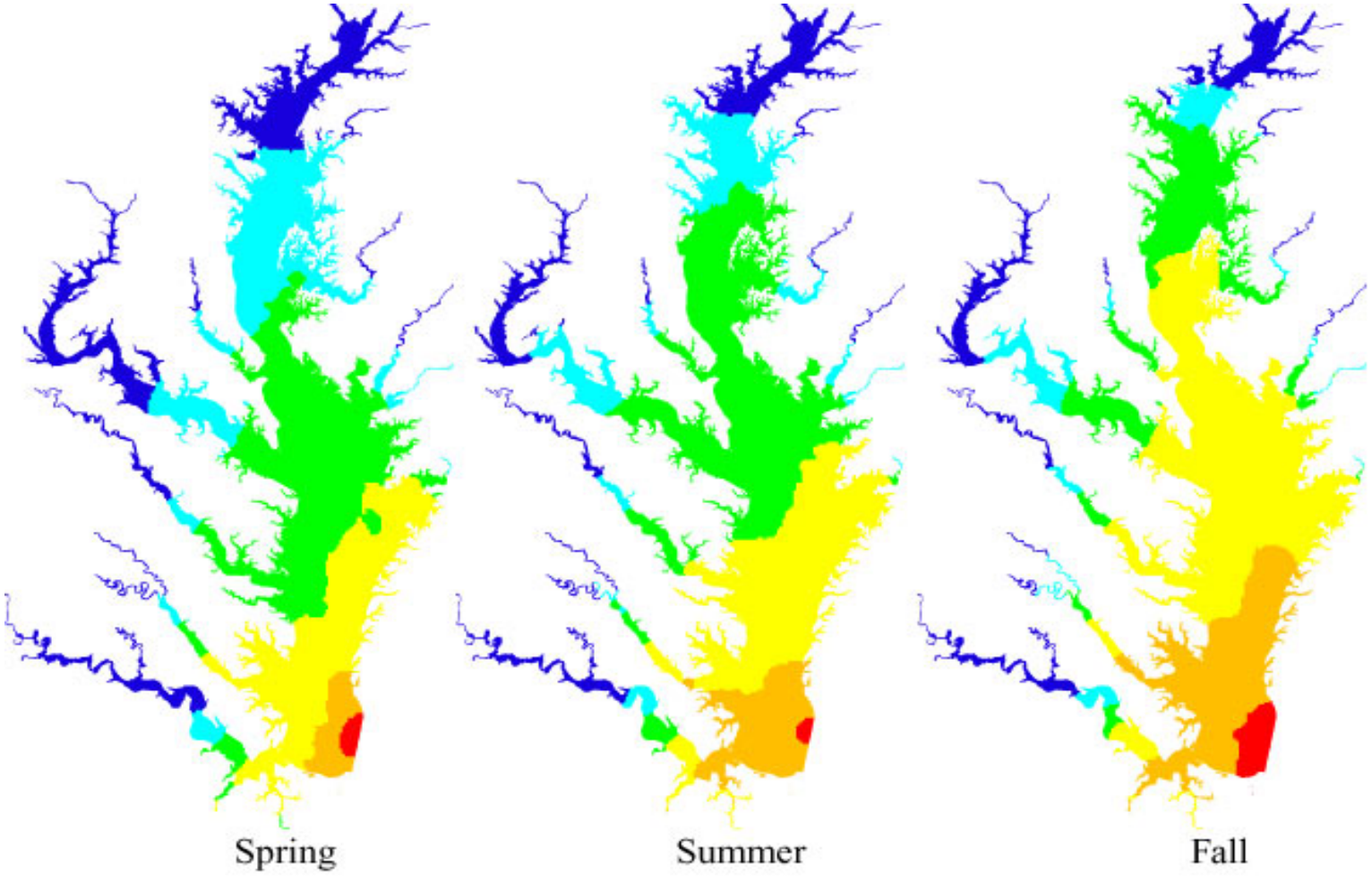
Chesapeake Bay Salinity MAp



Part 2: Striper Prey and Salinity

Vocabulary: Migration, schoolies, distribution, prey, predator, estuaries, juvenile

Materials: Same as class 1. Use the Plum Island Sound Seasonal Salinity Map handout. One per each group of students.

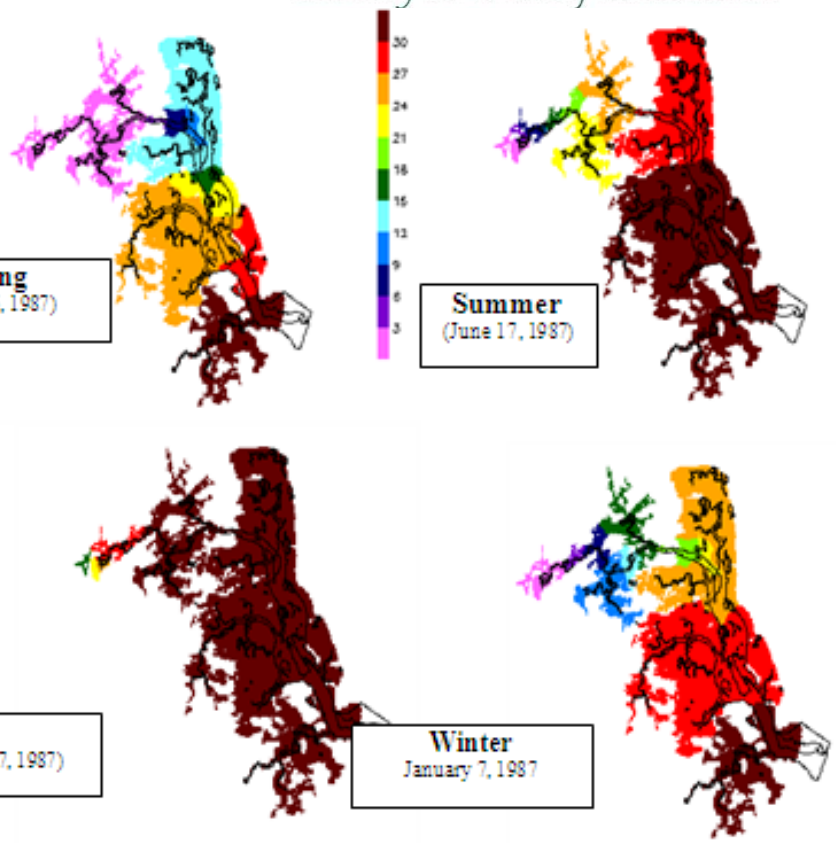
Slideshow Continued. Slides 15-20 introduction. 22-23 answers.

WAQUOIT BAY NATIONAL ESTUARINE RESEARCH RESERVE

Mass Audubon
Protecting the Nature of Massachusetts

Plum Island Sound – Seasonal Salinity Map

Based on the ELMR data, Where do you think will schoolie prey be found?



Design symbols to represent schoolie prey and put them on the maps.

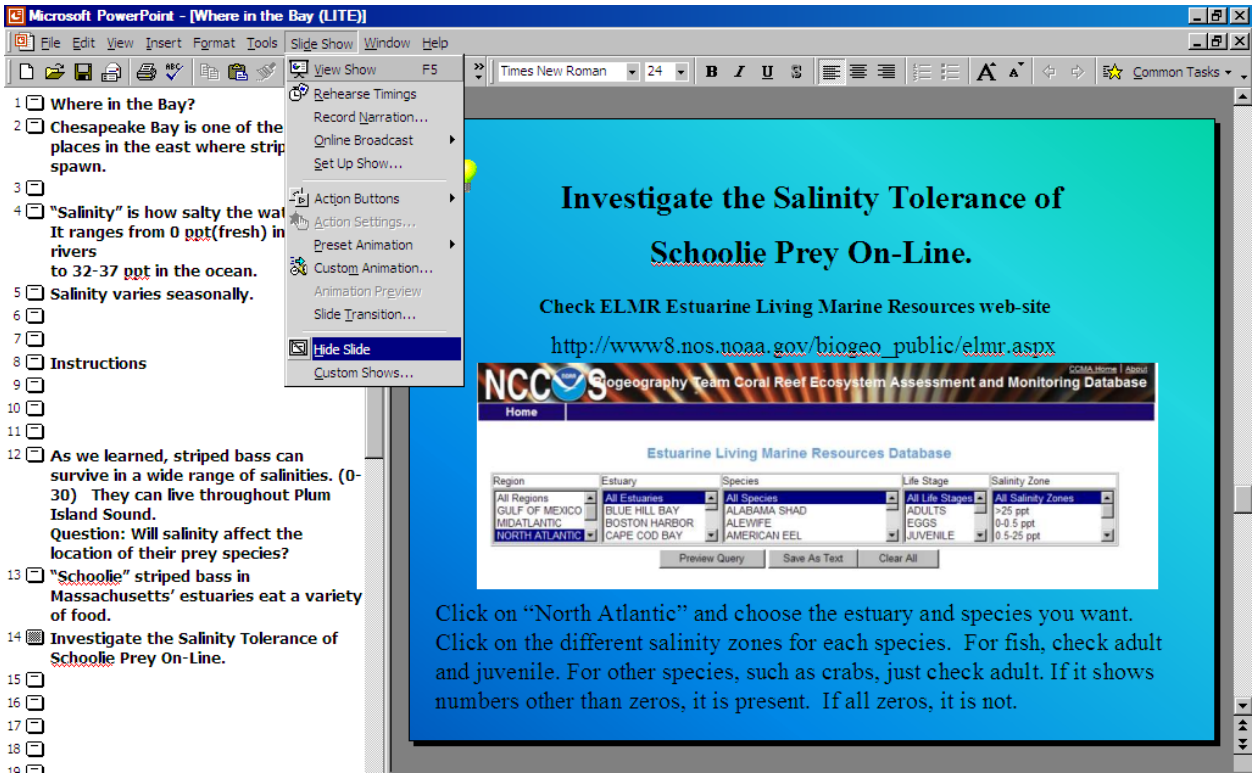
http://ecosystems.mbl.edu/pie/over.html

Prey Species (Adult)	Salinity	Low, High or High and Low
Alewife	0->25	
American Sand Lance	26-36 ppt	
American Lobster	8-36 ppt 16-36 at 77 °F Water temp	
Blueback Herring	0->25	
Daggerblade Grass Shrimp	Optimal 20 ppt .5->25	
Green Crab	Optimal 20-30 .5->25	
Menhaden	10-35	
Mummichog	0->25	
Sevenspine Bay Shrimp (Sand Shrimp)	0->25 Optimal 18-20 ppt	
Silversides	.5->25	

Part 3: Database Inquiry Via ELMR Data Base.

Materials Computer lab. The data base inquiry can be done in the classroom (with teams of students), in a computer lab, or as homework or extra credit, depending on what is available to teachers/students.

(If you are not doing the data base inquiry with students, you can "hide" those slides by clicking on the "Slideshow" drop down menu and clicking on "hide". Do this for every slide you do not wish to show.)



Science Process Skill: Data-base inquiry.

Investigate the salinity tolerance of Schoolie Prey on-line.

Check ELMR Estuarine Living Marine Resources web-site
http://www8.nos.noaa.gov/biogeo_public/elmr.aspx

Background information:

Project Summary

In 1985, the National Oceanic and Atmospheric Administration (NOAA) launched the Estuarine Living Marine Resources (ELMR) project to develop a consistent data base on the presence, distribution, relative abundance, and life history characteristics of ecologically and economically important fishes and invertebrates in the nation's estuaries. It has been conducted jointly by NOAA's National Ocean Service (NOS), NOAA's National Marine Fisheries Service (NMFS), and other agencies and institutions. The nationwide data base was completed in 1994, and includes data for 153 species found in 122 estuaries and coastal embayments in five regions. Regional revisions were completed for the Gulf of Mexico and Southeast in 1998.

The data base is divided into five study regions and contains the monthly relative abundance of each species' life stage by estuary for three salinity zones (seawater, mixing, and tidal fresh), as identified in NOAA's National Estuarine Inventory (NEI) Data Atlas-Volume I and supplement (NOAA 1985). Regional data summary reports have been published for the North Atlantic (Jury et al. 1994), Mid-Atlantic (Stone et al. 1994), Southeast (Nelson et al. 1991), Gulf of Mexico (Nelson et al. 1992), and West Coast (Monaco et al. 1990). Regional life history summary reports have been published for the West Coast (Emmett et al. 1991) and Gulf of Mexico (Pattillo et al. 1997). A National Overview report was completed in 2000 (Nelson and Monaco 2000). All reports are available for free upon request.

Instructions:

Click on “North Atlantic” and choose the estuary and species you want. For the area north of Cape Cod, MA choose “North Atlantic”. For Cape Cod south to the Chesapeake, choose “Mid Atlantic”. Choose “all estuaries” unless you are very close to one of the estuaries listed. Scroll down the list of species until you get to one on our list. We will assume that the bass are eating adult crabs, shrimp, and lobster. So, in general, choose “Adult” for life stage. Click on the different salinity zones for each species, and record whether that species is present for that salinity range. If it shows numbers other than zeros, it is present. If you see all zeros, it is not present. When you finish that, you can also check to see if “juvenile” is any different for fish species. Example: There are zero adult lobsters at 0-0.5 ppt salinity.

Address http://www8.nos.noaa.gov/biogeo_public/elmr.aspx

Google ELMR Go Bookmarks 8 blocked Check AutoLink

Estuarine Living Marine Resources Database

Region	Estuary	Species	Life Stage	Salinity Zone
All Regions GULF OF MEXICO MIDATLANTIC NORTH ATLANTIC	All Estuaries BLUE HILL BAY BOSTON HARBOR CAPE COD BAY	All Species ALABAMA SHAD ALEWIFE AMERICAN EEL	All Life Stages ADULTS EGGS JUVENILE	All Salinity Zones >25 ppt 0-0.5 ppt 0.5-25 ppt

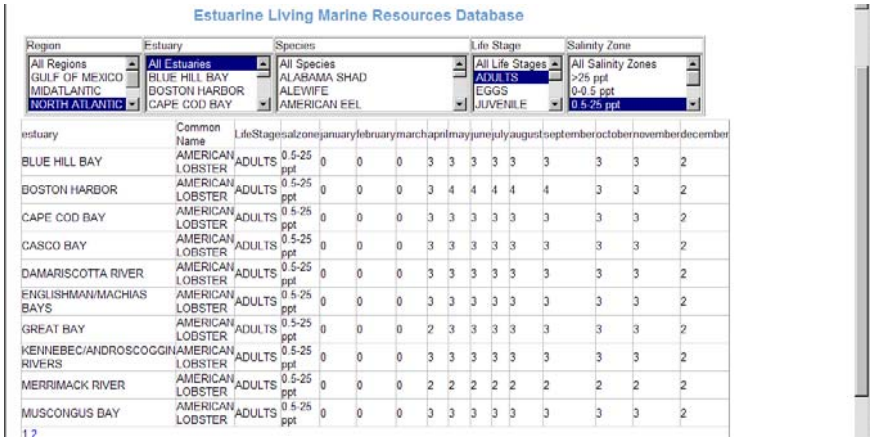
estuary	Common Name	LifeStage	salzone	january	february	march	april	may	june	july	august	september	october	november	december
BARNEGAT BAY	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0
BLUE HILL BAY	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0
CASCO BAY	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0
CHESAPEAKE BAY	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0
CHESTER RIVER	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0
CHOPTANK RIVER	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0
CONNECTICUT RIVER	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0
DAMARISCOTTA RIVER	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0
DELAWARE BAY	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0
ENGLISHMAN/MACHIAS BAYS	AMERICAN LOBSTER	ADULTS	0-0.5 ppt	0	0	0	0	0	0	0	0	0	0	0	0

1 2 3

Preview Query | Save As Text | Clear All

Adult lobsters can be found at .5-25 ppt in the months of April through December.

Extensions: What other questions can this data base help you answer? In your science journal, or on the back of this paper, list your questions. Choose one and investigate. Write down your question and its answer.



estuary	Common Name	LifeStage	salzone	january	february	march	april	may	june	july	august	september	october	november	december
BLUE HILL BAY	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	3	3	3	3	3	3	3	3	2
BOSTON HARBOR	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	3	4	4	4	4	4	3	3	2
CAPE COD BAY	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	3	3	3	3	3	3	3	3	2
CASCO BAY	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	3	3	3	3	3	3	3	3	2
DAMARISCOTTA RIVER	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	3	3	3	3	3	3	3	3	2
ENGLISHMAN/MACHIAS BAYS	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	3	3	3	3	3	3	3	3	2
GREAT BAY	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	2	3	3	3	3	3	3	3	2
KENNEBEC/ANDROSCOGGIN RIVERS	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	3	3	3	3	3	3	3	3	2
MERRIMACK RIVER	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	2	2	2	2	2	2	2	2	2
MUSCONGUS BAY	AMERICAN LOBSTER	ADULTS	0.5-25 ppt	0	0	0	3	3	3	3	3	3	3	3	2

1 2

Some possible questions: Striped Bass Adults survive at a wide range of salinity levels. Is this true for Bass at all life stages? Investigate. What estuaries can they be found in the egg stage?

What species do you see have different salt tolerances at different life stages? You could have each student investigate the life cycle of the prey of striped bass. What stages do they go through? What salinity tolerances do they have. Is there an optimal salinity for their species?

Discuss as a class: What besides salinity might impact the location of Striped Bass and Striped Bass prey. (Temperature is one thing. Bigelow and Schroder Fishes of the Gulf of Maine http://www.gma.org/fogm/ has information about temperature listed with fish species). There is a more recent version of this book, however.

Name(s) _____ Date: _____

Will salinity affect the location of their prey species? Young striped bass called "schoolies" eat the species listed below. Check ELMR Estuarine Living Marine Resources web-site http://www8.nos.noaa.gov/biogeo_public/elmr.aspx to see which prey species can tolerate each salinity level. If you see all zeros in the chart, the species cannot tolerate that salinity level. Write "NO" to indicate it cannot tolerate that level. Write "Yes" next to the levels each species can tolerate. One has been done for you.

Be sure to choose "North Atlantic" "All estuaries" "Adults" each time.
If you finish early, check to see if juveniles have the same results.

Results for Adults

Prey Species	Fresh	.5-25	>25
Alewife			
American Sand Lance			
American Lobster	No	Yes	Yes
Blueback Herring			
(Daggerblade) Grass Shrimp			
Green Crab			
Menhaden			
Mummichog			
Sevenspine Bay Shrimp (Sand Shrimp)			
Silversides			

Results for juveniles

Prey Species	Fresh	.5-25	>25
Alewife			
American Sand Lance			
Blueback Herring			
Menhaden			
Mummichog			
Silversides			

What other questions can this data base help you answer? In your science journal, or on the back of this paper, list your questions. Choose one and investigate. Write down your question and its answer.

Handouts: Salinity Maps of Chesapeake and Plum Island Sound.

Ocean Literacy Concepts:

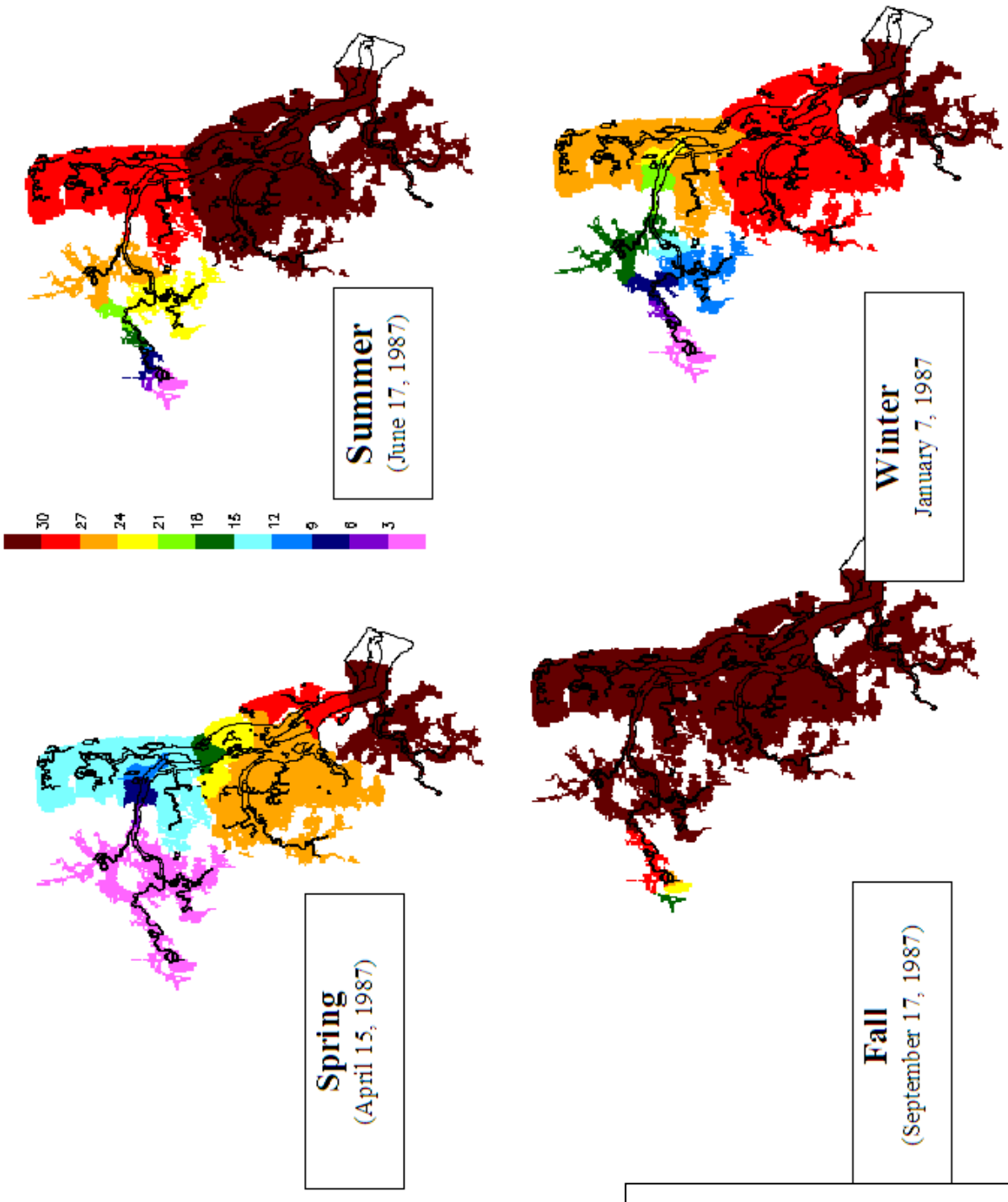
5. The ocean supports a great diversity of life and ecosystems.
d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.
f. Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate and circulation, ocean life is not evenly distributed temporally or spatially, i.e., it is "patchy". Some regions of the ocean support more diverse and abundant life than anywhere on Earth, while much of the
ocean is considered a desert.
Extentions:
h. Tides, waves and predation cause vertical zonation patterns along the shore, influencing the distribution and diversity of organisms.
i Estuaries provide important and productive nursery areas for many marine and aquatic species.

LIFE SCIENCE	5d	5f	5h	5i
16. Characteristics of Organisms	x	x	x	
17. Life Cycles of Organisms	x			x
18. Organisms and Environments	x	x	x	x
22. Populations and Ecosystems	x	x	x	x
23. Diversity and Adaptations of Organisms	x	x	x	x
24. Interdependence of Organisms	x			x
25. Behavior of Organisms	x			
26. Matter, Energy and Organization in Living Systems		x	x	x
27. Biological Evolution	x	x	x	x
SCIENCE AS INQUIRY	5d	5f	5h	5i
67. Abilities Necessary to Do Scientific Inquiry K-12	x	x	x	x
68. Understanding About Scientific Inquiry K-12	x	x	x	x

Answer Sheet

Prey Species (Adult)	**Salinity**	**Low, High or high and low**
Alewife	0->25	Low and high
American Sand Lance	26-36 ppt	**High**
American Lobster	8-36 ppt 16-36 at 77 °F Water temp	8 and up. Low and high
Blueback Herring	0->25	Low and high
Daggerblade Grass Shrimp	Optimal 20 ppt .5->25	Low and high, not fresh
Green Crab	Optimal 20-30 .5->25	Low and high, not fresh.
Menhaden	10-35	Medium and high
Mummichog	0->25	Low and high
Sevenspine Bay Shrimp (Sand Shrimp)	0->25 Optimal 18-20 ppt	Low and high
Silversides	.5->25	Not fresh, low and high

Ocean Literacy Concept	Grades 6-8 Earth Science	Massachusetts Learning Standard	Striped Bass Activity
g. The ocean is connected to major lakes, watersheds and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments and pollutants from watersheds to estuaries and to the ocean. h. Although the ocean is large, it is finite and resources are limited.	Mapping the Earth	1. Recognize, interpret, and be able to create models of the earth's common physical features in various mapping representations, including contour maps.	Map the migration route of the Striped Bass.
	<u>Grades 6-8 Life Sciences</u>		
	Evolution and Biodiversity	12. Relate the extinction of species to a mismatch of adaptation and the environment.	Investigate the extinction or near extinction of fish and marine mammal species and relate it to a mismatch between attempts to escape predation, or wasting by humans.
	Living Things and Their Environment	13. Give examples of ways in which organisms interact and have different functions within an ecosystem that enables the ecosystem to survive.	Explore the role of the striped bass as a top predator in an estuary. Invetigate how other species fluctuate as bass populations fluctuate.: Activity Computer animation? Seining, Powerpoint slideshow, video tape of scientists.
	Energy and Living Things	14. Explain the roles and relationships of producers, consumers, and decomposers in the process of energy transfer in a food web.	Explore the role of the striped bass as a top predator in an estuary. Invetigate how other species fluctuate as bass populations fluctuate.: Activity Computer animation? Seining, Powerpoint slideshow, video tape of scientists.



Based on your data, where do you think schoolie prey will be found? Use different symbols to show on the maps. In the box to the right, create a key to help others understand your symbols

Vocabulary

distribution: the arrangement of items over a specified area

estuary: the wide part of a river where it nears the sea; fresh and salt water mix

fish migration: Movement of fish from one aquatic habitat to another; in the case of anadromous fish, movement from freshwater to estuarine and marine habitats or vice versa

juvenile: Fish from one year of age until sexual maturity.

predator: an animal that lives by killing and eating other animals

prey: an animal hunted or caught for food;

salinity: the concentration of mineral salts dissolved in water.

schoolies: Young striped bass, typically 3-5 years old.