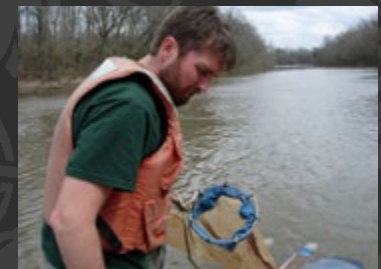


American Shad Life History,
(when and where do they spawn, where do they live, what do they eat, what are their predators , how old do they get, where do they go, how do we know?)



Above are nets that can be lowered off bridges to collect eggs and larvae from the water as the current flows under the Bridge.



How do we know all this about American Shad?

Answer = Mostly from college students (students doing research as part of their educational requirements for fishery science graduate degrees at universities in North Carolina.

Above are graduate students from NCSU and on the left is a professor at East Carolina University who has taught many students with research projects as well.

Dr. Joe Hightower at NCSU has had several students that have contributed to understanding American shad in our rivers and Dr. Roger Rulifson has had students as well that contributed greatly to our understanding of American shad movement patterns. This is a great situation because it helps educate students and helps them develop work experience that makes it easier for them to find jobs.



A close-up photograph of an American shad fish. The fish has a silvery, shimmering body with a pattern of dark spots. A bright yellow dart tag is visible on its dorsal fin. The background is a blurred, naturalistic setting with blue and brown tones.

How do we know where they go?

American shad with dart tag with identification numbers. Tagging fish allowed biologists to learn where American shad lived at different times. More recently some fish have been tagged with implanted transponders that can be detected by remote sensors placed along the rivers. Transponder tags are also used by veterinarians in dogs and cats so that if you lose your pet the pet's information owner / address are always with the pet in case they are found, but have lost their collar tags.

How old is a fish?

opaque zone
(slower growth)



translucent zone
(faster growth)

Credit: Florida Fish and Wildlife Conservation Commission

AGING BY COUNTING RINGS IN THE EAR BONE (OTILITH),
SIMILAR TO COUNTING RINGS ON A TREE STUMP. ALSO CAN
COUNT RINGS ON SCALES WHICH DOES NOT HURT THE
FISH. EACH RING = 1 YEAR OF AGE.



Probably started spawning



Spawning for sure



When do they spawn?

Maybe started spawning



Too early in the Neuse,
likely in the Cape Fear
but start looking for
other signs

Daffodils bloom a little before the shad start to spawn near Raleigh, dogwoods a little after. Trout lily's and shadbush are the best signs). Note spawning occurs earlier nearer the coast and further south. Fish in the Cape fear spawn about a month before the Neuse. Feb-March Cape Fear River / March-April Neuse River / March-April-June Roanoke River

A photograph of a river with rapids. The water is turbulent and white with foam as it flows over rocks. In the background, a large, dark log floats in the water. The sky is not visible.

Where do they spawn?

Spawning often
takes place below a
natural grade
change (rapids)
where dissolved
oxygen is high

American shad need well oxygenated water

Migratory Spawning and
Nursery Habitats

Shallow-Water and
Open-Water Habitats

Deep-Water Habitats

Deep-Channel Habitats

6

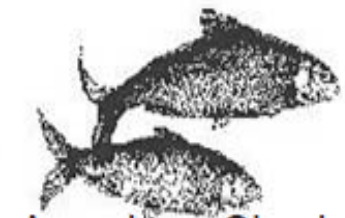


Striped Bass: 5-6

5



White Perch: 5



American Shad: 5

4



Hard Clams: 5



Yellow Perch: 5

3



Crabs: 3



Alewife: 3.6

2



Spot: 2



Bay Anchovy: 3

1



Worms: 1

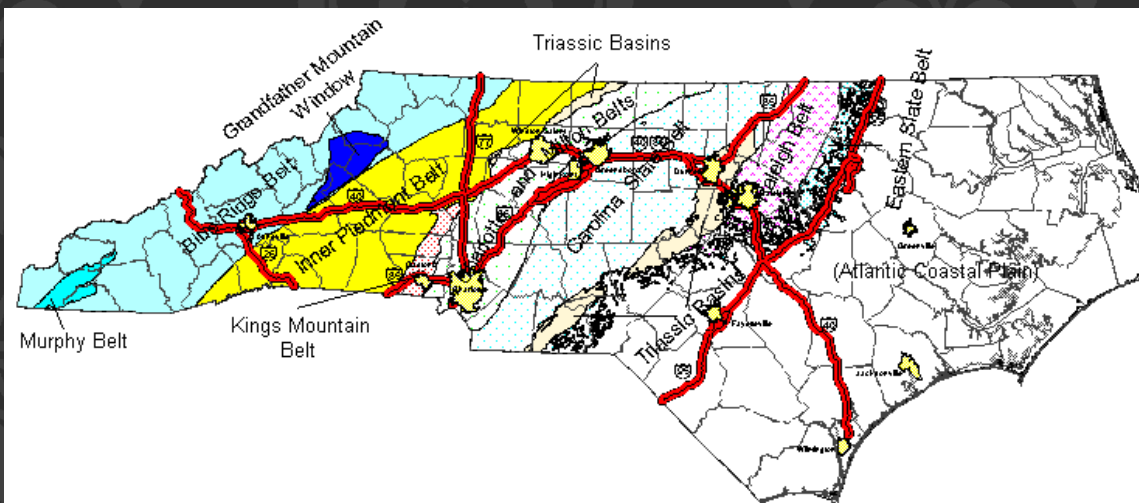
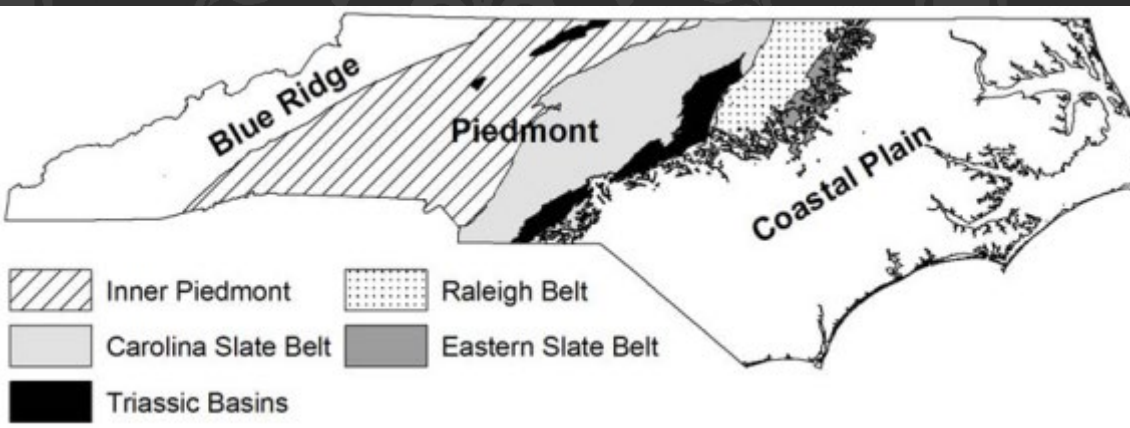
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Dissolved oxygen requirements (ppm)

Why spawn near rapids?



Red lines = Fault Lines



Lakes Gaston, Falls and Jordan are built in close proximity to fault lines. The majority of quality spawning habitat for American shad lies between the first major reservoir and I-95 HW. Historically spawning habitat extended into the Carolina slate belt, which for the Neuse and Cape Fear basin is roughly boundared by I-85 HW.

Where are the rapids?


Female American shad on the spawning grounds below Milburnie Dam on the Neuse River .





AMERICAN SHAD AT EDENTON NATIONAL FISH HATCHERY

Spawning in the wild occurs at 57 - 68 degrees F , depths of 1.6 to 4 feet and at flow velocities of 0.7- 2 ft./sec. Eggs mature in batches and a single female can release up to 600,000 eggs per season. Preferred spawning sites have river bottoms of gravel, cobble, bolder and bedrock that is found near and above the fall line in the piedmont.



American shad eggs about to hatch, after hatching larvae feed off yolk sacs for 4-7 days, less time in tanks in heated classrooms. Eggs hatch in 2- 17 days after fertilization depending on temperature.



Larvae

© JAY FLEMING

Eggs after being fertilized hatch in 2-17 days (depending on temperature to become

Larvae which at about one inch or 21-28 days become

Juveniles, not yet sexually mature but look like fish

Adults have reached sexual maturity



Juveniles

© JAY FLEMING

Cladacera
Daphnia parvula



Rotifer



Zooplankton
Food for larval American shad

Zooplankton can be small, less than
1/10 th. the width of a drop of water

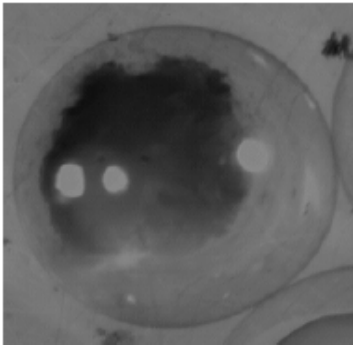
Copepod, cycloid



Egg staging criteria used in this study were taken from Jones et al. (1976, American shad), Mansueti (1962, hickory shad), and Pearson (1938, striped bass). Photographs are from eggs collected during this study.

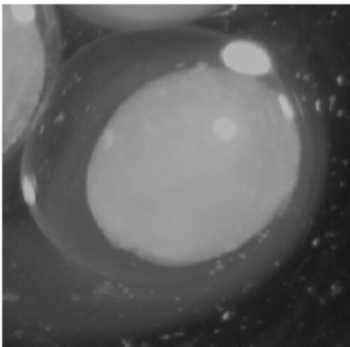
American shad

Dead



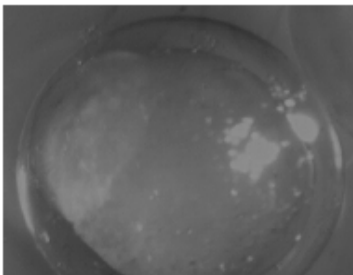
American shad eggs with grainy and scattered yolks were considered dead upon capture.

Stage 1



In the earliest stage of development, American shad eggs have not yet formed their blastodisc and the perivitelline space is initially very small. As they progress they enter the morula stage and numerous blastomeres form a visible cap on the yolk.

Stages 2 and 3



In stage 2 (photo on the left), eggs enter the blastula stage, defined by the presence of a kidney-shaped blastocoel. In the blastula stage blastomere cells are tightly packed and more numerous than in the morula stage. In stage 3, an embryonic shield is formed and a germ ring is visible.



How do we know where they spawn ?
Direct observation and Sampling for eggs and larvae.

15 days old



© JAY FLEMING

30 days old



© JAY FLEMING

Caddis fly larvae

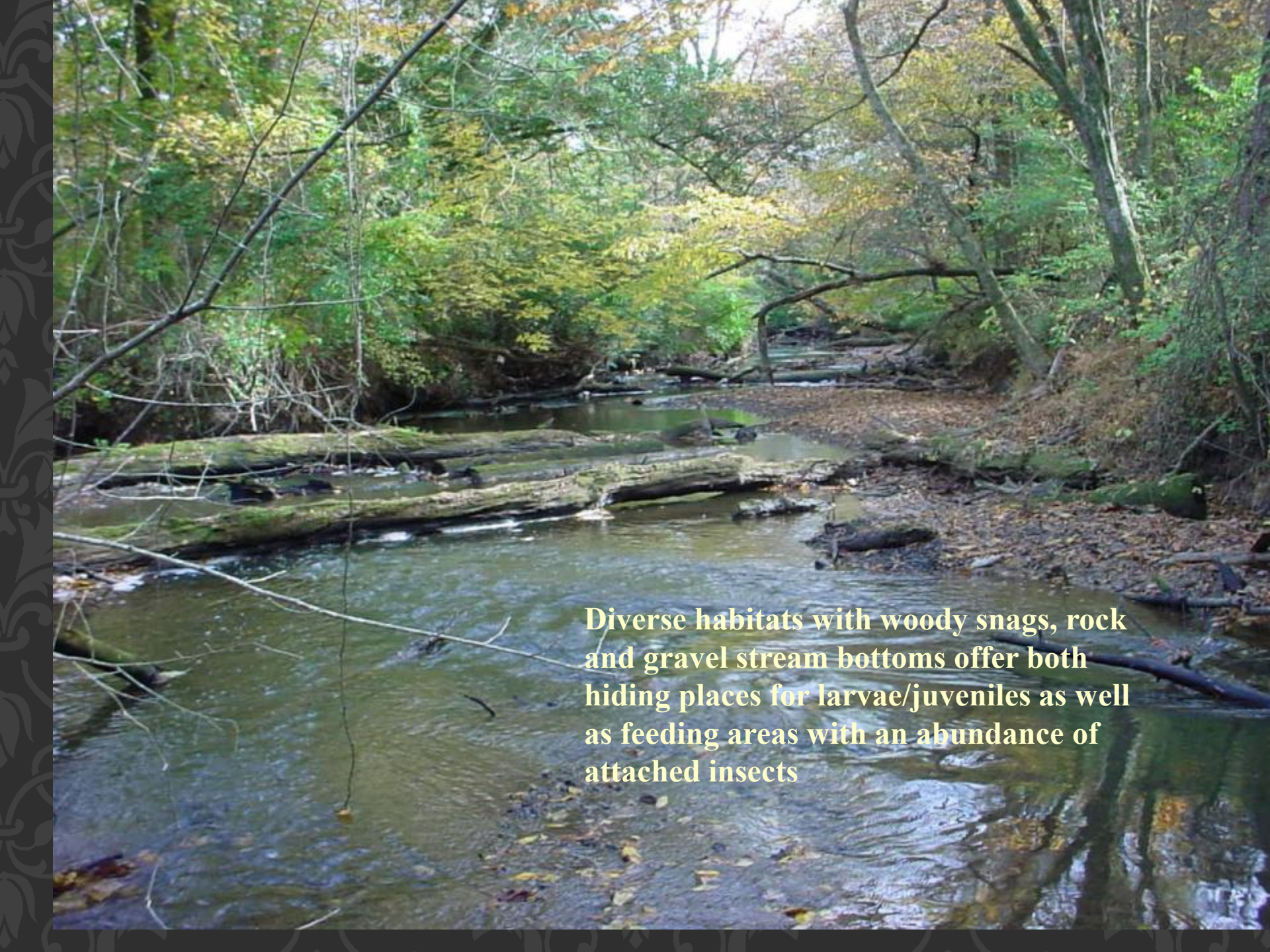


Food for juveniles

Mayfly nymph



Amphipod

A photograph of a small stream flowing through a forest. The water is clear and reflects the surrounding trees. The stream bed is composed of rocks and gravel. Several large, moss-covered logs are partially submerged in the water, creating small rapids. The banks are covered with fallen leaves and branches. The trees are mostly green, with some showing early autumn colors.

Diverse habitats with woody snags, rock and gravel stream bottoms offer both hiding places for larvae/juveniles as well as feeding areas with an abundance of attached insects

Predators of American shad eggs, larvae and juveniles



Creek chub



Spottail shiner



Redbreast sunfish



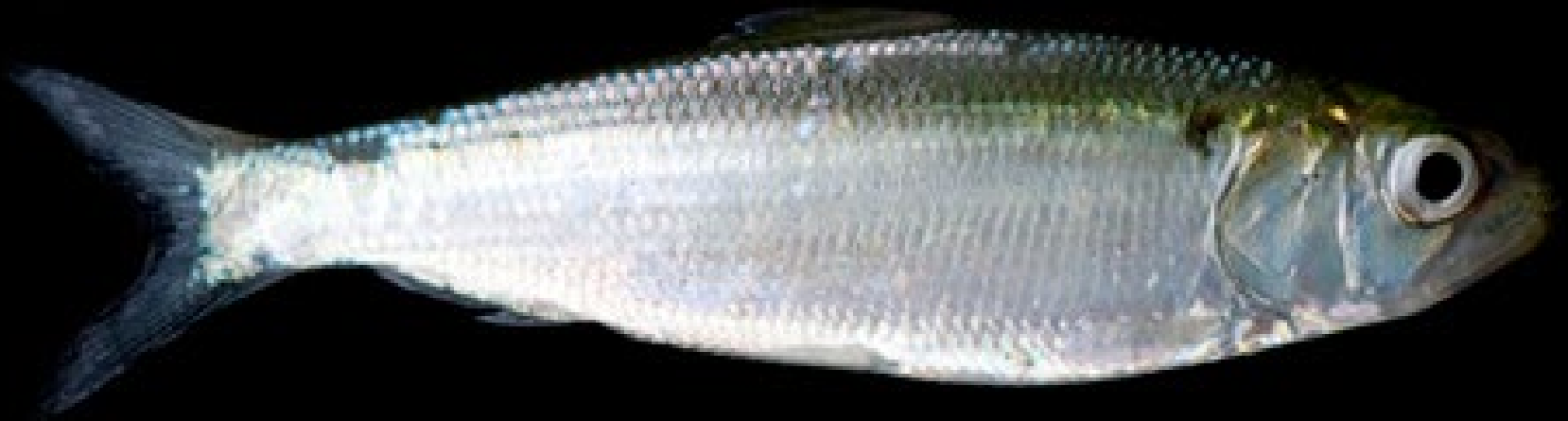
Largemouth bass



American eel, a catadromous fish lives in freshwater spawns in the Ocean (saltwater).



Bluegill sunfish



© JAY FLEMING

90 Day Old Juvenile



**JANUARY & FEBRUARY – OFFSHORE
FROM FLORIDA TO NOVA SCOTIA**

**MARCH AND APRIL – MOVING
OFFSHORE AND NORTHWARD TO NOVA
SCOTIA**

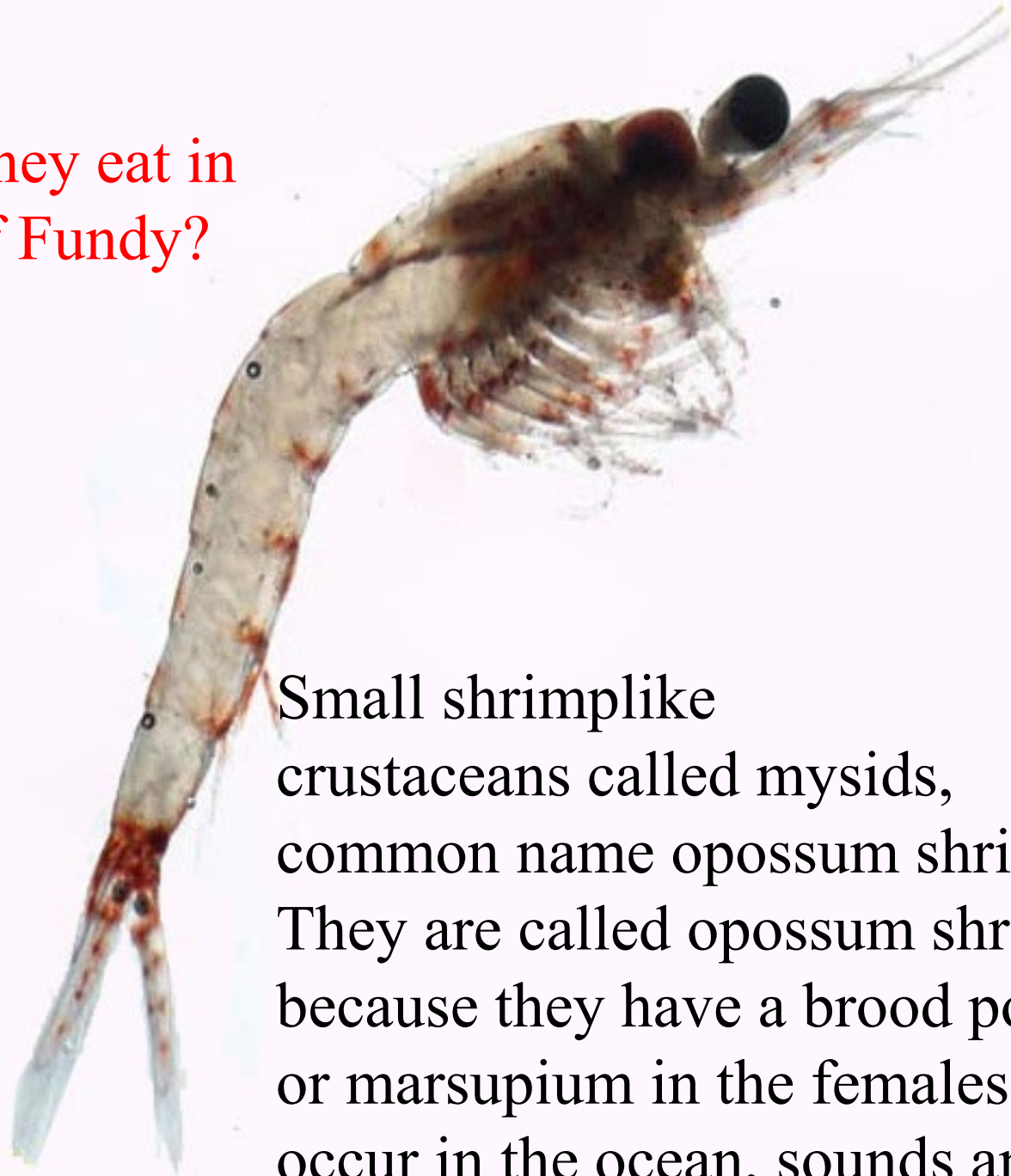
**LATE JUNE – CONCENTRATED IN THE
INNER BAY OF FUNDY, INNER GULF OF
ST. LAWRENCE, GULF OF MAINE, AND
OFF NEWFOUNDLAND AND LABRADOR**

**AUTUMN – LEAVING SUMMER AREAS
PAST MAINE TO LONG ISLAND AND
TRAVELING ALONG COAST SOUTH WITH
SOME GOING AS FAR AS GEORGIA AND
FLORIDA**

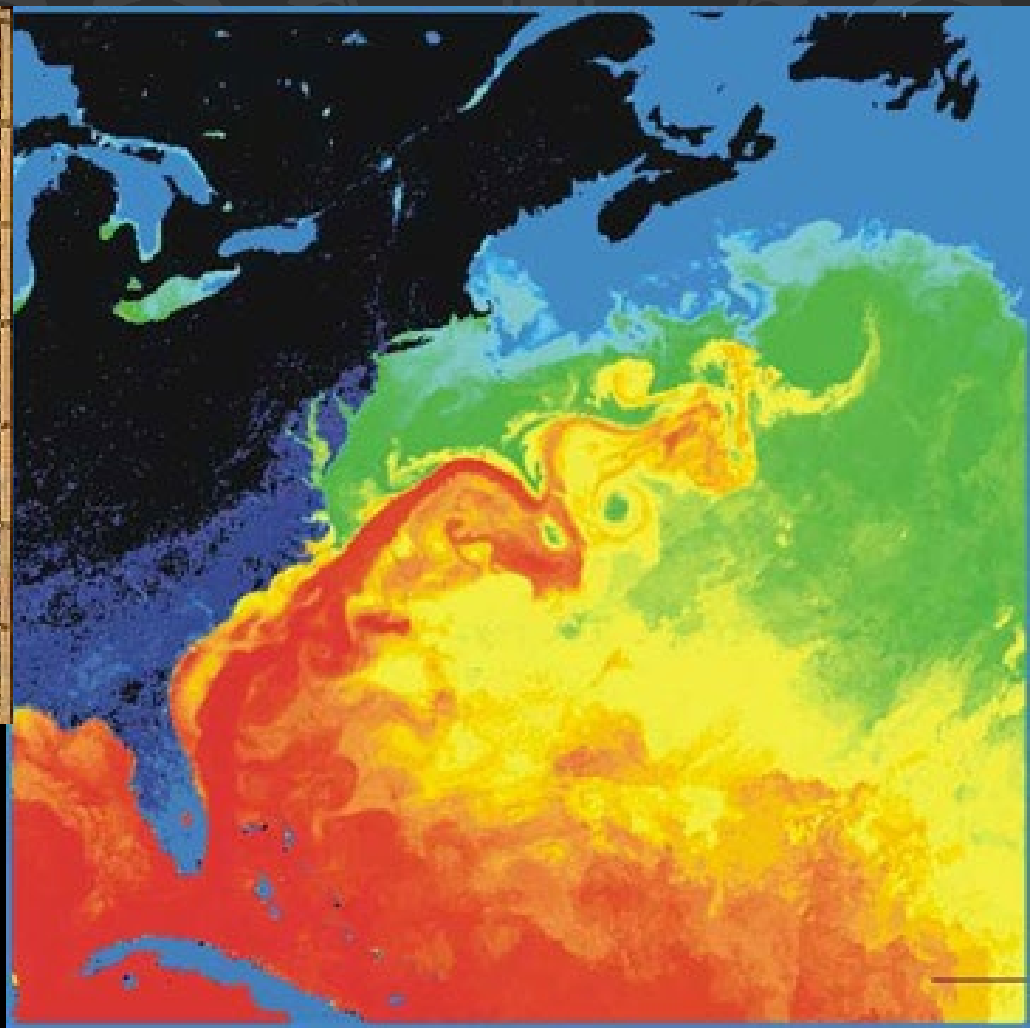
**LIVE 5 TO 7 YEARS & REMAIN IN OCEAN
2 TO 6 YEARS BEFORE BECOMING
SEXUALLY MATURE**



What do they eat in
the Bay of Fundy?



Small shrimplike
crustaceans called mysids,
common name opossum shrimp.
They are called opossum shrimp
because they have a brood pouch
or marsupium in the females. They
occur in the ocean, sounds and rivers.



Where specifically in the ocean are they as they move from northern summering grounds to overwintering grounds further south?

Anadromous fish live in saltwater (the ocean) but spawn in freshwater (rivers).

American shad move with isotherms associated with the Gulf Stream of 54 to 64 degrees F (very similar to the spawning temperature mentioned earlier). The red color in the photograph above shows the warmer temperatures of the Gulf Stream. Above on the left is a map made by Benjamin Franklin of the Gulf Stream. So in the summer they are heading north to stay in their preferred temperature.

Predators in the ocean



Atlantic bottlenose dolphin



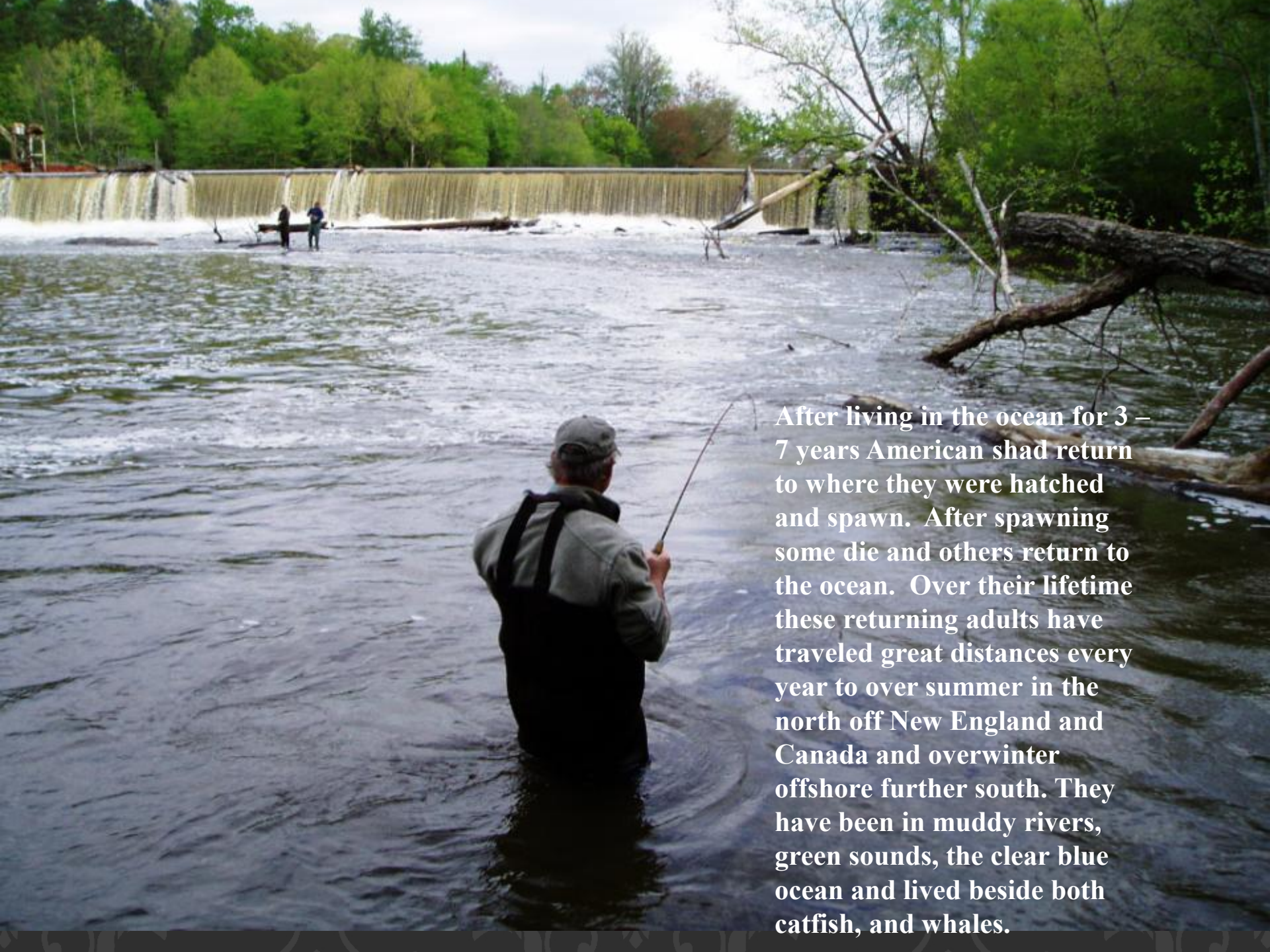
Harbor seal



Bluefin tuna



Striped bass



After living in the ocean for 3 – 7 years American shad return to where they were hatched and spawn. After spawning some die and others return to the ocean. Over their lifetime these returning adults have traveled great distances every year to over summer in the north off New England and Canada and overwinter offshore further south. They have been in muddy rivers, green sounds, the clear blue ocean and lived beside both catfish, and whales.