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?)
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.
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.
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.
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
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

<table>
<thead>
<tr>
<th>Dissolved Oxygen Requirements (ppm)</th>
<th>Migratory Spawning and Nursery Habitats</th>
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<tbody>
<tr>
<td></td>
<td>6</td>
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<tr>
<td></td>
<td>Striped Bass: 5-6</td>
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<tr>
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<td>American Shad: 5</td>
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<tr>
<td></td>
<td>White Perch: 5</td>
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<tr>
<td></td>
<td>Yellow Perch: 5</td>
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<td>Hard Clams: 5</td>
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<td>Alewife: 3.6</td>
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<td>story</td>
<td>Crabs: 3</td>
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<td>Bay Anchovy: 3</td>
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<td>story</td>
<td>Spot: 2</td>
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<td>Worms: 1</td>
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*Why spawn near rapids?*
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.
Female American shad on the spawning grounds below Milburnie Dam on the Neuse River.
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.
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
Zooplankton
Food for larval American shad

Zooplankton can be small, less than 1/10 th. the width of a drop of water
How do we know where they spawn?
Direct observation and Sampling for eggs and larvae.

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 perivitteline 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.

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.
Food for juveniles

- Caddis fly larvae
- Mayfly nymph
- Chironomids (Midge Larvae)
- Amphipod
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
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
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.

What do they eat in the Bay of Fundy?
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

Bluefin tuna

Harbor seal

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.