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Species Update

Science Serving the Recreational Angler

STRIPED BASS

Morone saxatilis (Walbaum, 1792)

Striped bass are the largest species of the sea bass family, Moronidae, order Perciformes, often called “temperate” or “true” bass to distinguish them from species such as largemouth, smallmouth, and spotted bass which are actually members of the sunfish family, Centrarchidae. Of their Latin name, *Morone* is of unknown derivation and *saxatilis* means “dwelling among rocks”.

Striped bass are an important species of fish for recreational and commercial fishing in the Chesapeake Bay. They are one of the most sought after fish by anglers because they fight the line and are delicious. Historically they have been a vital resource since colonial times. Striped bass as well as codfish were among the first resources protected by conservation measures. In 1639, the Court of the Massachusetts Bay Colony passed a law prohibiting the sale of either fish to be used as fertilizer. In 1670, an act of the Plymouth Colony required that all income from striped bass, mackerel, and herring be used for a free school. The school financed from these fisheries off of Cape Cod was the first public school in the thirteen colonies. Today the

Age & Growth Laboratory ~ Center for Quantitative Fisheries Ecology
Old Dominion University

"The Basse is one of the best fishes in the countrey,... The way to catch them is with hooke and line: the fisherman taking a great cod-line, to which he fastneth a peece of lobster, and throwes it into the sea, the fish biting at it he pulls her to him, and knockes her on the head with a sticke... the English at the top of an high water do crossee the creekes with long seanes of Basse netts, which stop in the fish: and the water ebbing from them they are left on the dry ground, sometimes two or three thousand at a set..."

William Wood
1634

fish holds just as important role as it did then and has been given a place of honor on the Great Seal of Maryland.

The striped bass (also known as striper, linesider, bass, rockfish, rock, sewer trout and in French, *bar raye*) is native to most of the East Coast, ranging from the Lower St. Lawrence in Canada to northern Florida, and along portions of the Gulf of Mexico. Spawning however takes place almost entirely in the Hudson River and the Chesapeake Bay.

The unique angling qualities of this trophy fish and it's adaptability to freshwater environments have led to a major North American range expansion within the last 100 years. A valuable fishery has been created on the west coast (*see sidebar on page 3*) and inland fisheries have been developed in 31 states by stocking the striped bass into lakes and reservoirs.

Stripers are *anadromous* (ascending rivers from the sea for breeding; the opposite, *catadromous*, means living in freshwater and going to the sea to spawn).

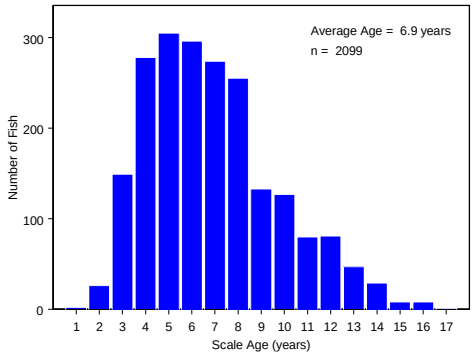
Juvenile striped bass remain in fresh and brackish waters of the Bay for 1 to 3 years. (A juvenile is any fish which is not yet sexually mature.)

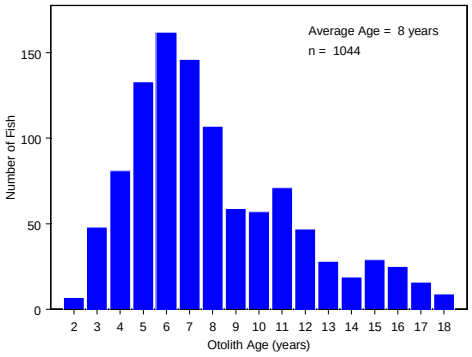
Stripers tend to school by size rather than age. Only females exceeding 30 pounds show any tendency to be solitary. As young fish, they remain in their natal bays. As they grow, from age 2 to 3, they leave these bays and join coastal migrations, moving north in summer and south in winter; More than 50% of Atlantic coast catch originates from spawning grounds in Chesapeake Bay. These groups are rarely more than few miles offshore. The distance traveled appears related to size and age (the larger and older the fish, the farther offshore they venture) for Chesapeake Bay fish. Feeding is not continuous and within schools is often synchronized.

They are voracious *piscivores* (fish eaters) and grow rapidly as a result. Their diet is seasonal, comprising bay anchovy and Atlantic menhaden in the summer and fall, and juvenile spot and Atlantic croaker throughout the winter. During the early spring their forage consists almost entirely of white perch with blueback herring and alewife becoming available to them in late spring and early summer.

In the late summer and fall months, it is extremely important for the bass to store up body fat. Besides giving the fish reserves to live on during the lean winter months, the body fat in males assists in the development of gonads for spawning. The spring and fall seasons are also when striped bass attain most of their growth for the year.

Anglers usually catch stripers in river mouths,shallow bays and along rocky shorlines and sandy beaches.

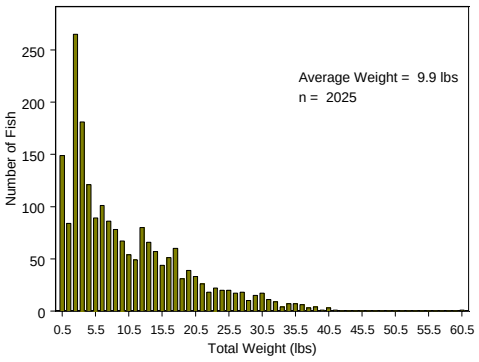


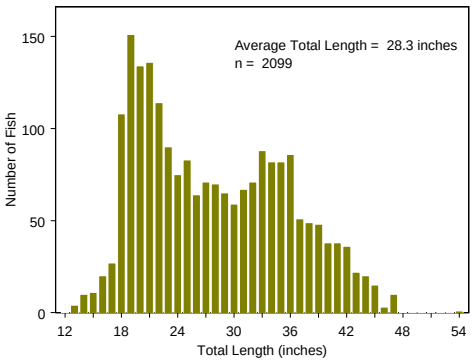


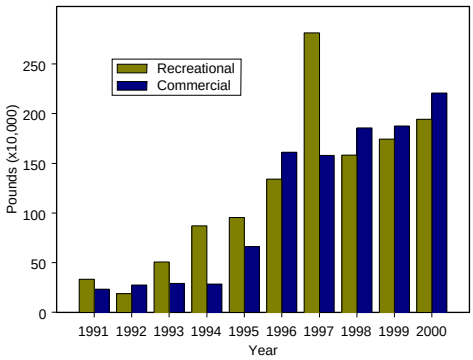
In our sampling of Chesapeake Bay and coastal ocean waters, the average otolith age of striped bass was 8 years, while the average scale age was 7 years. We collected fish as young as one year old and as old as old as 18 years. The average length was 28.3 inches, with a range of length from 13 inches to 54 inches. The average weight of the striped bass we sampled was a little under 10 pounds, with a minimum of 8 ounces and a maximum of just over 60 pounds.

Although striped bass grow more slowly than do other Chesapeake Bay fish (e.g. weakfish, drums), their growth is just as variable. A 35 inch striped bass can be anywhere from 7 to 15 years of age and a 10 lb striped bass can be from 6 to 16 years old. Size and weight alone do not indicate the age of these fish.

In Virginia, striped bass recreational and commercial harvests are approximately equal. Virginia and the other East Coast states have long been under harvest restrictions in order to prevent/reduce overfishing. In Virginia there are both size and season limits. See the Virginia Marine Resources Commission website for more details at http://www.mrc.state.va.us/swrecfishingrules.htm.







A Well-traveled Fish

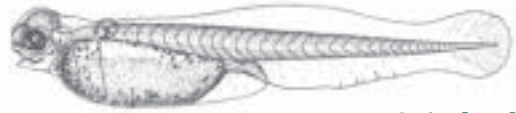
Striped bass, a native of the East Coast of the U S, was so popular that in 1879 a population of 132 fish was taken from the Navesink river in New Jersey across the country in barrels by way of the great railroad. In 1882, 300 fish were released in lower Suisun Bay. They spawned in the Sacramento and San JoaquinRivers.

They have now spread as far south as Baja California and north to Barkley Sound, British Columbia.

Development

4-cell stage embryo Morula Advanced

.13 inch yolk-sac larva



.21 inch yolk-sac larva

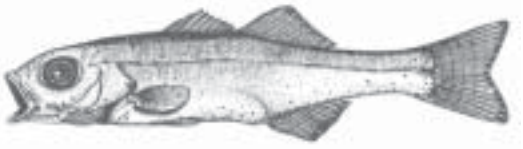
Top view

Top view *Bottom view*

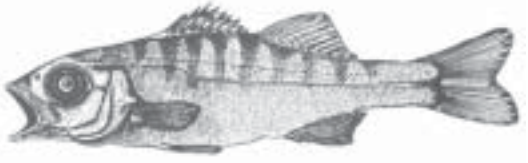
.24 inch yolk-sac larva head

.32 inch larva

.55 inch larva



1.3 inch early juvenile



1.8 inch juvenile

Most females reach maturity at 3-4 years, some as late as 8 years, and at total lengths of about 17 inches; males mature at 2 years and 6.8 - 10 inches total length; the larval stage lasts from 35-50 days; larvae begin active feeding at about 8 days (6-7 days); juvenile stage lasts from 35-50 days to maturity.

Spawning occurs when water temperatures reach 60-70°F. The semi-buoyant eggs are released in flowing water and fertilized by several males in a thrashing event known as a "fight". As many as 3,000,000 eggs may be released by one female. Eggs require a flow adequate to prevent their settling to the bottom during the incubation period. Embryos "kick" after about 40 hours, and hatch after 48 to 50 hours. During their first few days of life the larval fish are sustained by a yolk material while they continue to develop until they can feed on zooplankton.

The survival and maturation of the eggs is dependent on both salinity and temperature. The best survival rates occur with a salinity of 9-9.5 parts per thousand. While eggs have been found at temperatures between 46.5 and 77°F., those at the extremes would probably not survive. The optimum temperature for egg maturation is about 63°F. and the best hatches have been observed at 68°F.

Yolk-sac larvae hatch at about 0.12". The mouth and divisions of the brain become evident after 2-4 days at 0.18-0.20", with teeth visible at about 0.13-0.23". The eye becomes mobile after 8 days at about 0.23-0.26". Pectoral fins and caudal rays are visible at about 0.24". Feeding begins at between 4 to 10 days.

Diet

As fry in Virginia culture ponds, striped bass ate cladocerans, copepods, and insects. Cladoceran abundance in stomachs increased when bass were 1.18-1.57 in. total length. Food consumption change when the fish become juveniles to include primarily small shrimps (*Gammarus* and *Crangon*), other small crustaceans, annelid worms, and insects. Fish become increasingly more important in the diets of juvenile striped bass larger than 3.94 in., and by age two striped bass are primarily piscivorous (fish eating).


Cladoceran
"water flea"

The diet of adult striped bass consists mostly of soft-rayed fish. Preferred species in fresh water are threadfin shad, gizzard shad and blueback herring.


gizzard shad


threadfin shad


blueback herring

Striped bass commonly herd schools of prey fish against the surface, where their frenzied feeding can splash water several feet in the air.


flounder

In the sea, adults eat a wide variety of fishes such as alewives, herring, smelt, eels, flounders, mummichogs, rock gunnels, sand lance, silver hake, and silversides.


rock gunnel


silver hake

They also consume invertebrates including squid, crabs, sea worms (Nereis), and amphipods and, along rocky shores, will take small lobsters. In rivers and lakes, food organisms are similar and other small fishes are taken when available.


Nereis
sea worm


blue crab

American shad is reported to be a common food item in the Chesapeake Bay region. Feeding ceases for a brief period before spawning and during the spawning period.


American shad

Scales

Scales into Teeth

The structure of placoid scales in Chondrichthyes is the same as the structure of teeth in vertebrates, leading to the question, which came first. Apparently, the dermal armor of the earliest known vertebrates, the ostracoderms (the early fossil jawless fishes of the Lower Paleozoic usually having a bony covering of plates or scales), broke up into smaller units, and some of these scales in the mouth evolved into teeth.

Scales are the characteristic external covering of fishes. There are four basic types of scales:

1 **Placoid** scales are common to all of the Chondrichthyes (*cartilaginous fishes - sharks, rays, chimaeras*). Each scale consists of a flattened rectangular basal plate in the upper part of the skin, from which a protruding spine projects backward on the surface. The outer layer is a hard, enamel-like substance. Each scale has a cup or core of dentine with a pulp cavity, just like mammalian teeth. These scales did not increase in size with fish growth but new scales were added between the old ones.

2 **Cosmoid** scales were present in fossil crossopterygians (*fringe-finned or tassel-finned fishes*) and fossil lungfish. The scales of recent lungfishes have lost their dentine layer. These scales are similar to Placoid scales and probably developed from fusion of Placoid scales. Cosmoid scales are composed of two basal layers of bone with a covering of cosmine, a noncellular dentinelike substance. Growth is by adding new bone beneath but not over the upper surface.

3 **Ganoid** scales were present in fossil paleoniscoids (*primitive chondrosteans*) and in Chondrostei (*sturgeons and paddlefishes*). They are modified Cosmoid scales, with the cosmine replaced by dentine and the surface covered by ganoine, an inorganic bone salt secreted by the dermis. Sturgeon scales are modified into large plates with most of the rest of the body naked.

4 **Cycloid** and **ctenoid** scales are almost completely dermal and there is almost no enamel-like layer. These scales evolved from ganoid scale by loss of the ganoin and thinning of the bony dermal plate. These scales are present in most bony fishes. They overlap like shingles, which lends flexability.

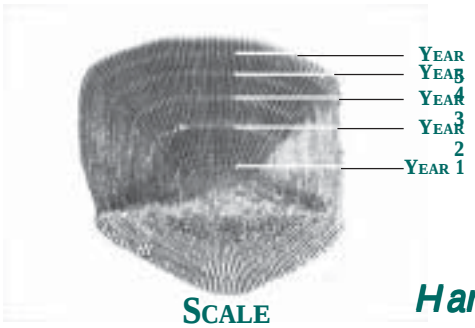
Scale size varies greatly in fishes. Scales may be microscopic and embedded as in freshwater eels, which led to their being classified as nonkosher because of the supposed absence of scales. Scales are small in mackerel, "normal" in perch, large enough to be used for junk jewelry in tarpon, and huge (the size of the palm of human hand) in Indian mahseer (Tor tor, a cyprinid (*minnows, bream, carps, etc.*)) gamefish reaching 106 pounds in weight.

In ray-finned fishes, scales usually develop first along the lateral line on the caudal peduncle (*the narrow part of the body just in front of the tail*), then in rows above and below the lateral line, then spread toward the head. The scales on the lateral line form pores from heat to tail. Once an individual fish has obtained its full complement of scales, the number remains fixed throughout its life .

Most scales remain in place for life, making them useful for recording events in the life history of the individual(*See Ageing Striped bass, page 7*).

Taken from The Diversity of Fishes pgs. 33-36 (*see References*)

Ageing striped bass



Scale

Otolith

Hard Parts from the same striped bass

Scales have traditionally been used to age striped bass, *Morone saxatilis,* and currently the Atlantic States Marine Fisheries Commission (ASMFC) requires states to use only scales to age striped bass. To age with scales, scientists count circuli. Circuli are growth rings around the scale. Retardation of growth during the fall and winter causes the spacing between the circulii to decrease, leaving a dark band on the scale called an annulus. However, many life stresses, spawning, injury, pollution, parasitism, etc. may also leave a mark.

In the past decade there have been several research studies that compared alternative structures for use in age determination for striped bass. These studies have consistently found that otoliths were superior to scales in accurate measurement of fish age, with scales consistently underestimating the age of larger and older fish.

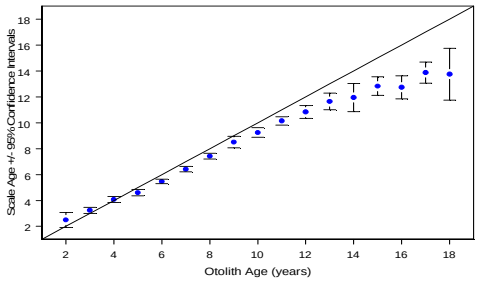


Figure 1

Virginia leads all other states by collecting both scales and otoliths to yield greater accuracy in age estimation. The scientists at CQFE have undertaken additional research to determine the most accurate method for ageing striped bass. From 1998 to the present they have collected sagittal otoliths and scales from over 1000 fish.

Results seen in Figure 1 show that age estimates of otoliths and scales up to age 9 are similar but thereafter scales consistently underestimate the age of striped bass. Because striped bass can live to 30 years, the underestimate becomes worse as the fishery recovers and true mean age in the population increases.

What are the ramifications of relying on inaccurate scale ages, ones that underestimate the true age of striped bass? In a recovering fishery managers might not know the full extent of recovery. There could possibly be

Continued on Page 8

References

Cover picture of striped bass from the NOAA Photo Library at http://www.photolib.noaa.gov/search.html

Definitions from the Merriam-Webster Unabridged on-line dictionary at http://www.m-w.com/home.htm

Striped bass development pictures from "Development of fishes of the mid-Atlantic bight", Volume 3, by Jerry D. Hardy, Jr., Fish and Wildlife Service, U.S. Department of the Interior, 1978.

Threadfin shad, American shad, and blueback herring pictures from The South Carolina B.A.S.S. Federation Inc. web site at http://www.scbass.com/sc_fish/striped_bass.html.

The Texas Freshwater Fishing web site at http://www.tpwd.state.tx.us/fish/infish/species/str/str.htm.

The Virginia Institute of Marine Science web site at http://www.fisheries.vims.edu/trawlseine/sbinfo.htm.

The National Marine Fisheries Service web site at http://www.nefsc.nmfs.gov/sos/spsyn/af/sbass.

The Chesapeake Research Consortium web site at http://www.chesapeake.org/ties/mwt/fishinfo/striped_bass.htm.

The Combat Fishing web site at http://www.combat-fishing.com/fishencyclo1/temporatebasses/striper.htm.

The Fair Harbor web site at http://fairharbor.com/do_fish_bass_biology.htm.

ODU Working paper on Otolith/Scale Age Comparisons for Striped bass.

Continued from Page 7

more fish available for harvest. While this makes sense in terms of conservation, the full potential of the fishery is not being exploited. Conversely, when the fishery is being overfished, managers will not be able to identify one of the most important early warning signs, the loss of the oldest fish in the stock.

Cladoceran picture from the Water Flea web site at http://www.ucl.ac.uk/~ucfagls/.

Gizzard shad picture from Jim's Big Fishin' Homepage at http://www.geocities.com/Yosemite/Rapids/9007/gzsh.html.
Silver hake picture from the New Jersey Fishing web page at http://www.fishingnj .org/prohake.htm.

Rock gunnel picture from the Marine Life of Atlantic Canada web site at http://www.jodive.ns.ca/marinelife/11.htm.
Nereis sea worm picture from the Lane Community College web site at http://www.lanecc.edu/science/Estuary/sandworm.htm.

Helfman, G.S., Collette, B.B., & Facey, D.E. 1997, The Diversity of Fishes, Blackwell Science. Malden, Mass.

Bond, C.E. 1979, Biology of Fishes (2nd Ed.) Saunders College Publishing, Philadelphia.

Evans, D.H. 1997, The Physiology of Fishes (2nd Ed.) CRC Press, New York.

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Speces Update **is produced by:**
Cynthia M. Jones ~ Director
Stephen J. Bobko ~ lab Manager
William E. Persons III ~ Editor

For more information on Striped Bass or any of the fish studied by the Age & Growth laboratory, visit our web site.
www.odu.edu/fish

Please send any comments or suggestions to *Species Update* Editor Will Persons at wpersons@odu.edu