Pennsylvania Fishes

Pennsylvania Fish & Boat Commission

Pennsylvania Fishes

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2000 Edition

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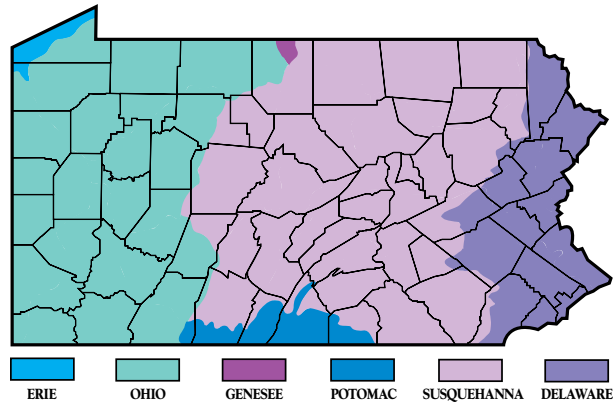


The story of Pennsylvania's fishes is better than any movie, computer game or even textbook. It's as big as 83,000 miles of rivers and streams in Pennsylvania and nearly 4,000 lakes, reservoirs and ponds. It spans some 280 million years (lampreys, see page 32). This story even has air-breathing fish (gars, see page 40) and creatures as long as 12 to 14 feet (Atlantic sturgeon, see page 36).

The information in this book is fascinating. But that's not the only reason why this book was created. It was written to provide the newest information on Pennsylvania's common fishes. It was written to provide basic details about these fishes all in one source. These details include fish life histories, biology/ecology descriptions, general identification and distribution. The fish families in this book appear in phylogenetic order. This means that the later a family chapter appears in the book, the more recently the species in that family developed. Species accounts within families are listed alphabetically according to their scientific names.

This book is not comprehensive; it doesn't include information on all Pennsylvania fish species. We produced this book to explain facts about Pennsylvania fishes that anglers and others may encounter when fishing, boating, collecting bait and just turning over rocks along a waterway's shoreline. Sources of more complete fish information are listed under "References," on page 170.

The Fish & Boat Commission has produced other books and publications on the fishes of Pennsylvania. This book is a compilation of the most important information from these other Commission publications. The book also includes information on game fish and nongame fish species.

This book is not intended to be a scientific text. This means that the book can be useful to a wide range of people. Readers can learn about basic fish biology in the initial chapter. To learn where fishes in Pennsylvania can be found, readers can consult the chart in Chapter 2, which lists

fish species according to the major watersheds in which they have been known to occur. To identify any fish, on the water or perhaps only from a description, readers can consult Chapter 3. It includes a key to identifying Pennsylvania fishes. The book also includes a glossary of technical terms.

This book also complements other Commission education and information efforts and will be useful in the Commission's teacher training efforts.

Producing this book was a team effort. Freelance writer Linda Steiner wrote the text. Commission Art Director Ted Walke illustrated the individual fish species, provided other artwork, and designed the book. Aquatic Resource Education Manager Carl Richardson planned the project, and reviewed and contributed to the manuscript. The following Commission employees reviewed the text: Richard A. Snyder, Division of Fisheries Management Chief; Tom Greene, Coldwater Unit Leader; Robert Lorantas, Warmwater Unit Leader; Andrew L. Shiels, Nongame and Endangered Species Unit Leader; and Robert J. Weber, Coldwater Unit Technician.

Without this thorough technical review, this work would not have been published. We thank these people and all the Pennsylvania Fish & Boat Commission employees who helped make this book possible, and who ensure that Pennsylvania fishes have a place to live.

Art Michaels
Editor, Educational Media, 2000

Pennsylvania Fishes has been updated to include information and illustrations on additional common fishes of the Commonwealth including minnows, trout and salmon, sunfishes, and perches. It also provides updates to scientific names and the status of fishes in or introduced into Pennsylvania's major watersheds such as the burbot, which is now an endangered species. In addition, the index has been reorganized to help you easily find the information you need. We hope you enjoy this latest edition.

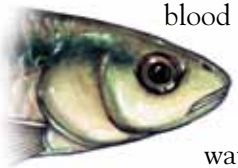
Spring Gearhart
Media Services Section Manager, 2010

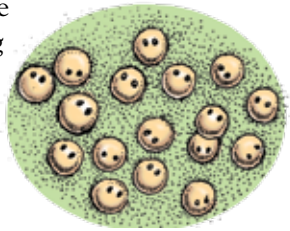
Fish Biology

What makes a fish a fish? Individual fish may look very different. Consider the flat, pan-shaped bluegill, the slender eel and the huge sturgeon. Nevertheless, all fish share some body forms, functions and habits.

Most fish are ectothermic (cold-blooded) animals that live underwater. "Ectothermic" means they tend to assume the temperature of their surroundings, instead of generating their own body heat. Most fishes have a bony backbone and skeleton. They are grouped together under the scientific class Osteichthyes. A few fish, like the lamprey, skates, sharks and rays, have a skeleton of rubbery, gristly tissue called cartilage. Instead of legs, fish have fins to help them get around in their liquid habitat. They breathe by taking up oxygen that is dissolved in the water through their gills. The gills also allow the release of waste gases, like carbon dioxide and ammonia.

What else do most fish have in common? Their skin is protected and lubricated by mucous glands. The skin is also generally covered by scales, or in a few fish, bony plates. Catfish and bullheads also have only skin and no plates or scales. Fish have a two-chambered heart and a blood circulatory system. Fish don't have eyelids, so they can't close their eyes. Their ears are all internal, with nothing showing on the outside. Most fish reproduce by laying small, round, jellylike eggs in the water. They are all adapted to living in water, a medium that is very different from the air in which we move about. Water is denser and generally colder than air, and fish must also withstand the forces of water pressure.



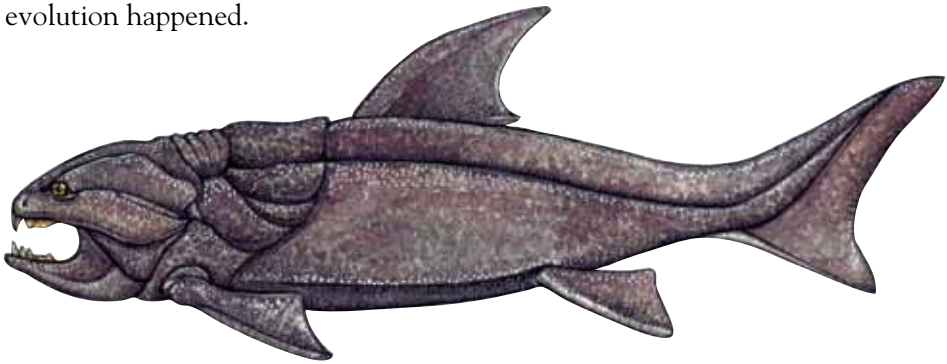


With water covering so much of the Earth, it's no surprise that fishes are found worldwide, both in the salt water of oceans and the fresh water of lakes and rivers on the continents. With so many different places in which to live, it's no wonder that so many different types of fish developed. Worldwide there are about 29,000 species of fish, grouped in 445 families. Here, in North America, there are over 800

species, which biologists have assigned, because of their similarities and differences, to nearly 40 freshwater families and about 10 marine families.

In Pennsylvania, with some 83,000 miles of streams and rivers and hundreds of lakes, there are currently over 160 species of fish in about 24 different families. The numbers are approximate because non-native fish species may be stocked or accidentally released. In addition, fish that were once present may have disappeared from the state (extirpated), or they may have become extinct. Fish species that were thought gone are also occasionally rediscovered in the state.

Fish are very old forms of life, with some species seeming to be unchanged in body form from their fossilized ancestors found in rocks hundreds of millions of years old. Other fish have changed dramatically over time, in body shape, function and probably behavior, to survive or prosper in habitats that have been altered or to take advantage of new habitat opportunities. The science of the origin of fishes, paleoichthyology, investigates the fossilized remnants of these ancient fishes to learn how this evolution happened.



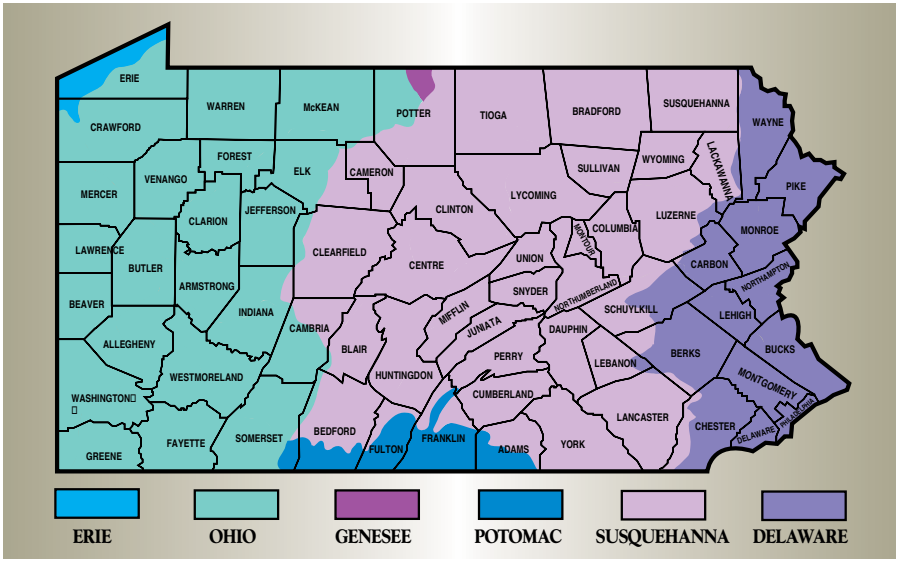
***Dunkleosteus*, 400-million-year-old prehistoric fish**

The oldest fish fossils that scientists have identified date from 425 million years ago. These fish were jawless underwater creatures, with armorlike plates covering the body. Sharks, like the prehistoric *Dunkleosteus*, appeared about 400 million years ago. Fossils show that this prehistoric fish was as big as a school bus. Bony fish are more recent in the time scale than cartilage-skeleton fish such as sharks. About 200 million years ago, the Ichthyosaur, a fishlike reptile, swam in ancient seas. By 10 million years ago, fish had developed into such forms as the sabertooth salmon, which grew to eight feet long. Fish like bass and walleyes are more modern than trout or bowfins, which retain some body characteristics that were typical of "primitive" fishes.

Fish in Pennsylvania

Pennsylvania has many different types of fish because it offers many types of aquatic conditions. Its water habitats range from deep, cold lakes to shallow, swampy lakes, to chilly, clear mountain streams, to slow-moving, warm, silty rivers. There are lots of places that fall between these habitat descriptions, plus some tidally changing waters. Some of the state's fish are similar to fish, or are also found, in Eurasia, like the northern pike and brown trout. Others are native only to North America, like the sunfishes and the catfishes.

Even if appropriate habitat exists, a fish species may not be in a lake or stream simply because it doesn't live in that watershed. When rain falls to the ground in Pennsylvania, it drains into one of six major watershed systems. In the northwest, it might flow toward Lake Erie. In most of the rest of western Pennsylvania, water flows into a tributary of the Ohio River, which feeds the Mississippi River. Most of central Pennsylvania's water empties into the Susquehanna River and its branches, which flow to the Chesapeake Bay. The smallest Pennsylvania watershed is the Genesee River, which collects water along the central part of Pennsylvania's boundary with New York state and sends it north to Lake Ontario. Along the central section of Pennsylvania's southern boundary, streams flow to the Potomac River, which eventually meets the Chesapeake Bay. Eastern Pennsylvania is in the Delaware River watershed, which opens into the Atlantic Ocean.



These watersheds flow to different destinations. Even though fish can't cross mountain tops, they can spread upstream and downstream in a watershed simply by swimming. Although Pennsylvania's watersheds share many fish, like smallmouth bass and white suckers, other fish are found only in one or two watersheds, like the johnny darter and flathead catfish. Some fish species entered new watersheds when glaciers advanced and retreated, over about a half-million years, ending about 15,000 years ago. Across northern Pennsylvania, the huge ice masses blocked and rerouted north-flowing streams and sometimes added their flow to already south-going rivers, mixing the fish life. The Allegheny River and its tributaries in northwestern Pennsylvania have a diverse aquatic community because the glaciers changed the state's landscape and redirected those streams and the species of fish that lived there.

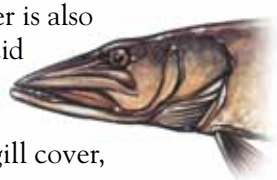
Life in Water

External fish anatomy

A fish's outside appearance can reveal a lot about where and how it lives. The shape, color and form of parts of a fish's body, its external anatomy, suit it to its habitat and its feeding methods. Some fish bodies are laterally compressed. That is, when the fish is viewed head on, it's narrow side to side. Others are dorsally compressed, which means they're more flat top to bottom. Others may be roundish in shape, viewed from the front, or somewhere between these extremes. When viewed from the side, some fish are long and slender. Others appear blocky or circular-shaped in the body, like the pan-shaped sunfish.

Most fish have the same basic parts. Except in the eels and lampreys, which are slender their whole length, fish have a definite head portion and a longer, wider body section, and they narrow to a tail. They have a mouth, which may range in size and shape from large-jawed with strong teeth, as in the walleye; toothless and capable of being extended for "vacuuming" small food items from the bottom, like suckers; or even a round, jawless disk for attaching to a host fish, like some lampreys. The snout has nasal openings, or nares, to let them sample the chemical "odors" in the water. The eye is usually on the upper portion of the side of the head.

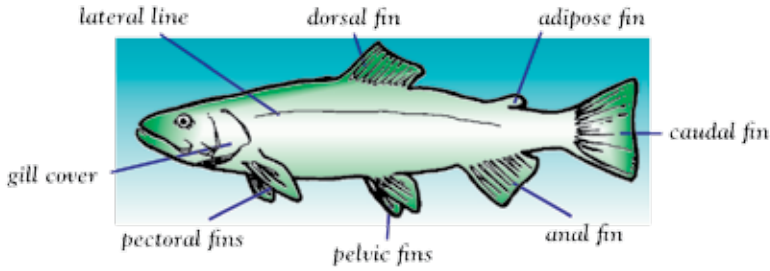
Most fish have a flat cheek area behind the eye and jaw, and a flap behind that, which covers the gills, called the operculum. The presence or absence of scales on the cheek and/or the gill cover is also often used in determining the difference among Esocid (pike family) species.



Along the back, at the end of the tail, on the undersides and just behind the lower portion of the gill cover,

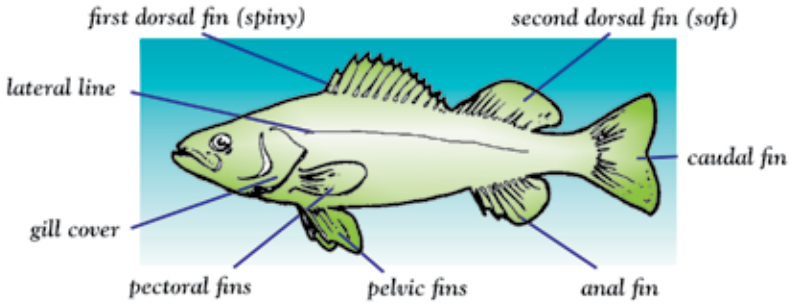
most fish have fins. How many there are, their length, location and shape, vary greatly among fish families and species. Some fish, like the perch, have distinct, well-developed, separated fins. Other fish, like the eel, have a long, continuous fin curving around their length from top to bottom.

Soft-Rayed Fish *(Trout)*



The fin or fins along a fish's back are called the dorsal fin. This may start just behind the head, as in the darters, or it might be positioned far back on the body, as in the pikes. There may be one or two dorsal fins, the second either widely separately or close against the first, along the back toward the tail. Some fish, like trout, have a small, fleshy or fatty lobe that grows from the back behind the dorsal fin, which is called the adipose fin. The fish's tail is finished off by the tail fin, or caudal fin. Fish show many different forms of caudal fins, from small and roundish to large with long, pointy lobes, and many shapes in between.

Spiny-Rayed Fish *(Yellow Perch)*



On the underside of the fish's body, in front of the tail, is a rudderlike fin called the anal fin. Farther forward along the belly is generally a pair of small fins called the pelvic fins. And on each side of the fish, usually just behind the lower part of the gill cover, is a fin called the pectoral fin.

Fins are supported by filaments called rays. Rays can also spread out, saillike, or draw in a fish's fins. In some fish, like trout and pickerel, all of the rays on all of the fins are soft, so these are called soft-rayed fish. Rays can also be hard, spiny and sharp, as in the bullheads and sunfish, which are called spiny-rayed fish. Counting the number of spiny rays and noting their position can be helpful in identifying which fish is which. When present, spiny rays are usually in the first dorsal and/or the front edge of the pectoral, pelvic and anal fins, and can inflict pain if the fish is handled carelessly.

A fish's skin may be naked, but most often it is covered with thin, fingernaillike, roundish, overlapping scales. Scales may be large and coinlike, as in the carp, or embedded in the skin and easy to overlook, as in the brook trout. The scales of soft-rayed fish are roundish, cycloid and smooth, which give the fish a slick feeling. Spiny-rayed fish have ctenoid scales, which have tiny "teeth," and give these fish a rough feel. Scales can also be diamond-shaped, called "rhombic," as in the gars. Instead of scales, primitive fish like sharks and sturgeons have bony plates, especially on the head.

Pigment cells give the fish's skin its color and pattern. These can be intensified or reduced by the nervous system in response to the fish's environment or hormonal changes. Salmon, for instance, "color up" in spawning season. Their colors fade and their scales just reflect and refract the light in silver and rainbow tints when they are in deep, open water. Some fish are colored in patterns that hide or camouflage them in their surroundings, like the pickerel in its weed beds. Others have markings that advertise which sex they are, like the male bowfin's dark spot at the base of the tail.

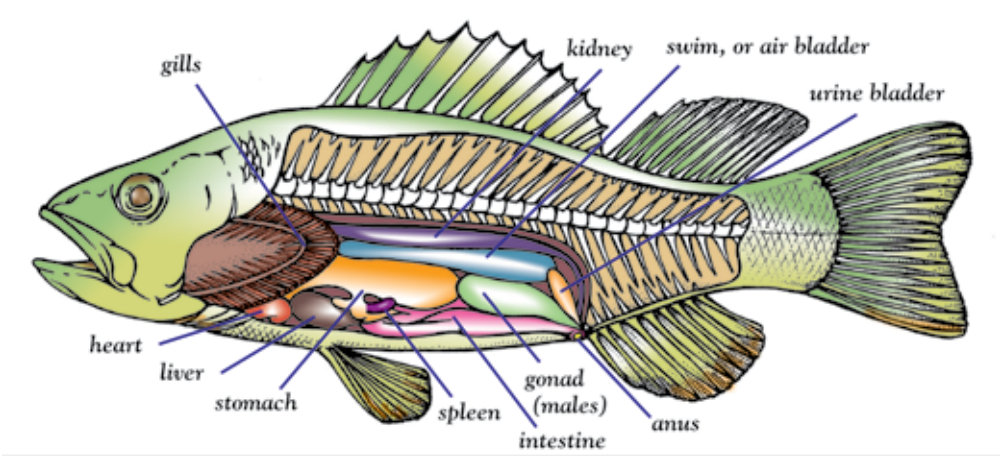
Many fish have an interrupted line marking, often visible on the skin, that runs along the middle of the side, from head to tail, called the lateral line. This is actually a sense organ that detects vibrations and changes in water pressure. A slimy covering, produced by glands in the skin and called mucous, helps to protect the fish against disease and scrapes. A fish's skin may also have poison glands, as in the madtoms.

Internal fish anatomy

Internally, bony fish have some organs that are like our own, and some that are not. Yet, we share most of the basic animal body functions. From head to tail, bony fish have a spinal cord encased in a backbone, and a skeleton that consists of a row of thin, flattish bones above the backbone, supporting the muscles and giving the fish's body shape. Below the backbone, protecting and making room for the fish's internal organs, the row of bones is paired and curved, forming a rib cage. A row of single bones completes the skeleton behind the ribs and below the backbone in the tail. Fish bones are shaped like a curve. In others, single bones branch into "Ys," which branch into even smaller "Ys," as in suckers and shad.

Fish have a brain, a two-chambered heart that is small for their size, a closed circulatory system, digestive and elimination system, liver, kidneys, pancreas and reproductive organs such as ovaries and testes, much like other more advanced animals. Most also have an internal air-filled sac, called an air bladder, which helps the fish maintain and adjust its position in the water, providing it with neutral buoyancy, so that it can suspend itself and not sink. The air bladder also aids in hearing by intensifying sound, and in some fishes it is used as a sort of "lung," for gulping air above the water's surface.

Gills are the organ fish use to "breathe." This process is different from that of land animals, although the result is the same. The gills take in life-giving oxygen and remove waste gases, like carbon dioxide. The gills



consist of blood-filled filaments with lamellae, which look like teeth on a comb, supported by bony arches. The lamellae are covered with a single layer of cells and have a large network of tiny blood vessels. This is where the gas exchange takes place. Fish take in water by opening the mouth, allowing water to pass over the gill filaments, and out through the opening of the gill flap. It's a one-way trip, so the fish doesn't "breathe" in and out, as people do. Some fish, like trout, need lots of oxygen. Because more oxygen can be dissolved in cold water, that's where trout live. Other fish, like carp, can live in warm, silty water, because they don't require as much oxygen. In the breathing function, a fish's mouth works as our noses work. A fish can open its mouth to take in oxygenated water to flow across its gills, without opening its throat to swallow.

Fish movement

A bluegill waves its fins as it moves slightly up and down, back and forth, deciding whether to take a bait or lure. This is proof any angler can see that fins are made for fine adjustments. But when the fish decides to swim away, it's the muscles of the fish's body that produce that strong, swift motion. If the skin is stripped away, the fish's body muscles can be seen following one another as thin, W-shaped segments from head to tail. The muscle segments contract in succession, first along one side and then along the other, so the fish swims by pushing against the water side to side. The tail fin adds an extra kick. The other fins aid in balance. The dorsal, anal and caudal fins act as rudders. The pelvic and pectoral fins help in turning, as a banking airplane. The pelvic and pectoral fins can also be spread against the forward motion of the fish, to "put on the brakes," or they can be folded against the body, to streamline the fish when it wants to swim fast. Fish with air bladders can move easiest up and down in the water, or keep their position in the water column. Fish without air bladders have to dart from place to place along the bottom, like the darters, because they are heavier than water and sink.

Water temperature and fish

Habitat influences the species and numbers of fish found in a waterway. If the habitat meets a fish's needs, it can survive there. If the habitat doesn't meet the fish's needs, it won't be found there. One very important habitat factor is water temperature. The temperature of a waterway is determined by many variables. Water temperature is influenced by the time of year, the amount of sunlight reaching the water, the amount and speed of the water (flowing water and currents), the source of the water (springs or runoff), and the amount of material suspended in the water.

Fish can't maintain their body temperature at a constant level as humans and other warm-blooded animals can. They are what biologists call "ectotherms." The temperature of their surroundings influences their body temperature and bodily functions. This is why water temperature is such an important habitat factor for fish.

Each fish species has a specific range of water temperatures in which it can live. If the water is outside that range, it can't survive. Within that range is a narrower range of temperatures. This is called a fish's "preferred temperature." Fish can live, grow and reproduce when they are within their preferred temperature range. The preferred temperatures are ideal for the fish's survival.

Biologists group fish with similar temperature preferences into three groups: Cold, cool and warm. Fish in a group often have other similar habitat needs. The groups do overlap, however. They overlap because temperature preferences among groups overlap. The habitats where they

Temperature and Fish Communities

COLDWATER FISHES

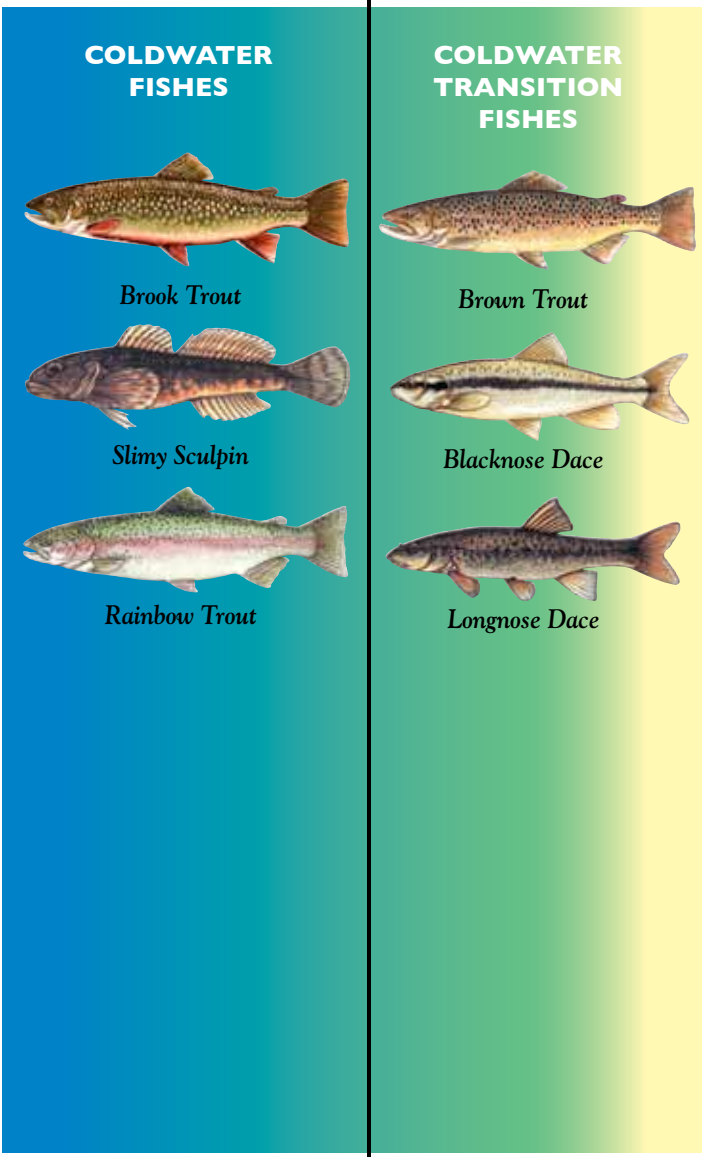
Group of fishes that thrives and reproduces in water temperatures less than 70 degrees. The preferred temperature range for these fishes is between 50 and 65 degrees.

COOLWATER FISHES

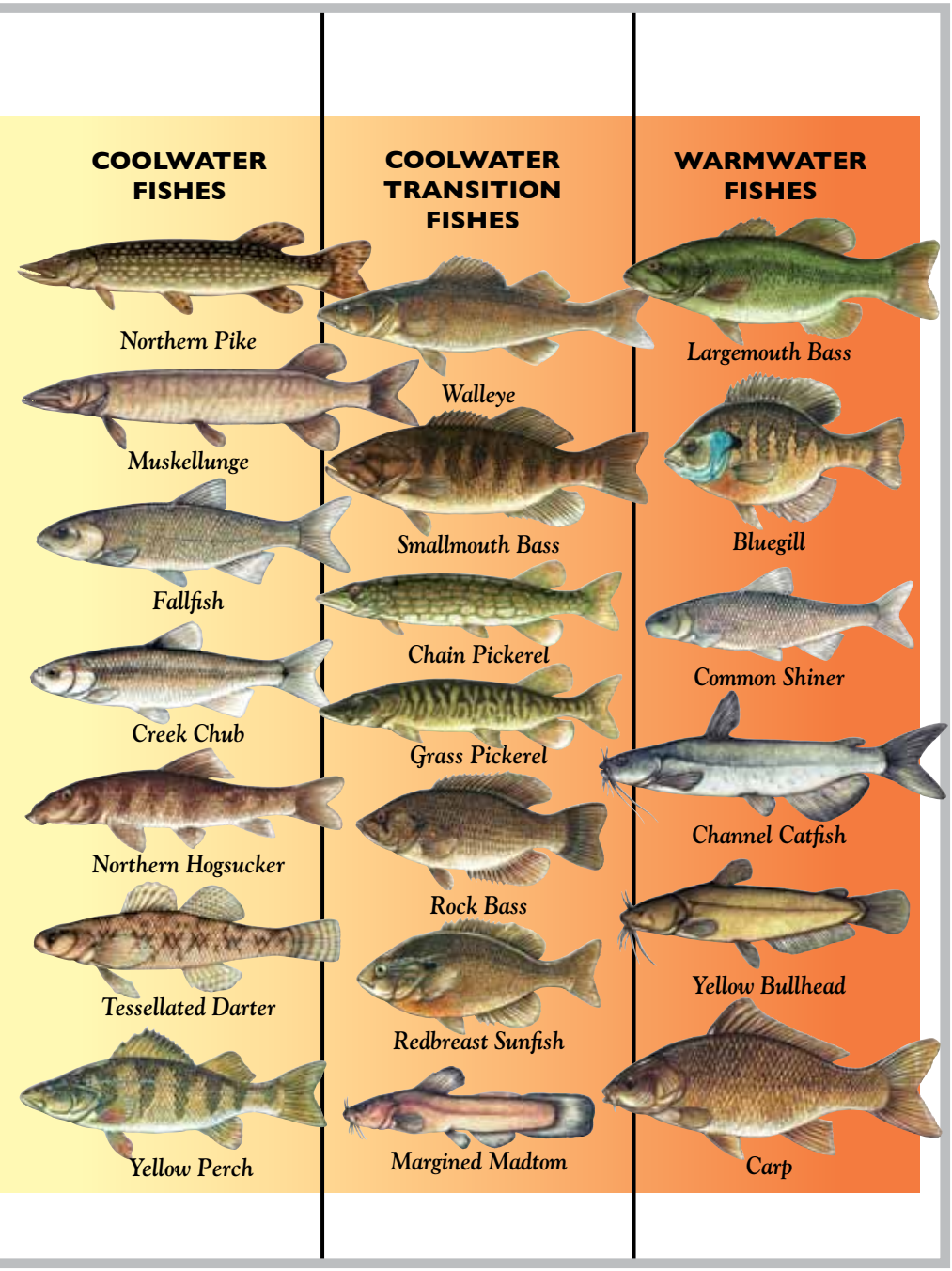
Group of fishes that thrives and reproduces in water temperatures less than 80 degrees but warmer than 60 degrees. The preferred temperature range for these fishes is between 65 and 70 degrees.

WARMWATER FISHES

Group of fishes that thrives and reproduces in water temperatures warmer than 80 degrees. The preferred temperature range for these fishes is between 70 and 85 degrees.



overlap are called "transition waters." Transition waters may be ideal for one group, but not for both. Brown trout, for example, are considered coldwater fish. However, they can tolerate warmer water than brook trout.



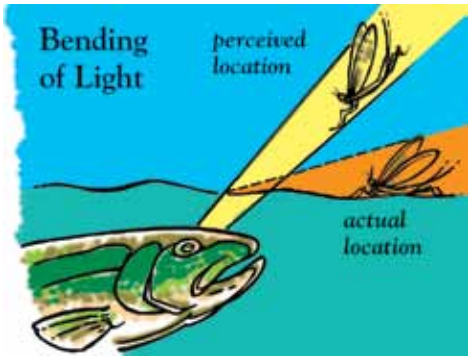
Because they can tolerate higher water temperatures, they may be found with coolwater fish and in transition waters.

Senses

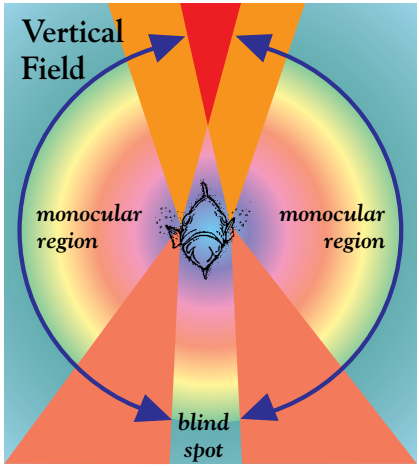
Sight

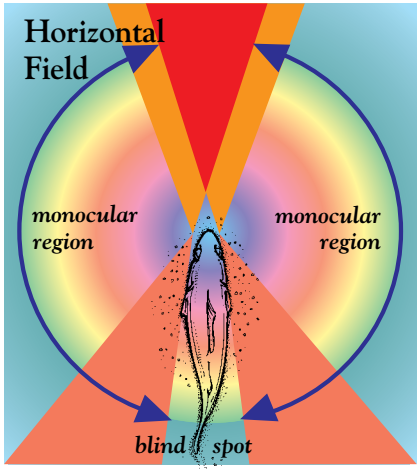
Although made to work underwater, fish eyes have a lot of similarities to ours. Fish eyes and human eyes work like a camera and lens. They also have differences, such as no eyelid (fish do sleep, but they don't have to close their eyes) or tear ducts (a fish's eyes are always moisturized). Fish don't have an iris like ours that contracts and expands to regulate light. To focus, the fish has a lens in its eye that moves back and forth.

In addition, fish that have to look for food or danger at or above the surface have to deal with a property of light called refraction. Light bends when it goes from air to denser water, or vice versa, so a mayfly at the surface or a fisherman on a bank appears higher than it really is. This idea is like seeing around a corner, which is why an angler should stay low when approaching fish in clear, shallow water. Generally, if you can see the fish, the fish can see you.



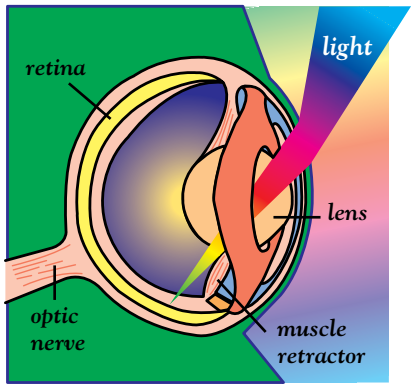
Fish have both binocular and monocular vision. With eyes on the sides of the head, they can see in nearly all directions, except for small blind spots directly in front and in back of them. Because most fish in flowing water face upstream, watching for incoming food, an angler





approaching from downstream of the fish has less chance of being seen. Where the area of the fish eyes' vision overlaps, a narrow cone of about 30 degrees in front and above its snout, the fish can see in three dimensions. This binocular vision helps it judge the distance to something like drifting food or a baited hook. But the fish's monocular vision, when just one eye is looking more directly at an object, is best. Fish are near-sighted and see best close-up, which is why they may move up to an angler's fly and look it over with just one eye.

Biologists believe freshwater fish see in color and can tell the difference between bright and dark. Fish are thought to have three sets of light-sensitive cells, called cones, in each eye, which can detect colors and even ultraviolet light (which we can't). Fish eyes also have rods, cells that are especially good at detecting movement and seeing contrast. Some fish, like walleyes, have a reflective layer in their eyes that helps them see better in the dark or in cloudy water. When fish take a black lure at night, they are seeing the solid lure's outline against the lighter sky above.

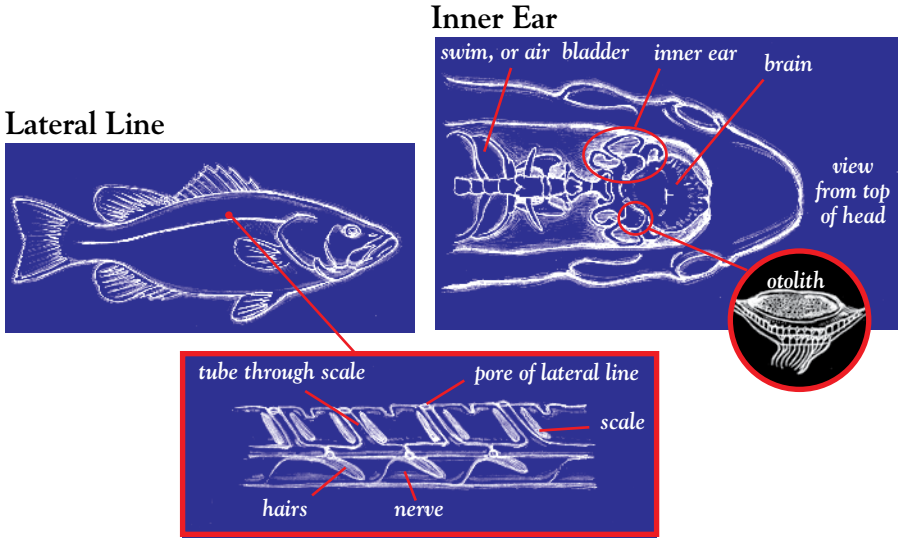


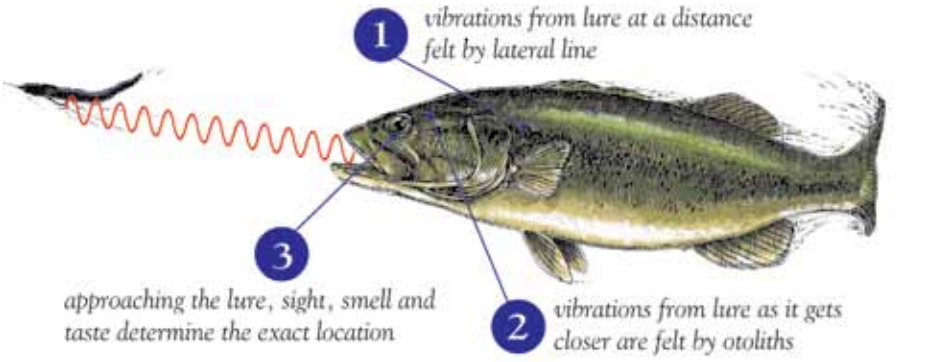
As light penetrates ever-deeper water, it loses its color, red first. Yellow, white and bright lime-green stay visible in deep water and are popular lure colors for anglers after deep or bottom-dwelling fish.

Hearing

Inexperienced boat anglers are often told to sit still and be quiet, because they'll scare the fish. There is some truth to this, not just because the fidgeting gets on the other fisherman's nerves. Sound waves travel in water, especially low-frequency waves, and fish do have ears. The ears are internal, one inner ear on each side of the fish's brain. The inner ear receives and interprets sounds and helps the fish maintain its balance. Solid ear bones, called otoliths, are surrounded by a fluid-filled sac that is lined with tiny hairs. The sound waves penetrate the fish's body and vibrate the otoliths, which stimulate the hairs and attached nerves and send the signal to the brain. The air bladder can also work as a resonating chamber in intensifying sounds.

Fish also "hear" with the lateral line. Most fish have a line of tiny pores, which are openings to tubes, running from the head to the tail along their sides. This is the lateral line. The tubes go through the scales to a large nerve. The fish receives sound waves or low-frequency vibrations, like an oar bumped against the side of a boat, along the length of its lateral

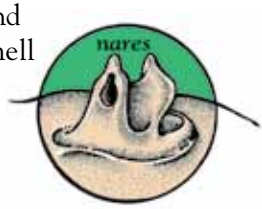


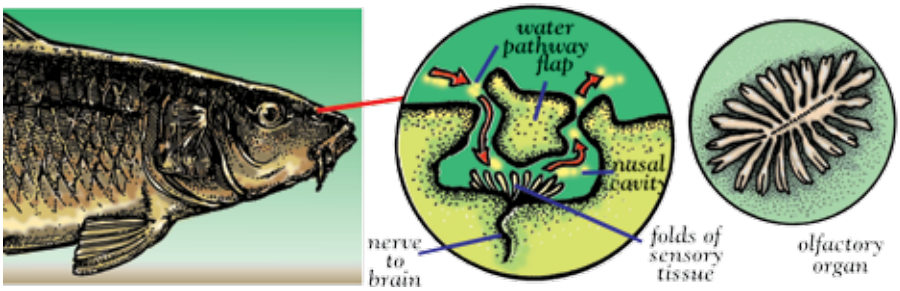


line. Fish can tell with great accuracy where the "noise" or disturbance is coming from. The sense in the lateral line has also been called "faraway touch," and helps schooling fish move together. The lateral line sense works best for the fish when the vibrations are coming to it from far away. Actual hearing with the ears takes over when the object sending the waves is close by and the sounds are of a higher frequency.

Smell and taste

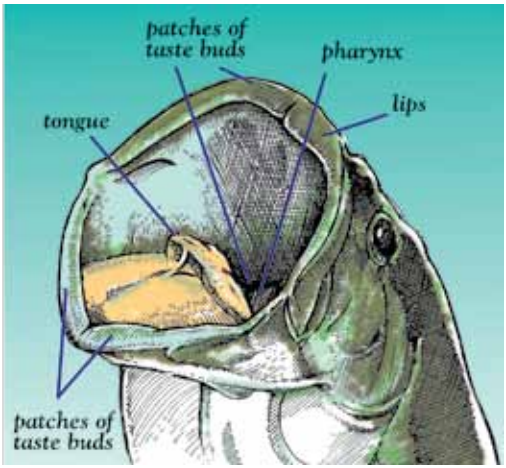
Fish live in a world of dissolved chemicals, scents and tastes from the rocks and aquatic vegetation, the stonefly nymphs and minnows, even a fisherman's hip boots. The senses of smell and taste detect and interpret these chemicals. Smell is something like tasting at a distance. Fish have nostrils, called nares, on either side of the snout. Water flowing through the nares circulates to the fish's olfactory, or





smelling, organ. Nerves in that organ transmit signals that the brain reads. Some fish have extremely sensitive scenting abilities, detecting concentrations as low as one part in one trillion. Salmon are famous for the ability to scent out the stream in which they were born, from all the streams along a coastline, returning to just that one tributary to spawn.

Fish have taste buds, more than 10,000, not only in the mouth and on the tongue, but on the lips and deep inside the mouth. Catfish can even taste through the skin and barbels, because taste buds are also located there. Some fish feed mostly by sight, like northern pike. Others, like carp and catfish, rely heavily on scent and taste to find food. This is why strong-smelling baits work for these fish. Not coincidentally, carp and catfish find food in silty water without much visibility. Sight-feeding fish tend to live only in clear water. Fish have well-developed tastes for sourness, bitterness and salt, but many are insensitive to sweetness.

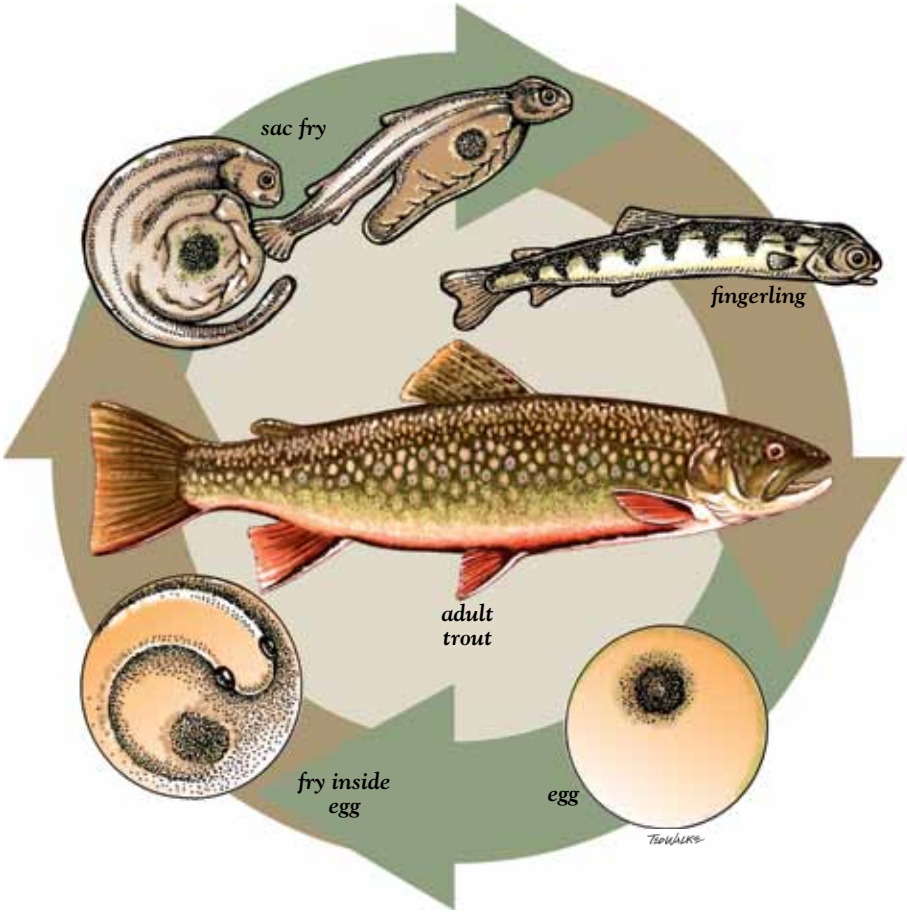


Reproduction

How adult fish produce a new generation is basically the same as in the other higher animals: The female produces eggs in her ovaries and the male produces sperm in the testes. The two combine to produce a new individual, containing genetic material from both parents. Many fish species are live-bearers. However, no live-bearing fish live in Pennsylvania waters.

Most fish use external fertilization, in which the eggs or sperm are released from the fish's vent, near its anal fin, into the water. Eggs and sperm mix, and new fish life begins. The embryo grows larger as cells in

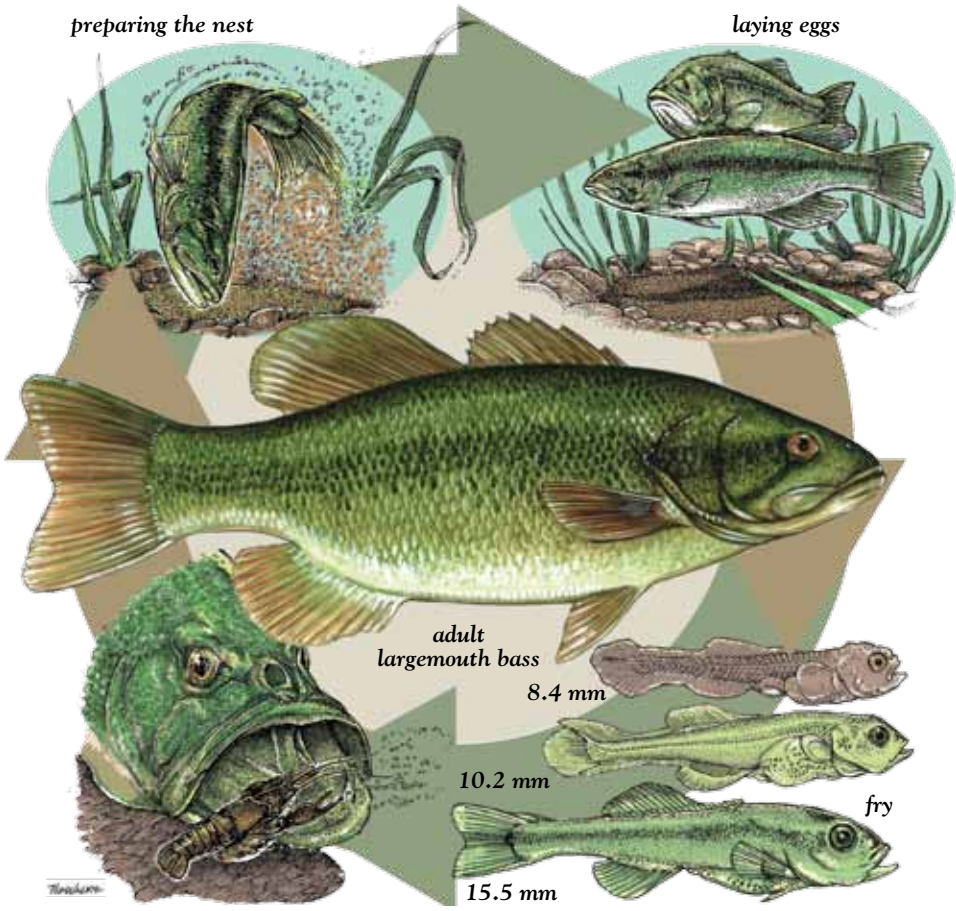
Brook Trout



the fertilized egg divide, and a tiny fish develops inside the small sphere. After a time–a shorter period in warm water, a longer time in cold water– the rubbery, thin egg "shell" splits and the baby fish emerges. Now called a "sac fry," because its underbelly is swollen by a nourishing yolk sac, the young fish gradually uses up its food supply and then strikes out on its own. Eventually, if it is lucky, and good at getting food and keeping from being eaten itself, it will spawn another generation of its kind.

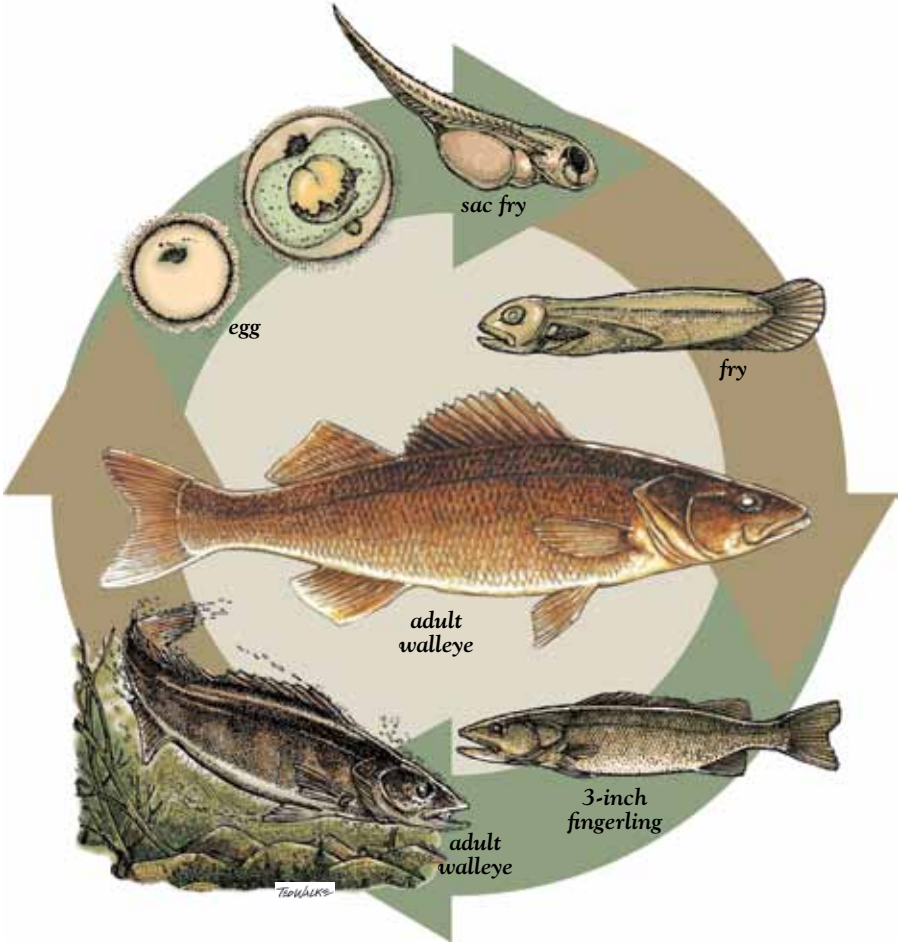
Before the adult male and female fish spawn, there is often preparation. In some species there is a journey, a spawning migration, to reach the proper water flow, depth, temperature and/or bottom structure, like

Largemouth Bass



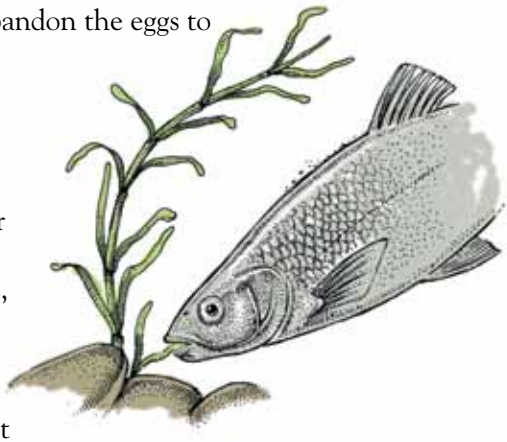
gravel or weeds. Some migrations are short, the fish traveling just to the shallow riffle above the creek hole in which it spends its whole life. Other fish, like American shad and striped bass, swim many miles through the ocean and upriver to reach their spawning grounds. Fish often engage in a courtship between potential spawning partners, swimming against each other, nipping each other, or engaging in other activity. In some fish, such as American shad, one of the sexes reaches the spawning grounds before the other, and anglers might notice schools that are all males or all females. Many female fish release eggs during the spawning season with several males, which diversifies the gene combinations.

Walleye



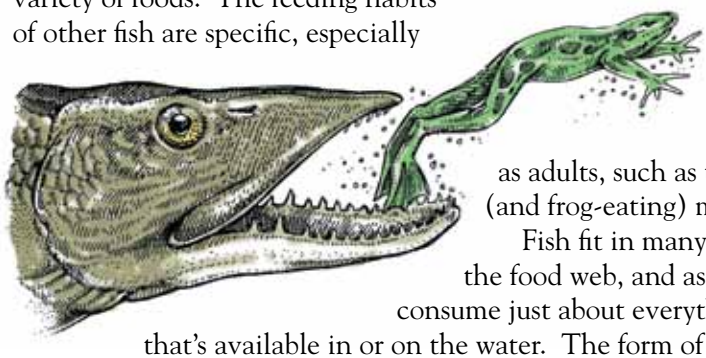
Exactly where and how fertilized eggs are distributed depends on the fish species. Some take no care at all of their eggs, except perhaps to release them over a suitable bottom for that type of fish, like rock rubble or sunken woody debris. Most fish eggs are sticky, so they adhere where they settle, giving them protection from washing away. Some fish simply release eggs and milt into the water column, allowing the fertilized eggs to drift downstream. These are called random spawners, and they usually produce great numbers of eggs, but suffer a high mortality among their young. Other fish expend much energy in constructing nests for their eggs. The nests can range from dishlike depressions that are cleared in the bottom by the male's fins, to piles of gravel that the fish carries to the nest site, piece by piece, with its mouth. Eggs may also be placed on the underside of rocks or in holes in stream banks.

Depending on the species, the eggs and emerging young fish may or may not be guarded by a parent fish, usually the male. Some fish, like largemouth bass, sunfish and catfish, are vigorous at tending their nests and eggs, chasing away other fish and picking up and removing items that fall onto their nest areas. Many other fish, such as trout and American shad, once they have spawned, abandon the eggs to develop on their own.



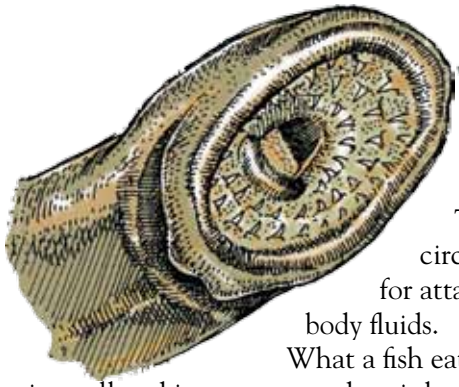
Feeding

It's true that big fish eat little fish, and that little fish eat smaller fish in turn. But fish species also eat algae and other plants, insects, mollusks and crustaceans. They also consume organic bottom material and even eat birds and small mammals that happen to get into the water. Some fish, like bullheads, are generalists, consuming a wide variety of foods. The feeding habits of other fish are specific, especially



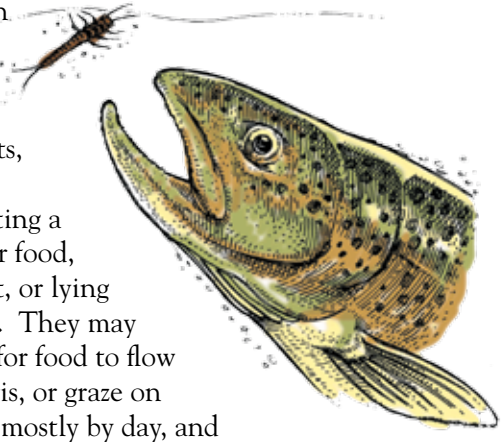
as adults, such as the fish-eating (and frog-eating) muskellunge.

Fish fit in many places on the food web, and as a group may consume just about everything edible that's available in or on the water. The form of a fish's body, especially its mouth, is suited for obtaining the foods it prefers. Some fish have toothless mouths that distend to form a sort of sucking tube, by which they can "vacuum" up their food. Some use their heavy snouts for turning over rocks to gobble up what's underneath. Many have toothy jaws and catch other fish and larger aquatic life. Some strain microscopic animal and plant organisms, called plankton, from the water with hundreds of closely spaced gill rakers. Even fish that don't seem to have teeth have toothlike structures in the throat, called pharyngeal teeth, which grind food against a horny pad.



Lampreys are classed as jawless fishes. They have an oral opening that is a circular sucking disk, with rasping teeth, for attaching to and feeding on a host fish's body fluids.

What a fish eats may also change from when the fish is small and immature to when it becomes a full-sized adult. Many fish begin life as plankton-eaters. Then they switch to eating small aquatic insects and other underwater invertebrates and small fish. Then they progress to eating larger insects, crustaceans and fish.



Fish use many methods for getting a full stomach, actively hunting their food, chasing or stalking and attacking it, or lying in wait and striking at passing prey. They may hang about in the current waiting for food to flow to them, root it out of bottom debris, or graze on underwater plants. Some fish feed mostly by day, and are called diurnal feeders, like bluegills. Others feed mainly at night. They are nocturnal feeders like walleyes. But most fish actively feed in the lower light hours around dawn and near sunset, and that's generally when fishing's best.

Behavior

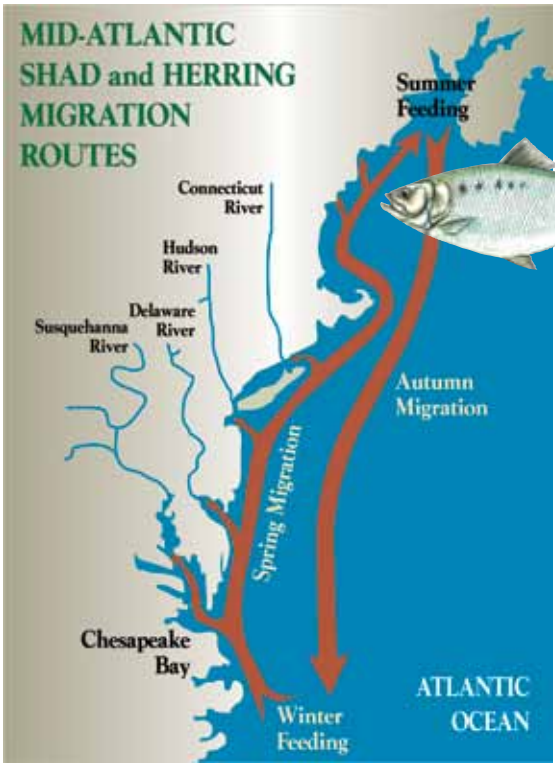
What affects a fish's behavior? What makes it do something other than just go about its daily round of eating and trying to keep from being eaten? The rhythm of the seasons is one of the biggest influences on both the fish and their watery home. Fish may change their location in their home water, whether stream, river, pond or lake, with the season. This movement is a response to the water's warming and cooling, as the fish tries to stay in the temperature range that it is most suited to, and as it seeks out or follows food sources. So not only "structured" habitat influences where a fish is found. Thermal habitat also influences its location.

There may be winter and summer migrations, either to different places in the home water, such as off the mouth of tributary streams or near springs, or to different depths in the water column. In winter, the

warmest waters are generally on the bottom. In summer, the coolest waters are there. In spring and fall, there is a mixing of these water layers as the temperature becomes more uniform, and fish that had been found deep, for instance, may be found shallow as well.

When the water becomes too warm or too cold, and a fish can't get away, the fish's activity level decreases. Water that's too warm is more stressful on a fish's body than water that's too cold. In summer, some fish, like brown trout, switch to being mainly nocturnal, night-feeders, to avoid the effects of heat. They spend the daytime in deep water or they hide in shade under stream rocks and boulders. In spring, fall and winter, fish that would normally be active in early morning or toward evening when the water is warm, may be seen feeding during the sunlit middle of the day. They may also be in shallower water than usual, where they can take advantage of the sun's warmth.

Fish change their behavior as the seasons roll around to years, and they become old enough to feel the spawning urge. That, too, makes them leave their usual haunts and travel, or it makes them become aggressive toward, or associate more with, their own kind. Spawning time may even mean a change in the type of water in which a fish lives. Some fish, like salmon and shad, begin their life in fresh water and travel to salt water when still quite young and small. They grow up and spend most of their lives in the ocean. These anadromous fish return as adults, on a migratory run, upstream to flowing fresh water to spawn, and become available to inland fishermen. Other fish, like eels, are catadromous. They live as adults in inland freshwater streams and go to the ocean to reproduce.



Pennsylvania Species by Watersheds

This table lists most Pennsylvania fishes occurring naturally in or introduced into Pennsylvania's major watershed systems. Listings denote any known occurrence.

Status

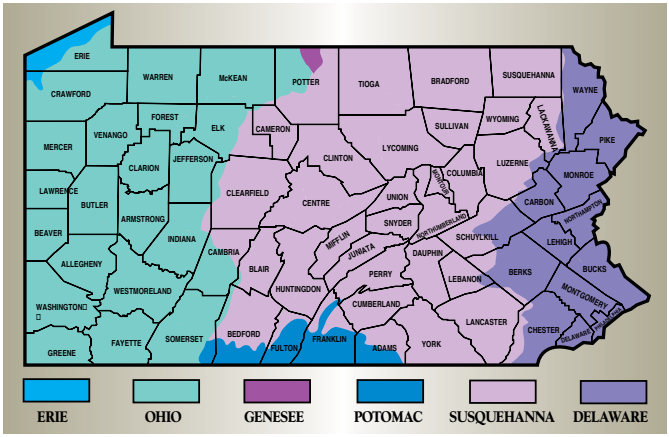
EN = Endangered
TH = Threatened
C = Candidate
EX = Believed extirpated
DL = Delisted *(removed from the endangered, threatened, or candidate species list due to significant expansion of range and abundance)*

ENDANGERED
THREATENED
CANDIDATE
EXTIRPATED

watershed indications are historical occurrences

= icons indicate family is included in this publication

* = Aquatic Invasive Species



Watersheds

E = Lake Erie
O = Ohio River
G = Genesee River
P = Potomac River
S = Susquehanna River
D = Delaware River

Watershed Status

I = Introduced
N = Native
X = Present in drainage, status uncertain at this time

SPECIES	PAGE	STATUS	WATERSHEDS E	O	G	P	S	D
Lampreys (Family Petromyzontidae)	**32**							
Ohio Lamprey (*Ichthyomyzon bdellium*)	32	C		N				
Northern Brook Lamprey (*Ichthyomyzon fossor*)	32	EN	N					
Mountain Brook Lamprey (*Ichthyomyzon greeleyi*)	32	TH		N				
Silver Lamprey (*Ichthyomyzon unicuspis*)			N					
Least Brook Lamprey (*Lampetra aepyptera*)	33	C		N			N	
American Brook Lamprey (*Lethenteron appendix*)	33	DL	N	N	N			N
Sea Lamprey* (*Petromyzon marinus*)	33		I				N	N

	SPECIES	PAGE	STATUS	WATERSHEDS E	O	G	P	S	D
	**Sturgeons (Family Acipenseridae)**	**35**							
	Shortnose Sturgeon (*Acipenser brevirostrum*)	35	EN						N
	Lake Sturgeon (*Acipenser fulvescens*)	36	EN	N	N				
	Atlantic Sturgeon (*Acipenser oxyrhynchus*)	36	EN					N	N
	Shovelnose Sturgeon (*Scaphirhynchus platorynchus*)		EX		N				
	**Paddlefishes (Family Polyodontidae)**	**38**							
	Paddlefish (*Polyodon spathula*)	38		N	N				
	**Gars (Family Lepisosteidae)**	**40**							
	Spotted Gar (*Lepisosteus oculatus*)	40	EN	N					
	Longnose Gar (*Lepisosteus osseus*)	41	DL	N	N			N	N
	Shortnose Gar (*Lepisosteus platostomus*)		EX		N				
	**Bowfins (Family Amiidae)**	**42**							
	Bowfin (*Amia calva*)	42	C	N	N			N	N
	Mooneyes (Family Hiodontidae)								
	Goldeye (*Hiodon alosoides*)		EX		N				
	Mooneye (*Hiodon tergisus*)		DL	N	N				
	Tenpounders (Family Elopidae)								
	Lady Fish (*Elops saurus*)								N
	**Freshwater Eels (Family Anguillidae)**	**44**							
	American Eel (*Anguilla rostrata*)	44			N		N	N	N
	Anchovies (Family Engraulidae)								
	Bay Anchovy (*Anchoa michilli*)								N
	**Herrings (Family Clupeidae)**	**46**							
	Blueback Herring (*Alosa aestivalis*)	47							N
	Skipjack Herring (*Alosa chrysochloris*)	46	DL		N				
	Hickory Shad (*Alosa mediocris*)	48	EN						N
	Alewife (*Alosa pseudoharengus*)	49		I				N	N
	American Shad (*Alosa sapidissima*)	51						N	N
	Atlantic Menhaden (*Brevoortia tyrannus*)								N
	Gizzard Shad (*Dorosoma cepedianum*)	54		N	N			N	N
	**Carps and Minnows (Family Cyprinidae)**	**56**							
	Central Stoneroller (*Campostoma anomalum*)	73		N	N	N	N	N	N
	Goldfish (*Carassius auratus*)			I	I		I	I	I
	Northern Redbelly Dace (*Chrosomus eos*)		EN		N			N	
	Southern Redbelly Dace (*Chrosomus erythrogaster*)		TH	N	N				
	Mountain Redbelly Dace (*Chrosomus oreas*)							I	
	Redside Dace (*Clinostomus elongatus*)			N	N	N		X	
	Rosyside Dace (*Clinostomus funduloides*)						N	N	N
	Grass Carp (*Ctenopharyngodon idella*)	61		I	I	I	I	I	I
	Satinfin Shiner (*Cyprinella analostana*)	58					N	N	N
	Spotfin Shiner (*Cyprinella spiloptera*)	58/73		N	N		N	N	N
	Steelcolor Shiner (*Cyprinella whipplei*)				N				
	Common Carp (*Cyprinus carpio*)	63		I	I		I	I	I
	Gravel Chub (*Erimystax x-punctatus*)	56	EN		N				
	Streamline Chub (*Erimystax dissimilis*)				N				
	Tonguetied Minnow (*Exoglossum laurae*)				N	N			
	Cutlips Minnow (*Exoglossum maxillingua*)	57					N	N	N
	Brassy Minnow (*Hybognathus hankinsoni*)				X				
	Eastern Silvery Minnow (*Hybognathus regius*)						N	N	N
	Bigeye Chub (*Hybopsis amblops*)			N	N				
	Bigmouth Shiner (*Hybopsis dorsalis*)		TH		N				
	Ide (*Leuciscus idus*)							I	I
	Striped Shiner (*Luxilus chrysocephalus*)	58		N	N				
	Common Shiner (*Luxilus cornutus*)	6s4		N	N	N	N	N	N

SPECIES	PAGE	STATUS	WATERSHEDS E	O	G	P	S	D
Redfin Shiner (*Lythrurus umbratilis*)	58	EN	N	N				
Silver Chub (*Macrhybopsis storeriana*)		DL	N	N				
Allegheny Pearl Dace (*Margariscus margarita*)	60		N	N	N	N	N	N
Hornyhead Chub (*Nocomis biguttatus*)	60/73	C	N	N				
River Chub (*Nocomis micropogon*)	65		N	N		N	N	I
Golden Shiner (*Notemigonus crysoleucas*)	66		N	N		N	N	N
Comely Shiner (*Notropis amoenus*)	58					N	N	N
Popeye Shiner (*Notropis ariommus*)	58	EX		N				
Emerald Shiner (*Notropis atherinoides*)	58		N	N				
Bridle Shiner (*Notropis bifrenatus*)	58	EN					X	N
River Shiner (*Notropis blennius*)	58	EN		N				
Silverjaw Minnow (*Notropis buccatus*)			N	N		N	N	
Ghost Shiner (*Notropis buchanani*)	58	EN		N				
Ironcolor Shiner (*Notropis chalybaeus*)	58	EN						N
Blackchin Shiner (*Notropis heterodon*)	58	EN	N	N				
Blacknose Shiner (*Notropis heterolepis*)			N	N				
Spottail Shiner (*Notropis hudsonius*)	58		N	I		N	N	N
Silver Shiner (*Notropis photogenus*)	58		N	N				
Swallowtail Shiner (*Notropis procne*)	58						N	N
Rosyface Shiner (*Notropis rubellus*)	58		N	N		N	N	I
Sand Shiner (*Notropis stramineus*)	58		N	N				
Mimic Shiner (*Notropis volucellus*)	58		N	N	N		I	
Channel Shiner (*Notropis wickliffi*)				N				
Pugnose Minnow (*Opsopoeodus emiliae*)				X				
Bluntnose Minnow (*Pimephales notatus*)	56		N	N	N	I	N	N
Fathead Minnow (*Pimephales promelas*)	68		N	N	N	I	I	I
Bullhead Minnow (*Pimephales vigilax*)		EX		N				
Blacknose Dace (*Rhinichthys atratulus*)	69		N	N	N	N	N	N
Longnose Dace (*Rhinichthys cataractae*)	70		N	N	N	N	N	N
Rudd* (*Scardinius erythrophthalmus*)			I	I			I	
Creek Chub (*Semotilus atromaculatus*)	71		N	N	N	N	N	N
Fallfish (*Semotilus corporalis*)	72			I		N	N	N
Suckers (Family Catostomidae)	**74**							
River Carpsucker (*Carpiodes carpio*)				N				
Quillback (*Carpiodes cyprinus*)	75		N	N			N	N
Highfin Carpsucker (*Carpiodes velifer*)		EX		N				
Longnose Sucker (*Catostomus catostomus*)		EN	N	N				
White Sucker (*Catostomus commersonii*)	76		N	N	N	N	N	N
Blue Sucker (*Cycleptus elongatus*)		EX		N				
Eastern Creek Chubsucker (*Erimyzon oblongus*)	74					N	N	N
Lake Chubsucker (*Erimyzon sucetta*)		EX	N					
Northern Hogsucker (*Hypentelium nigricans*)	77		N	N	N	N	N	X
Smallmouth Buffalo (*Ictiobus bubalus*)		DL	N	N				
Bigmouth Buffalo (*Ictiobus cyprinellus*)		EN	N	N				
Black Buffalo (*Ictiobus niger*)				N				
Spotted Sucker (*Minytrema melanops*)		TH	N	N				
Silver Redhorse (*Moxostoma anisurum*)	79		N	N				
Smallmouth Redhorse (*Moxostoma breviceps*)				N				
River Redhorse (*Moxostoma carinatum*)	79	DL		N				
Black Redhorse (*Moxostoma duquesnei*)	79		N	N				
Golden Redhorse (*Moxostoma erythrurum*)	79		N	N		X		
Shorthead Redhorse (*Moxostoma macrolepidotum*)	79		N			N	N	
North American Catfishes (Family Ictaluridae)	**82**							
White Catfish (*Ameiurus catus*)	83			I			N	N
Black Bullhead (*Ameiurus melas*)	84	EN	N	N				X
Yellow Bullhead (*Ameiurus natalis*)	84		N	N		N	N	N
Brown Bullhead (*Ameiurus nebulosus*)	85		N	N		N	N	N
Blue Catfish (*Ictalurus furcatus*)		EX		N				

SPECIES	PAGE	STATUS	WATERSHEDS E	O	G	P	S	D
Channel Catfish (*Ictalurus punctatus*)	87		N	N		I	I	I
Mountain Madtom (*Noturus eleutherus*)	88	EN		N				
Stonecat (*Noturus flavus*)	88		N	N	N			
Tadpole Madtom (*Noturus gyrinus*)	88	EN	N	N	N		N	N
Margined Madtom (*Noturus insignis*)	88					N	N	N
Brindled Madtom (*Noturus miurus*)	88	TH	N	N				
Northern Madtom (*Noturus stigmosus*)	88	EN		N				
Flathead Catfish (*Pylodictis olivaris*)	90		N	N			I	I
Smelts (Family Osmeridae)	**92**							
Rainbow Smelt (*Osmerus mordax*)	92		I				I	N
Trouts and Salmons (Family Salmonidae)	**94**							
Longjaw Cisco (*Coregonus alpenae*)		EX	N					
Cisco (*Coregonus artedi*)	94	EN	N				I	
Lake Whitefish (*Coregonus clupeaformis*)	94		N					
Pink Salmon (*Oncorhynchus gorbuscha*)	97		I					
Coho Salmon (*Oncorhynchus kisutch*)	94		I					
Rainbow Trout (*Oncorhynchus mykiss*)	98		I	I	I	I	I	I
Golden Rainbow Trout (*Oncorhynchus mykiss*)	100		X	X	X	X	X	X
Chinook Salmon (*Oncorhynchus tshawytscha*)	94		I				I	I
Sockeye Salmon (Kokanee) (*Oncorhynchus nerka*)							I	I
Atlantic Salmon (*Salmo salar*)	104		I	I			I	
Brown Trout (*Salmo trutta*)	101		I	I	I	I	I	I
Brook Trout (*Salvelinus fontinalis*)	103		N	N	N	N	N	N
Lake Trout (*Salvelinus namaycush*)	104		N				N	
Pikes and Mudminnows (Family Esocidae)	**106**							
Redfin Pickerel (*Esox americanus americanus*)	107						N	N
Grass Pickerel (*Esox americanus vermiculatus*)	108		N	N				
Northern Pike (*Esox lucius*)	109		N	N		I	X	I
Tiger Muskellunge (*Esox lucius x Esox masquinongy*)	111			X			X	X
Muskellunge (*Esox masquinongy*)	112		N	N		I	I	I
Chain Pickerel (*Esox niger*)	114			I		N	N	N
Amur Pike (*Esox reichertii*)			I			N	N	N
Central Mudminnow (*Umbra limi*)		C	N	N				
Eastern Mudminnow (*Umbra pygmaea*)		C						N
Trout-Perches (Family Percopsidae)								
Trout Perch (*Percopsis omiscomaycus*)			N	N				X
Pirate Perches (Family Aphredoderidae)								
Pirate Perch (*Aphredoderus sayanus*)		EX	N					N
Cods (Family Gadidae)	**116**							
Burbot (*Lota lota*) (endangered-inland populations only)	116	EN	N	N			N	
Toadfishes (Family Batrachoididae)								
Oyster Toadfish (*Opsanus tau*)								N
Mullets (Family Mugilidae)								
Striped Mullet (*Mugil cephalus*)								N
New World Silversides (Family Atherinopsidae)								
Brook Silverside (*Labidesthes sicculus*)		DL	N	N				
Rough Silverside (*Membras martinica*)								N
Inland Silverside (*Menidia beryllina*)								N
Atlantic Silverside (*Menidia menidia*)								N
Needlefishes (Family Belonidae)								
Atlantic Needlefish (*Strongylura marina*)								N
Agujon (*Tylosurus acus*)								N

SPECIES	PAGE	STATUS	WATERSHEDS E	O	G	P	S	D
Topminnows (Family Fundulidae)	**117**							
Banded Killifish (*Fundulus diaphanus*)	117		N	N		N	N	N
Mummichog (*Fundulus heteroclitus*)				I			I	N
Striped Killifish (*Fundulus majalis*)								N
Pupfishes (Family Cyprinodontidae)								
Sheepshead Minnow (*Cyprinodon variegatus*)								N
Livebearers (Family Poeciliidae)								
Western Mosquitofish (*Gambusia affinis*)						I		I
Eastern Mosquitofish (*Gambusia holbrooki*)								X
Sticklebacks (Family Gasterosteidae)	**119**							
Fourspine Stickleback (*Apeltes quadracus*)	119						I	N
Brook Stickleback (*Culaea inconstans*)	119	C	N	N			I	
Threespine Stickleback (*Gasterosteus aculeatus*)	119	EN						N
Pipefishes and Seahorses (Family Syngnathidae)								
Northern Pipefish (*Syngnathus fuscus*)								N
Sculpins (Family Cottidae)	**120**							
Mottled Sculpin (*Cottus bairdi*)	120		N	N	N	N	N	
Blue Ridge Sculpin (*Cottus caeruleomentum*)	120					N	N	
Slimy Sculpin (*Cottus cognatus*)	120						N	N
Potomac Sculpin (*Cottus girardi*)	120					N	N	
Spoonhead Sculpin (*Cottus ricei*)	120	EX	N					
Checkered Sculpin (*Cottus sp. cf. cognatus*)						N		
Deepwater Sculpin (*Myoxocephalus thompsoni*)	120	EX	N					
Temperate Basses (Family Moronidae)	**122**							
White Perch (*Morone americana*)	123		I	I			N	N
White Bass (*Morone chrysops*)	124		N	N			I	
Striped Bass (*Morone saxatilis*)	126				I		N	N
Striped Bass Hybrid (*Morone saxatilis x Morone chrysops*)	128			X			X	X
Sunfishes (Family Centrarchidae)	**130**							
Mud Sunfish (*Acantharchus pomotis*)	130/147	EX						N
Rock Bass (*Ambloplites rupestris*)	132		N	N		I	I	I
Blackbanded Sunfish (*Enneacanthus chaetodon*)	130/146	EX						N
Bluespotted Sunfish (*Enneacanthus gloriosus*)	130/146						N	N
Banded Sunfish (*Enneacanthus obesus*)	130/146	EN						N
Redbreast Sunfish (*Lepomis auritus*)	133					N	N	N
Green Sunfish (*Lepomis cyanellus*)	134		N	N		I	I	I
Pumpkinseed (*Lepomis gibbosus*)	135		N	N	N	N	N	N
Bluegill (*Lepomis macrochirus*)	136		N	N		I	I	I
Longear Sunfish (*Lepomis megalotis*)	130/147	EN		N			I	
Redear Sunfish (*Lepomis microlophus*)	130			I			I	I
Warmouth (*Lepomis gulosus*)	130/147	EN	N	N				N
Smallmouth Bass (*Micropterus dolomieu*)	138		N	N	N	I	I	I
Spotted Bass (*Micropterus punctulatus*)	139			N				
Largemouth Bass (*Micropterus salmoides*)	140		N	N		I	I	I
White Crappie (*Pomoxis annularis*)	142		N	N		I	I	I
Black Crappie (*Pomoxis nigromaculatus*)	144		N	N		I	I	I
Perches and Darters (Family Percidae)	**148**							
Eastern Sand Darter (*Ammocrypta pellucida*)	148/161	EN	N	N				
Greenside Darter (*Etheostoma blennioides*)	149		N	N	N	I	I	
Rainbow Darter (*Etheostoma caeruleum*)	161		N	N		I		
Bluebreast Darter (*Etheostoma camurum*)	148/160	TH		N				
Iowa Darter (*Etheostoma exile*)		EN	N	N				
Fantail Darter (*Etheostoma flabellare*)			N	N	N	N	N	

SPECIES	PAGE	STATUS	WATERSHEDS E	O	G	P	S	D
Swamp Darter *(Etheostoma fusiforme)*		EX						N
Spotted Darter (*Etheostoma maculatum*)	148/161	TH		N				
Johnny Darter (*Etheostoma nigrum*)	150		N	N	N			
Tessellated Darter (*Etheostoma olmstedi*)	151					N	N	N
Tippecanoe Darter (*Etheostoma tippecanoe*)	148/160	TH		N				
Variegate Darter *(Etheostoma variatum)*				N				
Banded Darter (*Etheostoma zonale*)	149			N			I	
Yellow Perch (*Perca flavescens*)	152		N	N		N	N	N
Chesapeake Logperch *(Percina bimaculata)*		TH					N	
Logperch (*Percina caprodes*)	154		N	N				
Channel Darter *(Percina copelandi)*		DL	N	N				
Gilt Darter (*Percina evides*)	148/160	TH		N				
Longhead Darter (*Percina macrocephala*)	148/161	DL		N				
Blackside Darter *(Percina maculata)*			N	N	N			
Sharpnose Darter *(Percina oxyrhyncha)*		EX		N				
Shield Darter *(Percina peltata)*						N	N	N
River Darter *(Percina shumardi)*				N				
Sauger (*Sander canadensis*)	156		N	N				
Walleye (*Sander vitreus*)	158		N	N		I	X	I
Blue Pike *(Sander vitreus glaucus)*		N	N					
Bluefishes (Family Pomatomidae)								
Bluefish *(Pomatomus saltatrix)*								N
Jacks (Family Carangidae)								
Florida Pompano *(Trachinotus carolinus)*								N
Snappers (Family Lutjanidae)								
Gray Snapper *(Lutjanus griseus)*								N
Drums and Croakers (Family Sciaenidae)	**162**							
Freshwater Drum (*Aplodinotus grunniens*)	162		N	N				
Silver Perch *(Bairdiella chrysoura)*								N
Weakfish *(Cynoscion regalis)*								N
Spot *(Leiostomus xanthurus)*								N
Atlantic Croaker *(Micropogonias undulatus)*								N
Cichlids and Tilapias (Family Cichlidae)								
Blue Tilapia *(Oreochromis aureus)*							I	
Gobies (Family Gobiidae)								
Naked Goby *(Gobiosoma bosc)*								N
Round Goby* *(Neogobius melanostomus)*			I					
Tubenose Goby* *(Proterorhinus semilunaris)*			I					
Snakeheads (Family Channidae)								
Northern Snakehead* *(Channa argus)*								I
Turbots (Family Scophthalmidae)								
Windowpane *(Scophthalmus aquosus)*								N
Sand Flounders (Family Paralichthyidae)								
Smallmouth Flounder *(Etropus microstomus)*								N
Summer Flounder *(Paralichthys dentatus)*								N
Righteye Flounders (Family Pleuronectidae)								
Winter Flounder *(Pseudopleuronectes americanus)*								N
American Soles (Family Achiridae)								
Hogchoker *(Trinectes maculatus)*								N

Key to Selected Families of Pennsylvania Fishes

You've caught an unfamiliar fish. What is it? You can look at a picture or drawing, ask someone who you think is knowledgeable, or you can consult a fish identification guide or field guide. Taxonomy is what science calls classifying living things according to their similar and dissimilar physical characteristics, and putting them in like-appearing groups.

Using a key, and without any previous knowledge or even a good guess, you can look at a fish, note physical items like the shape of its tail, the pattern of its scales, and whether it has a lateral line. You progress from point to point, clue to clue, as a detective, to "key out" what fish you wish to identify. A fish can be scientifically keyed out by counting fin rays and scales in certain positions, looking at the arrangement of pharyngeal teeth, and so on. For most people, the use of field marks, easily visible external features, is enough. Some fish of the same family may look nearly alike. Their color patterns fade as they grow older or when they are found in certain water conditions. Thus, field marks, like the number of pores under the jaw, can help you tell the difference between a muskellunge and a northern pike.

Beginning with 1a and 1b below, match the information to the characteristics of the fish you wish to identify. When you have placed the fish in its proper family, go to the page number indicated for help in determining the specific species. As you progress through the key, refer to the illustrations on page 8 and the glossary.

1a. Head with jaws; no pelvic fins; body long and "snakelike": Eel Family - Anguillidae, page 44.
1b. Pelvic fins present; body not long nor "snakelike": Go to 2.
2a. Upper portion of caudal (tail) fin base longer than lower portion: Go to 3.
2b. Upper and lower portions of caudal fin base about equal in length: Go to 5.
3a. Vertebrae extend into elongated upper portion of caudal fin; snout with four barbels on underside; body with separate rows of bony plates: Sturgeons family - Acipenseridae: Page 35.
3b. Vertebrae not noticeably extended into upper portion of caudal fin; tail somewhat rounded: Go to 4.
4a. Jaws long and thin with many teeth; scales thick and bony; dorsal fin short: Gars family - Lepisosteidae; Page 40.

4b. Jaws short and thick; dorsal fin very long: Bowfins family - Amiidae; Page 42.
5a. Adipose fin present: Go to 6.
5b. Adipose fin not present: Go to 7.
6a. Body scaleless with chin barbels present: Catfishes family - Ictaluridae; Page 84.
6b. Body with small scales: no chin barbels; body distinctly spotted; thin pointed flap of skin (axillary process) at base of pelvic fins: Trouts and Salmons family - Salmonidae; Page 94.
6c. Body with large scales; no axillary process at base of pelvic fins: Smelts family - Osmeridae; Page 92.
7a. Stout duck-bill snout and jaws with obvious sharp teeth; single dorsal fin with no spines: Pikes family - Esocidae; Page 114.
7b. Not with duck-bill snout; dorsal fin single or double with both spines and soft rays or soft rays only: Go to 8.
8a. Single soft-rayed dorsal fin completely forward of anal fin; mid-belly scales sharp and "saw-toothed"; silvery body strongly flattened from side to side; no lateral line: Herrings family - Clupeidae; Page 46.
8b. Single or double dorsal fin; lateral line present; "saw-toothed" mid-belly scales absent; body not strongly flattened from side to side: Go to 9.
9a. Single soft-rayed dorsal fin (include carp and goldfish which have first ray hardened); one or more large pharyngeal (throat) teeth on separated fifth gill arches: Go to 10.
9b. Dorsal fin single or double with both spines and soft rays; pharyngeal teeth present or absent (freshwater drum has teeth on fused pharyngeals): Go to 11.
10a. Mouth directed downward with thick fleshy lips; distance from back edge of gill flap to beginning of anal fin much greater than distance from beginning of anal fin to base of tail fin; pharyngeal teeth more than 15 and in single row: Suckers family - Catostomidae; Page 74.
10b. Mouth not with thick fleshy lips; distance between back edge of gill flap to beginning of anal fin only slightly greater than distance from beginning of anal fin to base of tail fins; pharyngeal teeth no more than 6 in one to three rows: Minnows family - Cyprinidae; Page 56.
11a. Body largely scaleless (small prickles present); large pectoral fins; head broad and flattened: Sculpins family - Cottidae; Page 120.
11b. Body with scales: Go to 12.
12a. Anal fin with 3 or more spines: Go to 13.
12b. Anal fin with 1 or 2 spines: Go to 14.
13a. Gill cover with spine: Temperate Basses family - Moronidae : Page 122.
13b. Gill cover without spine: Sunfishes family - Centrarchidae: Page 130.
14a. Lateral line ending at base of caudal fin: Perches family - Percidae; Page 148.
14b. Lateral line continues to end of caudal fin; soft-rayed portion of dorsal fin longer than spiny portion; large flat teeth present on heavy, fused lower pharyngeals; Drums family - Sciaenidae; Page 162.

Lampreys

Family Petromyzontidae

Family overview: Lampreys may not look like fish, but they are. Their round, sucking mouth, lack of pectoral and pelvic fins, and eellike body make lampreys appear very different from "typical" fish. They also have a unique life history, going through a transformation, or metamorphosis, from larva to adult. Pennsylvania has seven lamprey species.

CANDIDATE

The native **Ohio lamprey** (*Ichthyomyzon bdellium*) is found in the Allegheny River and Ohio River watersheds. In Pennsylvania, Ohio lampreys can sometimes be seen attached to and feeding on stream fish like smallmouth bass, walleyes, redhorse suckers and trout. Native parasitic lampreys, like the Ohio, are smaller than sea lampreys. They evolved with other native fishes, so they do not have a significant effect on populations of their host fishes. The Ohio lamprey is a Pennsylvania state candidate species.

ENDANGERED

The **northern brook lamprey** (*Ichthyomyzon fossor*) is nonparasitic. This little lamprey is rare throughout its limited Great Lakes and Midwest range, and is found in Pennsylvania only in a small portion of the northwest part of the state. The northern brook lamprey is a state endangered species.

THREATENED

The **mountain brook lamprey** (*Ichthyomyzon greeleyi*) is a state threatened species found in Pennsylvania in the Ohio River watershed. It, too, is nonparasitic.

The **least brook lamprey** (*Lampetra aepyptera*) is found in headwater streams. It has been documented in western Pennsylvania's Ohio River watershed and in the southeast's lower Susquehanna River watershed. This nonparasitic lamprey is widespread from Pennsylvania south to the Gulf of Mexico.

CANDIDATE

The nonparasitic **American brook lamprey** (*Lethenteron appendix*) has a broad range throughout the Midwest. In Pennsylvania it lives in streams in the northern section of the Allegheny River watershed and in the Genesee River and Lake Erie watersheds.

In body structure, lampreys are primitive fish. They and the marine hagfishes are considered to be the only living representatives of the ancient jawless fishes. Their extinct relatives, the ostracoderms, were the first vertebrates to appear in the fossil record, about 500 million years ago. In Pennsylvania, lampreys appeared in the fossil record 280 million years ago.

In Pennsylvania, the **sea lamprey** (*Petromyzon marinus*) naturally runs up the Delaware River from the Atlantic Ocean to spawn. It is also present in Lake Erie and the other Great Lakes. Sea lampreys bypassed the barrier of Niagara Falls after the Welland Canal was built. By the 1920s, they had spread all the way to the upper Great Lakes. Thus, although natives of the Delaware watershed, they are non-native to the Great Lakes and Lake Erie. Sea lampreys feed by attaching themselves by their concave, round, suction-disk mouth to the exterior of fish. They rasp a hole in the skin with their rough tongue, and feed on the host fish's body fluids. They may kill their host directly, or weaken it so much that fungus infections and other ills destroy it. The sea lamprey invasion of the Great Lakes caused disastrous declines in lake trout and whitefish populations, affecting commercial and sport fisheries. Great Lakes tributary streams where sea lampreys spawn are treated with a chemical to reduce this damaging parasite's numbers. Sea lampreys have little effect on native fishes in the Delaware River because the adult parasitic form inhabits the Atlantic Ocean.

Identification: Lampreys lack the typical jaws of other fishes, in both their larval and adult forms. Larval lampreys have a sort of oral hood. In parasitic lampreys, after metamorphosis the hood is replaced by the adult's concave, circular, sucker-disk mouth, with horny teeth. In nonparasitic lampreys, the hood does not change. The patterns of the teeth help biologists differentiate among lamprey species. Lampreys also do not have pectoral or pelvic fins, which are found on most other fishes. The lamprey's thin, cylindrical body is eellike or snakelike. It has a single, low, long dorsal fin. The dorsal fin may be notched, but it is never divided in two in lampreys, and it connects to the curved tail fin.

Lampreys have no body scales, and on the inside they have a poorly developed skeleton of cartilage. Most lampreys are gray, olive or brown. Some species have plain sides; others are mottled. The adult lamprey's eyes are small. Larval lampreys have no readily visible eyes, although they are present, covered and sightless. Behind the lamprey's eyes, on either side, is a row of roundish gill openings.

Female lampreys grow larger than males. The sea lamprey may reach three feet. Of Pennsylvania's other lampreys, the Ohio and American brook grow to about 12 inches. The mountain brook and least brook lampreys grow to about seven inches.

Life history: Lampreys have an unusual life cycle. They have a long larval stage, during which they are called "ammocoetes." Then there is a period of resting and metamorphosis to the adult form. In parasitic lampreys, there is more growth, feeding on host fish for about a year, sexual maturity, spawning and then, immediately following, death. The non-parasitic forms have a shorter life cycle. They become sexually mature during their transformation time, from larva to adult, so they don't feed after metamorphosis, but go right to the spawning and dying stages. In the nonparasitic species, the spawning adults are often smaller than the ammocoetes just before transformation.

Lampreys move upstream in rivers and creeks before spawning, congregating on gravelly riffles. Males and females help construct the depression that becomes the nest. Parasitic lampreys pick up and move gravelly particles downstream with their sucking mouths. Several lamprey pairs may use the same nest for spawning, at the same time, emitting sperm and eggs during their spawning embrace. Parasitic forms lay more eggs (more than 20,000) than do nonparasitic lampreys (500 to 3,000). All adults die shortly after spawning, while the fertilized eggs sift into the nest gravel. Hatched lamprey larvae drift downstream and settle to burrow into the silty bottom. There they feed on organic material and bacteria that they filter from the water. They grow for several years until the time of metamorphosis. Stream fishes prey heavily on lamprey eggs and the small larvae.

Sturgeons

Family Acipenseridae

Family overview: Biologists say that sturgeons are the most primitive of the bony fishes alive today. Extinct sturgeon relatives date back more than 350 million years. Sturgeons are found throughout the Northern Hemisphere, in both fresh water and salt water. In some parts of the world, sturgeons are commercially valuable for their meat and for their eggs, which are used for caviar. Although they were once a more common part of our native wildlife, nowadays Pennsylvania sturgeons are rare.

In Pennsylvania, there are currently three sturgeon species: The **shortnose sturgeon** (*Acipenser brevirostrum*), the **lake sturgeon** (*Acipenser fulvescens*) and the **Atlantic sturgeon** (*Acipenser oxyrhynchus*).

ENDANGERED

The state-endangered **shortnose sturgeon** is a marine and estuarine fish. It is found in Pennsylvania when it returns to the Delaware River to spawn. Some adults overwinter in the tidal Delaware as well. Juvenile sturgeon also inhabit the nursery water of the tidal Delaware. Past exploitation by commercial fishermen, pollution of tidal streams and estuaries used by spawning adults, and habitat loss have led to its reduced numbers.

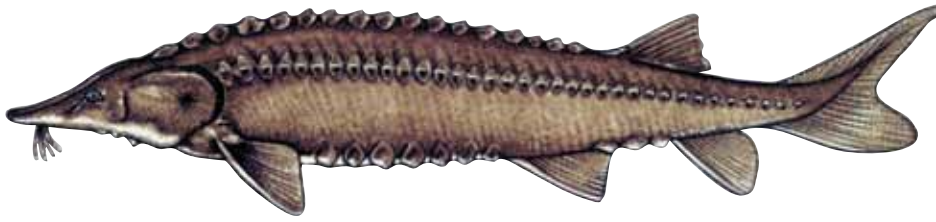
The lake sturgeon is also a state-endangered species, found primarily in fresh water. Although it once was seen in the Ohio and Allegheny River watersheds, in recent years it has been found in Pennsylvania only in Lake Erie. Pollution, and locks and dams across the large rivers it prefers, which block access to spawning grounds, have been responsible for the lake sturgeon's decline.

The Atlantic sturgeon is a endangered species in Pennsylvania. As different subspecies, this sturgeon ranges along the Atlantic Coast from Labrador to the Gulf of Mexico. The Atlantic sturgeon is found occasionally in the Delaware River in Pennsylvania, where the adults migrate to spawn and then return to the ocean. Juveniles also spend time there before going to the ocean.

Identification: Sturgeons are elongate, with a flattened head and snout, and seem to be five-sided. This is because they have five rows of bony plates running along the body, one along the back, two on the sides and two on the underside. The plates are sharp in young fish, but smooth with wear in older, larger fish.

Sturgeons have four soft barbels between the front of the snout and the toothless mouth, which protrudes to pick up food. The upper lobe of the tail fin is much longer than the lower lobe, and the dorsal fin is set far back toward the tail. The first ray of the pectoral fin is hardened into a bony spine. It is used by biologists to determine the fish's age.

The shortnose sturgeon grows to about three feet. It is dark-brown or black on the back, lighter brown to yellow below. The large, bony scales along its sides are lighter than the body color, and the paired fins are outlined in white.



ENDANGERED

Lake sturgeons reach seven feet long, with olive-brown to gray on the back and sides, white underparts, and dark-brown to gray fins. The rows of bony scales on the top and sides are the same color as the body.

ENDANGERED

Atlantic sturgeons are the state's largest fish. They reach a length of 12 to 14 feet. The upper body is gray or blue-black, and contrasts with the white spines on the body plates, the front edge of the paired fins, and the lower portion of the tail fin.

Life history: Sturgeons can live 50 to 100 years or more, depending on the species. However, they are slow to mature sexually, and there may be several years between each spawning. The shortnose sturgeon takes up to six years to mature. The lake sturgeon doesn't spawn until it is about 15 years old. The Atlantic sturgeon doesn't breed until it is at least 12 years old.

Sturgeon adults spawn in spring on a stony bottom in the fast current of large rivers. The lake sturgeon also spawns along the rocky shoreline of lakes. The tiny dark-brown or blackish eggs extruded by the female are adhesive and stick to the bottom. No nest is constructed by the adults. There is no parental care of the eggs or young fish. In the marine species, the juvenile sturgeon spend time in the brackish lower river and estuary, before heading for the ocean.

Even though they grow to great size, sturgeons eat tiny bottom-dwelling invertebrates, like sludgeworms, midges, shrimp, tiny bivalves and occasionally small fishes. They root for food from the soft bottom with their snout, and locate food using their barbels. Atlantic sturgeons are travelers. One tagged fish journeyed 900 miles in a single summer.

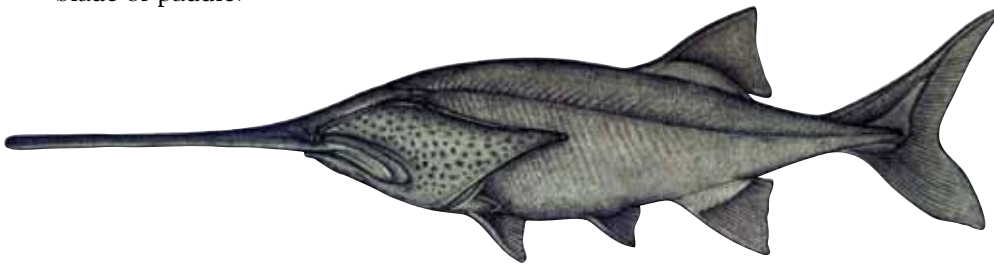
Paddlefishes

Family Polyodontidae

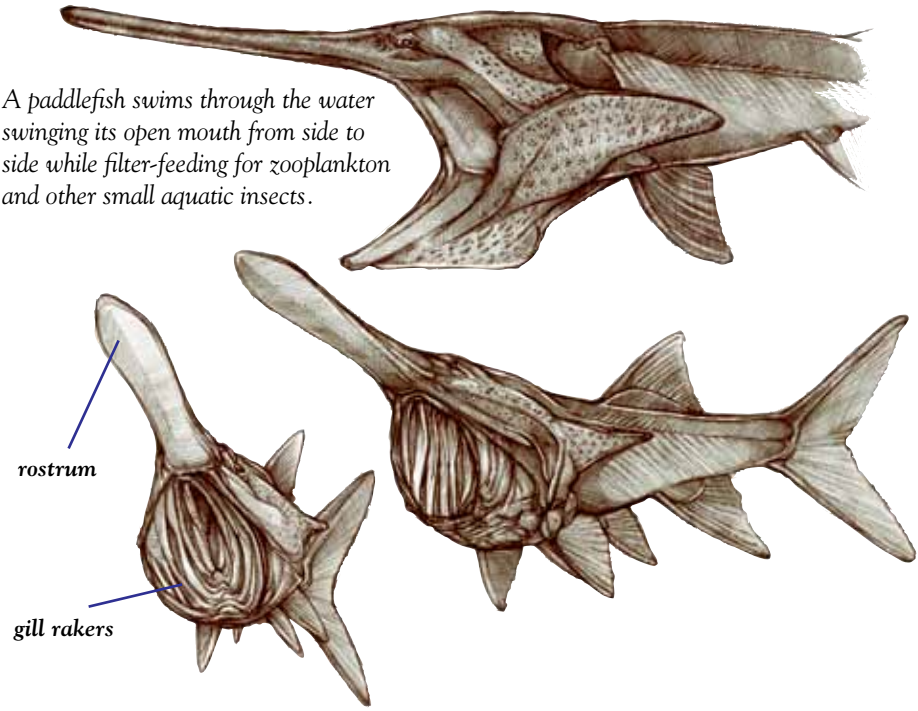
Family overview: Paddlefish are known from fossil records to be millions of years old. They are related to sturgeons. In North America, and Pennsylvania, there is only one paddlefish species, *Polyodon spathula*, which is called the "paddlefish." Its closest living relative is a species that lives in China.

Paddlefish are widely distributed throughout the Mississippi River watershed. In some states, the paddlefish is a threatened species because of the loss and degradation of its large-river habitat. It prefers big, deep pools with sluggish current. In Pennsylvania, paddlefish were once reported to be in Lake Erie, the Allegheny River and Clarion River, but were believed to be extirpated (no longer present in the state). Paddlefish were recently reintroduced by the Pennsylvania Fish & Boat Commission into their historical habitats in the Ohio and Allegheny rivers, in an effort to reestablish a secure, breeding population. Reintroduction efforts for species that take many years to mature require many years to determine the success of such efforts.

The genus name "*Polyodon*" means "many teeth," referring to the fish's many gill rakers. The species name "*spathula*," like "spatula," refers to a blade or paddle.



Identification: The paddlefish's most distinctive feature is its snout, or rostrum. This "paddle" is longer than the rest of the head and flattened on top and bottom, like a paddle. The snout is thought to be an organ of touch. It may also act as a stabilizer, keeping the fish swimming in a horizontal position when its jaw is extended downward during filter-feeding. Paddlefish have many long gill rakers that let them strain tiny food organisms from the water. Like the sturgeon, the paddlefish tail's upper lobe is longer than its lower lobe, but it has no bony scales or plates on its body. The skeleton is mostly cartilage. The paddlefish's gill cover extends backward in a long, flat point. The body color is generally medium to pale



A paddlefish swims through the water swinging its open mouth from side to side while filter-feeding for zooplankton and other small aquatic insects.

blue-gray. Young paddlefish don't have the adult's paddle-shaped snout. Young paddlefish also have teeth, which the adults lack.

Life history: Paddlefish are travelers. They range long distances in the spring in the large rivers where they live to spawn on submerged gravel bars in swift current. During the spawning season, they may be seen breaking the water's surface. Paddlefish release their adhesive eggs randomly over the bottom, and abandon them. Large females may produce over one-half million eggs a year, but may not spawn every year. Like sturgeons, paddlefish take a long time to become sexually mature and capable of spawning. Paddlefish males are ready at seven years and about 40 inches long. Females take nine or 10 years, and are about 42 inches long when they first spawn. Paddlefish grow rapidly and may reach five feet long when they are 17 years old. They are believed to live for 20 years or more. The world hook and line record is over 140 pounds.

Unlike its sturgeon relatives, the paddlefish does not feed on the bottom. Instead, it swims near the surface or in shallow water, feeding on minute plant and animal organisms, and on small aquatic insects, like mayflies.

Gars

Family Lepisosteidae

Family overview: Gars are primitive, ancient bony fish. Their ancestors date back more than 100 million years, as found in fossil records. In Pennsylvania, there are currently two gar species, the spotted (*Lepisosteus oculatus*) and the longnose (*Lepisosteus osseus*). At one time the shortnose gar was reported to be in the Pennsylvania portion of the Ohio River and in Lake Erie, but it has not been seen there in many years.

ENDANGERED

The **spotted gar** is found along the Gulf of Mexico, the Mississippi watershed, and lower Great Lakes. In Pennsylvania it lives mostly in and around Presque Isle Bay.

The longnose gar ranges widely through the Mississippi River watershed and lower Great Lakes. It is also found along the Atlantic Coast north to New Jersey. In Pennsylvania, it has been reported from scattered locations including Lake Erie, and the Allegheny and Ohio River watersheds. It has also been reported to be in the extreme southern portion of the Susquehanna River watershed. Never abundant, the longnose gar's primary Pennsylvania haunt is the shallow, weedy waters of Presque Isle Bay in Lake Erie.

One oddity of the gar is its tolerance of low oxygen conditions. Gars have a swim bladder that connects to the throat by an open tube. When hard-pressed for oxygen in the water, gars can go to the surface and gulp air into the swim bladder, which then acts as a lung.

The genus name "*Lepisosteus*" means "bony-scaled."

Identification: The gar has a long, relatively thin-looking, cylindrical body that is "armored" with large, thick, diamond-shaped scales. Its beak-like or swordlike snout is filled with fine, sharp teeth. The single dorsal fin and the anal fin are located far back toward the tail.

The spotted gar is usually olive-green on its back and silvery-white on the belly. There are large, roundish dark spots on the top and sides of the head, and on the upper part of the body. The fins have dark spots and may display orange tints. The spotted gar grows almost to four feet long.

Longnose gar are grayish to olive-green on the back and white on the belly. They may have dark spots or blotches on their fins and especially toward the rear along their sides. The fins may show yellow or orange tints. They can grow to about 50 inches long.

Life history: Longnose gar adults live in lakes or sluggish pools and backwaters in rivers. They spawn in the spring, in the vegetated shallows of lakes, or they may migrate upstream to find a gravel bottom. Males mature in three to four years. Females mature a year or so later. No nest is built. Females may spawn with several males over the long spawning season. Up to 30,000 tiny dark eggs are released by each female. The eggs stick to underwater objects and plants. The eggs, which are poisonous to humans and other mammals, take six to eight days to hatch. Then the young gars attach themselves, by means of a suction disk at the tip of the snout, to something submerged. There they await the absorption of the yolk sac. Young longnose gars grow fast, nearly to two feet the first year. They may live to be 20 years old.

Spotted gars also spawn in the spring, with large groups of males and females appearing over riffles and in the shallows along lake shores. They make no nest for the eggs, but the gravel is cleaned by their spawning activity. They also spawn over underwater vegetation. The spotted gar grows more slowly than the longnose.

Gars are voracious carnivores, preying on other fish. Their hunting tactic is to lie in wait for prey to move close, or they may stalk it slowly. Then they rush in and slash their sharp-toothed "beak" from side to side, killing or injuring the target fish. The prey is then grabbed crosswise in the gar's teeth and maneuvered in the jaws to be swallowed headfirst. Gars also occasionally feed on crustaceans. Gars are sometimes seen on sunny days, apparently basking, just beneath the water's surface.

Bowfins

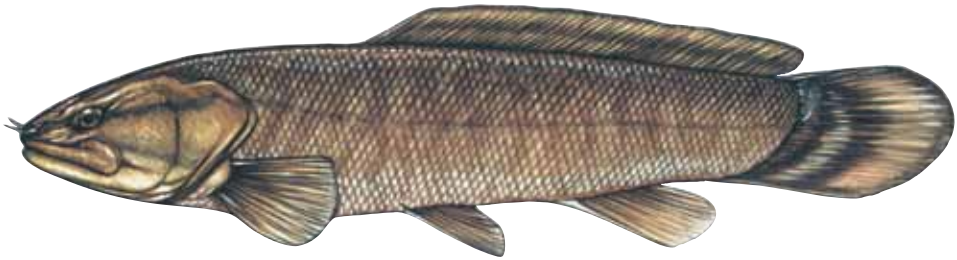
Family Amiidae

Family overview: The one bowfin species that exists today, *Amia calva*, is all that remains of a large group of marine and freshwater fishes that thrived about 150 million years ago. A "living fossil," the bowfin shows some body features, such as a lunglike swim bladder, which are typical of primitive fish, and other characteristics, like smooth scales, which are found in the more highly evolved soft-rayed fishes.

Bowfins are widely distributed over the eastern half of North America. In Pennsylvania, they are found in Presque Isle Bay, on Lake Erie, and in a few other scattered locations in the Delaware, Ohio and Susquehanna River watersheds. Their preferred habitat is heavily vegetated lakes, sluggish rivers and swamps. Bowfins can tolerate very warm water. Their body functions become limited and their activity slows when it becomes too hot. To overcome these adverse conditions, the bowfin has a swim bladder that opens to the throat. The bowfin, like the gar, can go to the surface, stick its head out, and gulp air. Bowfins have also been called "dogfish" and "mudfish."

Identification: Bowfins are robust-looking fish. The body is covered with heavy scales and the head is covered with bony plates. Their color is olive-green on the back, lighter and mottled on the sides, and yellowish on the belly. A single long, low dorsal fin extends over half the length of the body. It is light with lengthwise stripes. The dorsal fin is just barely separated from the broadly rounded tail fin, which shows curving stripes. A pair of short barbels protrudes near the nostrils. The mouth is filled with sharp, strong teeth. Male bowfins can be identified by the dark spot on the upper side of the base of the tail fin. This spot is ringed with bright-orange or yellow-green during the breeding season. This spot may represent a false eye that could direct predators to the bowfin's tail, instead of the head, thus providing it with an escape mechanism. Bowfins grow to several feet long and nearly 10 pounds.

Life history: Bowfins spawn in the spring. The male uses his fins to clear a round depression in the weedy shallows, into which the eggs of several females are deposited. The adhesive eggs fall on the vegetation and remain until they hatch, in about eight to 10 days, while the male guards them. The male also watches over the young fry. An average-sized female bowfin, of about four or five pounds, produces 23,000 to 64,000 eggs.



CANDIDATE

Bowfins are ready to spawn when they are two to four years old. The males then are about 18 inches long and the females are about two feet long. Their lifespan in the wild is about 10 years.

Bowfins are predators, eating mainly fish, but also taking crayfish, frogs, mollusks and aquatic insects. When compared to other fish, the bowfin's actions are sluggish, but with its size and feeding habits, it may strike an angler's artificial lure or live bait. As a Pennsylvania candidate species, bowfins must be released immediately unharmed.

GOING BACK IN TIME	
Age of Man	***Recent to 3 million years***
Age of Mammals	***3 million years to 70 million years***
Age of Reptiles	***70 million years to 225 million years***
Age of Amphibians	***225 million years to 300 million years***
Age of Fishes	***300 million years to 350 million years***

The bowfin, exhibiting features of primitive fish, is all that remains of a group of fishes that lived over 150 million years ago. This chart indicates that primitive fishes existed millions of years before man as well as other forms of life.

Freshwater Eels

Family Anguillidae

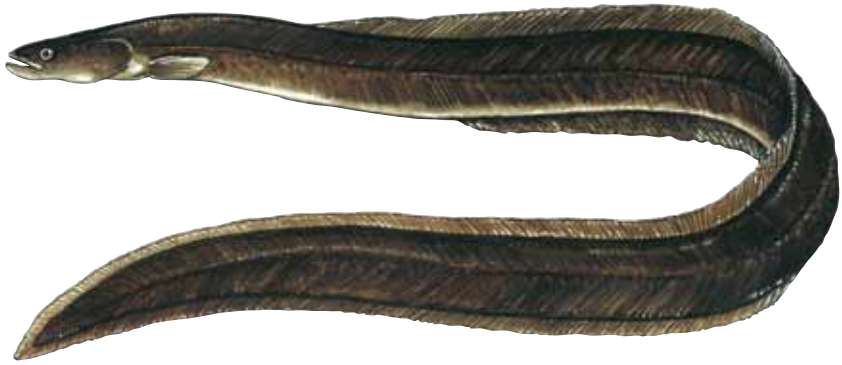
Family overview: Freshwater eels are the only catadromous fishes in North America. "Catadromous" means that they spawn in salt water and live as adults in fresh water. Anadromous fishes, like salmon and American shad, spawn in fresh water but live as adults in the ocean. On this continent, eels are represented by a single species, the American eel (*Anguilla rostrata*). Although the eel looks snakelike, it is a fish.

The American eel is found widely along the Atlantic and Gulf coasts, where the young eels move far upstream into small tributaries. The Delaware River in Pennsylvania has the most abundant population of eels of all the state's streams, because there are no dam obstructions to prevent the eel's upriver migration. Eels are rarely found in the Susquehanna River system. Passageways and lifts to move fish past all the Susquehanna's dams should soon return eels, shad and other ocean-migrating fish to that watershed. Eels are also occasionally seen in the Potomac River watershed. They have even been reported from some headwater sections of the Ohio River watershed in Pennsylvania. While in fresh water, eels live in a variety of stream habitats, especially where they can hide under logs, rocks and undercut banks.

Until the early 1900s, eels supported an intense commercial fishery in the Susquehanna and Delaware River systems. Adult eels on their downstream migration toward the sea were trapped by low, in-river V-shaped wing dams, which were barricades made of rocks. The eels entered these eel racks from the wide upstream side and swam through the small funnel opening downstream, into holding baskets. The remains of old "eel weirs" can still be seen in some Delaware and Susquehanna River watershed streams. Even in a "poor" eel year, the take was staggering: In 1912, called an "off year," 50,000 eels weighing more than 44,000 pounds were caught in Pennsylvania. Today, eels are caught mostly by anglers looking for food and sport (eels are good eating, especially smoked).

The genus name "*Anguilla*" is Latin for "eel." The species name "*rostrata*" means "long nose."

Identification: The American eel's body is long and slender, and seems scaleless. Actually, it has smooth, tiny scales that are embedded in the skin. A long, low dorsal fin extends over at least two-thirds of the back. It blends with the caudal fin and the anal fin, which is also long and low, on the underside. There are no pelvic fins, but the pectoral fins are well-developed. The presence of pectoral fins can be used to distinguish an



eel from a lamprey, which has no paired fins. The head has a smallish eye. The head is long, and tapers to a small mouth. The lower jaw sticks out a little farther than the upper jaw. Eels are yellowish brown to dark-olive, and lighter underneath. In Pennsylvania, the maximum size is two to three feet, although four feet or more is possible. Females grow larger than males.

Life history: The mysterious life history of freshwater eels was revealed only in this century, and even today, eels are not completely understood. The principal puzzle for many years was where eels spawned. Their spawning grounds have finally been identified as the Sargasso Sea, in the northern Caribbean-Bermuda region of the Atlantic Ocean. The eels that arrive there to spawn come from two directions, the American eel from the west and the European eel from the east. But how young eels of each species know which continent to go to has not yet been explained.

After the adult eels spawn, they die. The larval eels, called "leptocephali," are ribbonlike and transparent. These "glass eels" drift with other tiny organisms in the northward-flowing ocean currents. The transforming young eels, called elvers, enter river estuaries when they reach the continent. The females don't stop. They continue swimming many miles upstream, mainly at night, even to the river system's headwaters. The trip from the spawning grounds in the ocean to the eel's freshwater upstream home takes about a year. The male eels, which remain smaller than the females, stay in the lower reaches of the coastal river and in the brackish tidewater just off the river's mouth. After remaining in fresh water for 10 to 20 years, the adult females, now called "silver eels" because of their silvery appearance, migrate downstream in the fall on their long way back to the Sargasso Sea. Sexually mature female eels may contain two million or more eggs.

Eels are predators. They eat a wide variety of aquatic insects, crayfish and other crustaceans, frogs, fishes and worms. They feed mostly at night.

Herrings

Family Clupeidae

Family overview: The herrings are primitive, bony fish. The family Clupeidae dates back 120 million years. Worldwide the family includes about 200 species, including sardines, anchovies, menhaden, shad and herrings. Most herring family species are ocean-dwelling or anadromous, living in salt water as adults, but returning to fresh water to spawn, and spending the early part of their lives in fresh water. Other herring family members are strictly freshwater fish.

Pennsylvania is known to have, or have had, seven species of herrings. Skipjack herring have been reported by creel checks in angler catches. This species occurs in the Ohio River, near Pittsburgh. The skipjack looks much like the uncommon hickory shad, which has been reported in the lower Delaware River. Other herrings in Pennsylvania are the blueback, alewife, American shad and gizzard shad. The herrings can be found in the Delaware River and its estuary, especially during the spawning migration. Some (especially the American shad) are appearing in the Susquehanna River watershed because of fish lifts on dams and stocking. Other herring family members live in western Pennsylvania, in the Lake Erie and Ohio River watersheds (gizzard shad). The alewife has been introduced into larger reservoirs in the state as a forage species for large game fish.

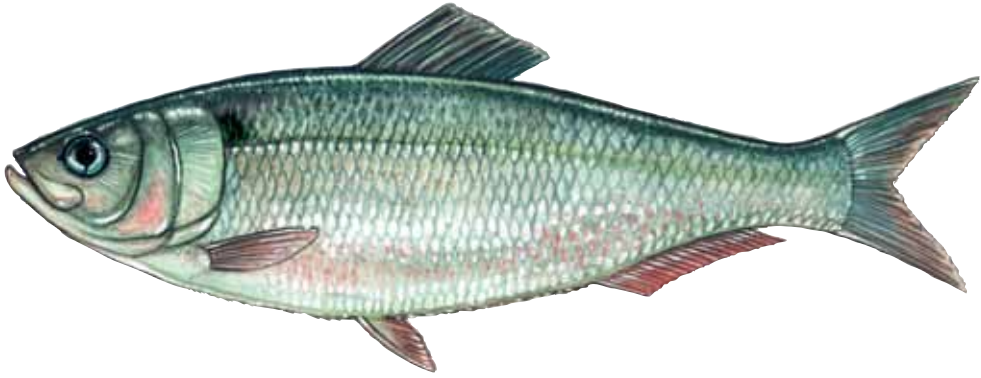
Identification: Very young herring are long and slender, much different from the adults. Adults of the herring family are deep-bodied when viewed from the side. They are extremely compressed and flattened when viewed head-on. They have large, brilliant-silver scales, which are cycloid, smooth to the touch, and easily shed when touched. There is one soft-rayed dorsal fin in the center of the back, and the tail is deeply forked. The eye is large. There are no scales on the head, and no lateral line on the sides. The scales on the midline of the belly are modified and have sharp points. These "scutes" give the belly a rough, saw-toothed edge. They account for several herring species' common name of "sawbelly."

Life history: Most herrings are pelagic–they are midwater forms not associating with bottom structure. Herrings are school fish and can occur in very large concentrations. All spawn in the spring, some migrating great distances from the adult's marine home, swimming upstream many miles into freshwater rivers. Other herrings spawn in tidal, brackish bays, or in the shallows in freshwater lakes. Herrings produce a large number of eggs for their size. A 12-inch, one-pound gizzard shad, for

example, can hold 250,000 eggs at maturity. Schools of herring, the males and females pairing, scatter adhesive, fertilized eggs over various bottom types, including the rocky riffles of rivers and the pebbled shoals of reservoirs. There is no nest-building or parental care. Herrings eat mostly zooplankton, tiny aquatic animal life. The larger species may also eat shrimp, fish eggs and fry. Herrings grow rapidly and are not long-lived.

Blueback Herring *Alosa aestivalis*

Species overview: Blueback herring look much like a closely related species, the alewife. Their marine range is along the Atlantic Coast from Nova Scotia to Florida. They migrate for spawning into the lower reaches of freshwater streams and rivers. In Pennsylvania, the blueback herring is found only in the lower Delaware River and the Delaware estuary, where it returns to spawn. Throughout its range, dams have blocked the blueblack from entering streams, and reduced its abundance and distribution in freshwater. South of Pennsylvania, blueback herring can be very common in river mouths in the spring, giving it the common name "glut herring."



Identification: Blueback herring look like alewives, with which they associate. The main difference between the alewife and blueback herring is internal: The alewife has a silver-gray lining (peritoneum) to its body cavity. The blueback's peritoneum is black. The eye of the blueback is smaller, comparatively, than the alewife's eye. Bluebacks have a single blue-black spot behind the upper part of the gill cover on the side of the body. The back is blue-green and the body sides are bright-silver. The cheek is longer than it is deep. The lower jaw projects slightly beyond the upper jaw, giving them a "stick out your chin" look. Bluebacks are generally more slender than alewives and are darker in color than other members of the herring family. The maximum size is about 15 inches and less than one pound. As in the other herrings, there is a row of saw-toothed scales along the belly line. There is also one dorsal fin, and the tail is deeply forked.

Habitat: Adult blueback herring are marine, inhabiting a narrow band of water off the coast. Fish enter the coastal rivers to spawn. Bluebacks spawn in fresh water several miles upstream of the tidal line in the Delaware River. While in streams, the blueback lives in the current over a rocky bottom, although its time there, during spawning, is brief.

Life history: As anadromous fish, blueback herring begin their lives in the flowing sections of ocean tributaries, not far from the stream's outlet. Adult bluebacks are mature and spawn in their fourth year, migrating from the sea into the mouths of freshwater rivers in late spring, after the alewife has spawned. These schooling fish spawn in brackish water and in fresh water over a firm, not silted bottom. Their sticky eggs sink and adhere there. After spawning, the parents head for the sea again, taking no care of the eggs or young. The tiny one-millimeter-long eggs hatch in two or three days, at a little over 70 degrees. When young bluebacks are about one month old and about two inches long, they head for salt water. Bluebacks feed on zooplankton, as well as shrimp, small fish and fish eggs.

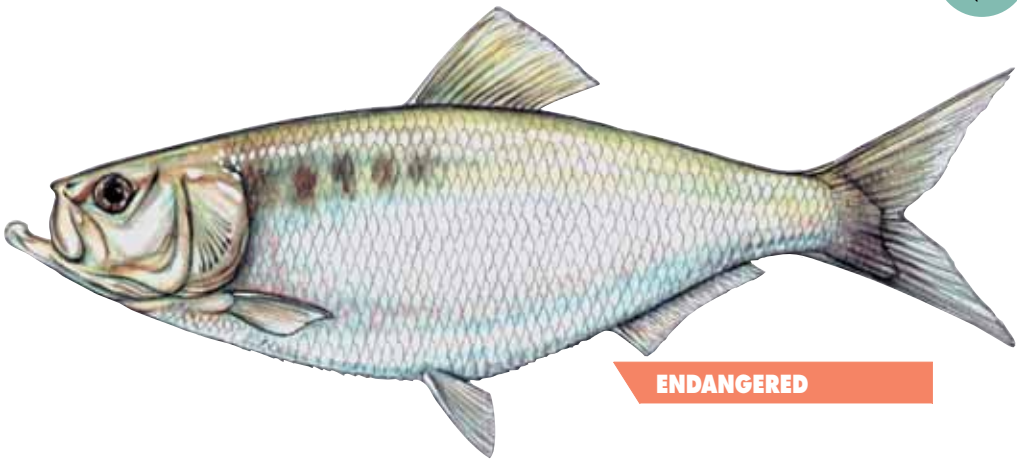
Hickory Shad *Alosa mediocris*

Species overview: Hickory shad live in coastal marine waters and move into fresh water to spawn. Hickory shad range from the Bay of Fundy in Maine to the St. Johns River in Florida. The hickory shad is common from Chesapeake Bay to North Carolina and in coastal waters of the northeast states. Between these areas, it is scarce. In Latin, the name "*mediocris*" means "not important," or "ordinary."

Like American shad, hickory shad are anadromous. They live in coastal ocean waters as adults and enter brackish estuaries, like the Delaware, and swim far upstream to spawn in freshwater rivers and creeks. Hickory shad are returning to the Susquehanna River watershed because of fish lifts on dams. Currently, they are on the list of endangered, threatened, and candidate fishes because of their extremely limited distribution and abundance. In states where their numbers are sufficient to allow sport fishing, they are pursued by light-tackle specialists for their fighting and leaping abilities.

Identification: The hickory shad is silver-sided with a dark spot on the shoulder followed in some individuals by several less distinct dark spots. The fish are grayish green on top fading to silvery on the sides. The sides of the head are bronze. The tip of the lower jaw, and the dorsal and caudal fins, are darker. The tail is deeply forked with pointed lobes. The lower jaw projects beyond the upper jaw.

The hickory shad's shape is unique. The back curves only slightly. The body is long but compressed. In cross section it is wedge-shaped.



The hickory shad ranges in size between the bigger American shad and the smaller blueback herring and alewife. The most common size of a hickory shad is about 12 to 15 inches. A very large specimen would measure 24 inches long, but hickory shad rarely reach two pounds.

Habitat: In its coastal ocean enviroment, the hickory shad feeds on squid, small fish, fish eggs and some invertebrates such as crabs and crustaceans. It is unknown whether or not hickory shad feed when they enter fresh water to spawn.

Life history: Very little is actually known about the hickory shad's life history, except that the species is anadromous. It is believed that hickory shad enter the Delaware estuary and Delaware River, and Chesapeake Bay and the Susquehanna River, in the spring, from April to June, to spawn. Spawning is believed to take place at night, between dusk and around midnight, when water temperatures reach 61 degrees. The eggs, which are buoyant and somewhat adhesive, are easily carried downstream by swift water and current. The eggs hatch in 48 to 70 hours.

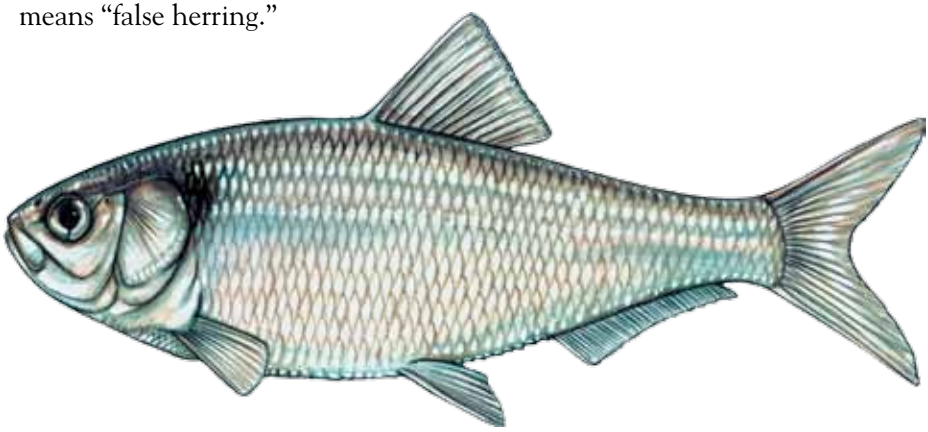
Alewife *Alosa pseudoharengus*

Species overview: The alewife is an anadromous herring in its natural range, living its adult life in salt water and swimming into freshwater tributaries to spawn. Its original distribution was along the Atlantic Coast, from South Carolina northward into Canada. Alewives enter Pennsylvania's Delaware River on spawning migrations.

The alewife can also live entirely in fresh water. It has become established in all the Great Lakes, including the Pennsylvania portion of Lake Erie. It was first reported in Lake Ontario in the 1870s, there either by accidental introduction or by making its way through water routes from New York's Finger Lakes, the St. Lawrence River or the Erie Canal. By

1931, the alewife was reported in Lake Erie, having bypassed Niagara Falls via the Welland Canal. As a food fish for larger game fish, alewives have also been stocked in impoundments across the state. They have also been accidentally spread as escapees from fishermen's bait buckets.

Its small size, large schools and availability to openwater game fish have made the alewife suited for stocking in some inland reservoirs as a forage fish. It has been introduced in Pennsylvania for that purpose in some of our larger impoundments. The species name "*pseudoharengus*" means "false herring."



Identification: On the exterior, the alewife is nearly identical to the closely related blueback herring. The surest difference is inside the fish. The alewife has a silver-gray lining (peritoneum) to its body cavity. The blueback's peritoneum is black. Alewives are bluish green or bluish gray on the back, silvery on the sides, with faint, dark stripes. They have a large eye that is wider than the distance between the front of the snout to the front of the eye. Like the blueback herring, alewives have a single dark spot behind the upper gill cover, and the rear edge of the upper jaw extends to the middle of the eye. The alewife's lower jaw does not project noticeably beyond the upper jaw. Like the American shad, the alewife has a deep notch in its upper jaw. Saltwater alewives seldom weigh over one pound. Their maximum length is 12 to 15 inches. Landlocked freshwater alewives rarely go more than nine inches. The usual size is three to six inches.

Habitat: Alewives can live in both fresh and salt water. Coastal marine fish, they enter freshwater tributary rivers seasonally to spawn, negotiating rapids and fishways to gain access upstream on their migration. Alewives can also spend their lives entirely in cool, freshwater lakes, reproducing successfully and becoming extremely abundant. Alewives are pelagic, schooling and feeding in midwater or at the surface, over any bottom type.

Life history: Alewives spawn about two or three weeks earlier in the spring than the American shad. They migrate upstream in April and May from the mouths of rivers and creeks that open to the ocean into the freshwater flows. They spawn in quiet areas with slow current or in still pools, randomly releasing their minute, sticky eggs over the rocks, pebbles or other bottom material. After spawning, the adults return to the stream mouth and may live in the shallow estuary until fall, before going back to the ocean for the winter.

In April, the landlocked alewife in large freshwater lakes moves from its deepwater habitat toward shore to spawn in the shallow water along beaches and on shoals. Spawning occurs day or night from June through August, but normally peaks in mid-July. After spawning, the school of adult alewives retreats to deep water. The eggs sink to the bottom, and develop and hatch on their own. Landlocked alewife females can spawn 10,000 to 22,000 eggs, while the larger oceangoing alewives can produce up to 100,000 minute eggs.

Young alewives reach two or three inches long their first year. The males spawn at two years old, the females at three. They eat zooplankton and other tiny water organisms, some crustaceans, shrimp, small fishes and fish eggs. Even as adults, alewives are able to feed extensively on zooplankton, because the gill rakers that filter the microscopic food from the water increase in number as the fish grow. They are not always a welcome addition to a lake because they compete with the young of other fishes for food and they eat larval fish. Along the Great Lakes, summer die-offs of immense numbers of alewives have occurred, the dead fish washing onto shorelines. This summer kill is probably the result of water temperature change, spawning stress and other causes.

American Shad *Alosa sapidissima*

Species overview: The American shad is the largest member of the herring family that lives in or visits Pennsylvania waters. The annual migration of shad up rivers that feed the Atlantic Coast was used as food by American Indians as well as early European settlers. The spring shad run is credited with helping to save General Washington's starving troops at Valley Forge during the Revolutionary War, arriving just in time. Shad also supported a commercial fishery on the Susquehanna River as well as the Delaware River.

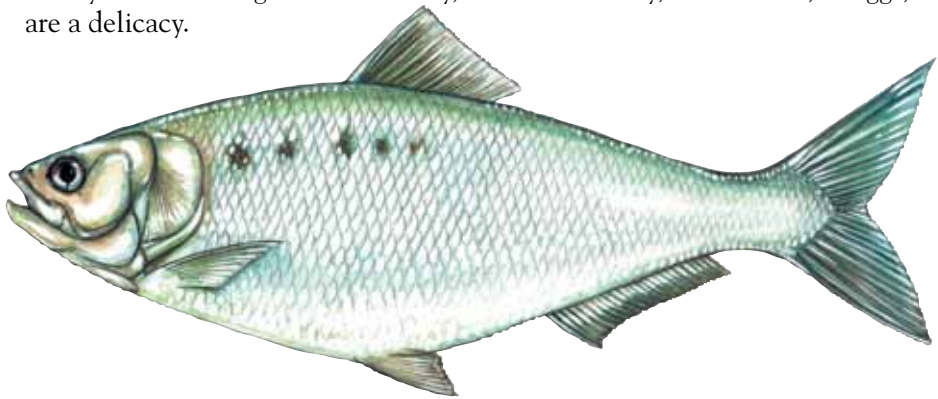
The Susquehanna's runs stopped when hydroelectric power dams were built across the river in the early 1900s. Since that blockage, efforts led by the Pennsylvania Fish & Boat Commission have been aimed at restoring shad to the Susquehanna watershed. The result is that now there are fish passage devices to enable fish passage at nearly all the dams. Full access to

the river system should be possible soon. Shad are once again returning to the Susquehanna through the fishways, and the shad are providing evidence of natural spawning. The Pennsylvania Fish & Boat Commission has also stocked shad in the Juniata River system, above the Susquehanna River dams, to help restore the run.

There are also fishways that allow shad migration over dam obstacles on the Schuylkill River and Lehigh River, but the only major waterway completely accessible to the natural shad migration in Pennsylvania is the Delaware River. Adult shad travel at least as far up as the confluence of the West Branch and East Branch of the Delaware, in extreme northeastern Pennsylvania.

Along the Atlantic Coast, shad range from Labrador to Florida, ascending coastal rivers all along the way during spawning runs, but they are most abundant from Connecticut to North Carolina. American shad were introduced into the Sacramento and Columbia rivers in California in 1871, and today there is a shad fishery on the Pacific Coast. In fact, shad eggs collected from the introduced population in the Columbia River have been used in the Susquehanna River restoration efforts. Past attempts failed to establish shad in Lake Ontario, the Mississippi River watershed and the Great Salt Lake.

The American shad's genus name "*Alosa*" is from "allis," an old Saxon name for the European shad. The species name "*sapidissima*" means "most savory." Even though shad are bony, the meat is tasty, and the roe, or eggs, are a delicacy.

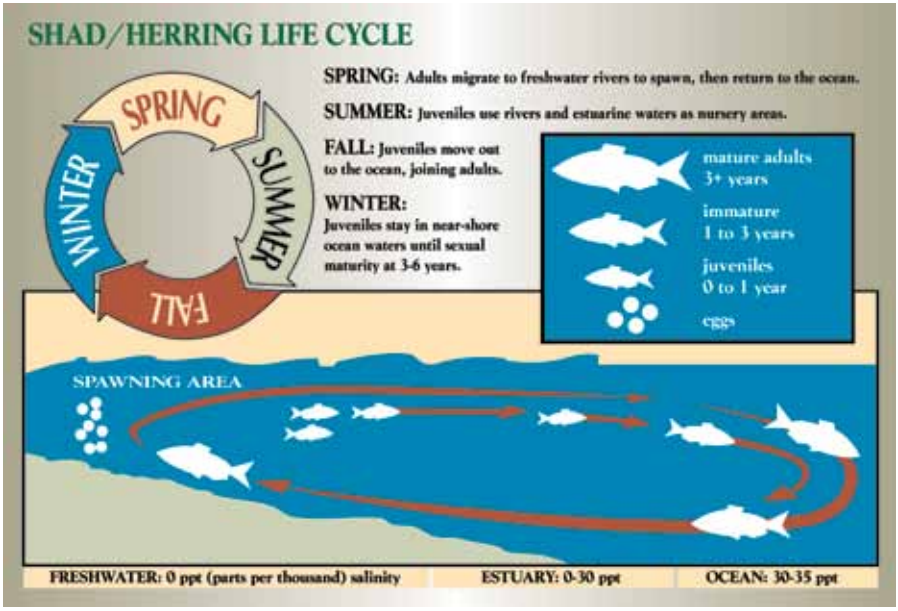


Identification: Female shad, carrying their eggs during the spawning run, average four to five pounds, with a six- or seven-pounder fairly common. The males are smaller for their age. Shad can grow to 30 inches, with a maximum weight of about 12 pounds. Shad are brilliantly silver on the sides, with a greenish or bluish-metallic sheen on the back. The scales are large and readily detach when the fish is handled. Shad have one to two, rarely three, rows of dark spots extending along the side from the back edge of the gill cover. The first spot is the largest. The body is deep from

the side and narrow seen head-on. Shad have sharp-edged modified scales along the belly line, as do other herrings. The dorsal fin is at the center of the back, and the tail is deeply notched. The dorsal and caudal fins are dusky. The caudal fin has a black edge, and the other fins are clear to light-green. The upper and lower jaws are about equal in length, neither jutting past the other. The rear corner of the upper jaw extends to the rear edge of the large eye. The head has a short, triangular look. The shad is notorious for its thin, easily torn mouth tissue.

Habitat: American shad are anadromous. They live in the open-water ocean as adults, entering brackish estuaries and swimming far upstream to spawn in freshwater rivers. They do not normally enter small streams and creeks, as does their cousin the hickory shad. American shad stay in the mainstem, bigger rivers. As marine adults, shad travel in schools extensively along the coast.

Life history: Shad run upriver from salt water into fresh water on their spring spawning migration when the water temperature is in the mid-50s to 60 degrees, with peak spawning activity occurring at about 65 degrees. The males travel upriver in schools ahead of the females. Shad spawn over sandbars or rocky riffles at night. Females, which are larger than the males, produce 100,000 eggs as an average, with 300,000 a documented high. Shad eggs are not adhesive and are just slightly heavier than water, so they do not readily sink. Instead, they drift along with the current. They develop and hatch in eight to 12 days, depending on



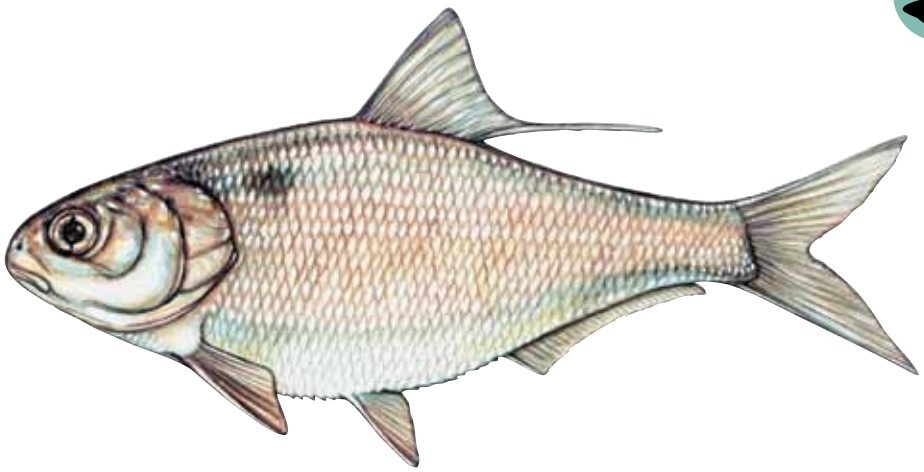
water temperature. Adult shad feed little on their upstream spawning run, although they strike anglers' offerings. The spawned-out, or spent, fish do eat on their way downriver to the sea again. Hatched shad live several months in fresh water, reaching the ocean by their first autumn. Shad stay in salt water for four or five years and until they are about 18 inches long, when they become sexually mature. Then they make their first freshwater spawning run. Some return to their home streams, but others show no migratory pattern. Shad feed mostly on microcrustaceans, or zooplankton, as well as some worms and small fish. While in fresh water, the young feed on insect larvae.

Gizzard Shad *Dorosoma cepedianum*

Species overview: The gizzard shad is a herring with a difference. It is set apart from its herring relatives (that are in the genus *Alosa*), by its gizzardlike stomach. The gizzard shad is found mainly in the Ohio River watershed and Lake Erie in appropriate habitat. However, as a result of both intentional and unintentional stocking, it is found statewide. The gizzard shad's original home range was the southeastern United States, except for the Appalachian Mountains, but the fish seems to be spreading northward. Biologists question whether or not the gizzard shad was native to Lake Erie. They believe it probably invaded the Great Lakes from the upper Mississippi River. Today, gizzard shad can be found in the St. Lawrence River, the Great Lakes, the Mississippi River and its tributaries, and the Atlantic and Gulf Coast watersheds.

The gizzard shad gets its common name from its muscular, gizzardlike stomach, which helps process the plankton and plant food this fish strains from the water. The genus name "*Dorosoma*" refers to a lancelike body. The species name "*cepedianum*" recognizes a French ichthyologist named Lacepede.

Identification: The gizzard shad has the typical herring family shape, but with a distinctive dorsal fin. Its short, soft-rayed dorsal fin is located at the center of its back. It has a long, trailing filament as the rear ray, longer than any of the other rays. The gizzard shad's back is silvery blue-green to gray. The sides are silvery or reflect blue, green, brassy or reddish tints. There is no lateral line. The tail is deeply forked, and the lower jaw is slightly shorter than the upper jaw. The snout is blunt. The mouth is small, and there is a deep notch in the center of the upper jaw. The gizzard shad's eye is large. There is a big, purplish-blue spot near the edge of the upper gill in young gizzard shad and small adults. This spot is faint or disappears completely in larger, older fish. The fins are dusky and there are the usual herring sawtooth-edged belly scales. Gizzard shad grow rapidly and can reach a maximum size of about 20 inches.



Habitat: The gizzard shad is a school fish of lakes and impoundments. It also lives in the backwaters of sluggish rivers and the deep, slow pools of smaller streams. Gizzard shad become more abundant as a lake eutrophies–that is, as it gains fertility through natural aging or added pollutants. Generally found in fresh water, gizzard shad can also live in the brackish water of tidal zones and estuaries. Unlike many other herrings, gizzard shad are nonmigratory and stay near their home areas. They are often found over a mucky bottom, which they filter when feeding.

Life history: The gizzard shad spawns in spring, May to June, when water temperatures reach the mid-60s to mid-70s. Spawning gizzard shad gather in large schools to broadcast their eggs in water several feet deep, near the shore. The actual spawning is done near the surface. The females participate with several males. An average female gizzard shad produces about 300,000 eggs, but some may expel a half-million, with maximum production by two-year-old fish. After releasing their eggs and milt, the adults return to the water depths. The sticky eggs fall to underwater roots, plant fibers and other debris. There they adhere and hatch in two or three days. Young gizzard shad are a food source for game fish, but grow rapidly, to as much as seven inches their first year. Their use as a forage fish is limited because they quickly grow past the prey size preferences of all but the largest predatory fish. In some fertile waters, gizzard shad become numerous, and extensive winter die-offs are not uncommon. Winter die-offs are associated with temperature stress. Massive mortality of gizzard shad may also follow spawning.

Gizzard shad are filter-feeders, straining small animal organisms and plants from bottom mud and organic deposits. The adults have very many, often more than 400, fine gill rakers that can catch even minute plankton. Gizzard shad have an unusual digestion process for fish. The vegetable material they eat is ground in a gizzardlike stomach.

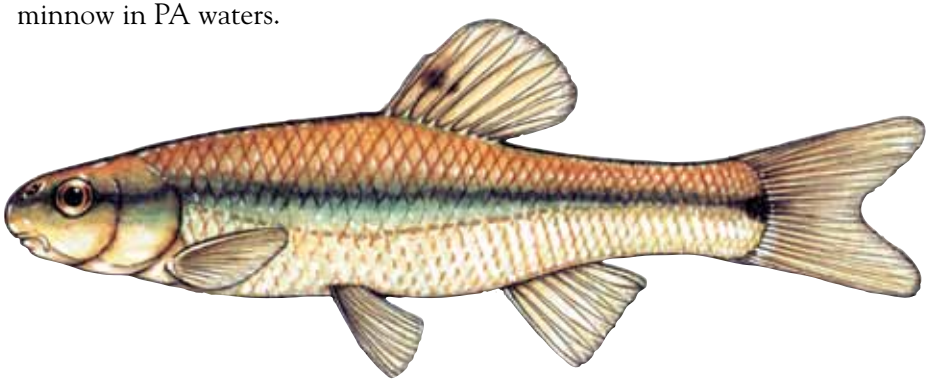
Carps and Minnows

Family Cyprinidae

Family overview: Minnows are a huge family of fishes. About 2,100 species are distributed in North America, Eurasia and Africa. North America alone (north of Mexico) has over 230 species of minnows. In Pennsylvania, 39 native minnow species have been documented in recent years, in 13 groups, or genera. There are also introduced minnows, like carp and goldfish. Many minnow species may be present in the same water area. Fifteen or more may be found together in streams with high biodiversity, like the tributaries of the Allegheny River. In all, minnows make up 25 percent of Pennsylvania's total fish fauna.

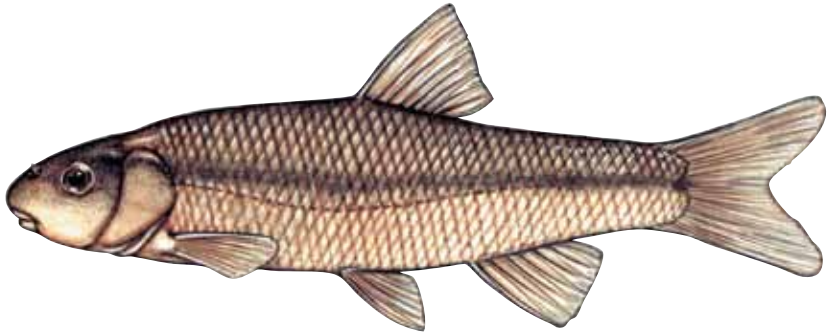
The young of most fish, including game fish, are sometimes incorrectly called "minnows," because of their small size. True minnows belong to the scientifically defined Cyprinidae family. They may be quite large, like a 50-pound carp, or a scant three inches long, like the blacknose dace. The carp is big enough to attract sport anglers. Other members of the minnow family provide fishermen's bait and are an important food source for game fish. In turn, minnows may eat the eggs and young of sport fishes and compete for available food. Nevertheless, all minnows and other non-game fish are an important part of Pennsylvania's aquatic life regardless of whether they provide food for "game fish."

Some minnows are plentiful in Pennsylvania. Other minnows are sensitive to pollution and are indicators of water quality. The gravel chub is so rare, it is an endangered species in the state. In 2000, Fish & Boat Commission biologists identified the first known occurrence of the pugnose minnow in PA waters.



Bluntnose Minnow *Pimephales notatus*

General identification: Size doesn't define the minnow, but certain body characteristics separate it from other fishes, especially the similar-appearing suckers. All minnow species have one brief dorsal fin, with nine or fewer soft rays (usually seven or eight). Minnows have well-defined cycloid, or smooth-feeling, scales, which may shed readily from the fish when it is handled. The anal fin is placed farther forward on minnows than it is on suckers. None of the minnows' fins has true spines, but in the carp, some of the soft rays harden into what feel like horny spines. Minnows have no teeth in the jaw, but they do have one to three rows of toothlike structures on the pharnygeal bone, the bony structure that supports gill tissues. Thus, the pharyngeal "teeth" are in the throat, where they are used to grind the minnow's food against a horny pad. Spawning minnow males, and occasionally females, develop horny nodules, called tubercles, or pearl organs, on the head, body or fins. The males also deepen in color or show additional red or yellow hues at spawning time. Except for a few extremes, most of the minnows are small fish, growing to less than 12 inches, sometimes much less, depending on the species.



Cutlips Minnow *Exoglossum maxillingua*

Life history: Minnows are found in many habitats, according to each species' preference, from big lakes to small streams. Most minnows favor medium-sized, fairly warm, unpolluted rivers. Many of the minnows spawn in the spring to early summer, but some spawn in late summer. Most do not build nests for spawning, but scatter eggs randomly. Others, like the stoneroller, hollow out nesting sites in the bottom. Some, like the creek chub and fallfish, are known for the stone piles they build in streams, into which eggs are deposited. Because other minnows may also use these stone mounds for spawning, natural hybridization of minnow species occurs. Minnows may eat animal life, like insects, small crustaceans, clams, smaller fishes and fish eggs, or they may consume plants, like algae and other organic matter in the stream. The stoneroller is specially equipped to digest plant material. It has an extremely long intestine that wraps around its swim bladder.

Shiners *Genera Notropis, Luxilus, Notemigonus*

Genus overview: The shiners of the genera *Notropis* and *Luxilus* are the second largest group of freshwater fishes in North America, numbering 75 species. Nearly 20 shiner species have been collected in Pennsylvania recently. Some of Pennsylvania's shiners are abundant. Others are so rare that they are candidates for the state's endangered or threatened species list.

In Pennsylvania, the common shiner is indeed common and in all watersheds. Other shiners are limited in distribution. Shiners of the Susquehanna River and its tributaries include the comely, satinfin, spottail, swallowtail, rosyface, spotfin and mimic. The Potomac River watershed in Pennsylvania has the comely, satinfin, spottail, rosyface and spotfin shiners.

The Delaware River watershed has the comely, satinfin, bridle (rare), spottail, swallowtail, rosyface and spotfin. The ironcolor shiner was rediscovered in a tributary to the upper Delaware River. It may occur in the lower river, but its presence has not been confirmed.

The Genesee River watershed, flowing from extreme northcentral Pennsylvania north into New York state, may have the blackchin shiner, because this fish's presence has been documented in the Genesee River watershed in New York.

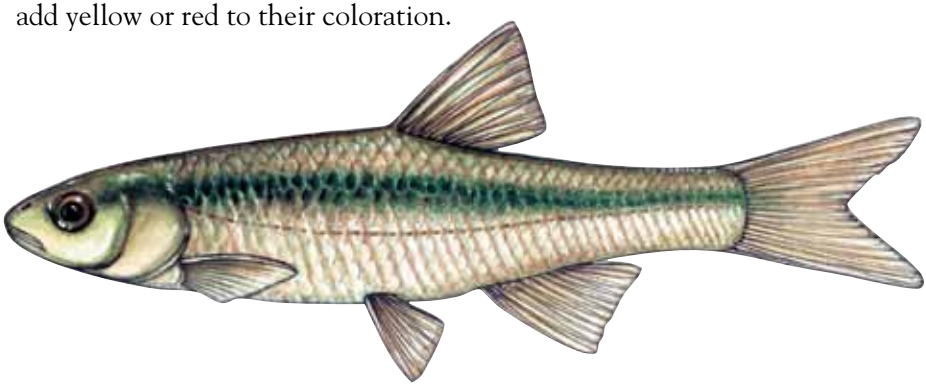
The Allegheny and Ohio River watersheds have a wide diversity of shiners, including the emerald, ghost (rare, recorded from the Monongahela River), striped, bigmouth, spottail, silver, rosyface, spotfin, sand, redfin and mimic. The Lake Erie watershed in Pennsylvania has been confirmed to have the emerald, striped, blackchin (in Lake Pleasant), spottail, silver, rosyface, spotfin, sand, redfin and mimic.

Some Pennsylvania shiners are of unknown status, or they are believed to be extirpated (gone from the state). The popeye shiner was last seen in 1853 at the mouth of the Clarion River. The river shiner has been seen on rare occasions since 1886, in the Ohio and Monongahela rivers.

The common shiner and striped shiner are assigned to the scientific genus *Luxilus*. Most other small shiners are in the genus *Notropis*. The golden shiner is in the genus *Notemigonus*, and is common across Pennsylvania, found in all the major watersheds.

Identification: Many shiners grow to a length only of two or three inches, but the common shiner may reach 10 inches, and the golden shiner, 12. The spottail, silver and spotfin shiners can grow to more than four inches long. Most shiners are slender fish, except the common, striped and golden, which are deeper bodied and more robust-looking. There are no barbels around a shiner's mouth, and there is a short, single soft-rayed dorsal fin. Shiners have pharyngeal teeth, toothlike structures in the throat, for grinding food. The scales, which look higher than they are wide, are very visible and reflect brilliant silver or brassy-gold tints, so the fish have

a "shining" appearance. Some shiners display darkish lines along the side and may show tints of blue or green. During breeding time, shiners may add yellow or red to their coloration.



Emerald Shiner *Notropis atherinoides*

Habitat: Shiners are found in many habitats, according to their species. Some shiners, like the emerald, golden, spottail, sand and mimic, can be found in lakes and the slow areas of large streams. Others, including the satinfin, common, striped and spotfin, prefer cool, fast headwaters and small streams. Some shiners, like the swallowtail, are tolerant of muddy water. Many shiner species need water that is clear and clean. The bridle and ironcolor shiner can live in brackish water near the tide line.

Life history: Shiners are schooling fish. They feed, travel and spawn sometimes in very large groups. Shiners, especially abundant types like the common, golden and emerald, are important forage fish, providing food for larger fish and game fish. Anglers also use shiners for bait.

Shiner species show a variety of spawning behaviors. Some shiners, such as the satinfin and spotfin, deposit eggs in the crevices of submerged tree bark or in rock cracks. The males defend the spawning territory. Some shiners, including the emerald, bridle, spottail and mimic, broadcast their eggs randomly over gravel, sand or mud bottoms. Several shiners, like the common, rosyface and striped, spawn over the stone-mound nests of creek chubs and hornyhead chubs, allowing their eggs to fall into the crevices of the already built spawning site. Because several shiner species may use the same spawning location at the same time, hybridization is common. Shiners spawn from spring throughout summer, according to their species. They do not defend the nest after spawning. Some shiners are pelagic, living in open water and feeding at midwater and on the surface. Their feeding "dimpling" may look like raindrops on the water. Shiners eat zooplankton, small crustaceans, aquatic insects, terrestrial insects that fall into the water, algae and other plant material.

Chubs *Genera Nocomis, Semotilus, Margariscus*

Genus overview: In Pennsylvania, three members of the minnow family are commonly called "chubs." They provide food for larger game fish. Some chubs, especially fallfish, may bite an angler's bait or fly.

River chubs belong to the genus *Nocomis*. In Pennsylvania, river chubs include the hornyhead chub and river chub. The hornyhead chub is a Midwestern fish that enters Pennsylvania only in the Allegheny River watershed. It is found mostly in tributary streams in the state's glaciated northwest region. The river chub has a very wide distribution in Pennsylvania, although its establishment in the Delaware River watershed is thought to be recent. The genus name "*Nocomis*" is an American Indian name that originally referred to these fishes.

The similarly appearing creek chubs are assigned to the genus *Semotilus*. In Pennsylvania they include the creek chub and fallfish. The smaller pearl dace (*Margariscus margarita*) is found in scattered locations in the state. It is never abundant, and is not found in the Lake Erie drainage. The genus name "*Semotilus*" means "spotted banner," referring to the spot on the creek chub's dorsal fin.

Identification: Chubs are stout-looking, cylindrical minnows, with large, reflective scales and a moderately large mouth. The river chubs (Genus *Nocomis*) all have yellow-orange to red fins. Their small eyes are set far up toward the top of the head. The creek chubs (Genus *Semotilus*) have a triangular flaplike barbel in the groove between the lip and snout. In all chubs, the males grow bigger than the females.

The hornyhead chub grows to about 10 inches. They are dark-olive to brown on the upper side and back, have green highlights on a yellow-brown side, and fade to light-yellow on the belly. A bright-red spot behind the eye appears on large males.

River chubs reach about one foot long. They are also dark-olive to brown on the back, shading to yellow-white on the belly, with a brassy, green iridescent side. The scales on the upper part of the body are dark-edged, and appear outlined.

Pearl dace are dark olive-gray on top. They have many small black and brown specks on their silvery sides. The breeding male has a bright orange-red stripe along its lower side. Pearl dace rarely grow more than five inches long.

During breeding time, the head of male chubs swells and the fish develop large tubercles, or pearl organs. These fleshy knobs are found mostly on the top of the head, but sometimes on the fins or other parts of the chub's body, according to the species. The males also brighten in color, with intense pink, orange, blue, green or purple hues on the body and fins. Creek chubs develop a rose-colored band along the side, and red surrounds the dark dorsal-fin spot.

Habitat: Chubs are fish of flowing water. The creek chub and hornyhead chub live in gravel riffles and quick-moving runs in small to moderate-sized cool streams. River chubs live in the rapid currents of rocky bottomed large creeks and small rivers. The less common pearl dace also thrives in the current of cool streams. The creek chub is tolerant of low oxygen situations, such as those caused by organic and coal mine pollution. It is present in a stream after almost all other fish have succumbed to water quality degradation.

Life history: All of the chubs build nests, except for the pearl dace. The males construct spawning sites in early summer by carrying river pebbles in their mouths, or pushing them with the snout one by one to build up a large pile in a riffle. When stream levels fall in the summer, the stone mounds may be left high and dry or they may protrude above the low water. The gravel piles become a curiosity, and a mystery, to those who don't know that fish built them.

Creek chubs build gravel nests that look like underwater ridges, sometimes measuring six feet long. They add to the downstream side of the pile during the spawning season, lengthening it and aligning it with the current flow. The males defend the nest territory, while several females add eggs to the gravel pile. Female creek chubs produce 2,200 to 7,500 eggs a year. The eggs fall into the spaces between the rocks or are covered and protected by additional stones the male carries in.

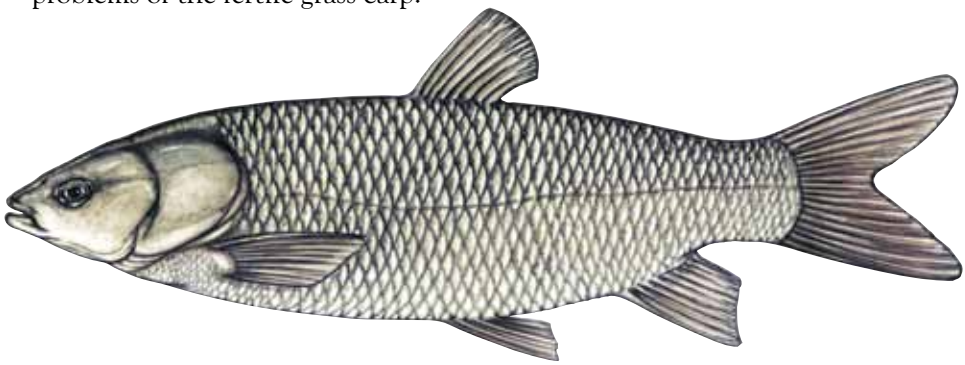
Other minnows gather over the nest mounds and deposit their eggs as well, leading to some hybridization among species. After spawning is completed, chubs provide no care for the eggs or young. The eggs hatch and disperse on their own. Chubs feed on stream invertebrates, including aquatic insects, plant material, tiny crustaceans and mollusks. The larger chubs eat larger insect larvae and adults, as well as small fish. Surface-feeding chubs, especially the creek chub and fallfish, are often caught by fly fishermen.

Grass Carp *Ctenopharyngodon idella*

Species overview. The grass carp, or white amur, was introduced into the United States from East Asia in the 1960s as a potential food fish and to control aquatic vegetation. By 1976, the grass carp had been stocked in or spread to, by traveling rivers, 35 to 40 states. Grass carp are voracious feeders on aquatic vegetation, eating many pounds in a single day. Because of this double-edged trait, they are an option for pond owners as a non-chemical control of aquatic vegetation and algae. However, grass carp are also prolific spawners, and fisheries managers view their introduction with caution. Their release into the wild could have devastating effects

on aquatic ecology, removing underwater vegetation that other water life depends on for food and cover.

In Pennsylvania, introducing grass carp into the state's waters, or possessing them without a permit, is prohibited. However, a reproductively sterile version of the fish, called the triploid grass carp, is allowed under a tightly regulated permit, available through the Pennsylvania Fish & Boat Commission. The triploid is created by physical alteration of grass carp eggs. The U.S. Fish & Wildlife Service tests each fish before it is sold or stocked to make sure it is sterile. The triploid then may answer the need for aquatic vegetation control on small waterways, without the potential problems of the fertile grass carp.



Identification: The grass carp looks somewhat like the common carp. Its color is olive to silvery-white, and it has large scales that are dark-edged, with a black spot at the base. The fins are clear to gray-brown, and the body is relatively slender and compressed-looking for a carp. Unlike the common carp, grass carp do not have spiny modified rays at the leading edge of the dorsal and anal fins. Grass carp also do not possess barbels around the mouth.

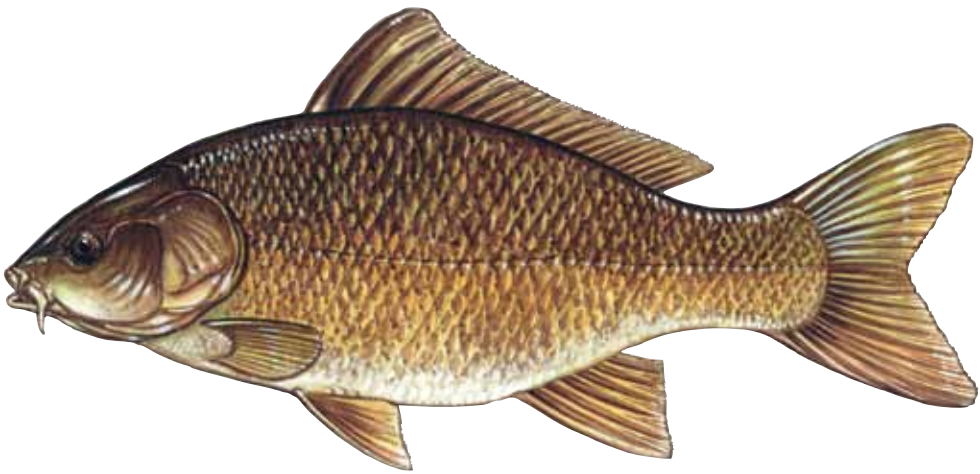
Habitat: The natural habitat of the grass carp is lakes, ponds, pools and the backwaters of large rivers. In Pennsylvania it is allowed only by permit in ponds.

Life history: Unaltered grass carp are highly fertile. Each female produces one million or more eggs. The eggs must remain suspended in the current for several days before hatching, so grass carp need long stretches of flowing water for successful reproduction. They grow rapidly, to more than 10 pounds in just two years. They are not readily taken by anglers, because they feed almost entirely on aquatic vegetation, algae and some small bottom-dwelling invertebrates. They can grow to 50 pounds or more and about four feet long.

Common Carp *Cyprinus carpio*

Species overview: Pennsylvania's biggest minnow is not a native of this continent, or this hemisphere. It was originally distributed throughout Europe and Asia. It is not known exactly when carp were brought to the United States from Europe, probably the mid-1800s to late 1800s. Some earlier reports by European settlers of "carp" in North America are thought to be misidentifications of the quillback (see page 85). By 1880, the U.S. Fish Commission had distributed more than 12,000 carp to people in 25 states and territories to establish the fish in this country. Today, carp are found not only throughout the United States, where they are especially abundant in the fertile waters of the Mississippi River watershed, but they occur in all 67 Pennsylvania counties. Young carp are an important part of the aquatic food base. Larger carp are a fisherman's challenge because of their tackle-testing weight. Carp are also pursued by bow fishermen, especially when the fish move into shallow water to spawn. The genus name "*Cyprinus*" is the old-world name for carp. "*Carpio*" is a Latinized word meaning "carp."

Identification: Carp can be confused with feral (wild) goldfish, except that the carp grows much larger and has two pairs of soft, fleshy barbels around its mouth. Goldfish don't have these barbels. The carp's body is robust, deep and thick, and arched toward the dorsal fin. It has large scales



that are dark-edged, with a black spot at the base. Most carp are heavily scaled, but two genetic mutants show either few, extremely large scales (the "mirror carp") or no scales at all (the "leather carp"). Carp have a lengthy dorsal fin, with nearly 20 soft rays. The dorsal fin extends well along the back. The dorsal and anal fins have a sharp "spine," actually, a hardened soft ray, on the front edge. The typical carp's back is olive-brown to

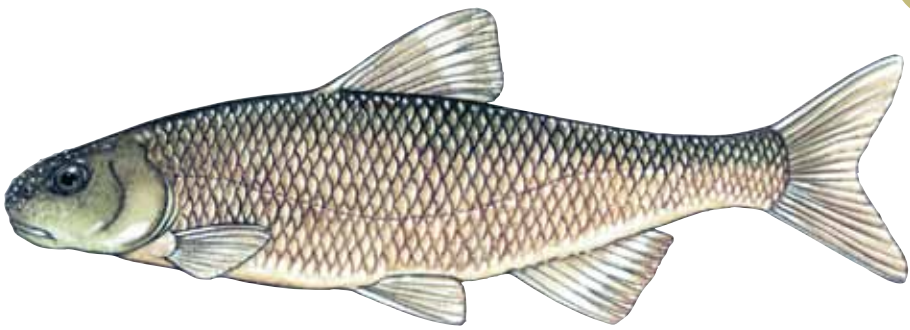
reddish brown, with the sides becoming silvery-bronze, brassy, or olive-gold. The belly is yellow or yellow-white. The caudal and anal fins are usually tinged with red. Carp generally grow to about 30 inches and 10 to 15 pounds. The Pennsylvania state record is over 50 pounds.

Habitat: Carp tolerate a variety of habitats, even heavily silted water or polluted water that most other fish cannot tolerate. They can also be found in clean streams, including the larger trout streams. When carp live in rivers, they inhabit the slower-flowing sections. They are also in ponds, lakes and reservoirs. Carp prefer shallow areas with plenty of underwater weed growth. But they can be found over any type of bottom, including mud, sand or gravel. Carp create their own turbidity, muddying the waters during their bottom-rooting feeding. They have been blamed for contributing to the decline of clean-water native fish, because their silt-stirring activities decrease light penetration. This inhibits plant growth, and causes mud to settle on and suffocate developing fish eggs.

Life history: Carp spawn in late spring to early summer, over aquatic vegetation. They may choose a shallow, weedy bay. After rains have swelled their home river over its banks, they may move into flooded fields to deposit eggs on submerged plants. The splashing of their spawning commotion in shallow water can often be seen and heard. Several males may spawn with a female, which can release up to two million tiny eggs. The carp parents abandon the eggs. The eggs adhere to submerged vegetation and to the bottom. They hatch in four or five days. Carp grow to four or five inches their first year. They mature in three or four years, and they can live to be about 20 years old. The carp is an omnivore, eating a wide variety of aquatic plants, algae, insect larvae and other invertebrates, and even small fish. Its usual feeding method is to disturb the bottom material with its snout and pick up the food it dislodges, usually kicking up clouds of silt. Carp have a well-developed sense of taste and a sensitive mouth. Their pharyngeal "teeth," located in the throat, are adapted for crushing. The larger ones look like human molars.

Common Shiner *Luxilus cornutus*

Species overview: The common shiner is indeed common in Pennsylvania, and it is an important component for the food web in Pennsylvania stream ecosystems. The common shiner lives in all of Pennsylvania's watersheds. It is found across southern Canada to Saskatchewan, and south to Kansas and Missouri in the Ohio and Mississippi River watersheds. It can be found in the Atlantic Coast states to Virginia's James River.



Identification: The common shiner averages three to four inches in length, but may attain a length of eight inches. The back of this relatively deep-bodied fish is olive-green with a noticeable purple or blue-gray stripe, becoming silvery on the sides and white on the belly.

The head of breeding males becomes swollen and pinkish purple, and it is marked with a dense covering of sharp tubercles that extends along the back to the dorsal fin. A single row of tubercles also is found along the hind corners of the lower jaw. The scales on each side are higher than they are wide. Their pigmentation makes it appear as if some scales are missing. The scales on the back just behind the head are small and crowded in irregular rows.

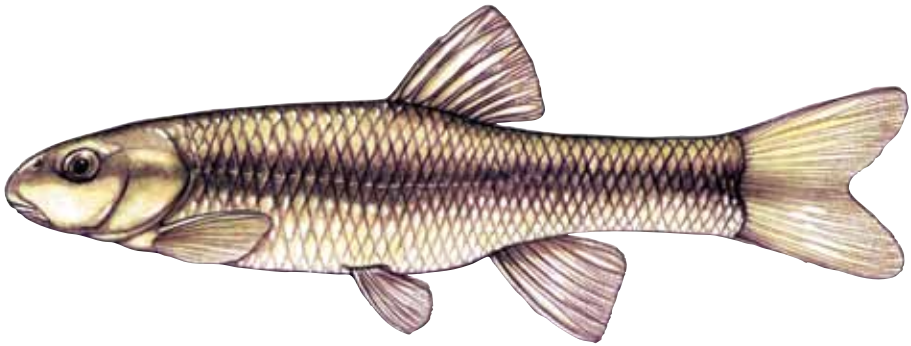
Habitat: The common shiner prefers streams of small to moderate size that are shaded with cool and clear water. It does not tolerate warmer or more silted conditions as well as other shiners.

Life history: Common shiners spawn at water temperatures of about 60 to 65 degrees, usually from May into July. The large range of the common shiner can probably be partly attributed to its spawning habitats, because it uses several habitats for this purpose. Common shiners spawn over gravel beds, depressions that they build in sand or gravel in flowing water, or the spawning sites of other fish, often including those of chubs. Males remain over nests to defend the eggs from predation.

River Chub *Nocomis micropogon*

Species overview: The river chub is one of Pennsylvania's most common baitfishes, and it appears throughout the state. Its native range includes Atlantic watersheds from the Susquehanna River to Virginia, and from New York state west to Michigan and south to Alabama and Georgia. The name "*micropogon*" comes from Greek words that mean "small" (*micro*) and "beard" (*pogon*), referring to the fish's barbel on the jaw.

Identification: Anglers sometimes catch large river chubs while fishing for other species. River chubs attain lengths of six to nine inches.



The river chub has small eyes and a long snout. The back is olive-brown, shading to silvery on the sides above a pale-yellowish belly. The head of large breeding males becomes swollen between and behind the eyes. The head has fewer than 40 large, sharp tubercles above the snout but below the eyes. The pectoral fins are somewhat rounded and blunt-tipped, and a fleshy barbel is present at the rear angle of the jaws.

Habitat: The river chub prefers moderate- to high-gradient large streams or small rivers and fast, clean, cool water with bedrock bottoms and gravelly riffles.

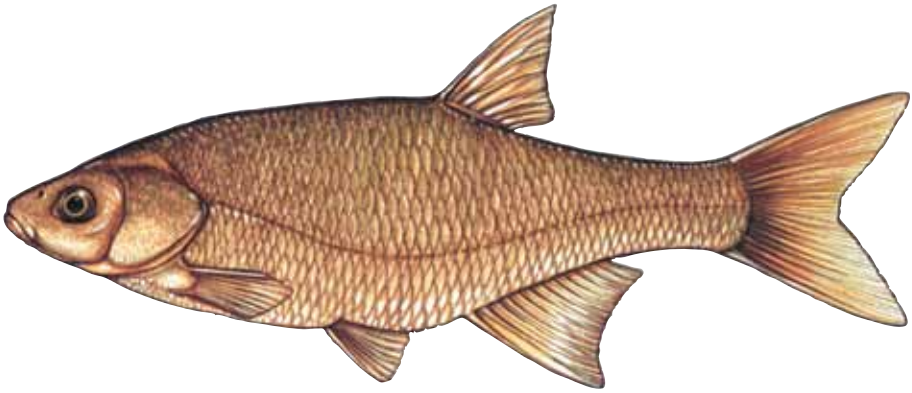
Life history: In addition to the head swelling, breeding males grow tubercles on the head and develop blue and green body colors. Males hold stones in their mouths and build nests of mounds that can reach a diameter of 24 inches. The river chub males defend their nests, but they tolerate other minnow species using their large spawning sites. Their nests are built during the higher flows of spring and early summer. These nests are often visible as mounds of gravel left high and dry when flows dwindle in late summer.

The diet of the river chub includes small clams and aquatic insects. River chubs live about five years.

Golden Shiner *Notemigonus crysoleucas*

Species overview: The golden shiner is widely distributed from the Canadian Maritime provinces, throughout the eastern and central United States, to South America, and in many parts of the western United States. The golden shiner is one of Pennsylvania's most common shiners. It can be found throughout the state. The golden shiner is most often used as bait. "*Notemigonus*" means "angled back," and "*crysoleucas*" means "golden-white."

Identification: Adults can reach sizes of seven to 10 inches, and may live as long as eight years. Anglers sometimes catch larger adults while fishing for other species. The golden shiner is deep-bodied with a small head. It has gold-colored sides and an olive-brown back. The sides sometimes reflect a silver color. The fins in the adult are yellow or light-olive, and silvery in the young. The smallest young, those smaller than about four inches, appear silvery all over, as do other shiners. Young golden shiners have a dark lateral stripe that becomes fainter as the fish grows, until it is absent in adults. The lateral line is curved noticeably downward.



The golden shiner's body has cycloid scales, but the head has no scales. It has four to six teeth in one or two rows on the pharyngeal arches. There are no teeth in the mouth. The golden shiner has a single, spineless dorsal fin with eight rays. The anal fin has 11 to 13 rays and is deeply curved.

The belly between the pelvic and anal fins is raised in a sharp keel that bears no scales.

Habitat: The golden shiner can be found in the quieter portions of lakes, rivers and streams with clear water, a bottom of sand or organic debris, and much aquatic vegetation.

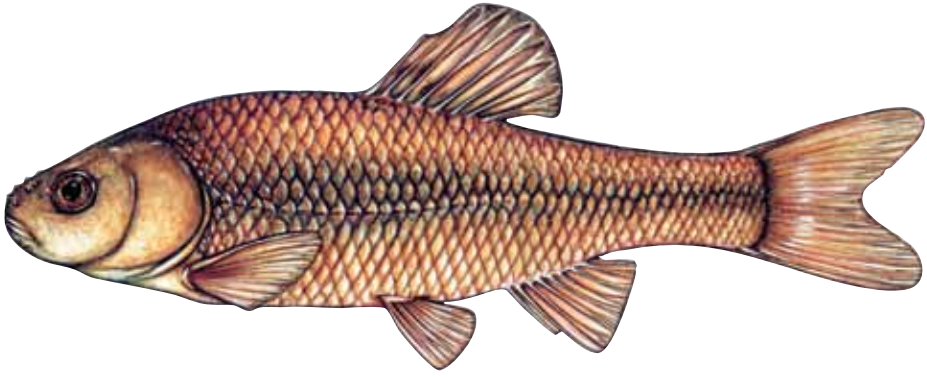
Life history: Golden shiners spawn in late spring through about mid-summer in water temperatures of 68 to 80 degrees. The female lays adhesive eggs in submerged vegetation. One or two males usually pursue the female, pushing the female with their snouts and moving in quick circles. Spawning males grow small tubercles on the top and sides of the head, and on the lower jaw.

Golden shiners feed on zooplankton and midge pupae. They also consume small mollusks, insect larvae, filamentous algae and terrestrial insects.

Fathead Minnow *Pimephales promelas*

Species overview: The fathead minnow's original range in Pennsylvania included the Appalachian Mountains and west. Today, this species is distributed statewide and appears most often in small, still waterways and slow-moving streams. The fathead minnow is a common baitbucket fish, propagated frequently because of its hardiness. This minnow is probably the most common baitfish sold in Pennsylvania. The fathead grows to a maximum size of about 3½ inches. The name "*promelas*" comes from Greek words that mean "in front of" and "black," referring to the color of the breeding male's head.

Identification: The fathead minnow is yellow-olive or olive-colored on the back with hints of purple and copper in older fish. The sides become lighter with more yellow, fading to yellowish white or silver on the bottom. The fins appear tinted with silver or olive-yellow. The lateral line can be complete or incomplete. The fathead minnow's body is completely scaled, with scales crowded in front of the dorsal fin. Breeding males develop tubercles on the snout and a gold-copper ring around the body right behind the head. The body of the breeding male darkens, and the head is almost black.

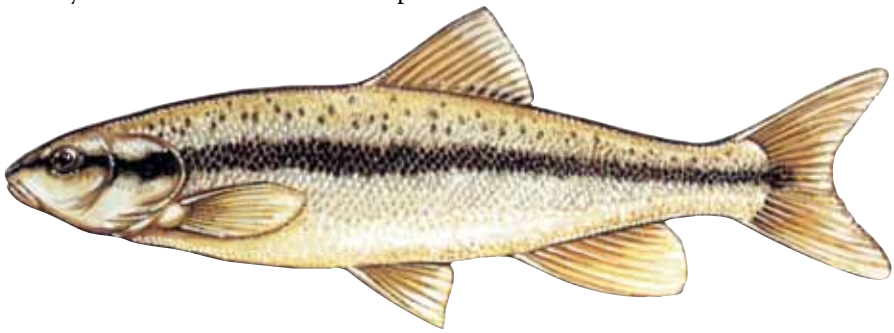


Habitat: Because the fathead minnow is so hardy, it tolerates a wide range of environments from clear water to cloudy water, and extremes of pH and low oxygen levels. Fathead minnows prefer slow-moving streams and still water.

Life history: Fathead minnows spawn from late spring into summer when water temperatures reach about 60 degrees. Males prepare nests by clearing a spot for the nest if it's on the bottom, and they establish territories. Females lay their eggs in the nests, or underneath lily pads, stones and logs, and other objects. The male grooms the eggs, which are contained in viscous material so that they don't scatter. Eggs hatch in six to nine days. Fathead minnows don't often live past their third year.

Blacknose Dace *Rhinichthys atratulus/Rhinichthys obtusus*

Species overview: The blacknose dace is a common small minnow, distributed throughout the Mississippi and Great Lakes watersheds, and along the Atlantic Coast to North Carolina. There are two species in Pennsylvania–the western blacknose dace (*Rhinichthys obtusus)* in western Pennsylvania and the eastern blacknose dace (*Rhinichthys atratulus)* in the eastern part of the state. Both look virtually alike. The blacknose dace's genus name "*Rhinichthys*" means "snout-fish," and the species name "*atratulus*" is derived from a word that means "clothed in black." Local Pennsylvania nicknames for this species are "redfin" and "redfin dace."



Identification: The blacknose dace is a small, slender minnow that grows to about three inches long. They have the typical minnow's short, single dorsal fin and a forked tail. The back is light or dark-brown, or gray. The sides shade lighter, toward a silvery-white belly. Sprinkled along the sides are dark scales that give the fish a spotted appearance. The blacknose dace's most obvious characteristic is its black side stripe. The stripe runs from the snout through the eye, and along the length of the side to the tail. At breeding time, the males also have a rusty-orange or red stripe immediately below the black side stripe. In spawning season, males also acquire pads on the upper surface of the pectoral fins, and the pectoral and pelvic fins become yellow-white or orange. The blacknose dace's cousin, the longnose dace, grows up to five inches long and is reddish brown to dark-olive, with scattered dark spots and a light belly. But it does not display the blacknose's prominent black "racing" stripe on its side.

Habitat: Blacknose dace are creatures of flowing water. They are found in most of the small streams in Pennsylvania, but are typically in the moderate current of headwaters and springfed runs. Although they thrive in stream pools as well as rocky riffles, they won't be found in the still water of lakes. The blacknose dace shares Pennsylvania with the longnose dace (*Rhinichthys cataractae*). Both dace are most often found in the same streams, but they use different habitats.

Life history: Blacknose dace spawn in spring, May to June, choosing a shallow, sandy or gravelly riffle. The males assemble over the spawning area and stake out territories, guarding a bit of underwater turf against other blacknose dace males. The males circle and seem to "dance" to attract females. Several females spawn on the male's nest site or in a nearby similar area. Each female deposits some 750 eggs. The eggs fall in or on the gravel and the parents abandon them to develop on their own. Blacknose dace live only three or four years. They feed on the tiny invertebrate animal life they find on the stream bottom, including blackfly and midge larvae, as well as diatoms and algae.

Longnose Dace *Rhinichthys cataractae*

Species overview: The longnose dace can be found throughout North America and northern Mexico. It occurs more often in the eastern United States than in our western states. In Pennsylvania the longnose dace is most abundant in swift-flowing streams with gravelly bottoms, although it does appear in some lakes.

Identification: Adults reach a length of four or five inches. On the upper sides and back, the longnose dace is reddish brown to dark-olive. The sides are lighter, sometimes with a faint darker lateral band, fading to silver or white on the bottom. Dusky scales are scattered along the sides, making the longdose dace appear mottled. The fins are transparent to light-green. The anal, pectoral and pelvic fins of spawning males are red, as are the lips. Spawning males develop large tubercles on the rays of the pectoral fins. The mouth is nearly horizontal, and the snout projects well beyond the mouth. The pelvic and dorsal fins have eight rays. The pectoral fins have 13 to 15 rays. The longnose dace has a barbel at the tip of the jaw.

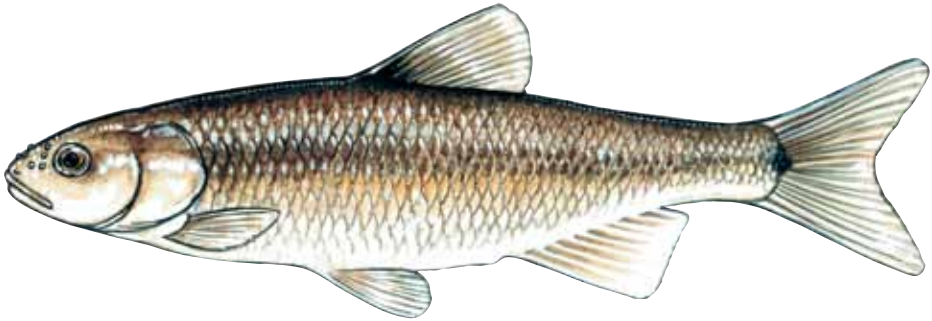
Habitat: The longnose dace prefers swift riffles in cold or cool fast-moving streams, most often trout streams in Pennsylvania. Their

downward-sloping head assists them in maintaining their position in the water column in the fast riffles they prefer. Longnose dace feed on aquatic insects, including mayflies, blackflies and midge larvae. Longnose dace occur throughout Pennsylvania.

Life history: Longnose dace usually spawn in the spring, from April into June. Spawning sites include areas over gravel or sand in fast water. Males defend the spawning site by butting and biting intruders. Each female lays some 200 to 2,000 adhesive, transparent eggs, which hatch in seven to 10 days at about 60 degrees.

Creek Chub *Semotilus atromaculatus*

Species overview: The creek chub is one of the most common stream fishes in central and eastern North America, and it is found in all of Pennsylvania's watersheds. Creek chubs are usually associated with transitional streams–streams that contain water temperatures typically warmer than coldwater streams and cooler than warmwater streams. Their adaptability has allowed them to establish and maintain a statewide distribution. Creek chubs are a popular bait fish.

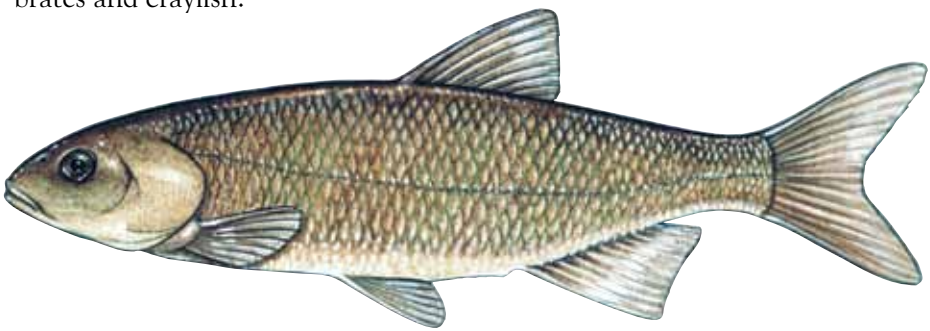


Identification: The creek chub may attain a length of 10 inches, but the length averages closer to four inches. The body is nearly cylindrical, tapering at the head and tail. The back is light to dark-olive, shading to silvery on the sides with purple-violet reflections above a silvery-white belly. The dorsal fin has a dark spot at the lower front corner. The head and body of breeding males are tinged with rose-purple, blue, yellow or orange. A single row of six to 12 large tubercles extends backward from the front of the snout to a point above and just behind each eye. Smaller tubercles are found on the gill cover and on the first six to eight rays of the pectoral fins.

Young creek chubs are more silvery than adults. The young also have the spot on the dorsal fin. A narrow black band extends along the middle of each side from the eye to the caudal fin base. It ends in a dark spot.

Habitat: Creek chubs prefer the deeper pools of small and medium-sized streams, but they can also be found in lakes and ponds.

Life history: Creek chubs spawn in spring when water temperatures reach about 55 degrees. Males build nests by pushing pebbles with their snouts and carrying them in their mouths. The nest is a row of gravel in line with the current flow. Males dig a depression at the downstream end of the pebble line. Some creek chub nests can be as long as about six feet. Males vigorously defend their nests. Young creek chubs feed on aquatic invertebrates. Adult creek chubs eat small fish, larger invertebrates and crayfish.



Fallfish *Semotilus corporalis*

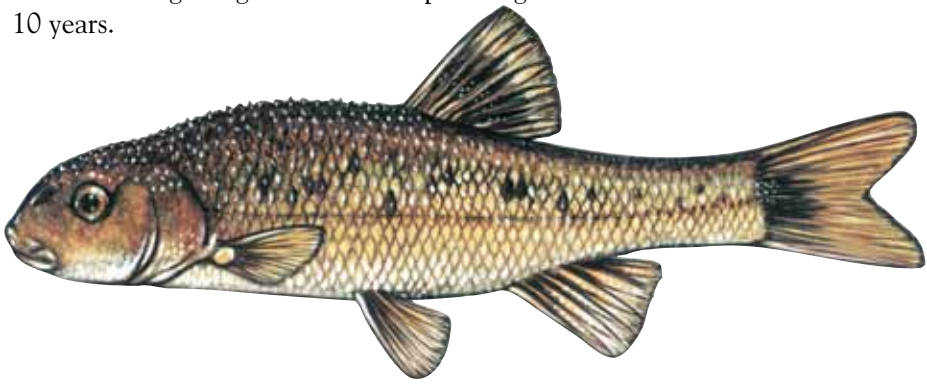
Species overview: The fallfish is a species of the East Coast, ranging from Canada to Virginia. The fallfish lives in the Susquehanna, Delaware and Potomac River watersheds in Pennsylvania. It is Pennsylvania's largest native minnow. Its name "*corporalis*" is a Latin word that means "bodily," but it could also reference the military rank and the fish's aggressive behavior.

Identification: Fallfish may attain lengths of about 18 inches, but they average half that. The back is olive-brown to black, shading to silvery on the sides. The belly is white. The side scales in adults are marked with a dark triangular bar at the front corners, so they appear outlined. Fallfish less than four inches are silvery with a prominent wide, dark band extending along the middle of each side. This band extends from the eye to the base of the caudal fin where it ends in a large spot. The caudal fin is forked with sharp-pointed lobes. The fallfish has a small barbel between the lip and snout, like the pearl dace and creek chub.

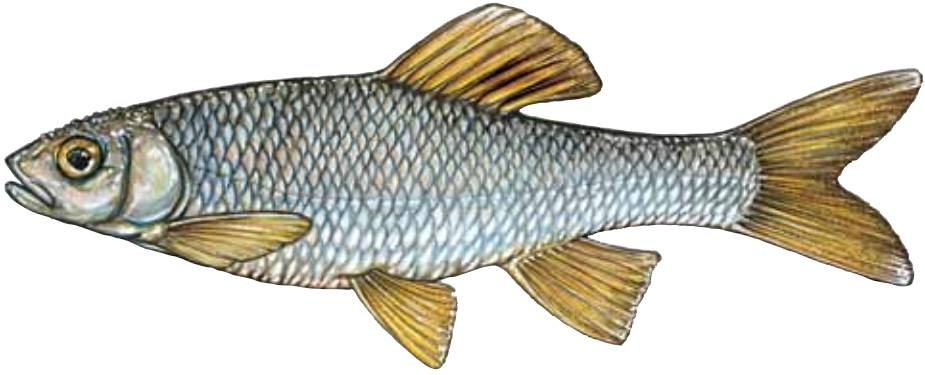
Habitat: Fallfish prefer clear, clean, gravelly pools and slower-flow areas of large streams. They can also be found in lakes.

Life history: Fallfish spawn when water temperatures reach about 58 degrees. The male clears an area and digs a small pit. Then he gathers pebbles and gravel in his mouth and builds a mound. In still water,

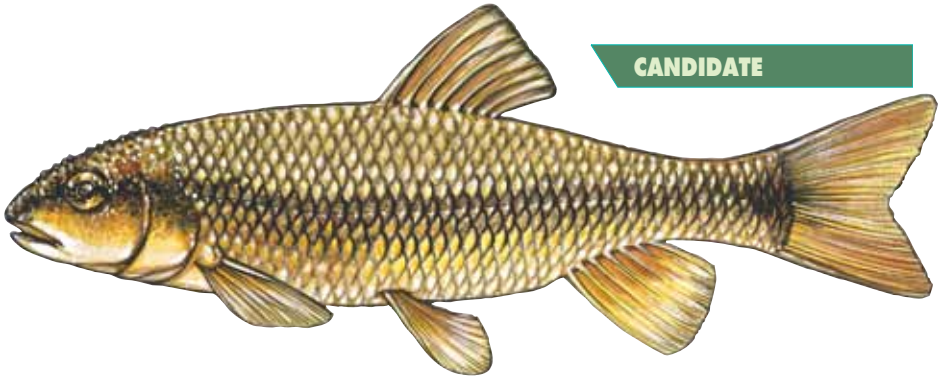
mounds are round, but in flowing water, the nest angles downstream. The largest nests can be six feet across and a foot or two high. Eggs hatch in about six days. Males vigorously defend the nests with displays that include flaring the gill covers and spreading the fins. Fallfish live about 10 years.



Central Stoneroller *Campostoma anomalum*



Spotfin Shiner *Cyprinella spiloptera*



Hornyhead Chub *Nocomis biguttatus*

Suckers

Family Catostomidae

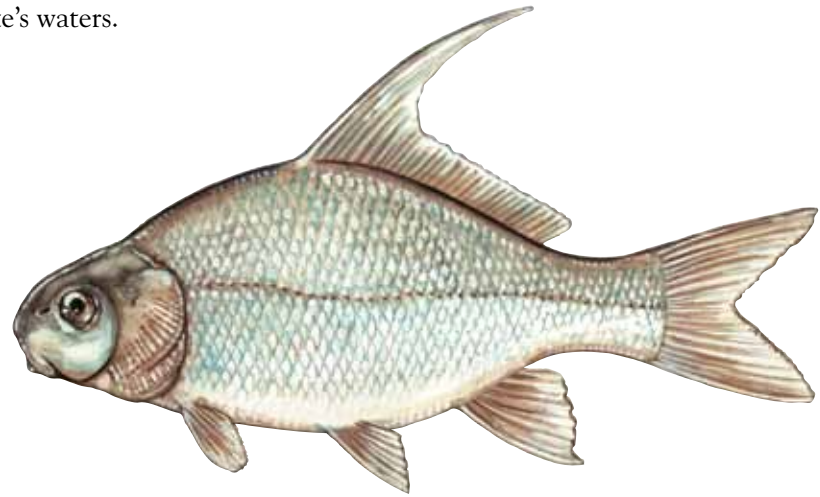
Family overview: Suckers sometimes resemble large minnows, but they are considered to be a separate family of fishes. Although suckers can be an important food source for large predatory fish, some grow large enough to provide angling sport in their own right, especially during their spring spawning movements. In Pennsylvania, 18 sucker species have been recorded. However, biologists question whether six of the species still exist here, because they have not been documented in a long time. One species, the longnose sucker, native to both North America and Siberia, is endangered in Pennsylvania. The sucker family is large, with some 68 species found throughout North America's fresh waters north of Mexico. The family name "Catostomidae" means "inferior mouth," referring to the ventral position of the mouth on the fish's head.

General identification: Suckers are moderate-sized, robust fish, with smooth-edged, or cycloid, scales. The smooth-feeling scales are present on the sucker's body, but not on its head. The scales are often large and reflective, giving many suckers a silvery or gold sheen. There are no sharp spines on any of the sucker's fins. The single dorsal fin is soft-rayed. The anal fin is set farther back on the sucker's belly than on a minnow's belly. Suckers do not have teeth in the mouth. They have a single row of more than 16 pharyngeal teeth, which are toothlike structures located in the throat that aide in digestion. The fleshy-lipped mouth is small, low and directed downward, which suits the way suckers feed. Most obtain food by "vacuuming" or "sucking" it into the mouth.

Life history: Most suckers live in the flowing water of streams and rivers, but some, like the white sucker and creek chubsucker, can also be found in lakes. Suckers spawn in early spring to early summer. Some species make mass migrations up tributary streams or travel to river riffles. Scientists have even noted some homing behavior, in which spawning suckers returned to previously used spawning sites. Most suckers scatter their eggs randomly. However, river redhorse males construct nestlike depressions in gravel, and chubsucker males defend a territory. Young suckers eat zooplankton and algae. They are important forage fish for larger game fishes. The adults eat aquatic invertebrates, insects and mollusks. They also consume some aquatic plant material.

Quillback *Carpiodes cyprinus*

Species overview: One of the quillback's common names is "quillback carpsucker." "Quillback" refers to the lengthy first dorsal rays and several following rays that form a long projection at the leading edge of the back fin, which might remind some of a quill pen or feather quill. "Carpsucker" is also appropriate because this sucker does look much like a carp. Its genus name "*Carpiodes*" means "carplike," and its species name "*cyprinus*" is the generic name of the carp. Quillbacks are uncommon even though they range from the Great Lakes and St. Lawrence River south along the Atlantic Coast to Virginia. They are present in the Mississippi River watershed, and in Gulf Coast watersheds. They are in all of Pennsylvania's major watersheds. Quillbacks are the only carpsuckers now living in the state's waters.



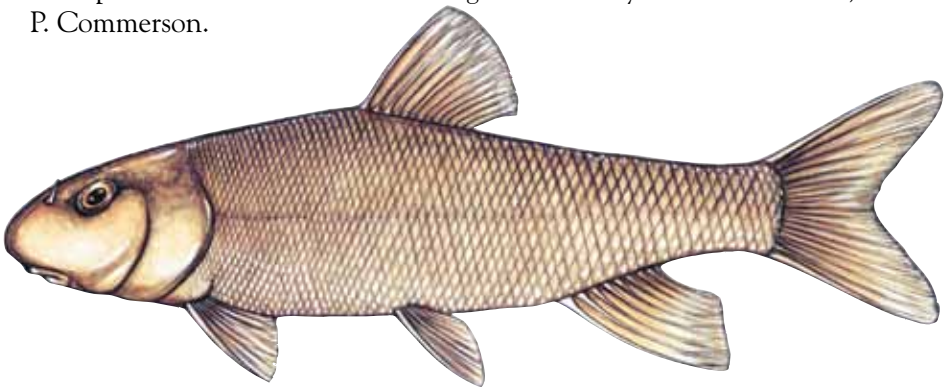
Identification: Quillbacks have a body that is deep when viewed from the side, but narrow when seen from the front (laterally compressed). The back color is olive-brown to grayish, with the sides silvery. The large, reflective scales add hints of shimmering-green or blue. The dorsal fin is long, stretching along the back nearly to the tail fin. The first several rays of the dorsal fin are very long, about five times longer than the short rays on the rear portion of the fin. The high front portion of the dorsal fin looks like a pointed projection and trails over the fish's back. There are no sharp spines on any of the fins. The quillback's pelvic fins are white to orange, and the head is small and conical. Quillbacks have typical sucker mouths. The upper jaw does not extend beyond the front of the eye. The tail is deeply forked. Quillbacks grow to about two feet long and about 12 pounds.

Habitat: Quillbacks live in slow-moving pools and backwaters of streams and rivers. They favor a gravel bottom and little silt in the water. They may also be found in lakes and reservoirs.

Life history: Quillbacks spawn in spring when the water temperature reaches about 60 degrees. Females release several hundred thousand eggs, which are scattered haphazardly in shallow water, over gravelly riffles, sand or mud. The parent quillbacks may make a run, or migration, to their spawning areas. The eggs are not guarded. They are left to develop and hatch on their own, which takes eight to 12 days. Mortality is high among the eggs, fry and young fish, because they provide forage for predatory fish. Among adult quillbacks, mortality is 60 to 70 percent annually. Quillbacks feed on the bottom, with aquatic insect larvae and other small animal organisms the bulk of their diet. They also eat mollusks, like fingernail clams, and some aquatic vegetation. Quillbacks travel in schools.

White Sucker *Catostomus commersonii*

Species overview: The white sucker is found across Pennsylvania. It is the most common and widely distributed sucker in the state. Its natural range is from northern Canada to Florida, throughout the uplands of eastern North America, and west to the Plains region. It grows large enough to be sought by anglers, who usually fish for them during the white sucker's spring spawning run. The genus name "*Catostomus*" means "inferior mouth," referring to the bottom position of the mouth on the head. The species name "*commersonii*" recognizes an early French naturalist, P. Commerson.



Identification: White suckers have a stout cylindrical or tube-shaped body. They reach a maximum length of about 24 inches and five pounds. The upper part of the head and back is olive-brown, shading to light-yellow. There is a dull, silvery sheen on the scales on the sides, and the belly is whitish. In the white sucker, the lower lip is wider than it is high, and is split into two parts. The rounded snout projects very little, or not at all, beyond the tip of the fleshy upper lip. There is a single dorsal fin with 10 to 13 soft rays. During spawning, the male white sucker's back becomes olive with a bright-lavender sheen, and there is a band of pink or red along each side.

Habitat: White suckers live in many habitats, from cool, clear headwater streams to warm rivers, to lakes, ponds and reservoirs. They are tolerant of pollution, low oxygen and silted water. Not particularly choosy about their home, white suckers can be found in dense weed beds, or in the rocky pools and riffles of streams.

Life history: In spring, when water temperatures reach about 50 degrees, white suckers make their spawning runs, or migrations. They sometimes enter small gravel-bottomed streams by the thousands. The fish may home in on spawning sites they have visited before. The fish spawn from early May to early June, which has given the white sucker one of its nicknames, "June sucker." In lakes, they spawn along the edges or on shallow shoals, over gravel.

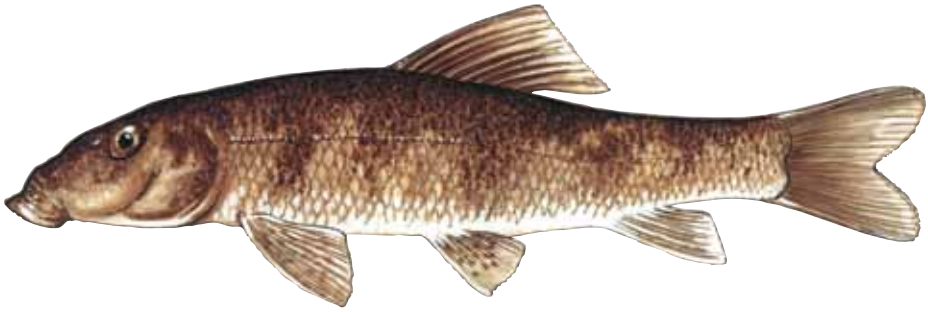
Spawning runs take place at night, with the actual spawning done after dark as well, in shallow water, sometimes with the fish's back out of the water. Two or more males spawn with each female, pressing against her as eggs and milt are released. The tiny, slightly adhesive eggs scatter over the gravel, generally 20,000 to 50,000 per female. The eggs adhere to the rocks or drift downstream before settling to the bottom. The motions of the spawning act disturb the gravel and help to cover the eggs slightly.

Neither parent cares for the eggs or young, which is typical of the sucker family. After they hatch, young white suckers remain in the safety of the gravel for a week or two. Then they move off. White suckers can grow rapidly with sufficient food, and they themselves are an important food for game fish. If not caught or eaten, white suckers can live up to 12 years.

White suckers are moderately active in the daytime, but do most of their feeding at sunrise and sunset, when they can move into shallow water in dim light. They are bottom-feeders. They eat both plant and animal material, like zooplankton, aquatic insects, mollusks and crustaceans. White suckers are schooling fish, and can sometimes be seen in groups in the pools of clear streams.

Northern Hogsucker *Hypentelium nigricans*

Species overview: Northern hogsuckers seem to be misnamed, because they don't like mud. Instead, they are a clean-stream fish. They are abundant, in suitable habitat, over the eastern half of the United States and southern Canada, from central Minnesota eastward through the Great Lakes region to New York, and down the Mississippi River watershed to the Gulf of Mexico. Hogsuckers are common over most of Pennsylvania, but they are missing from most of the Delaware River watershed. The genus name "*Hypentelium*" is of Greek origin and means "lower lip five-lobed." The species name "*nigricans*" means blackish.



Identification: Northern hogsuckers can grow to about 22 inches and four pounds. They are not as silvery as most other suckers, but are well-camouflaged to disappear against the gravel and rocks of their underwater home. The back and upper part of the hogsucker's head is brownish, with dark mottling. Across the back are four oblique dark bars, or saddles, which shade to lighter brown on the sides. The conical body has a dull, bronze sheen, and there are dark blotches above the whitish belly. Hogsuckers have a large, long head with a slight depression between the eyes. The snout is long and their fleshy lips protrude more than most other suckers' lips. The lower fins are dull-red, and all except the anal fin have dark mottling or spotting. During breeding, both sexes develop tubercles–tough, fleshy nobs–on some fins, and in the male on the body scales as well.

Habitat: Because they cannot tolerate siltation and move out of water that becomes tainted with pollutants, hogsuckers are considered indicators of good water quality. They are especially associated with gravelly riffles and adjacent shallow gravel or rubble areas in streams. When hogsuckers live in lakes or reservoirs, they can usually be found near the mouth of tributary streams where there is some water movement. Hogsuckers have a small home range, limiting their traveling to a few hundred feet. Hogsuckers don't mind cold water and can be found in trout streams.

Life history: Hogsuckers spawn in spring, when the water temperature warms to 60 degrees, over gravel-and-sand riffles, in shallow water. When they live in a large stream, hogsuckers may make an upstream run to spawn in smaller headwaters. Two or three males move alongside a female as she releases her eggs. The spawning activity produces violent thrashing and splashing. This helps to dig a shallow depression in the bottom gravel, into which the non-adhesive eggs fall. Waiting minnows may rush in to eat any eggs that are exposed. After spawning, hogsuckers leave, allowing the eggs to hatch on their own.

Northern hogsuckers are prolific egg-producers. Their many small young are used as food by other fish. Hogsuckers themselves are bottom-feeders, feasting on immature aquatic insects, snails and mollusks, crustaceans, algae and other plant material. Hogsuckers use their large head and strong snout to range through the riffles, turning over rocks. They scrape material off the rocks and eat the plant and tiny animal material underneath. This form of foraging dislodges other insects, crayfish, minnows and stream life. Other fish follow feeding northern hogsuckers and grab the food left or dislodged by the hogsuckers.

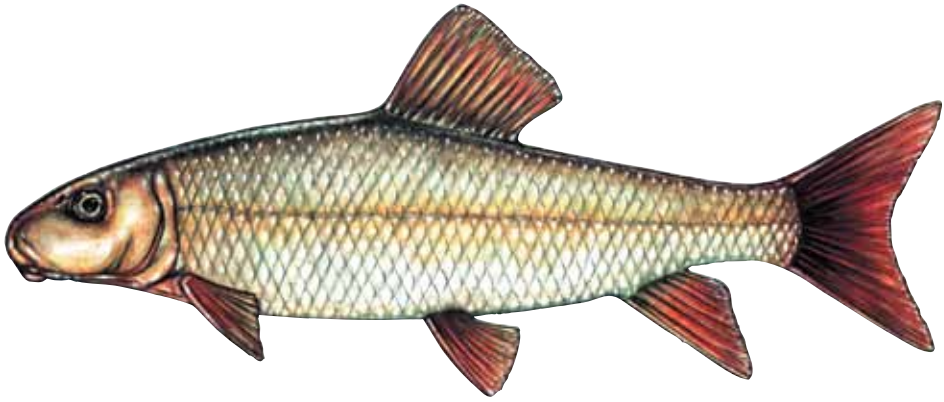
Northern hogsuckers have a reduced swim bladder. With their bulky head, tapered body, and low, spreading pectoral and pelvic fins, a reduced swim bladder suits them well for life on the bottom of fast-flowing streams. Like darters, hogsuckers rest on their fins on the stream bottom, but dart away when disturbed. Hogsuckers become inactive when the water temperature falls below 50 degrees.

The Redhorses Genus *Moxostoma* spp.

Genus overview: The redhorses are suckers best studied as a group, because even biologists have difficulty telling one species from another. Most are similar in appearance, with similar habitat requirements. Most species can sometimes be found together in the same stream. The redhorse genus includes 18 species throughout the Mississippi River basin, Great Lakes watershed, and parts of the southeastern United States.

In Pennsylvania there are six redhorses. The silver redhorse (*M. anisurum*) is common in the Allegheny River and its larger tributaries, and also in the Lake Erie watershed. The river redhorse (*M. carinatum*) is reported in the Allegheny River. The black redhorse (*M. duquesneii*) is locally plentiful in some sections of the Allegheny River. The golden redhorse (*M. erythrurum*) is also locally abundant in the Allegheny River and is found in Lake Erie tributaries. Golden redhorses have also been found in the Potomac River watershed in the southcentral part of the state, which is unusual because this fish is absent from most Atlantic Coast streams. The shorthead redhorse (*M. macrolepidotum*) is a widespread redhorse throughout central North America and in Pennsylvania, but it has not been reported in the Delaware River watershed. Redhorses get their common name from the orange or reddish color of the fins of most species. The genus name "*Moxostoma*" means "sucking mouth."

Identification: Redhorses reach a maximum size of 25 to 30 inches, depending on the species. Pennsylvania redhorse species are all near look-alikes. They are solid-bodied, cylindrical fish, with strong, smooth scaling reflecting silver or gold. They have the spineless fins, soft, toothless mouth and thick lips typical of the sucker family. The head has no scales.



River Redhorse *Moxostoma carinatum*

The redhorse's back is gray to olive-brown. The upper sides have copper, golden or greenish sheens. The lower sides are silver to bronze. The belly is golden or silver-white. The redhorse's fins, either all or some of them, depending on the species, are tinged with red-orange or pink-orange. The red coloring may be at the edges of the fins, or spread over the whole fin. In the black and golden redhorses, the dorsal and caudal fins are gray. In the shorthead redhorse, the tail fin's upper lobe is longer and more sharply pointed than the lower lobe. The river redhorse's caudal fin is an especially bright-red, and its other fins show red-orange. Biologists also find differences between the redhorse species in their lip shapes and the number of scale rows on various parts of the body.

Shorthead Redhorse *Moxostoma macrolepidotum*

Habitat: Redhorses live in slow areas of big rivers, in the fast waters of small creeks, or lakes, according to their species. Most are typically fish of clear, small to medium-sized rivers. The silver redhorse prefers the deep pools of big rivers, with slow flow and a soft bottom. It is fairly tolerant of muddy water. River redhorses live in medium to large rivers with swift water and are believed to be decreasing in numbers through their range because of dam impoundments. The black redhorse is found in clear, cool creeks and small rivers, in the current over a gravelly bottom. Golden redhorse juveniles can live in riffle margins, but the adults like slow, deep runs in rivers. The shorthead redhorse is different from other redhorses because it readily uses lake habitat, especially if there is a suitable stream flowing into the lake. Shorthead redhorses also live in the fast water of large rivers, over gravel and boulders, and are very vulnerable to pollution and siltation.

Life history: The redhorses spawn in spring, with most migrating upstream to shallow rubble or gravelly shoals in fast water. In some redhorse species the males are territorial. In other species the eggs are simply scattered and left on their own. Several males generally spawn with one female. The river redhorse male creates a nest depression, or redd, in the gravel, by pushing the stones with its head, tail and pectoral fins. Black redhorses gather in the pools above the spawning shoals before spawning, sometimes leaping out of the water. Several hours later the males drift down to the shoals and establish territories. Golden redhorse males are aggressive defenders of their spawning territories, which are usually in slower, shallower water than those that most other redhorses use for egg-laying. Shorthead redhorses are not territorial, and although their spawning activity creates a circular nest, biologists believe this to be accidental. Silver redhorses move out of their usual slow-water habitat into swifter river areas or small streams to spawn.

Redhorses spawn when water temperatures reach the high 50s to low 70s, according to each species' preference. Females deposit from 6,000 to 36,000 eggs, according to their size and type. Redhorses eat a variety of small aquatic animals and plants found on the stream bottom, including snails, mollusks, midges, aquatic insect larvae and algae. River redhorses are especially known for feeding on freshwater clams, crushing the small mollusks with their strong pharyngeal teeth (located in the throat).

North American Catfishes

Family Ictaluridae

Family overview: The Ictaluridae catfish family is also known as the North American freshwater catfishes. Of the 40 species found north of Mexico, 13 are known to live in Pennsylvania. These include three commonly called "bullheads" and three called "catfish." The rest, much smaller species, are called "madtoms." The yellow and brown bullheads are found around the state. The black bullhead is known from a few counties in western Pennsylvania, in the Ohio River watershed. The white catfish, channel catfish and flathead catfish are medium-sized to very large fish and are avidly sought by anglers.

The madtoms belong to the genus *Noturus*. They are not as likely to be seen as often as the other catfishes because of their miniature size, their secretive nature, and their rarity or scattered distribution. Two madtoms are endangered species in Pennsylvania and are found only in French Creek, in the northwest corner of the state: The mountain madtom, which grows to just two or three inches, and the northern madtom, which grows to about four inches. The northern madtom is also endangered. The brindled madtom is a threatened species. At the other end of the catfish family scale are the blue catfish and flathead catfish, which can grow to more than 100 pounds and four to five feet long. Catfishes are popular sport fish. Some species are raised commercially for human consumption, and the tiny ones are part of the forage base of small fishes in their home lakes or streams. Some madtoms are considered indicators of water quality.

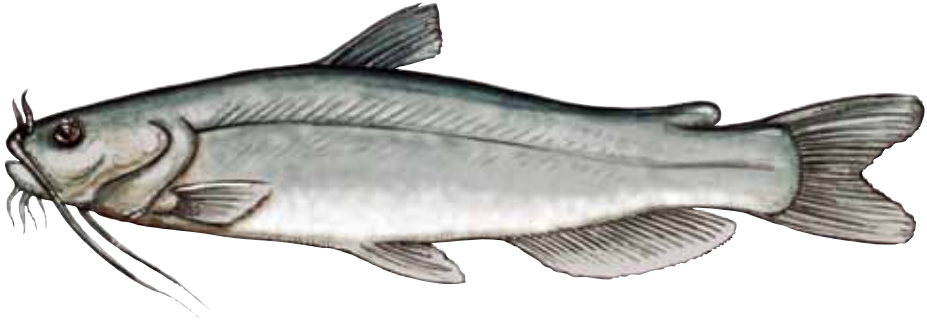
General identification: Catfish are scaleless, with a tough, smooth skin. All species have eight appendages on the head called "barbels," four on the upper jaw and four on the chin. The barbels are sometimes called "whiskers." They are fleshy, supple projections that narrow to a tip. The barbels don't inflict the notorious sting of the catfish. That's done by the strongly developed pectoral fin spines, one on each side of the fish, and the dorsal fin. The species have variously developed poison glands at the base of these spines, which can inflict a mild to beelike sting. The madtoms are especially known for their stinging spines. There is disagreement among scientists whether it's the gland at the base of the spine or the membrane around the spine that has the poison. Catfish also have a stout spine at the leading edge of the dorsal fin. On madtoms, the adipose fin, a fleshy lobe between the dorsal fin and the tail fin, is joined with the tail fin. On other catfish, the adipose fin is separate. Some catfish have

moderately to deeply forked tails. Albinism, which results in a white-colored, pink-eyed catfish, is known to occur.

Life history: Catfish spawn in spring to early summer. Both males and females may contribute to nest construction and care of eggs and young, but usually that duty is just the male's. Nests can be in holes in river or lake banks, in the open, or under rocks and other submerged objects. The female is clasped by the male and is stimulated to deposit a mass of sticky eggs. The male or both parents guard the nest and protect the young for a time. Young catfish form tight schools and separate individually only to hide when they have been frightened. Adult catfishes are most active at night. When they are active in daytime, it is generally in muddy, clouded water. They have poor vision and use the sense of smell and the taste buds on the skin, lips and barbels to find food.

White Catfish *Ameiurus catus*

Species overview: Although the white catfish has been stocked in waters where it was not native, its original home was Atlantic Coast watersheds from the lower Hudson River in New York, south to Florida and on to Mississippi. In Pennsylvania the white catfish's range has included the Susquehanna and Delaware River systems, and it has been introduced into parts of the Ohio River watershed. Its genus name "*Ameiurus*" means "unforked caudal fins," and its species name "*catus*" means "cat."



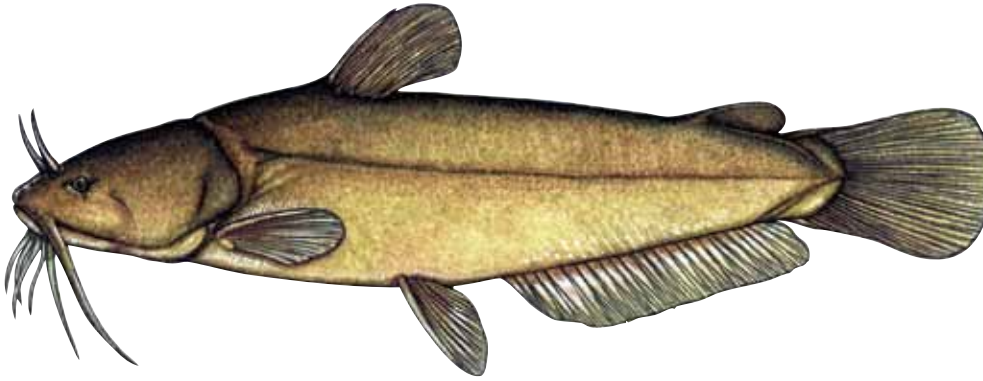
Identification: This medium-sized catfish has a back and upper sides that are light blue-gray to dark slate-gray. This shades lighter, with gray or blue markings, toward the belly, which becomes silvery or yellow-white. The chin barbels are whitish. The caudal fin is somewhat forked, but the fin's lobes are not as sharply pointed as are those of the channel catfish, and may be somewhat rounded, especially in older fish. The head is very broad. Young white catfish are slender. Older fish become heavy bodied and robust-looking. The spine on each pectoral fin has a sawtoothed back edge. The anal fin has 25 or fewer rays. The maximum size for the white catfish is about 24 inches.

Habitat: White catfish live in channels, pools and backwaters in rivers or streams, mostly in sluggish current over mud bottoms. They go into swift water, but not as much as channel catfish. Of all the catfishes, white catfish are the most tolerant of salt water. They live in brackish bays and tidewater sections of streams. They also live in lakes and river impoundments. In habitat preference, white catfish are midway between the channel catfish, which uses firmer bottoms and swift currents, and bullheads, which live in slow water over soft, silty bottoms.

Life history: The white catfish's spawning habits are similar to those of the channel catfish, although it has less of a tendency to migrate when looking for a spawning site. Male white catfish excavate a burrow nest or use an existing hole. The sticky egg mass is deposited there by the female. The male briefly guards the eggs and the young. White catfish eat some plant material, but they eat mostly animal life like midge larvae and other aquatic insects, crustaceans and fish.

Yellow Bullhead *Ameiurus natalis*

Species overview: The North American catfish family includes species known as the "bullheads." They are the brown bullhead, yellow bullhead and black bullhead. All are similar in appearance, with some anatomical differences and different coloring. The yellow bullhead's natural range is the Atlantic and Gulf Coast watersheds from New York to northern Mexico. It is also native to the St. Lawrence River and Great Lakes system and the Mississippi River watershed. Yellow bullheads have also been widely stocked. Although it is found in all of Pennsylvania's watersheds, the yellow bullhead is not as plentiful as the brown bullhead.



Identification: Yellow bullheads may grow 18 or 19 inches long, but most are much smaller. The back is yellow-olive to a slate-gray, shading to a lighter yellow-olive on the sides. The belly is bright-yellow or whitish. The chin barbels are white or yellow. Yellow bullheads have a long anal fin

with 24 to 27 rays. Like the brown bullhead, there are five to eight sawlike teeth on the back edges of the pectoral spines. The rear edge of the tail fin is nearly straight or rounded.

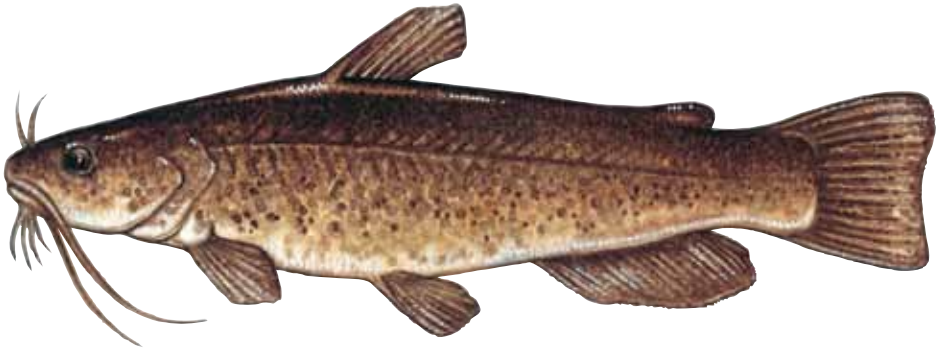
Habitat: The yellow bullhead is tolerant of low oxygen and highly silted water. It can withstand pollution that many other fishes cannot tolerate. Yellow bullheads prefer backwaters and slow currents in streams and rivers. They also live in ponds and reservoirs, especially where there is a mucky bottom and dense aquatic vegetation. Where logs, stumps and water weeds are removed, the number of yellow bullheads decreases.

Life history: Yellow bullheads spawn in spring, usually May, with both males and females helping to excavate a nest. The nest can range from a shallow depression in the muddy bottom to a two-foot-deep burrow in the stream or lake bank, usually near protective rocks or stumps. The females produce from 1,700 to 4,300 eggs, depositing up to 700 at each spawning. The care of the sticky, yellowish-white eggs and the hatched fry is the duty primarily of the male, which guards the young fish until they are about two inches long. Yellow bullheads are omnivores and eat aquatic insect larvae, snails, freshwater clams, crayfish, small fish and other underwater animal life, as well as plant material. They have an excellent sense of smell, which helps them locate food in muddy water.

Brown Bullhead *Ameiurus nebulosus*

Species overview: The brown bullhead is the most widely distributed bullhead, found across Pennsylvania in suitable habitat. It is native to Atlantic and Gulf Coast watersheds, from eastern Canada to Alabama. It was also originally found in the Great Lakes system, Hudson Bay and the Mississippi River watershed. It has also been widely introduced. Its species name "*nebulosus*" means "clouded," referring to the fish's mottled sides.

Identification: An 18-inch and three-pound brown bullhead is a trophy, and is near the size maximum of the species. Brown bullheads



average 12 to 15 inches. The upper part of the head, back and sides are dark to light yellow-brown or olive-brown, shading to grayish white or yellowish white on the belly. The sides have brown or black mottling. The brown bullhead's chin barbels are dark, grayish black, but may have whitish color at the base. These help to distinguish the brown bullhead from the black bullhead, which is known from a few northwestern Pennsylvania counties. The black bullhead's chin barbels are all black. The brown bullhead's caudal fin is square-tipped, or slightly rounded. Its strong pectoral fin spines have five to eight sawlike teeth on their rear edges. The anal fin has 18 to 24 rays, usually 22 or 23.

Habitat: Brown bullheads live in several habitat types, but they are found mostly in ponds and the bays of larger lakes, and in slow-moving sections and pools of warmwater streams. They are bottom-dwellers, usually living over soft mud or muck, where there is plenty of underwater vegetation. Brown bullheads can sometimes be found as deep as 40 feet. They are tolerant of very warm water temperatures, high carbon dioxide and low oxygen levels, and levels of pollution that other fish cannot tolerate.

Life history: Brown bullheads spawn in late spring, May to June, when water temperatures reach 70 degrees. Both males and females participate in nest construction, which can be a shallow saucer on the bottom mud or sand, or among roots of aquatic plants, near the protection of stumps, rocks or downed trees. Nests can also be excavated holes or natural burrows. Spawning can also occur under sunken boards and logs, and in hollow stumps. The water depth for spawning ranges from six inches to several feet. The nests are usually around the shoreline or in coves, or in the mouth of a creek.

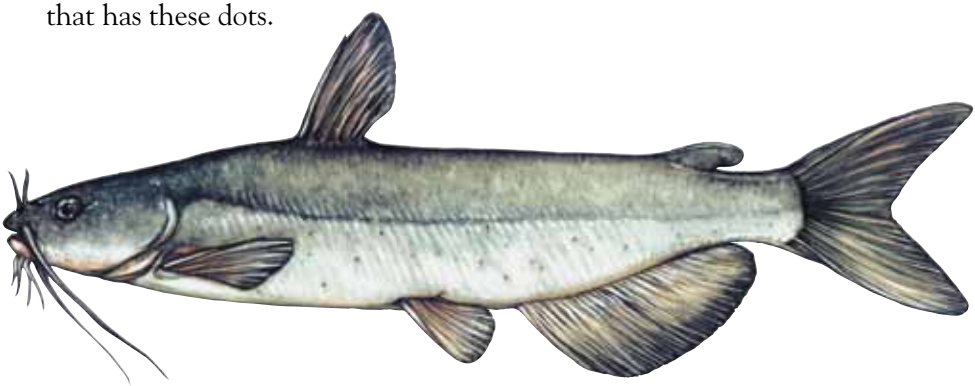
Brown bullheads usually spawn in the daytime. Their courtship includes the male and female caressing each other with their barbels. They spawn beside each other, but facing in the opposite direction. The females produce from 2,000 to 13,000 cream-colored, mucous-covered eggs. Sometimes one or both parents eat some of the eggs. Both male and female brown bullheads cooperate in protecting the nest, eggs and young. The parents fan and stir the eggs with their fins, aerating them. The parents have also been seen to take the eggs into their mouths, presumably cleaning them, and to blow the eggs back into the nest again. Hatched brown bullheads are pitch-black and may be mistaken for tadpoles. One or both parents shepherd the loose ball of fry for several weeks, until the young are about one inch long.

Like other catfish, brown bullheads are active mostly at night, when their sensitive barbels help them find food in the darkness. They are

omnivorous bottom-feeders and eat a wide variety of plant and animal material, including aquatic insects and larvae, worms, minnows and other small fish, crayfish, snails, freshwater clams and even algae. Brown bullheads are able to exist on atmospheric air for a time. They can remain alive for hours if kept moist when they are out of the water.

Channel Catfish *Ictalurus punctatus*

Species overview: Next to the flathead catfish, the channel catfish is the largest catfish in Pennsylvania. Weights of up to 15 pounds are not unusual at lengths of about 30 inches. The state record is over 35 pounds. Channel "cats" are avidly sought sport fish and are raised commercially for the table. They are found statewide, introduced where they did not occur naturally. The native range of channel catfish is believed to be the Great Lakes and St. Lawrence River watershed, the Missouri River system, the Mississippi River watershed, Gulf of Mexico watershed and parts of Mexico. They were not native to the Atlantic Coast north of Florida. The channel catfish's species name "*punctatus*" means "spotted," referring to the small, dark spots on its sides. The channel catfish is the only catfish that has these dots.



Identification: The channel cat has a deeply forked tail, with tail lobes that are sharply pointed. In bigger fish, the fork is less noticeable or disappears. Channel cats have 24 to 30 rays on the anal fin, a small, fleshy adipose fin that is separated from the tail, and typical catfish spines on its dorsal and pectoral fins. The barbels are black and long. The back is blue-gray to slate-gray or bluish olive. The sides tend to be silvery-gray, and the belly is whitish. Except for some large adults, especially the males, channel catfish have small, irregular spots on the sides and back. None of the other catfishes has these spots. Males become darker, almost blue-black, during spawning time.

Habitat: The channel catfish is an adaptable fish, usually found in clear, warm lakes and moderately large to large rivers, over clean sand,

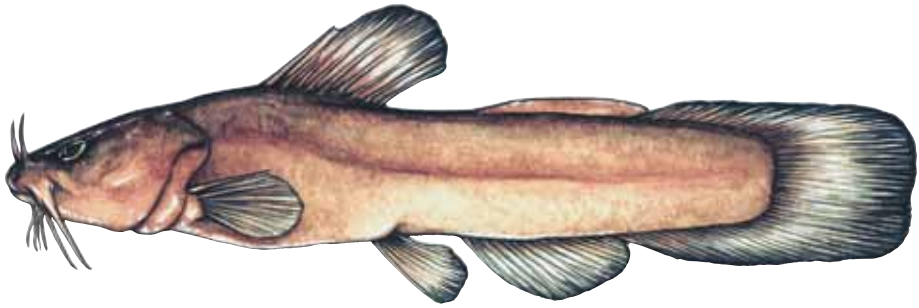
gravel or rock-rubble bottoms. It is generally not found in the muddied, weed-choked waters that some other catfish species frequent. Channel cats, especially young fish, may be found in fast-flowing water. Usually, channel catfish prefer deep pools and runs in rivers that have alternating pool and riffle habitats. It is also found in reservoirs, lakes and farm ponds, and even in some of the larger trout streams.

Life history: Channel catfish spawn in May to early June, when the water temperature ranges from 75 to 85 degrees, with 80 degrees the optimum. The male prepares the nest, which is usually a depression or hole in an undercut bank, or an excavated burrow under logs or rocks. Sometimes channel cats spawn in sunken, hollow logs or abandoned muskrat holes. In clear ponds, spawning channel cats must have semi-darkened shelters, either natural or provided. From reservoirs, channel catfish sometimes move upstream to spawn in tributary rivers. A female channel cat may lay 2,000 to 70,000 eggs per year, depending on her size. After spawning, the males protect the adhesive egg mass and aerate and clean the eggs by fanning their fins. The males also guard the hatched fish for a time. Young channel cats are insect-eaters, feeding on mayfly nymphs, caddis larvae and midge larvae. As they grow, they switch to fish, crayfish and mollusks, but still feed on aquatic insects, and occasionally eat plant matter. Yearling and subadult channel cats are more tolerant of fast water than larger adults. They move out of slow water into the quicker current or swim short distances into tributary streams to feed. Channel cats feed mostly at night, but may forage on the bottom, where it's dim during the day. Channel catfish, especially young fish, have been known to feed on the surface. Like other catfish, at night they depend on their barbels and their sense of taste to find food. Even so, channel cats are believed to be more of a sight-feeder than other catfishes, because of their clear-water habitat.

Stonecat *Noturus flavus*

Species overview: The stonecat is one of the largest members of the madtoms, a group of small fishes in the catfish family. The genus name "*Noturus*" means "back tail." It refers to the way the adipose fin is fused its entire length to the madtom's back. The species name "*flavus*" means "yellow" and describes the fish's color. The madtoms are not well-known because most are little fish and hide during the day, even burying themselves in the gravel, emerging to feed at night.

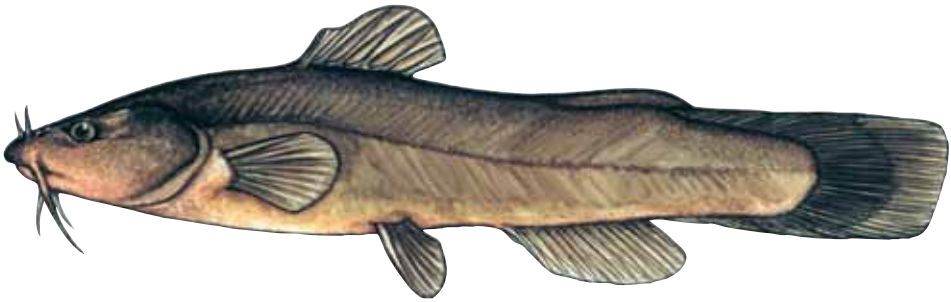
In Pennsylvania there are six madtom species. Some are rare, like the mountain, brindled, tadpole and northern madtoms. The margined madtom of eastern Pennsylvania is widely distributed and abundant. Madtoms have poison glands at the base of their pectoral spines. If handled improperly, they can give a sting as painful as a bee sting.



Margined Madtom *Noturus insignis*

The stonecat is found throughout the Mississippi River and Great Lakes watersheds. It is not found in Atlantic Coast streams south of the Hudson River. In Pennsylvania, it is the most common madtom of the western part of the state, living in the Ohio River and Lake Erie watersheds, and can be locally plentiful.

Identification: The slender-shaped stonecat grows to about 12 inches long, but averages six to eight inches. Its back is yellow-olive to slate-gray or blue-gray. The sides are lighter, with yellow or pink tints. Its underparts are yellow or white. The tail is rounded or square-looking, with a light border. The adipose fin is completely bound to the body, a trait that distinguishes the madtoms. The upper jaw is much longer than the lower jaw. Its upper barbels are gray. The chin barbels are white. There is a light-yellow or whitish oval-shaped spot on the rear portion of the dorsal fin. The stonecat has no or few and weak sawteeth on the back edges of its pectoral spines. The anal fin has 15 to 18 rays.



Stonecat *Noturus flavus*

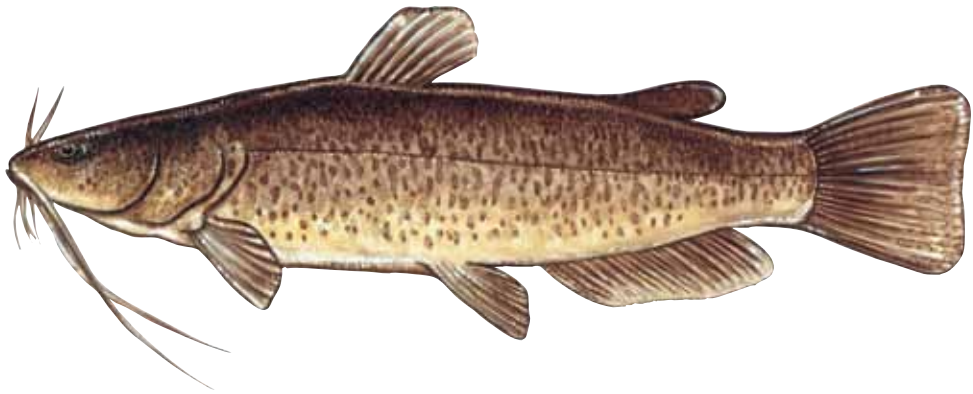
Habitat: The stonecat lives in rocky riffles or rapids in creeks and small to large rivers. It is also found over gravelly wind-swept and wave-stirred shoals of lakes, including Lake Erie. The word "stone" in its name refers to where it likes to live. It is a warmwater fish and avoids cold water.

Life history: Stonecats spawn in early summer, beginning at about 77 degrees and peaking at 82 degrees. The females produce up to 1,200 eggs annually, laying 100 to 500 of them in each nest. The opaque, yellow eggs are attached in a compact, sticky mass to the underside of flat stones or similar objects in flowing water. The parents guard the eggs and young for a time. Like most other catfish, stonecats feed at night and have a varied diet, especially consuming fishes and aquatic insect larvae such as midges, caddises, stoneflies and mayflies, as well as crustaceans and other small invertebrates.

Flathead Catfish *Pylodictis olivaris*

Species overview: Flathead catfish grow longer and heavier than other Pennsylvania catfish. In fact, they are one of the state's biggest fish, of any kind. Flathead catfish are known to grow to more than 100 pounds, but 20 or 30 pounds is more likely in Pennsylvania. The Pennsylvania record is over 40 pounds. Flathead catfish are native to the lower Great Lakes and the Mississippi River basin, from western Pennsylvania southward. They are also in Gulf of Mexico watersheds, and can live in reservoirs. In Pennsylvania, flatheads are found mainly in the Ohio, Allegheny and Monongahela rivers. Fossils of this catfish genus that are about 15 million years old, from the mid-Miocene Epoch, can't be distinguished from the modern flathead catfish. The flathead's genus name "*Pylodictis*" means "mud fish," and its species name "*olivaris*" means "olive-colored."

Identification: Flathead catfish have the scaleless, strong body and the well-developed pectoral and dorsal fin spines typical of catfish. The tail is only slightly indented, or may appear square or rounded. The dorsal fin is high, and the lower jaw projects past the upper jaw. The body looks long and slender. The upper portion of the flathead catfish's body is yellowish brown to dark, even purplish brown, with black or brown mottling on



lighter brown sides. The belly is grayish or yellowish white. It does have a flat-looking head, very wide and depressed. The chin barbels are white to yellow, the fins are mottled, and the anal fin, which has fewer than 16 rays, is short and rounded. Except for very large adults, flathead catfish have a white tip on the upper lobe of the caudal fin. Young flathead catfish are nearly black on the back.

Habitat: Flathead catfish are found in large rivers, streams and lakes, usually over hard bottoms. They prefer deep, sluggish pools, with logs and other submerged debris that can be used as cover. Young flatheads live in rocky or sandy runs in the river and in the riffles.

Life history: The flathead is a loner and a traveler, leading a solitary existence except at spawning time. Flatheads spawn in early summer, later than channel catfish. The flathead's spawning behavior is like that of other catfish. The adults form pairs and build nests in natural cavelike depressions in the bank, or they may hollow out a cavity under an underwater object, like a log or boulder. Their compact egg masses contain from 4,000 to 100,000 eggs. The male guards the nest and the newly hatched fry, becoming aggressive toward the female.

Flatheads grow fairly rapidly and mature sexually at about 15 inches and five years old. They can live to at least 19 years old. Juvenile flatheads live in riffle areas and feed on larvae and nymphs of aquatic insects. As the flathead grows, it switches to crayfish and fishes, although many items are on its menu. During the day, flathead catfish stay out of sight, hiding beneath undercut banks, in brush piles and log jams. At night they forage in a variety of habitats, including very shallow riffles where their backs and dorsal fins may be exposed. For this reason, angling at night is the way to catch a big flathead. Biologists report that one possible feeding strategy of the flathead is to lie motionless with its mouth open, until a fish looking for a spot in which to hide swims in. Others have observed flatheads lunging and grabbing prey after they have lain in wait.

Smelts

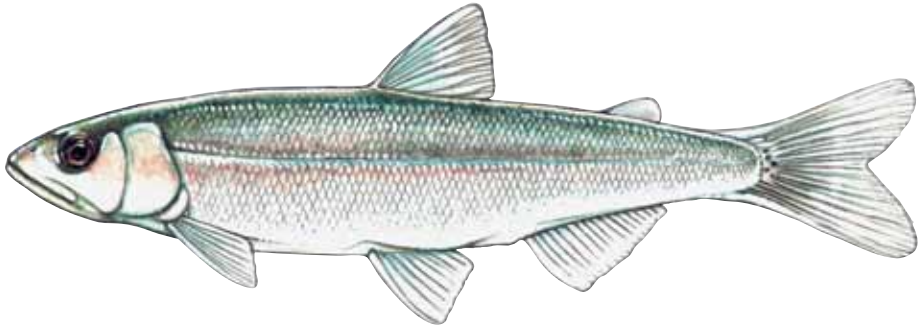
Family Osmeridae

Family overview: The smelts are coldwater fishes that live throughout the Northern Hemisphere. Smelt are anadromous fish. They spawn in fresh water and live in the ocean as adults. They can also live entirely in fresh water.

Only one species of smelt is found in Pennsylvania–the rainbow smelt (*Osmerus mordax*). Rainbow smelt were originally found in the North Atlantic and North Pacific oceans. They were introduced into Lake Michigan in 1912, and in the following years spread throughout the Great Lakes. Rainbow smelt are in Pennsylvania in Lake Erie and Presque Isle Bay, where they are an important food for large, predatory fish. They were also introduced into Harvey's Lake, Luzerne County, in 1952, as well as large impoundments like Raystown Lake and the Allegheny Reservoir, as forage for larger predatory fish. Rainbow smelt are occasionally observed in the Delaware River in Pennsylvania. The Delaware is the extreme southern end of their range.

The genus name "*Osmerus*" means "smell" or "scent," in reference to the "sliced cucumber" odor that is noticeable in breeding adults. The species name "*mordax*" means "biting."

Identification: The rainbow smelt is a small, slender, silvery fish, with a comparatively large mouth and strong teeth. Its large scales are cycloid, or smooth, and the upper jaw extends beyond the eye. The rainbow smelt's color is rainbowlike, ranging from pale to dark-olive on the back, to purple and pink on the sides, and shading to dark-blue and violet near the belly, which is whitish. The tail is deeply forked. Like trout, salmon and catfish, the smelt has a fleshy adipose fin, a small fin lobe on the back between the



dorsal and caudal fins. Spawning males develop very fine, sharp projections, called tubercles, on the head and body. Rainbow smelt grow to seven or eight inches long.

Life history: Rainbow smelt spawn early in the spring, when the water is in the mid-40s to upper 40s. Smelt run upstream into the mouths of small creeks to spawn at night, or they deposit their eggs along the lake shore. Each female releases 10,000 to 30,000 tiny, sticky eggs, which adhere to clean bottom sand or gravel. Two or more males accompany a female during spawning, and the breeding season lasts about a week. Eggs hatch in two to three weeks, and young smelt grow to about three inches their first year. Smelt are mature and ready to spawn in two or three years. They live five or six years. Young smelt live in the lake shallows in the summer, but move to deeper water in autumn. Adult smelt congregate in huge midwater schools in Lake Erie, but move closer to the surface at night.

Young smelt eat tiny aquatic organisms, but switch to aquatic insect larvae and other invertebrates and small fish as they grow. They may turn the table on their predators, and feast on the predator fish's young. Anglers "dip" smelt with nets during the spawning run. Anglers also fish for them with tiny baited hooks and jigs through the ice. In some places, smelt are important commercially, but not in Pennsylvania.

Trouts and Salmons

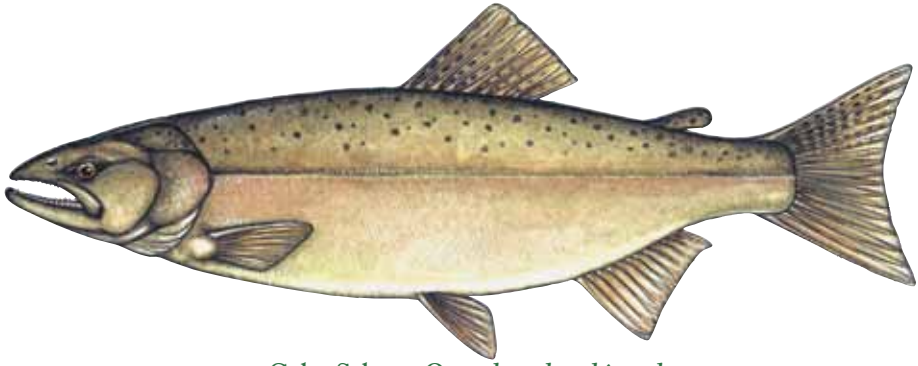
Family Salmonidae

Family overview: The trout and salmon family includes great game fish like trout, salmon, chars and grayling, as well as food and baitfishes like whitefish and ciscoes. The trout and salmon family is large. It is native to cool and cold streams and lakes throughout Europe, northern Asia and North America, and reaches as far south as northwest Mexico and extreme northern Africa. One family member, the Arctic char, is the freshwater fish that occurs the farthest north. Because of their popularity for sport and commercial fishing, this family has been stocked in waters worldwide and is now found on nearly every continent. Many trout that anglers catch in Pennsylvania are the result of the stocking of hatchery-raised fish. However, where streams are cold and clean enough, with proper spawning habitat, Pennsylvania also has a wealth of reproducing populations of wild trout.

In Pennsylvania, the trout and salmon family includes three species of the genus *Coregonus*, all native and found in Lake Erie–the rare longjaw cisco, the cisco or lake herring, and the lake whitefish–silvery well-scaled fishes with deeply forked tails. The whitefish is currently an important commercial species. It has rebounded with reductions in the numbers of sea lampreys and rainbow smelt. Rainbow smelt were believed to prey on whitefish eggs and young. Other members of the trout family native to Pennsylvania, not introduced, are chars, of the genus *Salvelinus*, the brook trout and the lake trout.

The brown trout, native to Eurasia, is stocked in the state and has established itself in the wild here. The Atlantic salmon, also of the genus *Salmo*, is native to the North Atlantic Ocean and its tributaries. It is anadromous–the Atlantic salmon spends its adult life in salt water and returns to freshwater streams to spawn. A landlocked form of the Atlantic salmon, which lives its entire life in fresh water, was stocked in Harvey's Lake, Luzerne County, and in Raystown Lake, Huntingdon County.

Anadromous Pacific salmon can use a large freshwater lake as adults. Pacific salmon were widely introduced throughout the Great Lakes, including Lake Erie, in the 1960s. Pennsylvania participated in the coho and chinook salmon plantings, but today the chinook is no longer stocked by the Fish & Boat Commission. Cohos are stocked only when available. Introduced pink salmon are self-sustaining and have spread through all the Great Lakes and are occasionally caught. The kokanee, a nonmigratory form of the sockeye salmon, was introduced into a few lakes in northeastern Pennsylvania, most notably Upper Woods Pond. The kokanee



Coho Salmon *Oncorhynchus kisutch*

salmon did not reproduce sufficiently to sustain a continuing fishery, and stockings have been discontinued. These West Coast salmon are of the genus *Oncorhynchus*, as is the rainbow trout. The rainbow's migratory form is the steelhead. It has replaced Pacific salmon, which die after spawning, in popularity with Lake Erie anglers.

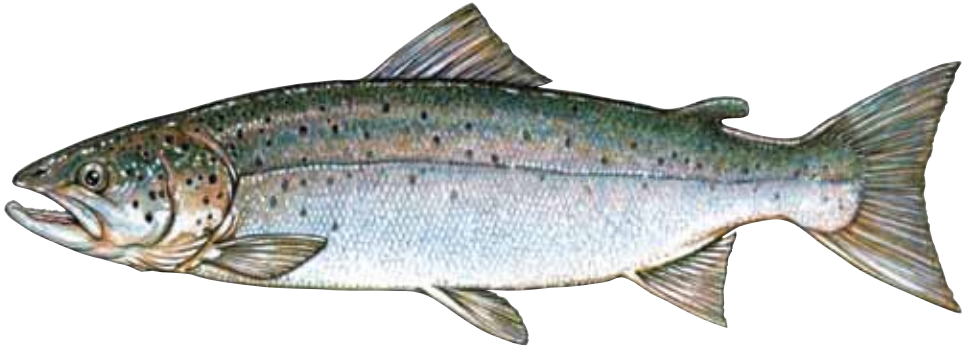
Identification: In size, Pennsylvania's trout and salmon range from wild fish that are less than six inches long at maturity to Lake Erie behemoths of nearly 30 pounds and three feet long. Trout and salmon have a fleshy lobe, called the adipose fin, between the dorsal fin and the tail. Their scales are small and cycloid, or smooth, and embedded in a slimy mucous that is most obvious in the salmons. Trout and salmon have an obvious lateral line, large mouth and teeth. In big specimens, the teeth are caninelike. The tail may be forked or squarish, depending on the species, and none of the fins has spines. Mature males look different from females because they develop a long, hooked lower jaw, called a "kype." Mature males also deepen or gain in color at spawning time. Coloration in trout and salmon varies from dull to intense, according to the species, where the fish lives and the time of year. Trout and salmon that live in the sea or a large lake become silvery. Juvenile fish have a series of vertical, oval "parr marks" along each side from cheek to tail.

Chinook Salmon *Oncorhynchus tshawytscha*

Life history: The trout and salmon family live either in fresh water all their lives, or migrate to the sea and return to fresh water to spawn. Salmon are especially noted for anadromous behavior. Through chemical cues and the sense of smell, they can home in on their birth streams when returning to spawn. Trout may also run to the ocean, or a large lake, when they have access. Trout and salmon spawn either in spring or fall, according to the species, over gravelly shoals, usually in small streams. The female digs a shallow dish nest in the gravel by lying on her side against the bottom and swimming forward energetically. Her body and fins flush out the stones. One or several males join her in the actual spawning. Afterward, the adults abandon the nest, called a redd. The eggs fall into the spaces between the gravel. They may be covered slightly with more gravel by the female before she leaves. Eggs hatch in four to 10 weeks, depending on water temperature. Silt, clogging the spaces between the stones, can reduce hatching success. Young trout stay in the gravel until the yolk sac is absorbed. Then they move out into the stream. The presence of reproducing populations of trout has been used as an indicator of high-quality, well-oxygenated, unpolluted water.

Trout and salmon are not school fish. Stream trout eat mostly adult and immature aquatic insects. They also eat terrestrial insects that fall onto the water, crayfish and other freshwater crustaceans. They also eat fish, especially as they grow larger. Trout feed most readily when water temperatures are in the 50s and 60s. They also feed in the winter and are popular with ice anglers.

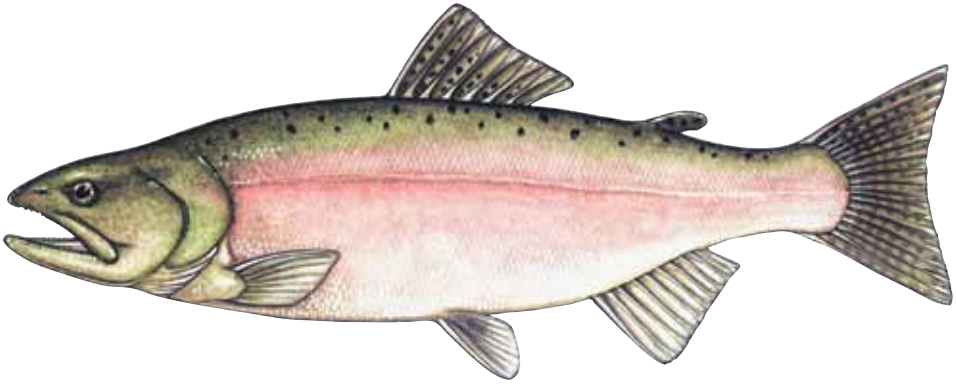
In the early part of the 20th century and late 1800s, Pennsylvania streams were stocked extensively with trout, with varied success. Wild brook and brown trout are now widespread. Reproducing populations of rainbow trout are in a few scattered streams in the state. In the hatchery, trout strains were later developed that responded better to artificial culture. They were disease-resistant and spawned at times other than their natural times of the year. Manipulative fish culture also produced hybrids and genetic variations of trout as extras for anglers, including the splake (lake trout x brook trout), tiger trout (brown trout x brook trout), and the palomino trout (golden rainbow trout x rainbow trout).



Atlantic Salmon *Salmo salar*

Pink Salmon *Oncorhynchus gorbuscha*

Species overview: The pink salmon is one of several Pacific salmon species successfully introduced into waters of the eastern U.S. Reports of pink salmon spawning in several Pennsylvania Lake Erie tributaries date from 1979. Today, they are rarely found in Pennsylvania tributaries. Pink salmon spawn once in their lives and then die. It's believed that pink salmon arrived in Lake Erie as a result of British Columbia stocks that were introduced into Lake Superior in the 1950s. In Russian, "*gorbuscha*," part of the pink salmon's scientific name, means "hump-backed." Pink salmon are also called "humpies" and "hump-backed" salmon.



Identification: The pink salmon may reach lengths of 24 inches in the ocean, but seldom more than 18 to 20 inches in fresh water. Large, dark, oval spots are found on the adipose fin, tail and the upper sides of the body. The upper surfaces are blue to blue-green. The sides are silvery and in breeding males become pale-reddish with greenish-brown blotches. Breeding males also develop elongated jaws, the upper one longer and hooked downward. In addition, a noticeable hump appears on the back between the head and dorsal fin. Counting the number of scales in the row just above the lateral line can be helpful in separating the pink salmon from other salmon species. The pink salmon has 169 or more scales in this row, compared to fewer than 155 on other species.

Habitat: Pink salmon are anadromous in the ocean. Pennsylvania's pink salmon live in Lake Erie and ascend tributary streams to spawn in late summer or early fall. Plankton are the main food of young salmon entering Lake Erie. As they grow, they eat a variety of smaller fishes.

Life history: As do other salmon species, pink salmon build redds, or nests, after ascending Lake Erie's tributary streams. The female fans out an area lying on her side, pushing the gravel aside. Some pink salmon redds can be as deep as a foot or more and three feet long. The female deposits about 1,500 to 1,900 eggs. Females guard their nests until they die, a few

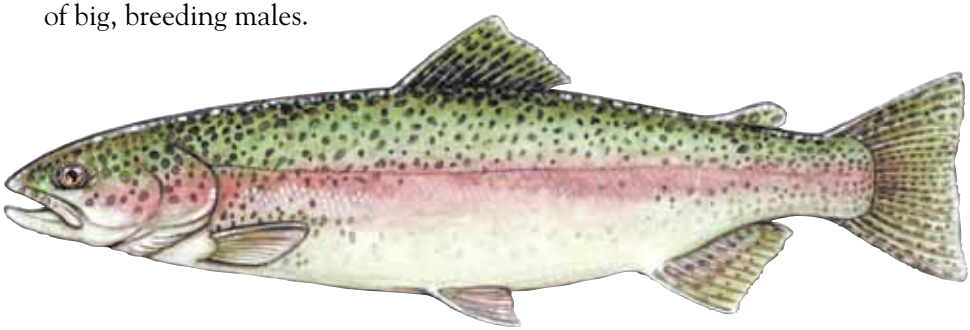
days after spawning. The eggs hatch from December through February, and the young feed on the yolk sac in the redd until the yolk sac is absorbed. In April or May, the newborn pink salmon swim downstream to Lake Erie. Pink salmon spawn at about age 2.

Anglers catch pink salmon in Lake Erie by trolling a variety of crankbaits and spoons.

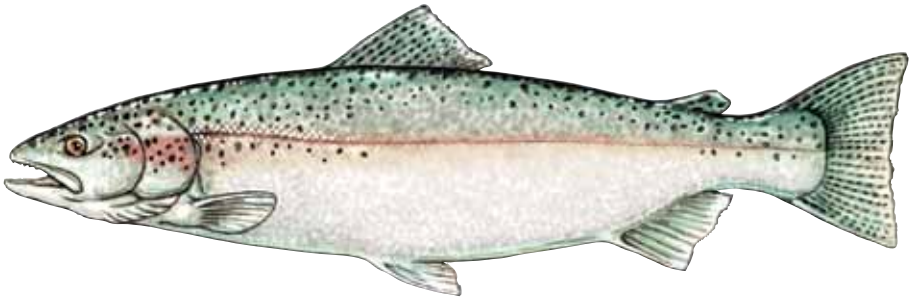
Rainbow Trout *Oncorhynchus mykiss*

Species overview: Rainbow trout are a western North American species, native to the Pacific slope from California to Alaska. In a turn-of-the-century effort to restore Pennsylvania's degraded trout fishery, rainbows were introduced throughout the state. But today, as wild fish, rainbows sustain reproducing populations only in a handful of fast-falling creeks scattered around the state. As stocked, hatchery-reared fish, rainbows are found throughout Pennsylvania's watersheds.

For many years the rainbow was considered a near relative of the brown trout, and it was given the scientific name *Salmo gairdneri*, which still appears in some reference books. Today, biologists consider the rainbow more closely akin to the Pacific salmons and the cutthroat trout of the West. Its scientific name was changed to reflect that link. Like those salmons, some rainbows (steelhead) run to the ocean or a large sealike lake, like the Great Lakes, if they have access, returning upstream for spawning. Then they are called "steelhead" (they appear steel-colored, or more silvery, than stream rainbows). Rainbows are flashy fighters when hooked, jumping out of the water more than other trout. The genus name "*Oncorhynchus*" means "hooked snout," referring to the hooked lower jaw of big, breeding males.



Identification: Rainbow trout are silvery-gray to dark-green on the back and sides. They have a pinkish or reddish lateral stripe, sometimes with lavendar or orange overtones, from the gill cover running the length of the fish to the tail. The caudal fin has rows of small dark spots, and there are more small blackish spots sprinkled on the head and sides, and spotting on the dorsal and adipose fins. The belly is whitish. The lower



Steelhead

fins are pale-pink without spots. At spawning time, males become deeply colored with an intensely red side stripe. Steelhead can be separated from similar-looking coho and chinook salmon by looking at the inside of the mouth. The mouth is completely white in the steelhead. In the salmons, the mouth has some gray or black. Steelhead and other deepwater, big-lake rainbows are more silvery than stream fish, with less of a side stripe. Great Lakes steelhead can grow to 30 inches and larger. The state record is more than 20 pounds.

Habitat: Rainbows are considered fastwater fish, preferring the swift runs and riffle areas of streams. They may live in small creeks, as well as suitable spots in large rivers, the tailwaters of dams, and in lakes and reservoirs. As trout, rainbows live in cold, clean, well-oxygenated water. Their optimum water temperature is about 55 degrees. Although they do best when the water is under 70 degrees, they can withstand temperatures into the 70s if there is plenty of oxygen and a cool, shady place to which they can retreat. Rainbows are the trout least tolerant of acidity. They do best in slightly alkaline waters. As steelhead, rainbows inhabit the cool waters of large lakes, especially Lake Erie and other Great Lakes, as well as oceans. Rainbow trout respond well to hatchery culture and have been introduced for sport fishing throughout the world. In some places, especially the mountains of the southeastern United States, introduced rainbows have encroached on native brook trout populations.

Life history: Rainbow trout are considered spring spawners, but steelhead may enter streams to spawn from late fall through spring. Spawning takes place when the water temperature is about 50 degrees, over gravel beds with good water flow. Rainbow trout move upstream to find the proper spawning area. Rainbows in lakes seek tributary streams. Like other trout, the female rainbow prepares the nest depression by turning on her side and "kicking" against the bottom gravel with her body and fins. Male rainbows are aggressive on the spawning grounds, driving other males away from the female's nest. When the actual spawning takes place, several males may be beside the female. The females produce several

hundred to over 12,000 eggs, depending on their size. After the eggs are deposited into the gravel and fertilized, no parental care is given. The eggs hatch in four to seven weeks. The fry take up to another week in the gravel to absorb the yolk sac. Then they become free-swimming. Most rainbows are sexually mature when they reach about three to five years old.

Documentation of successful natural reproduction in Pennsylvania is rare. Self-sustaining populations of rainbow trout are found only in a few scattered streams. But mature rainbows, especially steelhead that have run up Lake Erie tributaries, successfully spawn and produce young. However, adult returns are mostly comprised of hatchery-released fish. Unlike salmon, which die after spawning, steelhead can spawn again, returning to the ocean or large lake to grow even bigger before the next year's spawning run. Steelhead also follow other spawning fish migrating upstream and prey on their eggs and young. Rainbows feed on aquatic and terrestrial insects, crayfish and other crustaceans. Rainbows also eat fish, as well as plankton, snails, leeches and fish eggs. They take a variety of anglers' flies, lures and baits.

Rainbows have been intensively cultured in fish hatcheries. Strains have been developed that are of various colors, are tolerant of warm water, grow rapidly, resist disease and spawn at times different from the rainbow's natural spawning time.

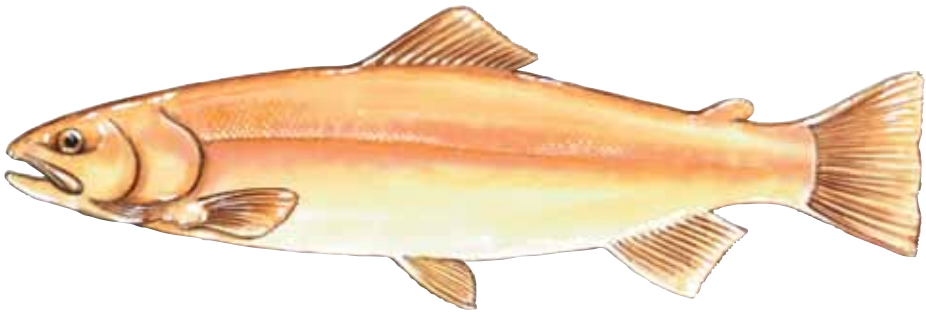
The lifespan of the steelhead in the Great Lakes is six to eight years. Small-stream rainbows may live only to be three or four years old.

Golden Rainbow Trout *Oncorhynchus mykiss*

Species overview: The golden rainbow trout is a gold-orange rainbow trout raised under artificial fish culture conditions and stocked as a novelty for angling sport. The golden rainbow was developed from one fish, a single female trout with a genetic mutation that gave her a mixed golden and normal rainbow trout coloration. She was found in the West Virginia hatchery system in 1954. Through selective breeding with regularly marked rainbow trout, an all-gold, golden rainbow trout was developed. In 1963, this fish strain was popularized as the "West Virginia Centennial Golden Trout." Pennsylvania and other states hybridized the pure strain of West Virginia golden trout with normal rainbows and produced palomino trout, which were true genetic palominos. Palomino trout were first stocked in Pennsylvania in 1967. Since then, the genetic strain in Pennsylvania has weakened, but in recent years the hybrid was selectively bred back closer to the stronger, better-colored golden rainbow trout. Although palominos were stocked as both average-sized and large trout, today's golden rainbow is raised only to trophy size for anglers and stocked throughout the state.

The golden rainbow trout is a different species than the golden trout (*Oncorhynchus aguabonita*) of some California streams. In fish hatcheries, the rainbow trout has occasionally produced other unusual genetic mutations, such as the blue rainbow trout, whose body color is sky-blue.

Identification: Golden rainbows are a deep golden-yellow in body color, with pinkish lower fins, pink or red tones on their cheeks and with the rainbow's reddish lateral stripe. There is no spotting on the body or fins. The Pennsylvania record golden rainbow trout is over 13 pounds.



Habitat: The golden rainbow trout's habitat preferences are identical to those of the normally colored rainbow trout. It is stocked throughout the state in appropriate trout waters. No rainbow trout or golden rainbows are planted in the Lake Erie watershed.

Life history: The golden rainbow is reared in fish culture stations. Spawning in the wild is unlikely, because golden rainbows are highly visible in streams both to anglers and predators like blue herons and ospreys. Golden rainbows and palomino rainbows grow larger and faster than regular rainbows. They have "hybrid vigor," a trait often seen in crossbred plants and animals. Their food preferences are similar to those of other trout.

Brown Trout *Salmo trutta*

Species overview: The brown trout is not a native Pennsylvanian, although it is now naturalized and widespread here in the wild, even becoming the main trout species in streams previously dominated by brook trout. Brown trout were originally found in Eurasia and were stocked in the late 1800s in the United States as strains from various locations, including Scotland and Germany. Pennsylvania received its first brown trout in 1886. Brown trout are considered more difficult to catch than brook trout. The larger ones tend to feed at night. Brown trout are closely related to Atlantic salmon (*Salmo salar*). The genus name "*Salmo*" is the Latin name for the Atlantic salmon. The species name "*trutta*" is the Latin name for "trout."

Identification: Brown trout are brownish in overall tone. The back and upper sides are dark-brown to gray-brown, with yellow-brown to silvery lower sides. Large, dark spots are outlined with pale halos on the sides, the back and dorsal fin, with reddish-orange or yellow spots scattered on the sides. The fins are clear, yellow-brown, and unmarked. The belly is white-yellow. Like other trout and salmon, breeding males develop a long, hooked jaw and brighten in color. Wild brown trout in infertile streams may grow only slightly larger than the brook trout there. But in more fertile streams brown trout that weigh a pound are common. A brown trout over 10 pounds is a trophy. Brown trout may exceed 30 inches in length. The state record is more than 19 pounds.

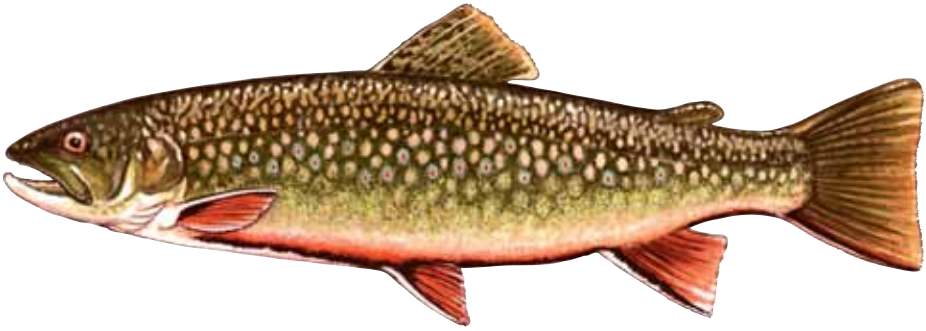
Habitat: The brown trout lives in cold or cool streams, rivers, lakes and impoundments. It is more tolerant of siltation and higher water temperatures than brook trout. A brown trout's optimum water temperature range is 50 to 60 degrees, although it can tolerate water temperatures in the low 70s. Like brook trout, they are also somewhat tolerant of acidity. Brown trout may be found in all of the state's watersheds, from limestone spring creeks, infertile headwaters and swampy outflows to suitable habitat in the larger rivers and reservoir tailwaters. Some brown trout can "hold over" after they are stocked. They can last a year or more in a stream, because they are adaptable to stream changes and are not that easy to catch.

Life history: Brown trout spawn in the fall, a little later than brook trout, when water temperatures are in the mid-40s to high 40s. Eggs are deposited in a stream gravel depression that the female prepares with swimming actions of her fins and body. Large females produce 4,000 to 12,000 eggs. Several males may accompany the female during spawning. The eggs hatch the following spring, with no parental attention. Brown trout eat aquatic and terrestrial insects, crayfish and other crustaceans, and especially fish. The big ones may also eat small mammals (like mice), salamanders, frogs and turtles. Large browns feed mainly at night, especially during the summer. Their life span in the wild can be 10 to 12 years.

Brook Trout *Salvelinus fontinalis*

Species overview: The brook trout is Pennsylvania's official state fish. It is technically a char. It is related to the Arctic char of the Far North, the Dolly Varden and bull trouts of the West, and the lake trout. The chars live farther north than most other trout and salmon family members. The brook trout's original home was northeastern North America, through the Great Lakes, and south along the Appalachian Mountains to Georgia. It is the only stream trout that is native to Pennsylvania. The genus name *"Salvelinus"* is derived from an old name for char. The species name *"fontinalis"* means "of springs." Brook trout are sometimes called speckled trout, squaretails or just "brookies."

Identification: The brook trout's general body color is dark-green. Looking closer, its back is dark olive-green or gray-green, mottled with dark, squiggly or wormlike markings from head to tail. The sides and belly shade lighter, sometimes with green, gray or even lavendar tones, and additional irregular marks. The sides also have scattered red dots, surrounded by bright-blue halos. The belly is usually pale yellow-orange, with a blackish or gray streak down the middle. The pectoral, pelvic and anal fins are pale to bright-orange with a white leading edge followed by a black stripe. There are dark blotches on the dorsal and caudal fins. The brook trout's tail fin is less forked than that of most trout and salmon. It's even squarish. In spawning males, colors become more intense and the belly becomes deep-orange. At maturity, wild brook trout may be from five inches to 18 inches long, according to the availability of food in the home stream.



Habitat: The brook trout lives naturally in small, cold, clean streams. It also adapts to ponds and lakes, as well as instream beaver ponds. Brook trout are found in Pennsylvania as wild populations in the Ohio, Susquehanna, Genesee, Potomac and Delaware River watersheds. Brook

trout are also found throughout the state as hatchery-raised, stocked fish. The habitat of wild brook trout has been greatly reduced in Pennsylvania since European settlers arrived, with land-use changes, mining, and warming and silting of streams, and with other pollution and stream habitat degradation. Naturally self-sustaining populations can still be found in limestone spring-fed streams and cold, mountain creeks. Brook trout can tolerate relatively acidic waters, but not temperatures much over 65 degrees.

Life history: Brook trout spawn in the fall, from mid-September through November and may travel to upstream headwaters to find the right spawning spot. Similar to other trout, with violent motion of the body and tail, the female digs a shallow nest depression in the bottom gravel where there is good water flow to bring oxygen to the eggs. The males become aggressive on the spawning grounds, chasing one another, but several males may accompany the female in the spawning act. After fertilization, the eggs receive a small additional covering of gravel, often from females digging new areas just upstream. The eggs are given no further parental care. Eggs develop over the winter and hatch in late winter or early spring. In small streams, sexually mature fish may be only four or five inches long, and produce only a few hundred eggs. A brook trout over 18 inches might produce around 4,000 eggs. In headwater, infertile streams, few brook trout may reach "legal" keeping size for anglers. Large brook trout caught by anglers in Pennsylvania are mostly hatchery-stocked fish. But they may have spent some time in the stream since their planting, grown bigger, and become wary of anglers. Brook trout feed on aquatic and terrestrial insects, both under and on the water's surface, crustaceans and small fish. They can be caught on a variety of artificial flies, lures and natural baits. Brook trout are relatively short-lived. Few survive in the wild longer than five years.

Lake Trout *Salvelinus namaycush*

Species overview: The lake trout is a char that lives mostly farther north than Pennsylvania. Besides the brook trout, the lake trout is the only trout and salmon family member that is native to the state. It is found naturally in Lake Erie and in Silver Lake, Susquehanna County. Elsewhere the limits of its original range follow the southern boundary of the glacial advances across North America. The genus name "*Salvelinus*" is an old name for "char," and the species name "*namaycush*" is an American Indian name for the lake trout.

Identification: The lake trout's body has a background gray color, often with an bronze-olive overtone. It shades to silvery-white on the belly. The back and sides have many large light-colored, irregularly shaped markings, some of which are wavy or wormlike, like the brook trout's markings. There

is also light speckling on the dorsal and adipose fins and on the deeply forked caudal fin, plus a white leading edge on the pectoral, pelvic and anal fins. The Pennsylvania record, from Lake Erie, is more than 27 pounds. Elsewhere, lake trout have been known to grow to more than 50 inches and reach over 100 pounds.

Habitat: Lake trout live in deep, cold, usually infertile lakes. Their numbers have been affected by pollution and the parasitic sea lamprey, which invaded and spread throughout the Great Lakes earlier in this century. Artificial culture in fish hatcheries and stocking have helped to return the lake trout to the Great Lakes, including the Pennsylvania portion of Lake Erie. In the state, lake trout have also been stocked in Harvey's Lake, Luzerne County, Raystown Lake, Huntingdon County, and the Allegheny Reservoir, Warren County. Lake trout are roamers and may move widely in their home lakes and go several hundred feet deep. Their preferred water temperature is about 50 degrees. In the summer they stay deep and can usually be caught by deep trolling. But as the water cools with the fall season and into spring, lake trout may be taken by artificial lures and flies fished shallower, near shore. Lake trout are the least tolerant of salt water of all the chars.

Life history: Lake trout are mature enough to reproduce when they are six or seven years old. Some lake trout respond to a homing instinct. They return to the same spawning grounds year after year, while others do not. Lake trout do not normally make an upstream spawning run. They spawn in their home lakes at night during the fall. The eggs are deposited over a boulder-strewn or rubble bottom, or over artificial spawning structure, in depths from 40 feet to about one foot. Lake trout may clean their spawning sites by rubbing against the rocks with the snout, body and fins, but they don't prepare a nest as do other trout. After release, the eggs drift down to settle in the spaces between the rocks. The eggs are not guarded. They develop by themselves and hatch the following spring.

Lake trout grow more slowly than other salmon and trout family members. They reach a large size because they live a long time, over 20 years. Lake trout feed on smelt and other fish, as well as crustaceans, terrestrial and aquatic insects, and plankton.

Pikes and Mudminnows

Family Esocidae

Family overview: Pike are long, slender, "duck-billed" predator fish, popular with anglers for the great size some species attain and for their sporting fight. Four species of the pike family live in the Northern Hemisphere. The grass pickerel and redfin pickerel (the two are closely related subspecies), the chain pickerel, the northern pike and the muskellunge are native to North America and to Pennsylvania. The northern pike is one of the few fish whose natural range includes both North America and Eurasia.

The native pike family residents of Pennsylvania range from the small redfin pickerel of eastern Pennsylvania and its close cousin the grass pickerel of northwestern Pennsylvania, which seldom reach one foot in length, to the mighty muskellunge, whose state angling record is over 54 pounds. Pike live in coolwater streams and large rivers, as well as lakes, from ponds to big impoundments, depending on the species. All pike are associated with submerged vegetation, although muskellunge also frequent rocky lake shoals. The family name "Esocidae" is from "Esox," an old European name for the pike.

Identification: The pikes are well-camouflaged to blend with their underwater surroundings. Markings and coloration vary among species, their concealment patterns ranging from oblique striping and broken horizontal bands to chain-link markings and beanlike spotting in light and dark tones. The pike family's general coloration is green, from a dark yellow-green to olive-brown, with yellowish markings or shadings. The fins in some species are dull-red or orangish. The eye is large and yellow. The pike's scales are cycloid, smooth, small and numerous, and embedded in a slimy mucous that makes the fish slick to the touch.

The pikes are slender, cylindrical fish. The pike family's most distinctive characteristic is the long, flattened snout that looks something like a duck's bill. The mouth is fitted with many strong, sharp teeth, and the forehead is like a bony plate. Pike have one dorsal fin that is placed far along the back, toward the tail, as is the opposing anal fin. The tail is forked, and may or may not be marked, according to the species. There is no adipose fin. Pike are built for their role as swift, aggressive predators.

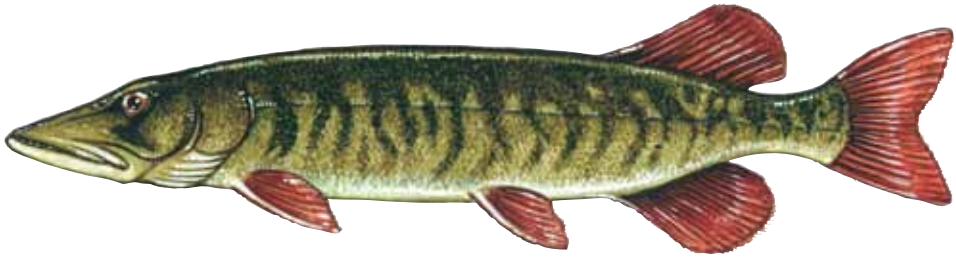
Life history: The pikes spawn in early spring, when water temperatures reach about 50 degrees. The pikes don't build nests. Several males spawn with a female, the fertilized eggs scattering over underwater plants, dead vegetation and other organic debris, in shallow sections of the lake or stream. Eggs are sticky at first and adhere to vegetation and objects above the silty bottom. Staying out of the mud appears to be necessary for successful egg-hatching. Pike eggs are abandoned by the parents and hatch in 10 to 12 days. The fry, or just-hatched fish, have an adhesive organ at the top of the snout, with which they attach themselves to submerged plants. They remain "stuck" there for about a week, while their nourishing egg sac is absorbed.

Until they are about two inches long, young pike eat aquatic invertebrates. Then they switch to the main source of food for the rest of their lives–fish. In crowded conditions, pike even eat one another. Pike are top-level predators in their habitat, living solitarily and feeding on other fish, plus any birds, small mammals, snakes and frogs that happen into the water. They feed by ambush, waiting motionless in concealing cover until their prey approaches. Then they lunge swiftly to grab it. Prey is taken at the midsection, and then shifted in the pike's mouth and swallowed headfirst. Pike are sight-feeders and are active by day, even continuing to feed during winter months, which makes them available to ice anglers. The pikes grow fast, with the young of the larger species reaching 12 to 18 inches their first year. The females grow fastest, live longer and attain larger sizes than the males.

Redfin Pickerel *Esox americanus americanus*

Species overview: The redfin pickerel is the eastern half of the *Esox americanus* subspecies twins. The other is northwest Pennsylvania's grass pickerel (*Esox americanus vermiculatus*). The redfin's native range is along the Atlantic Coast from Massachusetts to Florida. In the Gulf Coast and southeast states, it mixes and interbreeds with the grass pickerel. The redfin is a common small pickerel in the Delaware River watershed in Pennsylvania. It is found rarely in the Susquehanna River watershed. In Pennsylvania, there is no natural overlap in the geographic distribution of these subspecies.

Identification: The redfin, along with the grass pickerel, is the smallest member of the pike family, growing to 12 inches at most. Its range restriction in this state, east of the Allegheny Mountains, is the best way to distinguish it from the grass pickerel. With few exceptions, the two fish are similar in appearance. The redfin pickerel is greenish gray to dark olive-bronze on the back, with shading down its sides. Over the sides are wavy or wormy-looking lighter markings that can appear as a series of vertical,



irregular bars. The belly is white or yellow-tinted. The redfin's cheek and opercle are fully scaled, and the black "tear drop" beneath its eye extends backward. The snout is short and broad and the fins are unspotted and reddish, providing its common name.

Habitat: Redfin pickerel inhabit the weedy shallows of slow-moving streams, as well as lakes and ponds. Although they are usually found over a soft, mud bottom, redfin pickerel prefer the water itself to be clear. They can live in naturally acidic water, like that which flows from the tannic-stained bogs in Pennsylvania's northeast region. They can tolerate swampy waters with low oxygen content and brackish waters, where fresh water and ocean salt water mix.

Life history: Redfin pickerel spawn in spring, when the water temperature reaches about 50 degrees. The sticky eggs are randomly broadcast in the shallows over underwater vegetation and other organic debris. The eggs, which hatch in about two weeks, receive no parental care. Unlike larger pikes, the redfin does not include fish as a primary part of its diet. Instead, it feeds on small crustaceans, crayfish, aquatic insects and other invertebrates. The small size of redfin pickerel, as well as their restricted shallow-water habitat, may be why so few fish are on their menu.

Grass Pickerel *Esox americanus vermiculatus*

Species overview: The grass pickerel subspecies could be mistaken for the redfin, if their ranges were not so distinct. The grass pickerel is distributed throughout the Mississippi River watershed. The redfin is an East Coast fish. Where their ranges cross along the Gulf Coast, from Louisiana to Florida, the two small pickerel interbreed. In Pennsylvania, grass pickerel are found in northwestern Pennsylvania, in both the Lake Erie and Allegheny River watersheds, especially where the land has been glaciated. The grass pickerel's subspecies name "*vermiculatus*" means "wormlike," describing the wavy markings on the fish's sides.

Identification: Grass pickerel rarely grow over 12 inches long, so an adult grass pickerel could be mistaken for an immature northern pike or muskellunge, except for the scaling that covers its cheeks and gill covers. Grass pickerel are usually not as distinctly marked as redfins, and they do not have a red tinge to their fins. The sides and back are greenish to grayish, and the flanks have lighter, dusky streaks that curve and tend to be vertical. The streaks may look like bars or just shadowy, wandering lines. Grass pickerel have a black bar beneath the eyes, which trails slightly backward. The fins are amber or dusky with no markings.

Habitat: Grass pickerel live in the marshy areas of lakes and ponds, as well as in slow-flowing sections or backwaters of clear streams. They are usually found in and around dense, rooted aquatic vegetation over a soft, silt bottom.

Life history: Grass pickerel scatter their adhesive eggs over underwater plants, when water temperatures in the spring rise to the low 50s, generally April. They may also spawn in the fall, but the survival of the fry is probably very low, and they may occasionally hybridize with northern pike. With its small size, the grass pickerel eats few fish, but feasts instead on invertebrates, aquatic insects, crayfish and other crustaceans.

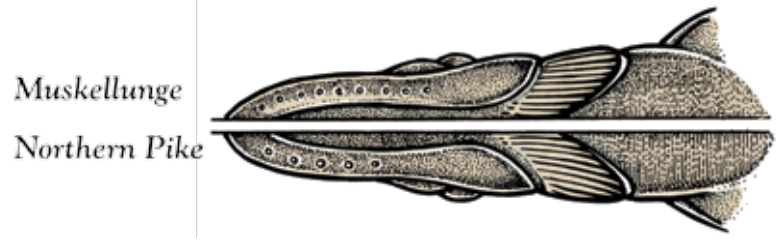
Northern Pike *Esox lucius*

Species overview: The northern pike's distribution is circumpolar–it lives in the Northern Hemisphere from North America to Europe and Asia. The northern pike has a long history in the Old World and is the subject of romantic myth and melodramatic folklore. The Latin name for the pike is "*lucius*," referring to "Luce, the waterwolf." In legend, the northern pike grows to a frightening size and age, even snapping up men, mules and swans that cross its path. Northern pike bones were even worn as talismans to defend against witchcraft, and medicines or potions were made of parts of its body. The Anglo-Saxons gave the fish the common name "pike," comparing it to that ancient weapon.

In Pennsylvania, the northern pike is native only to the Ohio and Allegheny River watersheds, and to Lake Erie, where it is found in weedy Presque Isle Bay. Northerns grow fast and provide exciting sport. They are eager to bite and make a slashing strike, so they have been stocked in the state outside their natural range, in suitable reservoirs.

Identification: With sufficient forage, northern pike can easily reach about 20 pounds and 40 inches. The state record is over 30 pounds. The northern's back and sides are dark yellow-green or gray-green, shading to whitish undersides. The smooth body scales may show silvery highlights. Over the sides are lateral rows of whitish or yellowish oblong or bean-shaped spots. The fins have black blotches or spots and usually have yellow, orange or red coloring.

One way to distinguish northerns from muskellunge is by checking the scales on the cheek and gill cover. On the northern, the cheek is fully scaled, but only the upper half of the opercle, or gill cover, is scaled. Another way to differentiate the fish is to count the pores, tiny sensory openings, along the underside of the jaw. In northerns, there are four or five pores on each side; muskellunge have six to nine pores on a side.



The northern's mouth has rows of sharp, canine-like teeth. One folklore tale about the fish is that it doesn't bite in the summer because its teeth are shed. Research has shown that the pike's teeth are constant in number, but are lost and replaced throughout the year. There is no seasonal tooth loss that keeps them from biting.

Habitat: Northern pike favor shallow, vegetated portions of lakes and ponds, although they are usually not found in as little water depth as the chain pickerel. Northerns also live in rivers and large streams, especially in pools and backwaters, where there is weed growth. Northerns are clear-water and coolwater fish. During the heat of summer they retire to deeper, cooler water during bright midday, and they are active in shallower water when the sky is overcast or the sun is low.

Life history: Despite folklore that says pike live hundreds of years, their natural lifespan is about 25 years. Most spawning northern pike are three to five years old. Northerns spawn very early in spring, when water temperatures are from 40 to a little over 50 degrees, just after ice-out. Spawning pike migrate to flooded marshes or shallow, weedy backwaters, broadcasting their adhesive eggs randomly, during daylight hours, over plants and organic debris. No parental care is given to the eggs or fry. Because pike spawn so early, their young are large enough to consume newly hatched suckers and other fish that appear later in the spring.

From 3,000 to 120,000 eggs are produced per northern pike female, depending on her size. The eggs hatch in about two weeks. Young pike remain attached to the plant stems until the yolk sac is absorbed. At first, young pike eat tiny underwater invertebrates, but within two weeks they are large enough to begin their lifelong role as fish-eaters. Northerns are one of our fastest growing fish, reaching six to 12 inches or more their first year, where there is sufficient food. Where they are overpopulated and the prey base is insufficient, northerns may become stunted, skinny and undersized "hammer handles."

Northerns are loners that feed only during the day. They hunt by ambush and take not only fish, but frogs and tadpoles, birds, muskrats, mice, crayfish, leeches and large aquatic insects. Active all winter, northerns can be caught by ice fishermen, especially with large live bait.

Tiger Muskellunge *Esox lucius x Esox masquinongy*

Species overview: The tiger muskellunge, or tiger musky, is the result of crossbreeding the male northern pike with the female muskellunge under fish culture conditions, although hybrids do occasionally occur in the wild. Tiger muskies have "hybrid vigor." They are hardier and faster-growing than their purebred parents, and they respond better to hatchery-raising. Tiger muskies are also easier to catch than purebred muskellunge, having more of the eagerness to bite anglers' baits and lures of their northern pike parent. However, because they are more easily caught, they don't live as long as regular muskies, so they don't attain the muskellunge's great size.

Identification: The tiger musky has strong, vertical or slanting barring on its sides, more pronounced than the markings on a purebred muskellunge. Its general color is dark gray-green on the back, a lighter green on the sides, with dark, equally spaced side bars giving the fish its "tiger" name. The dorsal, caudal and anal fins are spotted or streaked with black, and the belly is off-white. The body of the tiger musky may look more plump than a purebred's, because it tends to be shorter and more robust. Scalation on the cheek is intermediate between the northern pike, with a fully scaled cheek, and the muskellunge, which has scales on the upper half of the cheek. About the upper two-thirds of the tiger musky's cheek is scaled. The number of pores beneath one side of the lower jaw is six or seven.

Habitat: The tiger musky is stocked in suitable waters, large reservoirs and rivers, throughout Pennsylvania. It tends to be more of a wanderer than its parents, moving about in its home waters.

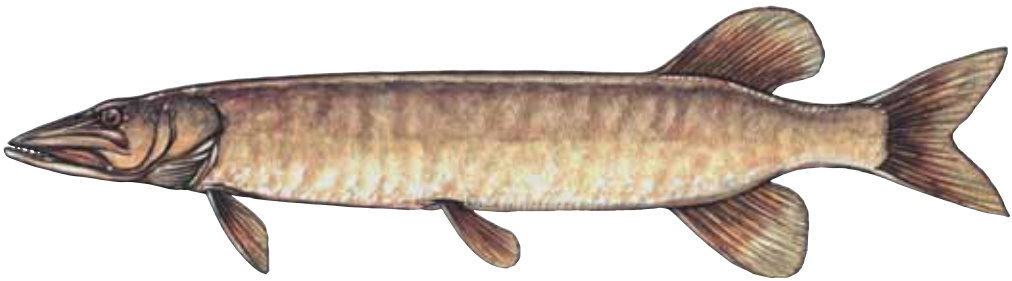
Life history: The male tiger musky is sterile, so natural reproduction among individuals does not occur. This gives fisheries management personnel much control over the number of these predators in a given waterway. Tiger muskies are produced for stocking by mixing of eggs and milt of the fish's muskellunge and northern pike parents. Their food preferences are similar to those of their relatives. Fish are their favorite meal.

Muskellunge *Esox masquinongy*

Species overview: A voracious predator, the muskellunge is one of Pennsylvania's largest and fastest-growing fish, with the state record standing at over 54 pounds. The muskellunge's original North American range was the St. Lawrence River, throughout the Great Lakes and Hudson Bay, and the Mississippi River basin, but it has been widely propagated and stocked elsewhere for sport fishing. In Pennsylvania, muskies were originally restricted to the northwest region, the Lake Erie and Ohio River watersheds, especially in the large glacier-formed lakes,

like Conneaut Lake in Crawford County and Presque Isle Bay in Lake Erie. The species name "*masquinongy*" comes from an Ojibwa (Chippewa) name for the fish–"mas," meaning "ugly," and "kinononge," meaning "fish."

Identification: The musky is streamlined with a dorsal and anal fin that are set so far back toward the tail that the fish is almost missile-shaped. Its flat, ducklike snout has many strong, sharp teeth. The musky has no scales on the lower half of its cheek and the lower half of its gill cover, which helps to distinguish it from the northern pike. Also, the musky has six to nine pores, tiny sensory openings, beneath each side of its jaw; the northern pike has five or fewer pores. Muskies vary in the color and the



intensity of their markings. The base color on the back and sides is light greenish gray or yellow-green to olive-brown, the sides shading lighter. The flanks have more or less vertical rows of darker spotting, or indistinct bars. The striping is more pronounced in younger fish. In older fish it may fade, giving the fish a uniform color. The musky's belly is white. Its fins are greenish cream to brownish orange, with dark blotches. There is no dark teardrop mark below the eye. Instead, a black horizontal streak runs through the eye. A musky of 20 to 35 pounds is not unusual, and they may grow over four feet long.

Habitat: Muskies are coolwater fish, found in clear natural lakes, reservoirs and rivers. They frequent quiet backwaters and slow pools that have plenty of aquatic weed growth, which the musky uses for cover and which attracts its prey. Muskies are usually found in fairly shallow water, 15 feet or less, but they have been caught 40 or 50 feet deep. They also associate with rocky or boulder-strewn shoals. Muskies use a restricted home range, rarely moving more than two miles from their summer feeding areas, with the large ones often remaining in one pool.

Life history: Muskellunge are solitary, territorial predators. They are very aggressive and will even attack and eat one another. Their main diet is fish, but they will take what opportunity gives them, including snakes, frogs, muskrats, mice and waterbirds.

Muskies spawn in the spring, after the northern pike, when water temperatures are in the high 50s to high 60s. They spawn at night in shallow water, often just six to 12 inches deep. Relatively long-distance spawning migrations have been documented because adults tend to return to the same spawning locations each year. As the male and female swim over the spawning site, which usually features underwater stumps and logs on a muck bottom, the eggs are released to fall as they will. Female muskies 25 to 53 inches long produce 22,000 to 180,000 eggs. The adhesive eggs hatch in eight to 14 days, and as is usual for the pike family, the fry attach themselves to sunken debris as they absorb their egg sacs.

Mortality of fry is high, because fish eat the vulnerable musky young. When muskies are about four days old, they turn the tables, and begin eating fish. On that diet they can grow to one foot long in only four months. Muskies are sexually mature at about three years old and a little over 20 inches long. Females grow faster than males, and all muskies grow best in the early summer and fall, when water temperatures reach about 68 degrees.

Muskies naturally hybridize with northern pike, producing the "tiger musky" (see page 61). Tiger muskies are also bred artificially in fish hatcheries and stocked for sport. The usual age of a musky that is caught is three to six years, but some have reached nearly 20 years old.

Chain Pickerel *Esox niger*

Species overview: Chain pickerel are the most abundant and widely distributed member of Pennsylvania's pike family. They are also the most often caught, biting the angler's bait or lure readily. The chain pickerel's original range was Atlantic and Gulf Coast tributaries, but the fish has been introduced elsewhere. In Pennsylvania, chain pickerel are restricted to the Delaware, Susquehanna and Potomac River watersheds. They are most common in the glaciated Pocono northeast.

Identification: Chain pickerel can grow to more than 30 inches long, but one of 25 inches and four or five pounds is considered a trophy in Pennsylvania. The state record is an eight-pounder. Two-pound pickerel are common where the fish have enough to eat. The chain pickerel hides easily in its weedy habitat, with its dark, greenish-yellow back, fading to lighter yellow-green along the sides. Over the sides is a pattern of dark chainlike markings that gives the fish its name. The belly is white. A dark mark, like a clown's painted tear, appears below each eye. The fins are unmarked and pale. As is typical of pickerel, both the cheek and the opercle, or gill cover, are fully scaled. Chain pickerel have a long snout. The distance from the tip of the nose to the front of the eye is greater than the distance from the back of the eye to the end of the gill cover.

Habitat: Chain pickerel live in and around weedbeds and sunken stumps and logs in natural lakes, swampy ponds and manmade impoundments. They can also be found in the sluggish parts of clear streams and in the naturally acidic, tannin-stained waters that drain boggy wetlands, as in northeastern Pennsylvania. Chain pickerel are commonly shallow-water dwellers, but they can live in deep lakes. They don't travel far from their selected home areas, and they tolerate a wide temperature range.

Life history: Chain pickerel spawn in early spring, when water temperatures are in the high 40s to low 50s. The spawning period lasts about one week. Chain pickerel are also reported to spawn in the fall, but the survival rate of eggs and young is suspected to be low. The sticky eggs, 6,000 to 8,000 typically deposited by each female, are scattered over underwater weeds. Chain pickerel have been known to hybridize in the wild with redfin pickerel, because their spawning site choices and breeding times overlap.

Just-hatched chain pickerel fry attach themselves to plant stems during the absorption of the yolk sac. Young chain pickerel eat aquatic insects and crustaceans, and are eaten by larger fish. As they grow, chain pickerel increasingly consume fish, which become the mainstay of their diet. At one year old, chain pickerel are about seven inches long. After four years, they are about 15 inches. Their natural lifespan is eight to 10 years.

Chain pickerel are solitary predators, feasting on fish, which they stalk through the underwater weedbeds, as well as crayfish, large aquatic insects, frogs and other small animal life that gets into the water. They feed during the day, especially at dawn and dusk, and are active through the winter, under the ice, so they can be caught by ice anglers. In ponds where they overpopulate and outstrip their food source, chain pickerel may become stunted "pencil pike," or "hammer handles," small in size and thin.

Cods

Family Gadidae

Family overview: The burbot (*Lota lota*) is Pennsylvania's only true freshwater representative of the primarily marine cod family and the only cod found within Pennsylvania. Inland populations of burbot are listed as a endangered species in Pennsylvania. Though reaching a length of 46 inches, burbot average only about 23 inches in length. The Allegheny River population is a relict distribution. This small population has persisted, but it is more vulnerable to physical habitat destruction and water quality degradation, specifically increased stream temperatures, sedimentation, and toxic chemical spills.

Burbot prefer the deep, cold waters of lakes and rivers. During late winter and early spring, after spawning, they often migrate from lakes to tributary rivers. The only Pennsylvania populations occur in Lake Erie and the Allegheny River headwaters. Even though burbot are found in several streams in the Allegheny River watershed, they are rarely abundant at any given location. The burbot's inland populations are listed as endangered.

Identification: The hindmost dorsal fin and the anal fin are long and nearly equal in length. A rounded tail fin separates both of these long fins. A pair of pelvic fins is located in the throat region in front of the large pectoral fins. A barbel-like tube extends from each nostril. A single barbel extends from the tip of the lower jaw.

Life history: The burbot is one of only a few Pennsylvania freshwater fishes to spawn in midwinter. Spawning may take place at night, over a sand-gravel bottom in the shallow portions of lakes or tributary streams under a covering of ice. Eggs drift along the bottom and hatch within 30 days. The young grow rapidly for their first four years, feeding mostly at night on a variety of invertebrates. They spend most of this time in lake shallows or stream channels. Adults more than 20 inches long feed almost entirely on other fishes during the summer, when in deeper water, and on invertebrates in the winter.

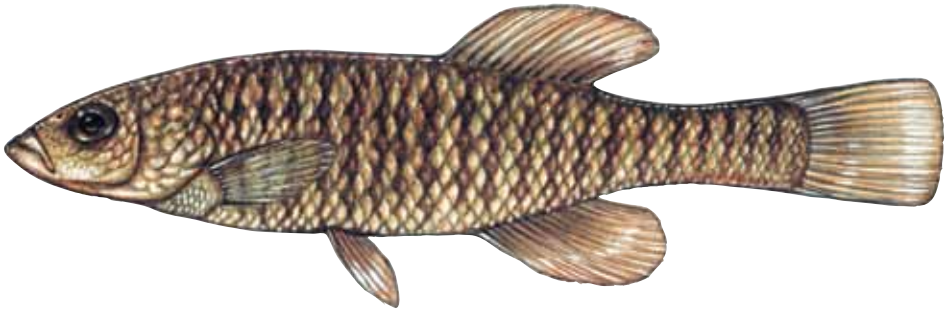
Topminnows

Family Fundulidae

Family overview: In North America, some 24 freshwater topminnows species are established in the northern states from South Carolina through the Dakotas. Other topminnows species can be found in North and Central America. Topminnows are also called "killifish," but they are not related to species in the minnow family (Cyprinidae).

Killifish are characterized by a round body, flattened back and head, and an upturned mouth. The dorsal and anal fins are farther back on the body than on other fishes. The dorsal fin originates a little farther ahead of the anal fin.

Banded killifish (*Fundulus diaphanus*), also called "killies," inhabit the surface portions of freshwater and coastal marine environments. In Pennsylvania, the banded killifish has been recorded from all Pennsylvania watersheds except the Genesee River watershed. They are often used as baitfish for other species.



Identification: The banded killifish has an elongated body with flattened sides and large, round scales. Both males and females have dark vertical lines on the sides. Lines near the tail are shorter than those on the body. The back is olive, yellowish olive, or brownish yellow, fading to yellowish white or silvery-white on the bottom. The fins are light-olive or yellowish olive.

Killifish have no lateral line, and the tail is squarish. The banded killifish has rows of small, sharp teeth in the upper and lower jaw. Adults are usually two to four inches long.

Life history: In Pennsylvania, banded killifish prefer the quieter portions of still water and slower-moving areas of streams. When small groups of banded killifish live in areas of sandy or fine-gravel bottoms, they

dig into the bottom when threatened. Larger schools of banded killifish show less of a tendency to bury.

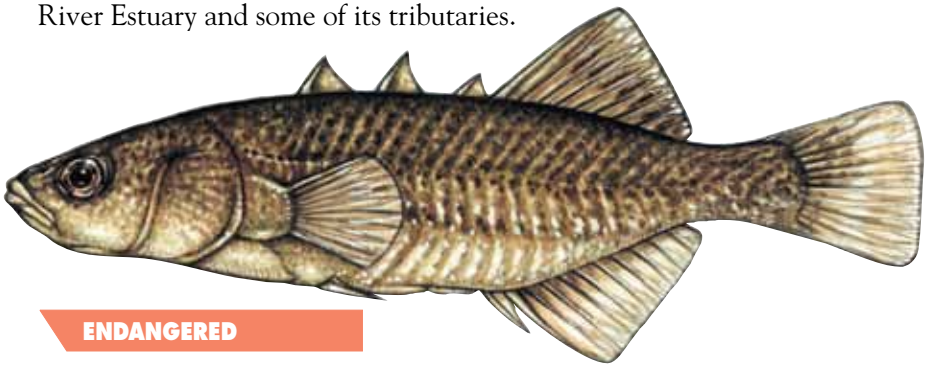
Killifish spawn in water of about 70 degrees. The male chooses a site and defends it against other males and intruders. As the male pursues a female, the female emits one egg, which stays attached to the female's body by a fine strand. When the male pursues the female even more persistently, they come together and the female then emits up to 10 eggs, which also stay attached for a short period. The eggs then fall to the bottom. The spawning pair separates, and when the female moves off, the male pursues her again. This behavior continues until some 50 eggs are deposited in about five minutes. Neither the male nor the female guards the nest or the eggs, which hatch in about three days.

Killifish feed at the surface, midwater and near the bottom on midge larvae and insects. The larger fish consume insects, mollusks and worms.

Sticklebacks

Family Gasterosteidae

Family overview: The stickleback family includes five genera and some seven species that are found across temperate areas of the Northern Hemisphere. Four stickleback species are native to North America. Sticklebacks are small, schooling fish. Adults measure at most some five or six inches long. The fourspine stickleback (*Apeltes quadracus*), brook stickleback (*Culaea inconstans*) and the threespine stickleback (*Gasterosteus aculeatus*) are found in Pennsylvania. The threespine stickleback is the rarest of the Pennsylvania species and occurs only in the lower Delaware River Estuary and some of its tributaries.



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Identification: All sticklebacks are characterized by bony plates along the sides, instead of scales. The threespine stickleback has three separate dorsal spines atop a compressed body. The back and upper sides are brown or green with some dusky spots. The sides fade to silvery along the belly. The fins are pale, and in some specimens the fins are tinged red. The lower sides become red in juveniles and breeding males, and they have bright-blue eyes.

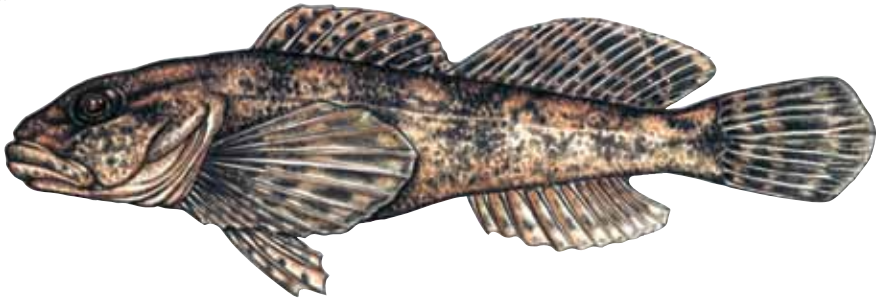
Life history: The threespine stickleback eats fish fry, fish eggs, a variety of crustaceans and aquatic and terrestrial insects. An elaborate courtship ritual characterizes a breeding period that lasts up to three months. At first, a male leaves the school and prepares a small, round nest from plant and bottom material. The male performs a ritualized courtship dance to entice a female to the nest. A female responds by depositing yellow or opaque adhesive eggs in the nest, and the male fertilizes them. The male then chases away the female, and guards the nest and the young. The threespine stickleback's lifespan is about three years.

Threespine sticklebacks prefer the weedy, quieter portions of rivers, streams, and still water. They prefer clear water.

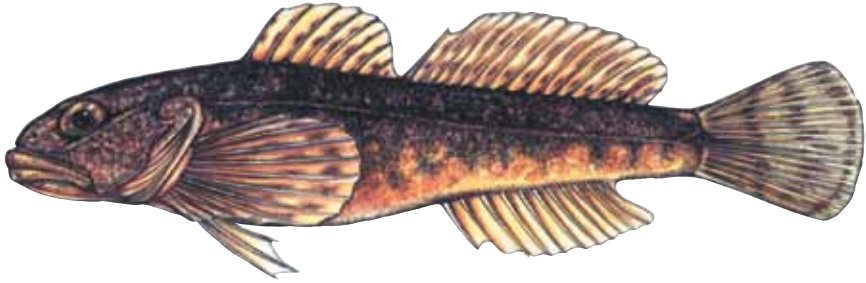
Sculpins

Family Cottidae

Family overview: Most members of the sculpin family are Northern Hemisphere saltwater fishes, but some species have adapted to living in fresh water. Most freshwater sculpins are small bottom-dwellers that prefer cool, headwater streams. In Pennsylvania, there are four common sculpin species for sure: The **mottled sculpin** (*Cottus bairdii*), the **blue ridge sculpin** (*Cottus caeruleomentum*), the **slimy sculpin** (*Cottus cognatus*) and the **Potomac sculpin** (*Cottus girardi*). The **spoonhead sculpin** (*Cottus ricei*) and **deepwater sculpin** (*Myoxocephalus thompsoni*) live in the depths of the Great Lakes and might be present in Lake Erie. They are extirpated species in Pennsylvania.



The **mottled sculpin** has a wide range over the central United States and Canada. It is common in clear, clean upland and mountain streams. Mottled sculpins often live in company with brook and brown trout, but they can also live in waters too warm for trout. In Pennsylvania, the mottled sculpin is found in all of the state's watersheds.



The **slimy sculpin** is found from New Brunswick, Canada, to Alaska. In Pennsylvania it lives in the Susquehanna and Delaware systems. It can thrive either in streams or lakes, but it must have a clean, stony bottom. Where the habitat is to its liking, it can become many times more abundant than the trout in the same stream. This is typical of a prey species.

The **Potomac sculpin**, as the name suggests, lives in the Potomac River watershed in Pennsylvania. It also lives in some nearby headwaters of the Susquehanna River. It is found in the rocky riffles of warm streams and the quiet pools above the riffles.

The **Blue Ridge sculpin** is a newly discovered species. It was determined to be distinct from the mottled sculpin because of differences in body morphology and protein analyses. Additional information on this species' abundance and distribution will become available as researchers begin to examine historic and future specimens more closely.

Identification: Sculpins are small, camouflaged fish reaching four or five inches in length. Their dark-and-light mottled color pattern helps them hide on the stream bottom. The broad head, fleshy mouth and upward-peering eyes look large for the rest of the body. Sculpins are compressed top to bottom, tapering quickly from a robust head to a narrow tail. The large, fanlike pectoral fins and the sculpin's flattened body shape allow it to stay pressed against the stream bottom, maintaining its position when in swift water–a hydrodynamic adaptation. Sculpins have no swim bladder, so they are nonbuoyant and move over the bottom in short spurts. There are two dorsal fins. The front fin is spiny and the rear one is soft. Both are held erect. The pelvic fins have a single spine and soft rays. The sculpin's body is scaleless, except for some scattered areas that have small, sharp scales called "prickles." The tail is straight or rounded.

The mottled sculpin is light to dark-brown with darker mottling on its back and sides, and a belly that is pale-brown or whitish. Its chin has irregular dark pigment, and there are spots and streaks of darker color on the dorsal, caudal, pectoral and anal fins. Mottled sculpins also have a short patch of teeth on each of the paired bones (palatine) in the forward roof of the mouth.

Slimy sculpins are dark-brown with darker mottling. They are lighter on the sides, blending to whitish on the belly. The spiny dorsal fin is dark at the base, and clear along its top edge. The second dorsal fin, caudal fin and anal fin may have light bars, and the pectoral fins are widely barred. There is no mottling on the chin, and no teeth on the palatine bones. The mottled sculpin and the slimy sculpin are difficult to tell apart in the field.

Life history: Mottled sculpins spawn in early spring. The males choose a hollow beneath a rock in a stream riffle. They invite females to spawn there by enacting an elaborate courtship ritual. The male moves his head quickly, bites the female, and may even grab her head and pull her toward the nest cavity. The eggs are laid on the underside of the rock, in a sticky mass. They hatch in two or three weeks. The male guards the nest as the eggs develop. Slimy and Potomac sculpins spawn similarly.

Temperate Basses

Family Moronidae

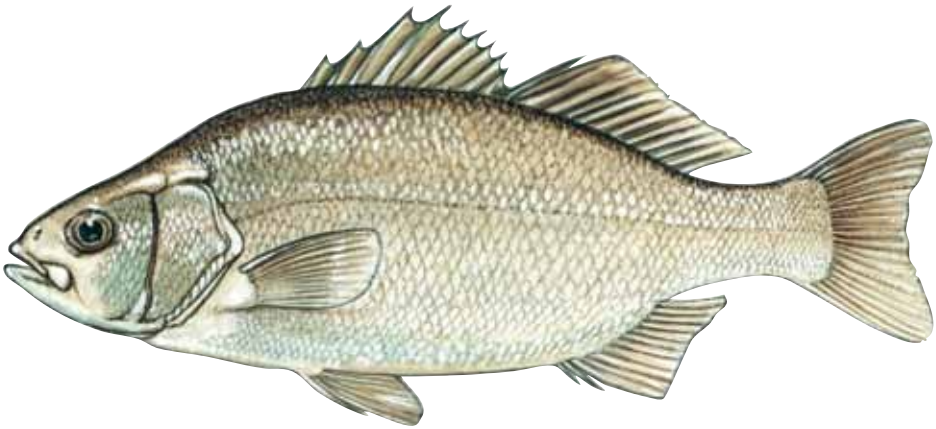
Family overview: The temperate basses are also called the "true" basses or "sea" basses. In Pennsylvania, the temperate basses are represented by three species and one hatchery-created hybrid: The white perch, white bass, striped bass and the striped bass hybrid. The hybrid is a cross between a white bass and a striped bass. The temperate bass family, known to science as the Moronidae, includes species in North America, Europe and North Africa. They are medium-sized to large-sized active predators and favorite trophy and sport fishes. Some species live in fresh water and others are anadromous, which means that they spend much of their life in salt or brackish water but return to fresh water to spawn. Temperate basses are found in Pennsylvania mainly along the lower Delaware River, in Lake Erie and in the Ohio River watershed, and as introductions to some of the larger reservoirs.

General identification: The temperate basses are deep-bodied fish when viewed from the side, and narrow, or compressed, when viewed from the front. They are silvery and most have dark horizontal stripes on their sides. The scales are large and rough to the touch. All temperate basses have a spine on the outer rear part of the gill cover, and an area of gill-like, secretion-emitting tissue under the surface of the gill cover. They have two dorsal fins, the first with about nine spines, the second with one spine and 11 to 14 soft rays. Temperate basses have three anal spines, a large mouth and a forked tail. The striped bass grows large. Pennsylvania's angling record is over 50 pounds. The white perch and white bass can grow to some 15 inches, a bit larger in the case of white bass, and weigh several pounds. The striped bass hybrid is a fast-growing sport fish whose length and weight fall between those of its parents.

Life history: All of the temperate basses are school fish, traveling and feeding in groups. They forage on smaller fishes, especially alewives, gizzard shad and smelt, following the little fish up from the depths to just below the water's surface at night. The temperate basses also spawn in schools. Large numbers move from their saltwater or brackish water homes, or from large impoundments, into streams or onto underwater shoals in the spring. The eggs of white perch and white bass stick to vegetation or rock rubble. Striped bass eggs are semi-buoyant and drift downstream. In the large waterways in which they live, the temperate basses are usually top-level predator fish.

White Perch *Morone americana*

Species overview: Although the white perch has "perch" in its common name, it does not look like, nor is it closely related to, the yellow perch. The white perch is a temperate bass native to the Atlantic Coast of North America, from Nova Scotia to North Carolina. It also occurs in Lake Ontario and the non-Pennsylvania portion of Lake Erie. In Pennsylvania, white perch are in the lower Delaware River and its estuary, where salt water mixes with fresh water, and in the lower Susquehanna River. They are also becoming more common in Lake Erie since colonization this century. Unfortunately, populations have been established in several southeastern Pennsylvania waters by illegal stocking.



Identification: White perch are silvery chunky-bodied fish, about 2 $^{1}/_{2}$ or three times as long as they are deep, not counting the tail. Their two dorsal fins are separated by a tiny notch. The first dorsal fin has nine spines. The second has one spine and 12 soft rays. The anal fin has three spines and eight or 10 soft rays. The ventral fins have a spine on the leading edge. When young, white perch may look like striped bass, showing lateral dark stripes. The adult white perch has no stripes, or very faint, interrupted ones. The white perch's back varies from olive-brown to blackish green, shading to paler silvery-green on the sides, and silver-white on the belly. The fins are dusky.

Habitat: The white perch can tolerate a wide range of salinity, living in fresh water, landlocked lakes, brackish backwaters and bays, and full-fledged salt water. It is especially at home in ponds connected to the sea.

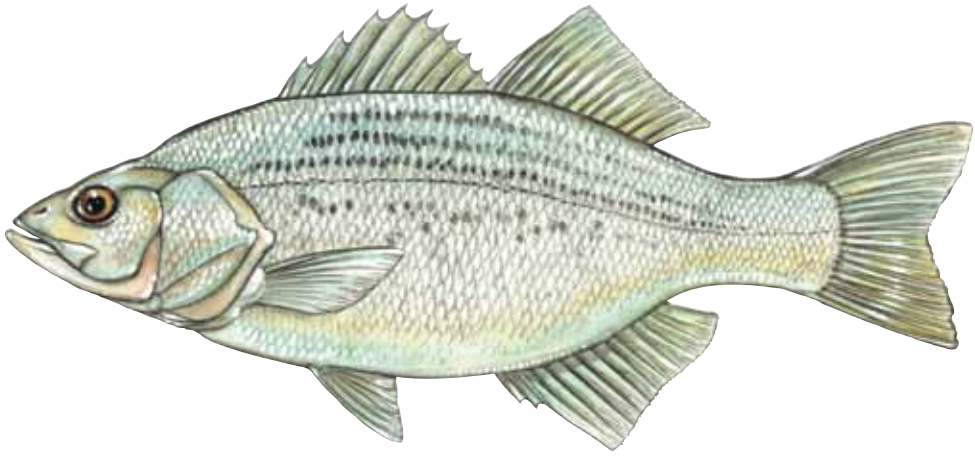
Life history: White perch are gregarious school fish with seasonal movements. In the spring they migrate upstream from brackish estuaries to spawn in freshwater runs and tributaries. Then they go back to the deeper, saltier water for fall and winter. They are haphazard about spawning, but

have great fertility and spawning success. When white perch spawn, the females and males chase one another in open water, milling about and splashing. The males release milt without pairing with specific females. The females extrude thousands of tiny eggs, about 150,000 for a one-pound fish. The eggs stick to anything they touch and hatch in less than five days. White perch populations fluctuate, but they do not seem to be affected by angling pressure because they are very capable of replenishing their numbers. White perch may overpopulate waters and become stunted and slow-growing. Illegal releases of this species have upset the natural balance of fish communities in several southeastern Pennsylvania lakes.

White perch average eight to 10 inches long and less than a pound, but in brackish water they can grow to 15 inches or so and about two pounds. They have a long lifespan, and fish 12 years old are not uncommon. Their diet varies with the season. White perch eat bottom-dwelling insect larvae in the winter and early spring. Then during the warmer months they consume large burrowing mayflies, crustaceans, water fleas and small fish. They seldom go into very shallow water, where minnows are abundant, but remain in deep water by day and near shore at sundown. In marine habitats, white perch eat small fish, squid, crabs and shrimp.

White Bass *Morone chrysops*

Species overview: The white bass is a freshwater fish, with its largest populations in the Great Lakes and the Mississippi River system. In Pennsylvania the white bass is native to the western counties, especially Lake Erie and the Ohio River watershed. Its species name "*chrysops*" refers to the fish's golden eye.



Identification: The white bass is a medium-sized fish, silvery, with an arched look to its back. The maximum size is about 18 to 20 inches, with a two- or three-pounder a trophy. The more usual size is one-half to about two pounds. White bass have a deep body, compressed laterally. The back is blue-gray or steel-gray. The base color of the sides is silvery-white to silvery pale-green, with a yellow tinge on the lower edge. The body is marked with four to seven gray-brown or black horizontal stripes, not as distinct as the stripes of the striped bass. The two dorsal fins are separated by a notch, and the anal fin has three spines and 12 to 13 soft rays. The eye is yellow and the dorsal and caudal fins are clear to gray. White bass have teeth in a patch on the base of the tongue, unlike the white perch, which has a thin band of teeth around the front edge of its tongue. The white bass's mouth is basslike. The lower jaw projects beyond the upper jaw.

Habitat: White bass inhabit large lakes and small to large rivers. They prefer water that is relatively clear, and they rarely maintain a population in lakes less than 300 acres. Prime white bass habitat includes extensive water acreage deeper than 10 feet, and gravelly shoals or rock- rubble reefs on which the fish can spawn. In recent years, white bass fishing has been exceptional at the Allegheny Reservoir, Warren County.

Life history: White bass are school fish, spawning, feeding and traveling in compact groups. In late April to early June, schools of white bass migrate to spawn over rocky or gravelly shoals, either going to that habitat in a lake or traveling upstream in a river to reach it. The bass appear to return to the same spawning site each spring. Spawning takes place near the surface in six or seven feet of water, at 58 to 64 degrees. The females release 25,000 to one million minute eggs into the current, accompanied by several spawning males. The eggs are adhesive, drifting to the bottom and sticking to the stones. They hatch in two or three days. Successful hatching depends on favorable conditions of current or wave action, and temperature. White bass produce abundant year-classes intermittently. Spawning success and year-class survival usually depend on a variety of environmental conditions.

Young white bass quickly show their schooling tendencies, drifting in large groups and eating zooplankton. As they grow they switch to larger prey, like aquatic insects, crustaceans and their primary food, fish, especially consuming schooling forage fish like gizzard shad. White bass show several daily peaks in feeding activity, which vary seasonally. They retire to deeper water by day and swim toward shallower water at nightfall. Aggressive feeders, white bass may make a great commotion on the surface when they attack a school of forage fish or during spawning activities, a tip-off to anglers of this fish's presence.

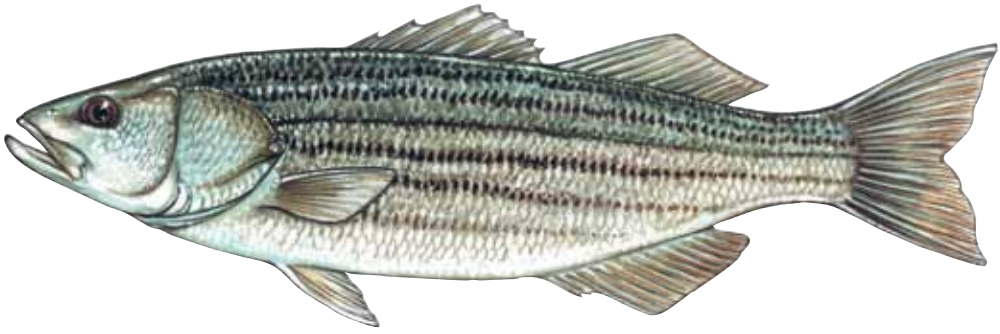
Striped Bass *Morone saxatilis*

Species overview: In their native habitat, the Atlantic Coast from the St. Lawrence River to Florida and some tributaries of the Gulf of Mexico, the striped bass is a true anadromous fish, living in salt water but traveling to fresh water to spawn. Through stocking, striped bass have reached the West Coast. Striped bass can also live entirely in fresh water as a landlocked form that cannot reach the sea. In Pennsylvania, striped bass are found in the Delaware River, and historically had been found throughout the Susquehanna River, the fish traveling upstream from the Chesapeake Bay. Dams on the Susquehanna had blocked the striped bass upstream migration to spawning grounds, but fish lifts, or fishways, on the dams should soon make access possible to the middle Susquehanna for this and other anadromous fishes. Striped bass have also been stocked in several of Pennsylvania's large inland reservoirs, with an especially good fishery having developed in Raystown Lake in Huntingdon County.

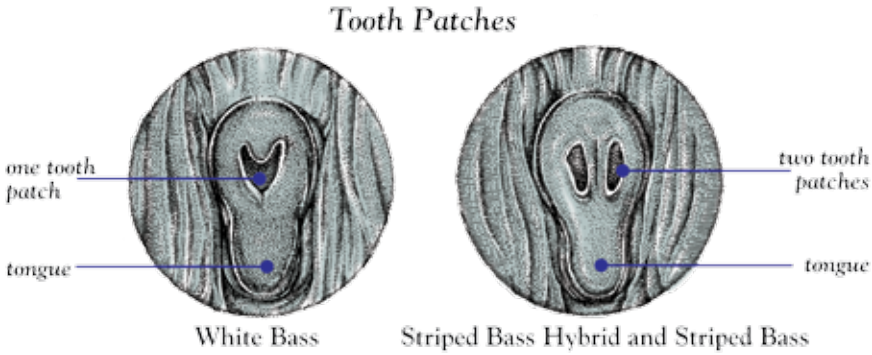
Striped bass are valuable food fish, as well as much sought-after sport fish. Striped bass provided an important food source for the Plymouth colonists, who as early as 1623, netted enough of the fish to support themselves during the summer months. Captain John Smith wrote of the excellent eating qualities of striped bass. The seagoing stripers along the Atlantic Coast occur in definite "races," or stocks, different from one another but not so much to be called subspecies, depending on where their home range is located.

When the Santee River in South Carolina was impounded during the 1940s, the striped bass present there produced a population that adapted to a freshwater landlocked existence. Offspring and subsequent generations of these fish have been stocked in many inland waters, reservoirs and the rivers that run into them throughout North America.

South of Pennsylvania and New Jersey, fishermen call stripers "rockfish." Their species name "*saxatilis*" means "dwelling among rocks."



Identification: The striped bass has a smoothly arched profile, slimmer and more streamlined than a striped bass hybrid, until it reaches a weight of five to 10 pounds, when its body becomes heavy-looking. The back is olive-green to steely blue-gray, sometimes almost black. The sides are silvery to pale silvery-green, shading to white on the belly. There are seven or eight distinct dark stripes that run laterally on the side of the body. Striped bass have two dorsal fins, the front spiny-rayed, the second mostly soft-rayed, separated by a notch. The back of the tongue has two tooth



patches, unlike the white bass, which has one tooth patch at the base of its tongue. There are three spines and 11 soft rays on the anal fin, with the longest of these spines less than half the height of the anal fin. Young striped bass do not have dark lateral stripes, but instead have dusky bars.

Striped bass catches in the 15- to 20-pound range are not uncommon in Pennsylvania. For sea-living striped bass, sizes in excess of 100 pounds have been reported. The Pennsylvania state records both for marine and landlocked striped bass are over 50 pounds.

Habitat: Striped bass live in salt water, in brackish estuaries and in fresh water. Migratory forms travel from the ocean or saltwater bays into freshwater rivers, above tidal influence, to spawn. Landlocked forms of striped bass live in large reservoirs as roaming, mid-water schools. Significant lengths of flowing water are needed for successful spawning, sufficient to keep eggs suspended before hatching.

Life history: From their saltwater homes, striped bass migrate upstream in the spring to spawn, traveling into the mouths of large freshwater rivers. Over stony riffles, several males chase a large female in what appears to be a battle, but it is actually frantic spawning antics and frenzied swimming–the striped bass's courtship and spawning ritual. Male striped bass become mature at about two years of age, with the females usually

ready to spawn in their fourth year, when they are 18 to 24 inches long. At all ages, the females are larger and heavier than the males. Water temperature signals spawning time, with some spawning occurring at 55 degrees, but most at 60 to 67 degrees. Young females may release just 65,000 eggs.

Striped bass eggs are greenish and somewhat buoyant. After they are released, the eggs drift freely with the current until they hatch, usually in two or three days. Flowing water is critical to the success of striped bass spawning. That helps explain why there is no reproduction or little natural reproduction of the fish when they are confined to inland lakes. Striped bass eggs that sink to the bottom die, because they become covered with silt or because of other factors. Just-hatched striped bass grow rapidly and stay in brackish bays at the end of their downstream float. Juveniles spend their first and second summers in the tidal Delaware River with most inhabitating that area from the Schuylkill River downstream into the state of Delaware. After several years in these "nursery areas," the adult striped bass become free-ranging along the Atlantic Coast.

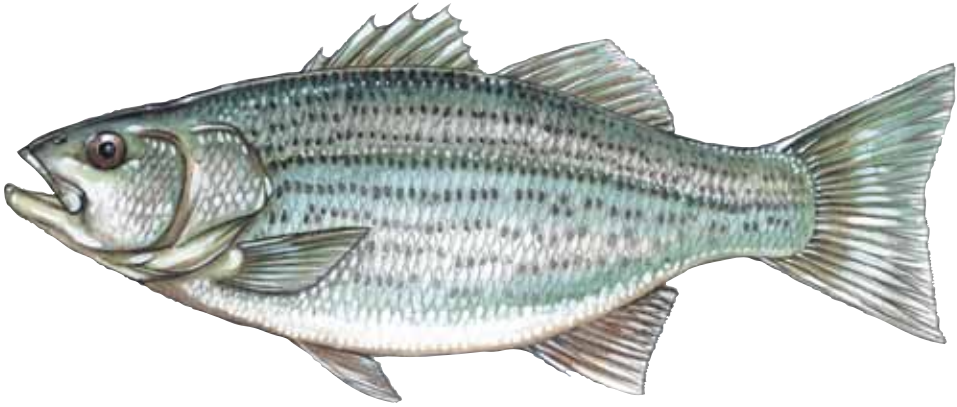
Marine striped bass make two migrations, one for spawning. The other, in fish two years old or older, occurs when a small percentage move out of their wintering areas, like the Chesapeake and Delaware bays, and travel north along the coast to New England and southern Canada. There they mingle with northern populations of striped bass during the summer. Then most return to their winter quarters. In reservoirs, the landlocked freshwater striped bass move according to temperature and dissolved oxygen in the lake, favoring cooler arms of the impoundment during the hot summer.

Striped bass feed on just about anything alive that is available. They are a top-level carnivore whether found in salt water or fresh water. Young striped bass eat microcrustaceans, or zooplankton, and midge larvae. As they grow, their diet changes to large crustaceans, mollusks and especially other fish. As adults, striped bass live in roving schools, feeding mostly at night. When chasing forage fish near the surface, the splashing and slashing make a spectacular display. Substantial increases in abundance of striped bass have occurred in the Delaware River since the mid-1980s because of improved river water quality and harvest restrictions.

Striped Bass Hybrid *Morone saxatilis x Morone chrysops*

Species overview: The striped bass hybrid is a hatchery-created cross between a white bass and a striped bass. It is stocked primarily because it tolerates warmer water than the purebred striped bass, which, as it grows older and larger, requires well-oxygenated water during the summer. In Pennsylvania it is stocked mostly in the western part of the state, in reservoirs such as Lake Arthur and Shenango Lake, and in the big-river

area of the Ohio and Allegheny rivers near Pittsburgh. Here the hybrid typically grows larger than the white bass. Fisheries managers in the state do not tend to stock the striped bass hybrid in lakes and rivers that lead to Delaware or Chesapeake bays to minimize the chance of the hybrids mixing and reproducing with wild marine striped bass.



Identification: The hybrid striped bass's body is stockier than that of a pure striped bass, and its lateral stripes are discontinuous and less distinct. Its back is dark, almost black. Its sides are silvery, with seven or eight faint and broken-looking lateral stripes, and its belly is white. The anal fin has 11 or 12 rays, and there are two tooth patches on the rear of its tongue. In size it grows to a length and weight midway between its parents. A 10- or 12-pounder is considered a big one.

Habitat: The striped bass hybrid is stocked in larger reservoirs and slow rivers, where there are open-water forage fish like gizzard shad and alewives.

Life history: The striped bass hybrid is fast-growing, which is typical of hybrids. It is generally sterile, and can be stocked instead of the purebred striped bass into waters to avoid the purebred's potential of reproducing too prolifically and outstripping its food source. However, occasionally fertile striped bass hybrids have occurred, and some states have reported the hybrid back-crossing with the white bass. Striped bass hybrids feast on forage fish as adults.

Sunfishes

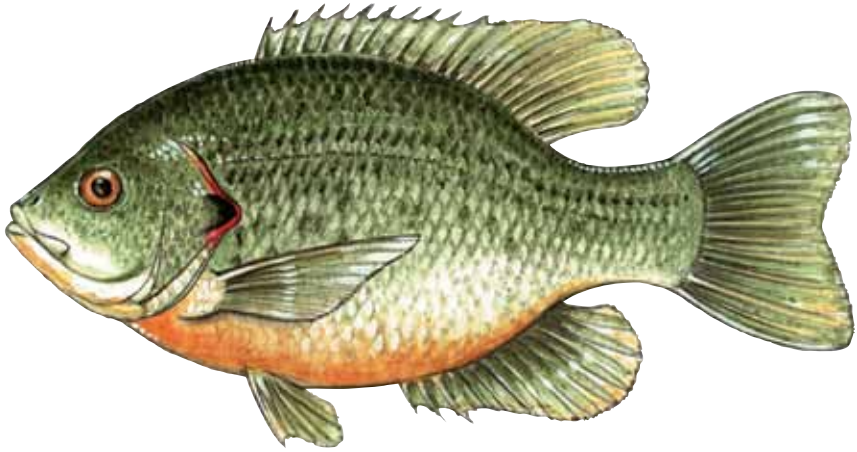
Family Centrarchidae

Family overview: The little bluegill in the local farm pond and the tackle-busting largemouth bass of the big lake are both members of the sunfish family. The two have plenty of "cousins" in Pennsylvania, because 17 sunfish species live in the state. The black basses (genus *Micropterus*), are represented by the largemouth bass, smallmouth bass and spotted bass. The sunfishes (genus *Lepomis*) include the redbreast sunfish, green sunfish, pumpkinseed, warmouth, bluegill, longear sunfish and redear sunfish. Others in the sunfish family include the black crappie and white crappie (genus *Pomoxis*), the rock bass (genus *Ambloplites*), the mud sunfish (genus *Acantharchus*), and the little sunfishes of the genus *Enneacanthus*, which are the blackbanded, bluespotted and banded sunfish (see page 146).

The sunfish family (with one non-Pennsylvania exception) was originally confined to the fresh waters of North America east of the Rocky Mountains. Some of them, especially the basses, have been widely stocked for sport across the United States and in other countries. In many places, sunfishes are the dominant fishes of warmwater habitats. They typically live in warm, rocky, weedy lakes, ponds and slow-moving streams. In Pennsylvania the sunfishes are distributed across the state, although a few species have restricted ranges.

The rare blackbanded and banded sunfishes are known to be present only in the lower Delaware River watershed, near Philadelphia. The small bluespotted sunfish is found in sluggish water or weedy ponds in the Delaware and Susquehanna River watersheds, but it is absent from the rest of the state. The warmouth is widely distributed in the eastern United States. It has been documented in Pennsylvania in the Allegheny River watershed. Longear sunfish are found throughout the Midwest. They have been occasionally seen in northwestern Pennsylvania. Redear sunfish are also very restricted here, having been introduced into some waters in the central and southwest parts of the state. Other sunfishes are common, or their home localities are described in the species section.

General identification: Many species of the sunfish family are beautifully colored and patterned. As a whole, the smaller family members are "pan" shaped, narrow when viewed head on and wide when viewed from the side (laterally compressed). The nickname "panfish" is well-deserved for body shape as well as for popularity of many of the family in the fisherman's frying pan. The eyes of the sunfish are large. The fish have no sharp spine near the back of the gill covers. The dorsal fin of sunfish



Redear Sunfish *Lepomis microlophus*

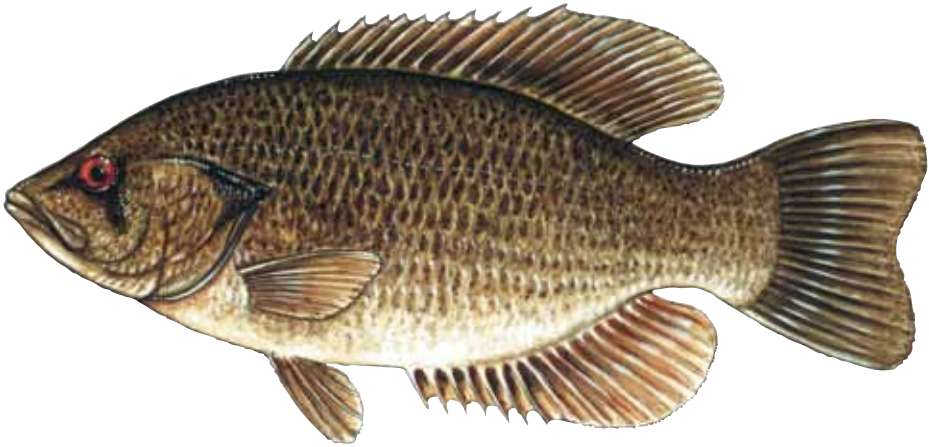
has two sections, the front section with five to 14 sharp, spiny rays, and a back section, which is soft-rayed. The two dorsal fin sections are joined a little or a lot, depending on the species, so they may look like two fins or one continuous fin. The pectoral fins are relatively high on the side of the body. The pelvic fins have a leading spine and five soft rays. The anal fin also has spines on its leading edge. The sunfishes have ctenoid scales, which means that each scale has a toothed rear edge that makes the scale, and the whole fish, feel rough to the touch.

Life history: Male sunfish are territorial at spawning time, which is spring through summer depending on the species. Each male prepares a nest that it defends against other fish. The females have no part in nest-building. The males construct a nest by finning vigorously over bottom gravel, sand, vegetation or other material, until they have made a clean, circular, slightly depressed area. Two or more females may contribute eggs to the nest, which are fertilized by the male. The females leave the site after spawning. Care of the adhesive eggs is taken over by the male, which aerates them with swimming motions of his fins, and guards the nest against all predators. Because of overlapping spawning habitat and behavior, it is not unusual for sunfishes, especially of the genus *Lepomis*, to hybridize. Most sunfish have "hangouts" they prefer, such as submerged stumps, rocks or patches of water weeds. Sunfish are sight-feeders and get their food by lying in wait and making a sudden lunge for it. Some sunfish are epibenthic feeders–they eat organisms typically attached to the surfaces of plants and rocks. Some sunfish pursue organisms like minnows and crayfish in the vicinity of these habitats. Some are bottom-feeders, and others go to the surface to grab a meal.

Angling tactics vary from "popping bugs" on the surface, especially for largemouth bass and bluegills, to bottom-bouncing jigs for crappies and smallmouth bass. Aggressive males can often be enticed to strike a bait or lure dragged across or near the nest.

Rock Bass *Ambloplites rupestris*

Species overview: Rock bass are basslike sunfish, sturdy-looking and more camouflage-colored than sunfish. Today they are found throughout Pennsylvania in suitable habitat, but they were originally distributed west of the Appalachian Mountains, in the Ohio River and Great Lakes watersheds. The canal systems of the last century are credited with giving the rock bass an avenue for colonizing Atlantic Ocean watersheds, like the Susquehanna River and Delaware River watersheds. The species name "*rupestris*" means "among the rocks." The fish's nicknames include "red-eye" and "goggle-eye."



Identification: Rock bass are robust fish, not as flattened from the sides as most other sunfish. They are an overall dark-olive to golden-brown, mottled and shading lighter on the sides. The belly is whitish. The scales on the sides have a dark spot at the base. Together these spots form loose, horizontal rows of dots along the fish's body. The eye is bright-red or orange, and its gill cover has a smudged-looking dark spot at its upper rear corner. The mouth extends past the front edge of the eye. Rock bass can also be distinguished by the five to seven spines on the front edge of the anal fin. They can easily reach a pound or more in weight in Pennsylvania, and a 12-incher is not uncommon.

Habitat: The rock bass is well-named because it is normally found around underwater rocks, stones and boulder rubble. It lives in warmwater lakes, reservoirs and especially in streams and rivers with rocky pools.

Rock bass are often associated with smallmouth bass, and their surprisingly large mouth allows them to take baits, lures and jigs that are fished for smallmouths. In the northern part of its range, rock bass live in cool, clear lakes, frequenting rocky or stone rubble areas.

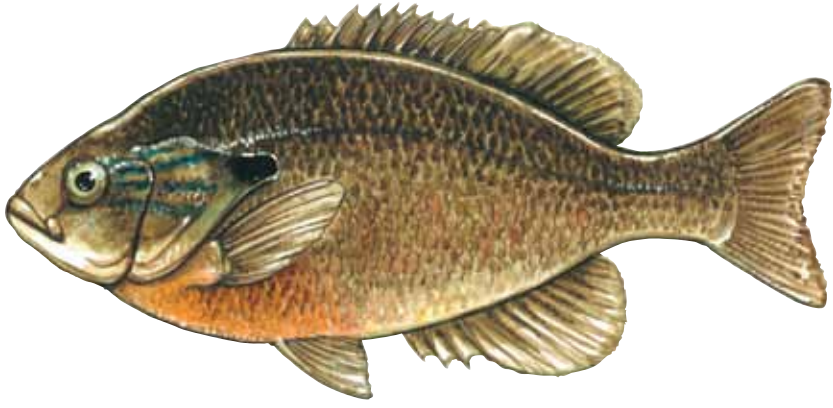
Life history: Rock bass spawn in spring or early summer, usually May or June, when the water temperature reaches 60 to 70 degrees. The males fan solitary circular nests in bottom sand and gravel. In streams, the nests are located in moderately flowing pools and are usually built near a log or large rock. Female rock bass produce 3,000 to 11,000 eggs, with an average of 5,000. The male guards the nest aggressively and stays with the hatched young until they disperse.

Rock bass are bottom-feeders, well-suited with a big mouth for preying on large aquatic insects, crayfish and small fishes. Adult rock bass move about in schools, and are one of the most common fish of large warmwater streams and rivers.

Redbreast Sunfish *Lepomis auritus*

Species overview: The redbreast sunfish is native to Atlantic Coast watersheds. It is found in southern and eastern Pennsylvania in the Delaware, Susquehanna and Potomac River watersheds. The species name "*auritus*" means "eared," referring to the long, dark gill flap. The common name describes the deep-orange or reddish belly.

Identification: Redbreast sunfish resemble bluegills, but with some important differences. The redbreast's back is blue-green to olive, and there may be indistinct, dark vertical bands against the lighter bluish green on the sides. The lower side and belly shades to yellow and orange. The breast, between the gill opening and the pelvic fin, may be a deep red-orange. The gill flap is very long, with an elongated black spot. The tail is slightly forked, not rounded as in most other sunfish. The mouth is small and the pectoral fins are short and round.

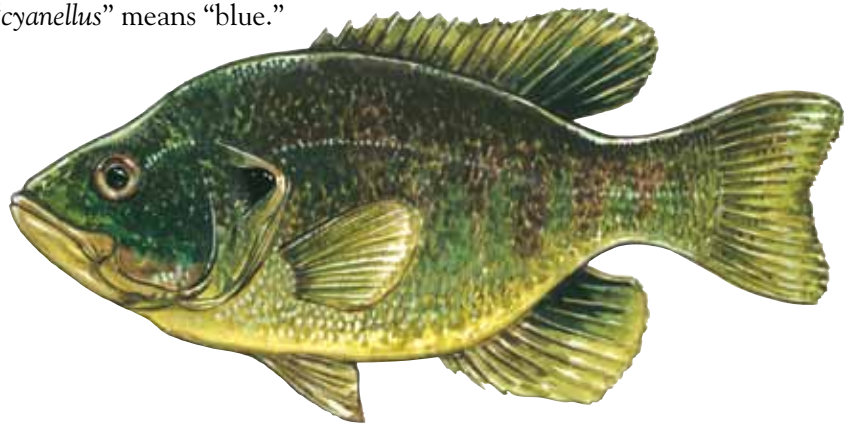


Habitat: The redbreast sunfish lives in a variety of habitats, from small creeks to big rivers and reservoirs. It can tolerate silted, turbid water. It prefers the same habitat as smallmouth bass and rock bass, and is often found in the larger rivers with them, but frequents the shallower water.

Life history: Except during the spawning season, the redbreast sunfish moves very little from its home area. Spawning is in spring and summer, usually June, when the water temperature reaches 68 degrees. Male redbreast sunfish fan a shallow nest of about 12 inches in diameter in gravel or sand. They guard the eggs and protect the young for a short while after the eggs hatch. The males construct a single nest, but the nests may be grouped in closely packed colonies, when appropriate bottom material is in short supply. The females deposit 3,300 or more eggs, depending on their size. Redbreast sunfish hybridize with bluegills and other sunfish. The redbreast feeds on aquatic insects and terrestrial insects that fall onto the water, including large ones like mayflies and dragonflies. They also eat crayfish and small fish. They are active in cooler water than the bluegill. Although widespread, redbreast sunfish don't become as locally abundant as other sunfishes, and they are normally loners when the water is warm. When the water cools, redbreasts form schools.

Green Sunfish *Lepomis cyanellus*

Species overview: The green sunfish was originally found west of the Appalachian Mountains, throughout the Mississippi watershed. It has been introduced elsewhere in the East, and is now found in most of Pennsylvania, although not in great numbers. The species name "*cyanellus*" means "blue."



Identification: The green sunfish's back and sides are olive, with a blue-green sheen and small, scattered dark specks. The lower sides and the belly have a brassy-gold tint and the head has bright-blue spots or lines. The gill flap is black with a pale-red, pink or yellow edge, and the pectoral

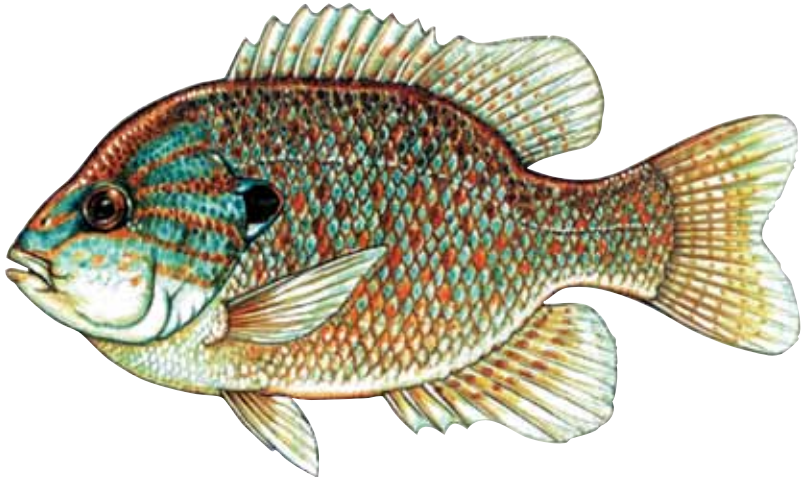
fins are short and rounded. There is a black blotch on the rear portion of the dorsal fin and at the base of the anal fin. The green sunfish's mouth is larger and the lips are heavier than in most sunfish. The top jaw extends past the front of the eye. Dorsal, caudal and anal fins are edged with a white, yellow or orange border. Green sunfish reach eight or nine inches in length.

Habitat: The green sunfish likes sluggish pools and backwaters in streams and rivers. It also lives in the shallows of ponds and lakes and is tolerant of siltation. Green sunfish do not roam far from their small home range.

Life history: Green sunfish spawn over several months, between June and August. The fish mature at two years of age, although they may be only three inches long. The males fan several dishlike depressions in the bottom with the tail, and defend the nests vigorously against other green sunfish males. Green sunfish may nest in colonies, and readily hybridize with other sunfish, like bluegills and pumpkinseeds. The females spawn 2,000 to 10,000 eggs onto the nests of several males, and the males stay with the nest about a week while the eggs develop. Green sunfish are prolific producers. They tend to overpopulate the shallow water areas where they live. Their rather large mouth lets them eat insects, snails, crayfish and even small fish.

Pumpkinseed *Lepomis gibbosus*

Species overview: As highly colored as any tropical fish, the pumpkinseed is one of our most common and frequently caught sunfish. Pumpkinseeds are found throughout Pennsylvania, and in eastern Canada and the eastern United States in the Atlantic watershed and



upper Mississippi watershed. The species name "*gibbosus*" means that it is "formed like the full moon," appropriate for its flat, roundish body.

Identification: The pumpkinseed is one of our smaller sunfishes, with eight inches an average size. The body is an overall light-olive to golden-brown, with irregular blue or blue-green lines and a sprinkling of olive, orange or red-orange spots. The fish's cheeks and gill covers are marked with wavy light-blue lines. The belly is reddish orange to yellow. The best way to identify a pumpkinseed is to observe its gill flap, which is at the rear edge of the gill cover. The black gill flap is smaller and more rigid than the bluegill's. It is bordered with lighter color and, most importantly, has a bright orange-red tip.

Habitat: Pumpkinseeds are found in the quiet, weedy shallows of streams, lakes and ponds. They usually live in cooler water than other sunfish. They can tolerate poorer water quality, surviving periods of low oxygen. They also tolerate muddy water and acidic water.

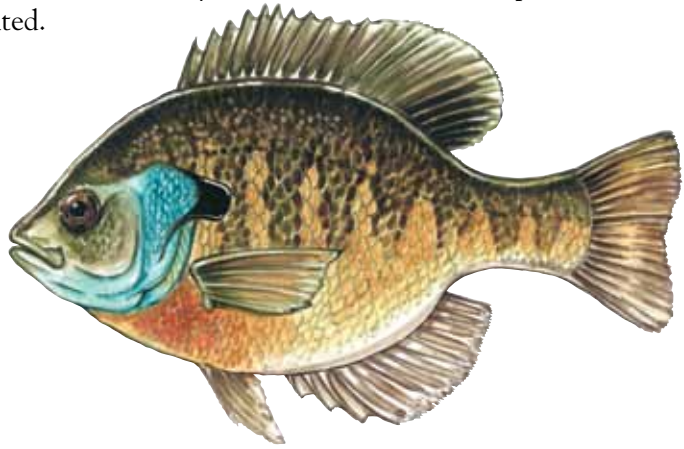
Life history: Pumpkinseeds spawn in late May to early June. The males clear small, saucer-shaped nests on the bottom in water three feet deep or less. Pumpkinseeds nest in small groups of up to three nests, but these groups of nests can be very close. The nests may have several thousand eggs each, which have been deposited by several females. Although the nest is guarded, other males may rush in and fertilize eggs. It takes about three days for the eggs to hatch, and each nest may produce more than 14,000 young pumpkinseeds. Pumpkinseeds may hybridize with bluegills and green, redbreast, longear and other sunfish. They feed heavily on snails and have special throat structures for doing so. Pumpkinseeds feed mostly on the bottom of a stream or pond, where they also eat burrowing and other aquatic insects. Like the bluegill, small baits, jigs and flies take pumpkinseeds best.

Bluegill *Lepomis macrochirus*

Species overview: The bluegill is what many people think of as a "sunfish." It is what they usually catch when they go fishing for "sunnies." The common name refers to the bluish color that curves from the lower jaw around the bottom of the gill cover. The scientific species name "*macrochirus*" means "large hand," probably describing the fish's body shape. The bluegill is found throughout Pennsylvania nowadays. It is believed not to have been present originally in Atlantic Ocean watersheds.

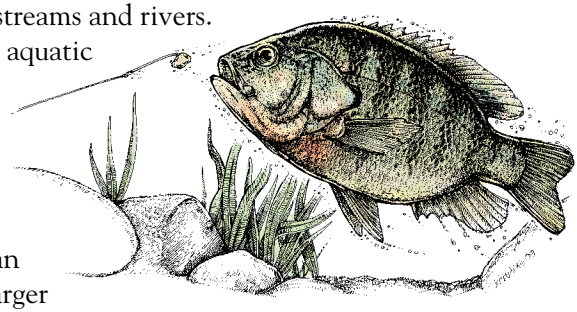
Identification: The bluegill has several characteristic markings, which are helpful because its colors vary so much. Generally, the bluegill has an olive to brownish back, with sides that shade to brownish, orange and even

pink. The sides have eight to 10 sets of double, bluish vertical bars that may look chainlike. The belly is white to yellow or coppery-orange. The sides of the head are greenish to blue-green, with lighter metallic-looking blue on the lower edge of the gill flap and under the lower jaw. Breeding males are darker, with rosy or lavendar sheens. The pectoral fin is long and pointed.



The giveaway marking that distinguishes this sunfish from others is that the flap at the end of its gill cover is black with no red spot. Bluegills also have a dark spot or blotch on the lower part of the back section of the dorsal fin.

Habitat: Bluegills prefer to live in habitats similar to those of largemouth bass. Bluegills are found in lakes, small farm ponds, and the slower parts of warmwater streams and rivers. Typical bluegill habitat has aquatic weeds, where the fish can hide and feed. They can also be found near submerged stumps, logs and rocks. In the daytime, schools of small bluegills can be found close to shore. Larger bluegills prefer nearby deep water. In the evening and early morning, the bigger bluegills move into the shallows to feed.



Dry flies and small poppers on a fly rod work well when bluegills are on the feed. Small jigs, wet flies, nymphs and a variety of small baits, fished on small hooks to accommodate the bluegill's small mouth, are also effective.

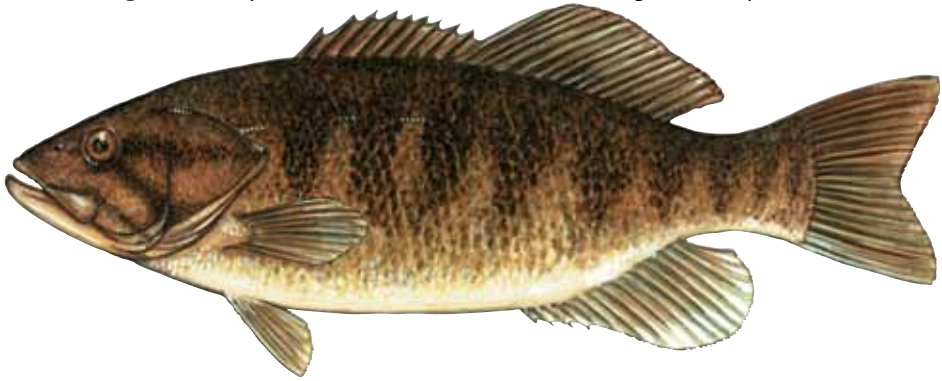
Life history: Bluegills spawn during a longer period than most sunfish, from May, when the water temperature reaches 67 degrees, until August. The males fan small, saucerlike depressions in sand and gravel as nests, and vigorously guard the eggs and hatched young. Large numbers of nests

are often in the same area and form colonies. One female may deposit as many as 38,000 eggs in a nest. Bluegill eggs hatch in two to five days. Because several females have contributed, there may be more than 60,000 young fish produced from a single nest. Bluegills may overpopulate their habitat, resulting in smaller and slower-growing fish. As generalized feeders, bluegills eat aquatic insects, crustaceans and minnows, and they have been known to eat aquatic plants. The bluegill feeds only in the daytime and throughout the water column. It may grow to a foot long and up to two pounds, although nine inches is an average.

Smallmouth Bass *Micropterus dolomieu*

Species overview: The smallmouth bass was native to and found only in the Great Lakes and Ohio River watersheds until the mid-1800s. When the railroads spread around the country in the second half of the 19th century, so did the smallmouth. It was transported by train and eventually became a popular sport fish throughout the United States. It is now found all across Pennsylvania. Because of its body's brownish-gold tints, the smallmouth has been nicknamed "bronzeback." Its species name recognizes a French naturalist, M. Dolomieu.

Identification: The robust-looking smallmouth has a brownish or bronze cast to its back. It is lighter on the sides and has a white or pale-yellow belly. There is a goldish sheen to its scales, and smallmouths have a series of eight to 15 olive-colored vertical, broken bars along each side. The end of the upper jaw of a smallmouth does not extend beyond the back edge of the eye. The dorsal fin sections are separated by a shallow



notch, not a deep notch as in the largemouth. The smallmouth's eye is orange-red, and dark lines radiate from the eye backward. In young smallmouths, the vertical side bars are prominent, and the tail fin has three colors: Orange at the base, then a black band, then white to yellow at the tip.

Habitat: Although largemouths and smallmouths may live in the same rivers or lakes, they are found in different habitats. Smallmouths prefer rocky locations, more water depth and heavier current than largemouths. In Pennsylvania, smallmouth bass are found in medium to large streams and clear, deep lakes and reservoirs with a summer water temperature between 60 and 80 degrees. In lakes, they hang around downed logs, stumps, stone rubble and rock outcrops, and along the steep sides of submerged creek channels. They prefer streams with riffles flowing over gravel or boulders, where they are found in the pools, pockets behind rocks, or in the deeper moving water.

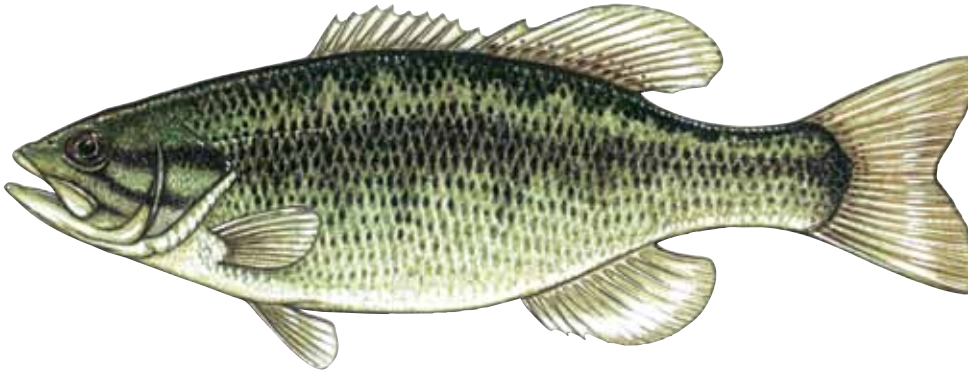
Life history: Smallmouth bass spawn in spring, May to early June, when water temperatures reach 60 to 70 degrees. The male builds the nest. The male fans a circular depression in gravel or sand with his fins. The nest is 14 to 30 inches in diameter and usually in three or four feet of water, although it may be more than 20 feet deep in clear water, as in Lake Erie. Smallmouths in lakes often move into tributary streams to spawn. Several females spawn on the same nest, adding 2,000 to 7,000 eggs per pound of body weight. Because the females spawn at different times, the eggs the male is guarding do not all hatch at the same time. Depending on water temperature, the eggs hatch in two to nine days. The young fish are ready to leave the nest five or six days after that.

In rivers and streams, flow and temperature can affect the survival of young smallmouth bass. High flows can sweep eggs and fry downriver, where they may perish. Conversely, moderate flows may lead to high fry survival. These early season events frequently lead to low or high densities of adult smallmouth bass.

Young smallmouths eat tiny crustaceans. Then they graduate to insect larvae, crayfish and fish. Smallmouths may reach 20 inches or more in length. The Pennsylvania smallmouth angling record is over eight pounds.

Spotted Bass *Micropterus punctulatus*

Species overview: The spotted bass is also called the "Kentucky" bass and is basically a southern fish. The spotted bass is uncommon in Pennsylvania, but it has been taken in the Ohio River near Pittsburgh and in the Beaver River. It is common in many Ohio River tributaries in Ohio and in the southern portion of the Mississippi watershed. Although in habitat preference and appearance it seems to be a cross between a largemouth and smallmouth bass, it is not. The spotted bass is a separate bass species. Its species name "*punctulatus*" means "dotted," referring to the rows of spots along its lower sides.



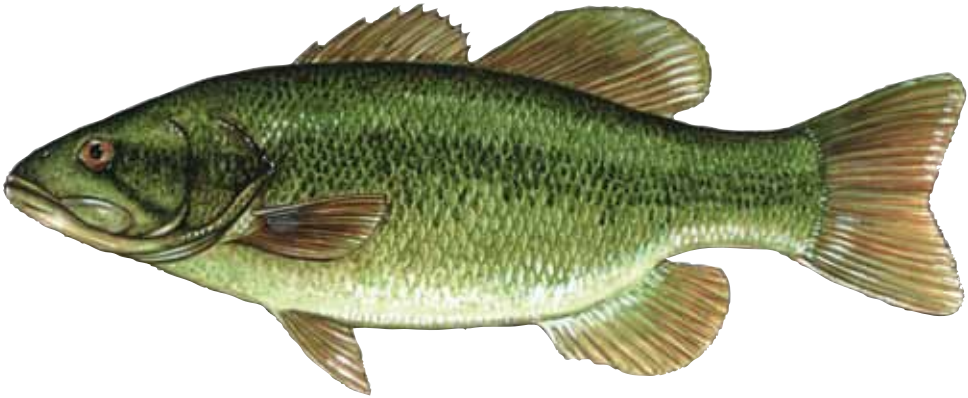
Identification: Spotted bass do not grow as large as either the largemouth or smallmouth bass, only to about 18 inches, and most are much smaller. The upper part of the head and back are a light to dark olive-green, its sides are silver-green and it has a whitish belly. There is a series of dark, generally diamond-shaped spots on its sides, above a splotchy dark band that runs from head to tail. Below the band are scales with dark bases that form a pattern of horizontal or small spots. The spots below the lateral band give the fish its common name. Like the smallmouth, the upper jaw in the spotted bass does not extend beyond the eye, and there are dark bands radiating backward from the eye. The eyes are reddish.

Habitat: Spotted bass prefer long, deep, silted pools in sluggish water. They can tolerate water that is more turbid than the water smallmouths prefer. In a stream, they occupy the habitat left vacant by largemouths, which like weedy coves, and smallmouths, which live in the rocky riffles.

Life history: The spotted bass spawns in early summer. Like other sunfish, the males construct the nest and guard the eggs and young fish for a time. The nests are small, not more than 15 inches in diameter. They are made over gravel or a softer bottom on the edges of pools. Young spotted bass eat zooplankton and insects, and then switch to crayfish and fishes as they mature.

Largemouth Bass *Micropterus salmoides*

Species overview: Largemouth bass were originally distributed in the Ohio River and Lake Erie watersheds in Pennsylvania. The largemouth has been established statewide in appropriate habitat. The largemouth bass is Pennsylvania's biggest sunfish. The state angling record is over 11 pounds, and the fish can grow two feet or more in length. The largest largemouths are generally females. The species name "*salmoides*" refers to trout ("*salmo*"), because the largemouth is sometimes called a "trout" in the



southern United States. One nickname is "bucketmouth," which, like the common name "largemouth," is well-deserved by the fish's gaping jaw, with which it can swallow sizable prey.

Identification: Along with growing larger, the largemouth is more rotund and less flattened laterally (side to side) than other members of the sunfish family. The largemouth's head and back are a bright-green to olive-green. Its sides are lighter green, and the belly is whitish or pale-yellow. The largemouth's upper jaw extends beyond the back edge of its eye. It has a broad black stripe or a line of broken splotches running along its side from head to tail. In the largemouth, the two sections of the dorsal fin are nearly separate.

Habitat: The largemouth bass lives throughout Pennsylvania in suitable warmwater habitat, which is usually a pond or small, weedy lake. It is also found in the shallow backwaters and coves of large lakes and in the sluggish sections of big rivers. Largemouths are almost always associated with aquatic weeds, a soft bottom or stumps and downed logs. They are rarely found over rocks or in depths of more than 20 feet.

Life history: In true sunfish style, the male largemouth fans a circular nest for spawning and aggressively defends the nest site, eggs and young fish. Largemouths spawn in spring and early summer, when water temperatures remain at 60 degrees for about three days. The typical nest is on gravel, sand or even soft mud. It is two to three feet in diameter, about six inches deep, and in one to four feet of water. Largemouths usually spawn within eight feet of a shoreline and keep their nests at least 20 feet apart.

Several largemouth bass females may spawn on one nest, each contributing 2,000 to 7,000 eggs per pound of body weight. Egg hatching takes about 10 days in 65-degree water. The young largemouths stay at the bottom of the nest for about a week, until the yolk sac is absorbed. Then they rise above the nest in a school and begin feeding. The male continues

to guard them for as long as a month. Young bass feed on zooplankton, insects and small fishes, and they are cannibalistic on one another.

Frequently, spring lake conditions determine the abundance of these forage items. Thus, the abundance of these forage items also determines the abundance of young largemouth bass. The number of young largemouth bass produced each year varies according to lake conditions and ultimately leads to changes in adult largemouth bass abundance.

Adult largemouths are predators and eat mostly fish and crayfish, but they also take frogs, snakes, and even small mammals and birds, like mice and ducklings that happen onto the water's surface. Largemouth bass feed day and night.

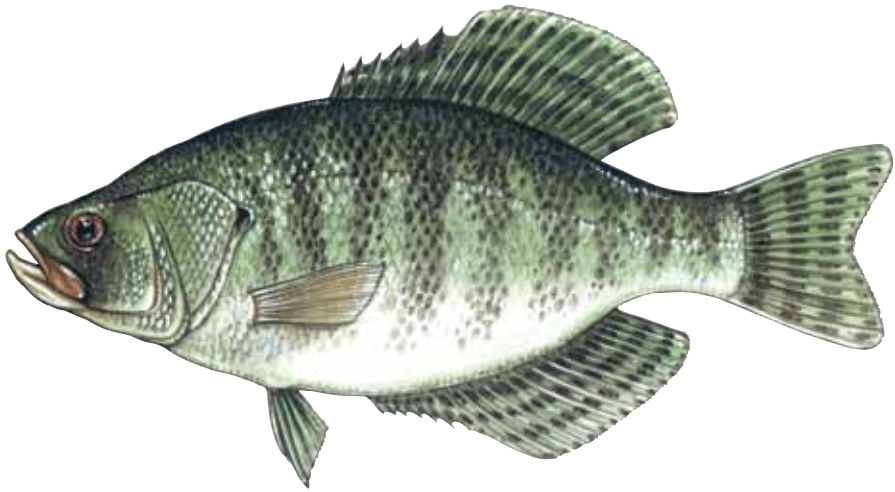
Attention-attracting, splashy surface plugs, minnowlike lures and soft-plastic worms or other slithery imitations, snaked through the weeds, all appeal to the aggressive largemouth.

White Crappie *Pomoxis annularis*

Species overview: Today the white crappie is found throughout Pennsylvania. It has been widely introduced around the United States. Biologists believe it was native to the Mississippi and Great Lakes watersheds, but not originally in Atlantic Coast watersheds. In Pennsylvania, the white crappie is less common than its cousin, the black crappie, but it is found across the state. The white crappie has a tendency sometimes to overpopulate its home waters, resulting in stunted fish. The species name "*annularis*" means "having rings," and probably refers to the bars on the side of the fish's body.

Identification: White crappies are wide when viewed from the side, but very compressed when observed head-on. They are olive to bright-green on the back, and silvery, with greenish or yellow hints, on the sides. The sides have about eight to 10 vertical, dark, broken bars, and other mottling. Dark spots or dark wavy lines pattern the dorsal, anal and tail fins. Males during the breeding season become darker. The white crappie is the only member of the sunfish family that has five or six spines on its dorsal fin, and a corresponding five or six spines on its anal fin. Its usual size is six to 12 inches long, but fish of 15 inches and several pounds are not uncommon. The white crappie has a large mouth, but the membrane behind the lips is thin and tears easily. This gives the fish its nickname, "papermouth."

Habitat: White crappies live in lakes, ponds and sluggish sections of streams and rivers. They tolerate, and seem to prefer, silted, turbid conditions. The fish isn't a bottom-dweller, but it does like cover, such as submerged brush, logs, stumps and tree roots. It doesn't need the cooler,



clear waters with hard, clean bottoms that black crappies prefer, and it doesn't associate with underwater vegetation as much as the black crappie.

Life history: The white crappie spawns in late spring and early summer, May to June, when water temperatures are a little under 60 to a little over 70 degrees. The nests are about a foot in diameter and are located in water deeper than the nests of most other sunfishes, up to eight or 10 feet. White crappie nests may be solitary or in colonies of as many as 50, located two to four feet apart. The male white crappie comes to the breeding grounds first, where he constructs a nest by fanning his fins over plant roots and submerged brush, or over gravel and small stones. When white crappies live in streams and rivers, they spawn in protected areas, such as coves or slow, deep pools. Females produce from 10,000 to as many as 160,000 eggs, depending on their age and size. They spawn in the nests of several males throughout the breeding season. Hatching takes two to five days, depending on the water temperature. The male guards the nest until the fry disperse. Young white crappies eat small aquatic insects and zooplankton.

White crappie populations can fluctuate. During a good year, when spawning and food conditions are right, many white crappies survive. This brood dominates the population for several years until the spawn of another good year can survive and become the next dominant year-class. Then the pattern repeats. This explains why anglers catch large crappies for several years and then almost none or only small fish.

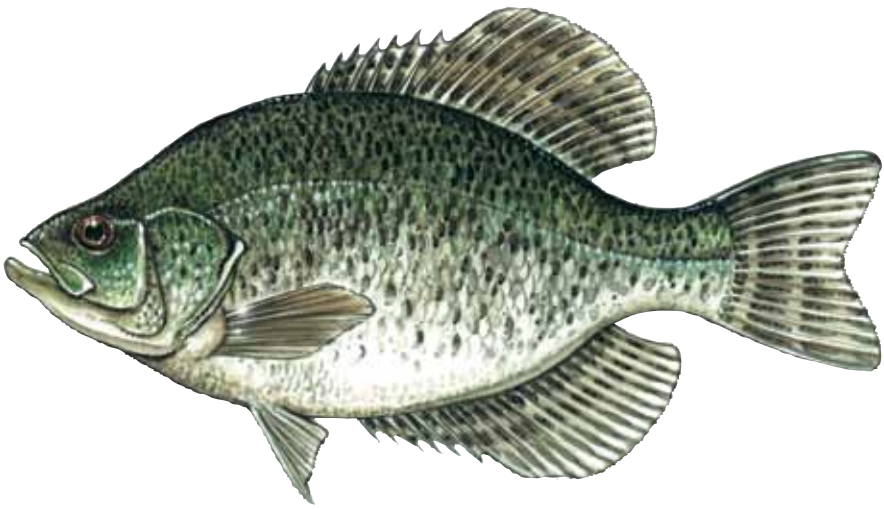
White crappies eat crayfish, leeches, crustaceans, insects and, most especially, small fish. Fish are the largest part of its diet. Because it is so prolific, white crappie populations may sometimes become overcrowded and outstrip their food supply, causing slow-growing, small individuals.

Although the crappie's mouth opens wide for prey, it is caught best on small minnows, lures and jigs, and it can be taken on streamers and weighted nymphs, fished like jigs.

Black Crappie *Pomoxis nigromaculatus*

Species overview: The black crappie closely resembles its cousin, the white crappie, but has physical and habitat differences. The range of the black crappie has been expanded through introduction. Originally it was found in the Mississippi watershed and eastern North America, and not present along the Atlantic Coast north of the Carolinas. Today in Pennsylvania it is widely distributed around the state. Its species name "*nigromaculatus*" means "black-spotted." The black crappie's nicknames are sometimes the same as those of the white crappie, and they include "calico bass," "crappie bass" and "papermouth," for its thin mouth tissues.

Identification: On first impressions, the black crappie looks black and white, but on closer examination it shows iridescent colors and sheens. Viewed from the front, its body is very compressed, narrow from side to side. Viewed from the side, it is deep-bodied, not as long-looking in its proportions as the white crappie. The back is olive to bright metallic-green, or a bluish gray. On its silvery sides are dark spots that are scattered or that appear in indistinct horizontal rows, not in vertical rows, as on the white crappie. There are also splotches that make a wavy pattern on its dorsal, anal and caudal fins. One way to distinguish the black crappie from the white is to count the spines on its dorsal fins. The black crappie has seven or eight spines on its dorsal fin. The white crappie has only five or

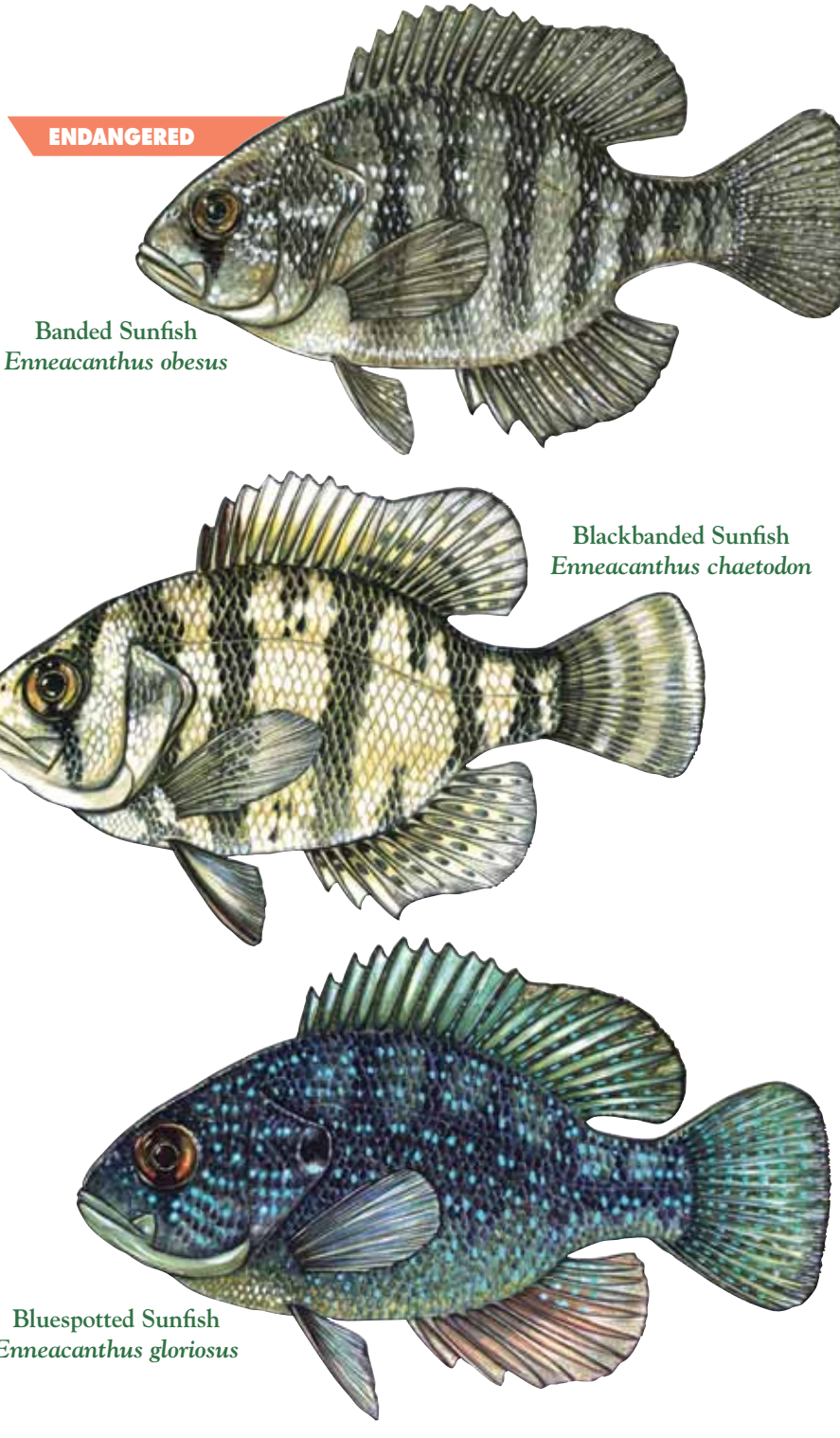


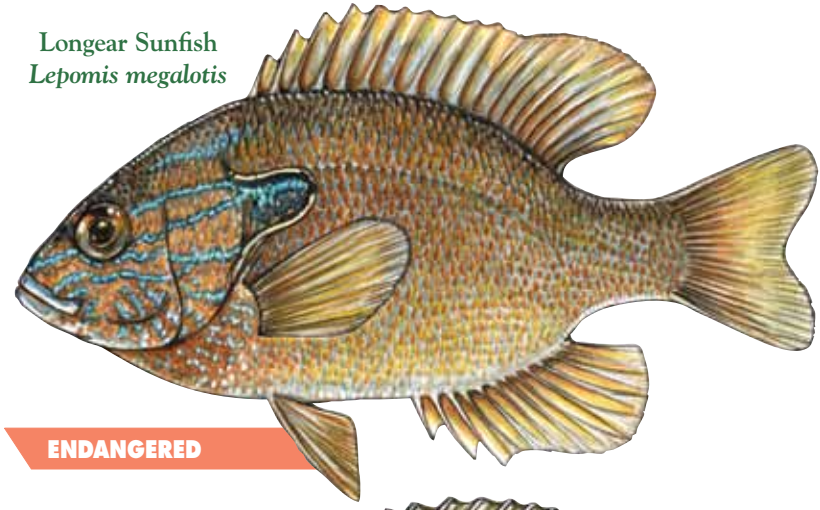
six dorsal spines. Black crappies that live in clear, vegetated water have darker contrasting patterns on the body, while those from murkier water are lighter, appearing more "bleached."

Habitat: The black crappie prefers waters that are clearer and cooler than those inhabited by the white crappie. The black crappie lives among more aquatic vegetation. It's a fish of quiet ponds and small lakes, the shallower areas of large lakes, and the slow-flowing sections of rivers, where it is almost always associated with underwater weeds. Black crappies are not as tolerant of silted water as white crappies, so they have probably been replaced by the white crappie where aquatic habitat has been made muddy by human influence.

Life history: Black crappies spawn in the spring or early summer, when water temperatures reach 66 to 68 degrees. Like other sunfish, the males clean dish-shaped nests on the bottom, near or among underwater plants in three to six feet of water. The nests are eight to 15 inches in diameter, in colonies, but spaced five to six feet apart. A half-pound black crappie female produces from 20,000 to 50,000 eggs, and may spawn in the nest of more than one male. The males guard the nest and eggs, which hatch in three to five days. The males protect the hatched fry for a short time, until the young fish leave the nest. Immature crappies eat tiny crustaceans and aquatic insects and grow fast, to about 3 $^{1}/_{2}$ inches the first year and to eight inches the second year. It usually takes four years for black crappies to reach 12 inches, and the fish may grow to 16 inches long, making them one of our largest panfishes. They mature in two years. As they grow, black crappie food preferences change to eating other fish, but as adults they also feed on mayflies, midges, dragonflies, other aquatic insects and crustaceans.

Black crappies are school fish, traveling, feeding and spawning in a group. They feed most actively early in the morning and late at night. Black crappies continue to feed during the winter, which makes them popular with ice anglers. Minnow imitations and live minnows work well for catching black crappies.


ENDANGERED
Banded Sunfish
Enneacanthus obesus
Blackbanded Sunfish
Enneacanthus chaetodon
Bluespotted Sunfish
Enneacanthus gloriosus



Longear Sunfish
Lepomis megalotis

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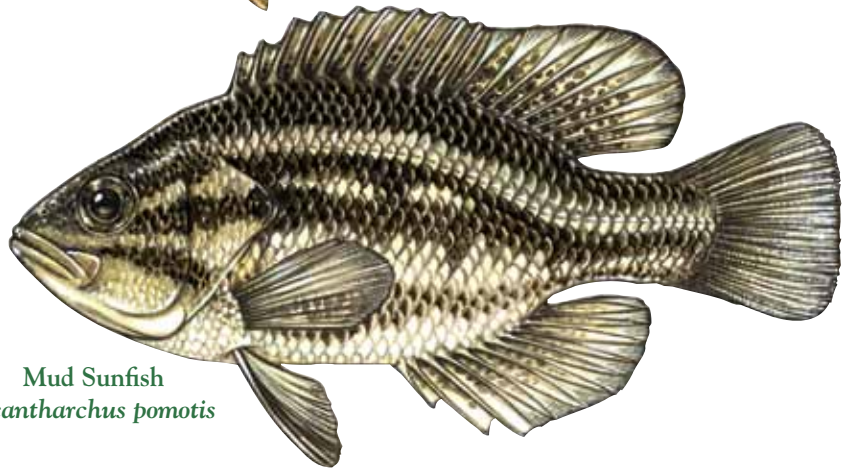
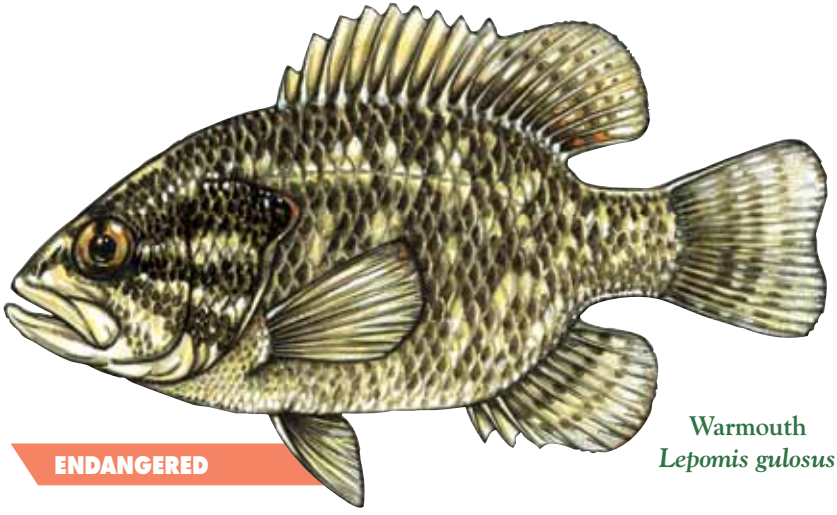


Mud Sunfish
Acantharchus pomotis



ENDANGERED

Warmouth
Lepomis gulosus

Perches and Darters

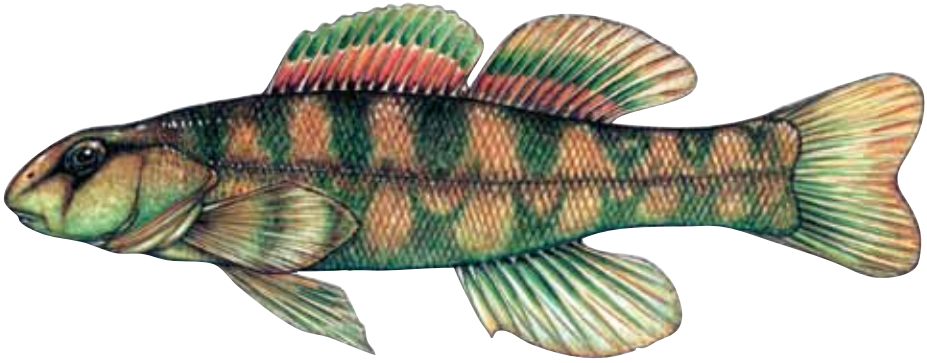
Family Percidae

Family overview: The perches are one of the largest families of fishes in North America, outnumbered only by one of the minnow families. The perch family includes the yellow perch, walleye, sauger and many darter species. The perch family is circumpolar. This means it is found in both North America and northern Europe and Asia. Our yellow perch (genus *Perca*), walleyes and saugers (genus *Sander*) have Eurasian counterparts, but the darters are found only in North America. Some of the earliest fossils of the perch family, uncovered in the Utah-Wyoming region, are 38 million years old. The family includes large, sought-after sport and food fishes, as well as some of the most beautifully colored small fishes on this continent. Members of the perch family live in a variety of habitats, from fast-flowing and slow-flowing streams to swamps and lakes.

Even though many anglers are familiar with yellow perch, walleyes and saugers, the darters are less known. The large darter group in the perch family includes 146 North American species. At least 21 darter species have been recorded in Pennsylvania, especially in the Allegheny River watershed. Several are endangered or threatened in the state: The bluebreast darter, eastern sand darter, gilt darter, longhead darter, spotted darter and Tippecanoe darter. A subspecies of the walleye that was found in Lake Erie, the blue pike (*Sander vitreus glaucus*), was once a popular food and sport fish, but it has disappeared from the lake. It is believed to be extinct.

Although many of the smaller members of this family are important as food for other fish, the family also includes predators like the walleye and sauger. The yellow perch is both a food source for larger fish and a fish-eater itself. Walleyes, saugers and saugeyes (a walleye x sauger hybrid) are artificially propagated for release as juveniles in waters where spawning has been impaired or in manmade reservoirs that do not accommodate successful reproduction of these species.

General identification: Perch family fishes are elongated–they look a lot longer than they are wide. Their two dorsal fins are separate or very narrowly joined. The leading dorsal fin has six to 15 spines. The second dorsal fin is soft-rayed. The anal fin has only one or two spines. Like the sunfishes, the perches have ctenoid scales, which make the fish feel rough. The back edge of the gill cover, or opercle, has a single sharp spine. During the reproductive season, some species develop breeding tubercles, raised projections on some part of the body. The males of the darters at



Greenside Darter *Etheostoma blennioides*

breeding time are especially bright and colorful. Walleyes and saugers are duller-colored and camouflage easily in their habitats.

Life history: Most members of the perch family prefer cool, flowing water with a clean, unsilted bottom. Some members of the darter family require such clean, clear water that they are considered indicators of water quality–high-quality water when they are present, degraded when they disappear.

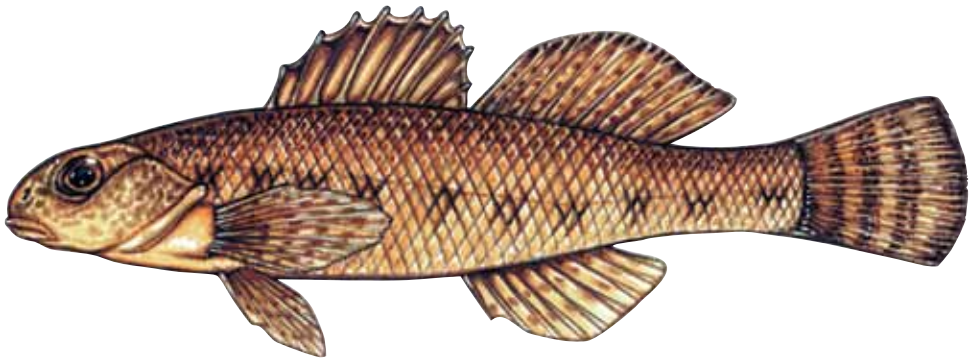
The spawning behavior of the perch family varies. Some species scatter eggs over bottom rock rubble or sand. Some species deposit eggs in gravel nests. In other species, males guard nests of adhesive eggs fastened to the underside of flat stones. In still other species, eggs are deposited singly or in draped strings over underwater vegetation.

Many of the perch family live near the stream or lake bottom. Darters usually rest on the bottom. When disturbed, they dart away quickly to a hiding place, which accounts for their common name. In darters, the swim bladder is small or absent, which explains their characteristic locomotion.

Banded Darter *Etheostoma zonale*

Johnny Darter *Etheostoma nigrum*

Species overview: The johnny darter is one of the smaller members of the perch family, belonging to the large sub-group of darters. Johnny darters are among the most widespread and abundant of the darters, but they lack the brilliant coloration that many other darters have. Johnny darters are found in the Mississippi River and Great Lakes watersheds, and in Atlantic Coast watersheds that are south of Pennsylvania. In Pennsylvania, the johnny darter is found in the western part of the state, in the Ohio River and Lake Erie watersheds. In eastern Pennsylvania, the similar tessellated darter occurs. Some biologists do not recognize the johnny darter and the tessellated darter as distinct species. Instead, they view them as a single species separated geographically.



Identification: The johnny darter seldom grows much over two inches long. Its body is slender, the head bluntly rounded. The background color is tan or straw-yellow, with brown markings. Brown markings across the back form six evenly spaced "saddles," and there is some dark spotting on the upper portion of the sides. Midway down the sides, and running from head to tail, are dark scales that seem to form up to a dozen "W," "M" or "X" patterns. The dorsal, caudal, pectoral and pelvic fins may be speckled. In breeding males, the overall color darkens, with the head looking almost black, and a very dark color on the dorsal, pelvic and anal fins.

Habitat: Johnny darters tolerate a wide variety of lake and stream habitats. They are not as specific about where they live as most other darters. Johnny darters are found mostly in areas with little stream current, over a bottom that is gravel or sand, and in lakes along firm shorelines. They have also been found in weedy areas and rocky riffles. The similar tessellated darter is found on gravelly shoals with some water current and vegetation. Although usually considered a fish of inshore waters, johnny darters have been recorded at depths of over 130 feet in the Great Lakes.

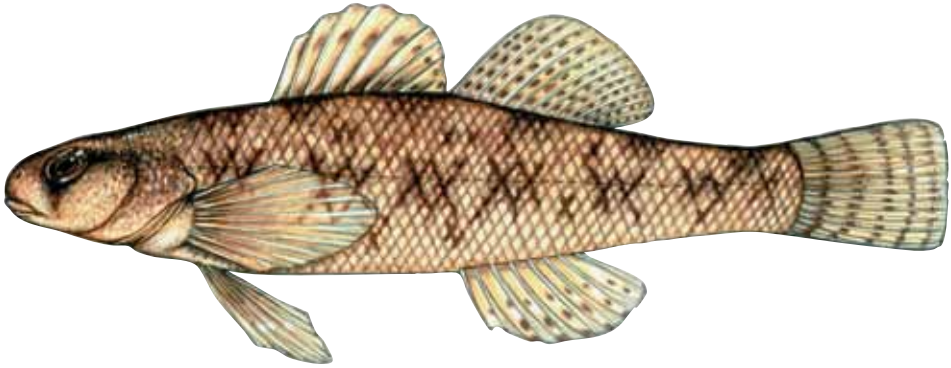
Life history: Johnny darters spawn in spring, April to May. Although the fish normally has a small home range, for spawning it will travel to find a suitable site. The males move into the spawning areas before the females and establish and defend a territory. The johnny darter creates a sort of nest, clearing a spot of silt and debris under an underwater object, like a rock. In a twist different from most other spawning fish, the male and female johnny darter turn upside down to spawn. The adhesive eggs, from 40 to 200 per female, stick to the underside of the rock in a single layer. Other females add to the male's nest, until the eggs there may number as many as 1,000. The male stays and maintains the site after spawning, fanning its fins to keep the eggs clean and aerated. The tiny eggs hatch in about two weeks, depending on water temperature.

Johnny darters show the bottom-dwelling and darting movement typical of other darters. They are sight-feeders, as are other darters. Johnny darters eat zooplankton, midge larvae, mayflies, caddis larvae and other small insects, worms and small snails. The males grow faster than females after the first year. Where they are present, they are a food source for other fishes.

Tessellated Darter *Etheostoma olmstedi*

Species overview: The tessellated darter can be found from southern Canada's St. Lawrence River drainage to Georgia. In Pennsylvania, it is found in the Delaware, Potomac and Susquehanna River watersheds. The tessellated darter greatly resembles the johnny darter, and it was formerly considered a subspecies of the johnny darter.

Identification: "Tessellated" refers to the fish's having a mosaic-like or checkered pattern. The tessellated darter's coloration is pale-sandy, fading to white on the bottom. The back and upper sides of the tessellated darter



have nine to 11 pronounced, small X-shaped or W-shaped marks. This species, like the johnny darter, has a single anal fin spine. Other darters in Pennsylvania have two anal fin spines. The mouth is positioned low and is horizontal. The mouth ends below the front of the eye.

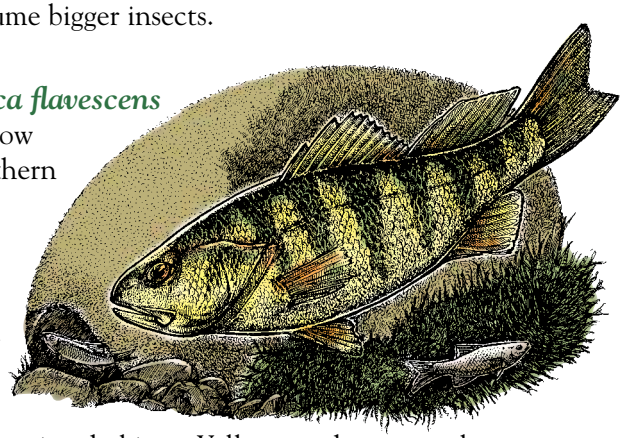
Tessellated darter breeding adults develop 12 or 13 vertical bars on the sides, while losing the X-shaped and W-shaped markings. The upper side scales become wholly outlined in a dark color. The fin membranes, except those of the pectoral fins, grow dark with lighter tips on the pelvic and pectoral fins. In this phase, tessellated darters are sometimes mistaken for small yellow perch. Tessellated darters reach a length of about 3 $^{1}/_{2}$ inches.

Habitat: The tessellated darter prefers the quieter portions of sandy or mud-bottomed flowing water or still water, except in the breeding season.

Life history: Tessellated darters spawn in the spring, around May or June. The female deposits adhesive eggs on the tops and sides of rocks. The female quivers as she drops her eggs, and the male fertilizes the eggs as he swims slowly over them. After spawning, the female leaves the nest. The male remains to guard the eggs. The male aerates the eggs either by swimming upside down, finning them with his pectoral fins, or by holding his position with the pectoral fins and fanning with his tail. The eggs incubate at around 65 degrees and hatch in about three weeks.

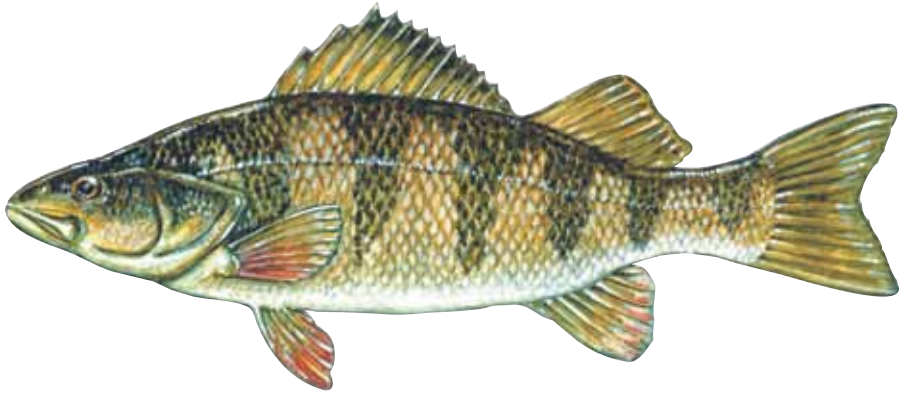
Tessellated darters feed mostly on small insects and crustaceans at first. As the fish grow, they consume bigger insects.

Yellow Perch *Perca flavescens*



Species overview: Yellow perch are native to the northern United States east of the Rocky Mountains and Atlantic Coast watersheds south to South Carolina. They have also been widely introduced throughout the country and are distributed across Pennsylvania in appropriate habitat. Yellow perch are popular with open-water anglers and ice fishermen. Yellow perch were netted commercially in Lake Erie. The genus name "*Perca*" means "perch," and the species name "*flavescens*" means "yellow."

Identification: Yellow perch have a long-looking body, but they are not as slim in appearance as other perch family species. The upper part of the head, back and sides is olive-green to golden-brown, shading to lighter yellow-green or yellow on the sides. The underside is white or



grayish. Some back and side scales are dark and form a pattern of six to nine vertical stripes that narrow as they approach the belly. These stripes are a perch's most distinctive feature. The pectoral, pelvic and anal fins are pale-yellow, becoming bright-orange on breeding-season males. The tail is slightly forked. The two dorsal fins are separated. The front dorsal fin has 13 to 15 sharp spines, and one or two spines can be found on the leading edge of the rear dorsal fin. The rest of the rear dorsal fin has soft rays. The anal fin has two spines, and there is a spine on the trailing edge of the gill cover, or opercle.

Habitat: Yellow perch live in a variety of aquatic habitats, including warm or cool lakes, ponds and sluggish streams. A prime yellow perch lake is cool and clear, with a sandy or gravelly bottom and rooted underwater vegetation. They also inhabit lakes with soft bottoms. Yellow perch are considered shallow-water dwellers and are not usually caught more than 30 feet deep.

Life history: Yellow perch spawn in spring, April and May, when water temperatures are in the mid-40s to mid-50s. This is usually about a week after walleyes spawn. Yellow perch males, which are smaller than females, move into the spawning areas first. Selected spawning sites are five to 10 feet deep in inland lakes, and over aquatic vegetation, submerged brush or along sand or gravelly shorelines. Big female perch can produce up to 100,000 eggs, but most produce 15,000 to 25,000 eggs. Spawning occurs at night and early morning. The females are accompanied by several males, which swim alongside or behind them. The eggs are deposited in a unique form–a long, sticky gelatinous mass that drapes over underwater objects. The accordionlike transparent egg mass absorbs water rapidly after it is emitted and swells, sometimes reaching seven feet long and weighing up to two pounds. The egg mass is semi-buoyant and moves gently with water currents and waves. Bad weather may cause the egg mass to be torn up and washed onto land. Unlike the sunfishes, yellow perch parents do not remain to guard the nest, eggs or young.

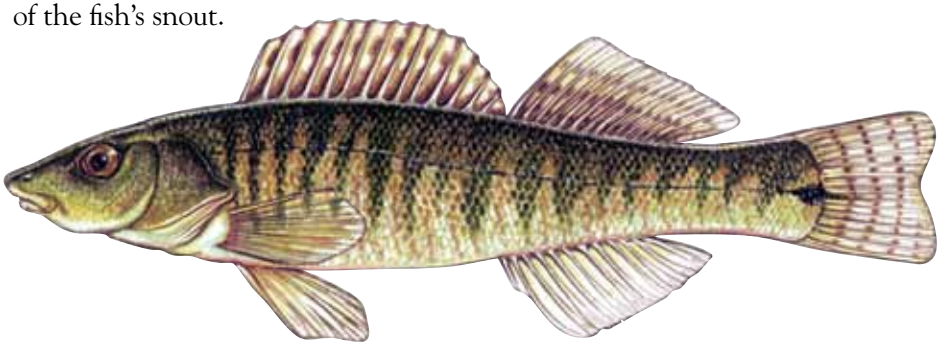
Yellow perch eggs take eight to 25 days to hatch, or longer. The hatching time of these and other fish eggs depends on water temperature. Hatching takes longer in cool water, a shorter time in warmer water. Newly hatched yellow perch head for deep water, where they form free-swimming schools. After about a month, they return to shallower water, and like the adults, live near the bottom. Young perch feed on zooplankton and small aquatic insects, and in turn are food for larger predator fish. Small fish, including small perch, are mainstays of the adult perch's diet. Adult perch also eat aquatic insects and crustaceans.

Yellow perch typically forage during daylight hours. They feed little or not at all at night. They are active all year long, including under the ice, making them a favorite with ice fishermen, who catch them on jigging rods and tip-ups. Minnows and jigs are popular perch-getters.

In small lakes, yellow perch may overpopulate, resulting in stunted, slow-growing fish. Perch commonly grow to 12 inches and may reach 14 inches. Even at a young age, the females grow faster than the males, and as adults, they are larger. Yellow perch sometimes travel in schools of from 50 to 200 individuals. The schools stay in deeper, darker areas during the day and move closer to the shallows to feed as evening approaches. Perch schools usually contain perch all of the same size, which are also generally the same age, or year-class. At times males and females roam in separate schools. In a lake, perch schools show migratory movements according to the season and the time of day, in response to temperature, food availability and spawning urge.

Logperch *Percina caprodes*

Species overview: The wide-ranging logperch is one of our biggest darters. It lives in the St. Lawrence River, the Great Lakes and their tributaries, and in the Mississippi River system and some Atlantic Coast watersheds outside of Pennsylvania. In Pennsylvania, the logperch is found only in the Ohio River watershed and Lake Erie and tributary streams. Its species name "*caprodes*" means "piglike," describing the shape of the fish's snout.



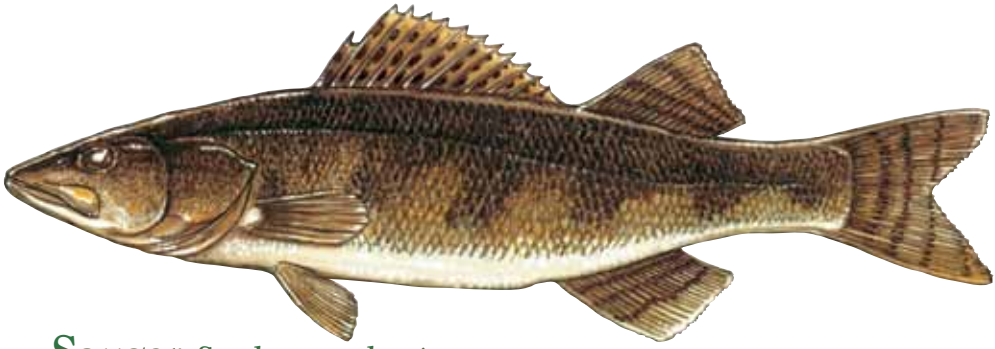
Identification: The logperch is a long, slim darter that reaches a length of four or five inches. It has distinctive "tiger stripes" along its sides. The thin stripes are dark-olive or black on the pale-yellow or greenish-yellow body, crossing the fish's back and extending toward its belly. The first dorsal fin is spiny, the second, soft-rayed. The soft dorsal fin and the caudal fin have dark markings on their rays. During the breeding season, the yellowish color of the males becomes more intense, and they also develop small, fleshy projections, called tubercles, on the belly and the underside of the fleshy part of the tail. The logperch's head is conical and pointed and its mouth is thick-lipped, suited to its rooting way of feeding.

Habitat: Logperch inhabit mud-bottomed, sandy, gravelly and rocky areas in big lakes. They can be found living over those bottom types in large rivers. They tend to stay offshore in water deeper than three or four feet, and have been captured at depths of more than 130 feet in Lake Erie. Logperch tolerate a wide variety of habitats, including stream riffles, and they can tolerate silty water. During its spawning runs, the logperch swims from the larger waterway in which it makes its usual home into smaller tributary streams, where for a short time the fish is abundant.

Life history: Logperch spawn in late spring to early summer. They swim from deep water offshore to sandy shallows or gravelly shoals, where a few to several hundred males gather in schools. Logperch also make spawning runs into the mouths of small streams that are tributary to the large rivers and lakes where they spend most of their time, including the Pennsylvania tributary streams to Lake Erie. They occasionally hybridize with other darter species.

When logperch are ready to spawn, the females join the school of males and swim through it, followed by a few or many of the males. When the female stops on the bottom, one of the males alights on her back and the two fish vibrate as they spawn. The vibrating helps to kick up the sand and bury the eggs. About 10 to 20 eggs are released at each spawning, and females can produce 1,000 to 3,000 eggs. The eggs are not guarded and the males are not territorial. After spawning, the eggs are left unguarded to hatch by themselves. Young logperch are found in dense beds of vegetation. They feed on small organisms, mostly zooplankton.

As adults, logperch feed on aquatic insects, especially mayfly nymphs, caddis larvae and midge larvae, which they find under rocks. Logperch use their fleshy, hoglike snouts to root under and roll over small stones, leaves and other objects on the bottom, to reach the aquatic insects beneath them. Logperch also eagerly eat logperch eggs that were not buried in the sand during spawning.



Sauger *Sander canadensis*

Species overview: The sauger is closely related to the walleye and very similar in appearance. The biggest difference between the two is habitat preference. Saugers are native to much of central North America, including the Mississippi and Missouri River watersheds and the Great Lakes and Hudson Bay watersheds. They were not originally present in Atlantic Coast waterways. Saugers appear in western Pennsylvania's Ohio River watershed, but do not occur east of the Appalachian Mountains, so they are absent from the central and eastern parts of the state. Saugers had been recorded in the Allegheny, Beaver and Youghiogheny rivers before 1900. Then they had not been seen in the state for many years. Studies have confirmed that in some years saugers are the most frequently caught species by anglers in the Ohio River watershed in Pennsylvania, and in navigation pools of the Monongahela River and Ohio River. They are fairly abundant in the lower Allegheny River and upper Ohio River. The species name "*canadense*" refers to Canada, where the fish was originally found.

Identification: Like the walleye, the sauger has a long, roundish body, a forked tail, canine teeth and large, glassy eyes. A light-reflective coating behind the retina gives the eye a milky glow. As in the walleye, this is an adaptation to feeding at night and in dim light. On its back and sides the sauger is olive-gray to brown or tan with a brassy tinge. Its back is crossed by three or four distinct, dark saddle markings, which extend down the sides. Its belly is white. It has two separate dorsal fins, the first with 12 or 13 spines, the second with two spines on its front end. The dorsal fins have small dark spots that form lengthwise rows. This characteristic is absent in walleyes. The sauger does not have a white tip on its lower tail, as does the walleye. There is no dark blotch at the back corner of the sauger's first dorsal fin, which the walleye has. The sauger does have a dark blotch at the base of its pectoral fin, which spills onto the fin itself. The sauger is generally a smaller fish than the walleye, reaching three to five pounds and 15 to 20 inches, but normally weighing only a pound or so. Female saugers of all ages are larger than the males.

Habitat: Saugers typically inhabit large, often muddy rivers and big, silty reservoirs. For an unknown reason, saugers do well only in the largest lakes and rivers. Schooling fish, they seem to need the "wide open spaces" of big, shallow waterways, which are typically turbid. Introductions of saugers in smaller lakes have always failed.

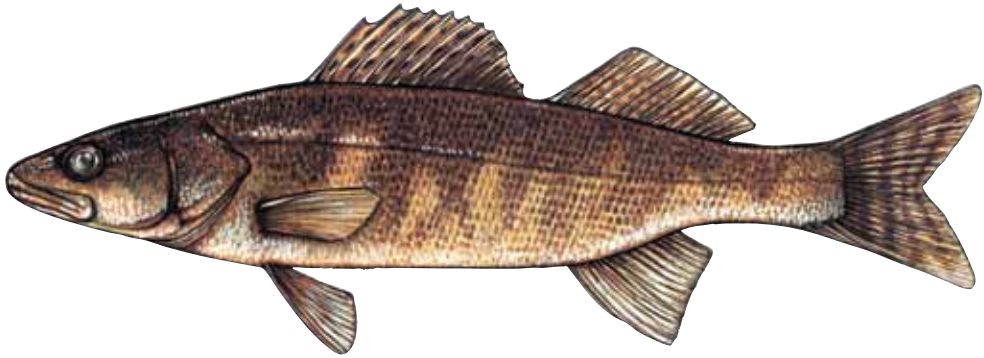
Life history: Except for its preference for bigger and muddier waters than the walleye, the sauger's lifestyle is much the same as that of the walleye. Saugers spawn very early in the spring, when water temperatures approach 45 degrees. They begin congregating near their spawning areas in late winter and may migrate a considerable distance to reach them. Because their spawning needs and timing are similar, natural hybrids between walleyes and saugers are not uncommon where the two occur. The resulting fish is the saugeye, which has characteristics of both parents.

Like the walleye, the sauger spawns at night. Spawning takes place over a two-week period, and there is no nest construction or parental care. Several males swim along with a female and spawn with her. The eggs are scattered over rock rubble and gravel. This may happen in impounded water, on an upstream run into a river, or in the tailrace of a dam. Large female saugers may produce more than 100,000 eggs, but most spawn 20,000 to 60,000. The adults go back to deep water after spawning. The sauger's eggs are smaller than the walleye's and adhesive for a short time, sticking to the gravelly bottom. Those that don't adhere may be widely dispersed by currents. Hatching takes about two weeks, depending on water temperature. The tiny fry feed on zooplankton and midge larvae. Like walleyes, as the young fish grow to adulthood, they switch to eating almost exclusively fishes, but they also eat insect larvae. Also like walleyes, saugers are nighttime feeders.

Saugeye *Sander canadensis* x *Sander vitreus*

Species overview: The saugeye is a hybrid, the result of mating the sauger with the walleye. The crossbreeding can occur in the wild, but is mostly the result of purposeful mixing of the species in fish hatcheries. As a hybrid, the saugeye has the advantage of "hybrid vigor," growing larger than the sauger parent. In Pennsylvania, the saugeye is stocked in a few waters that are in the natural range of the sauger, in the southwest part of the state.

Identification: Saugeyes have variable body markings and coloration, but generally look like the sauger, with saddles and blotches more subdued. In saugeyes, membranes of the spinous dorsal fin have distinct spots similar to those of a sauger. A black blotch is also usually present at the posterior base of the spinous dorsal fin, like the walleye. In saugeyes, a white spot is usually present at the tip of the lower caudal fin, also similar to walleyes.



Habitat: Like most hybrids, the saugeye's habitat preferences are similar to its parents, tending to survive best in turbid water. Saugeyes offer anglers an opportunity to catch a walleye-sized fish in habitats suited best for saugers.

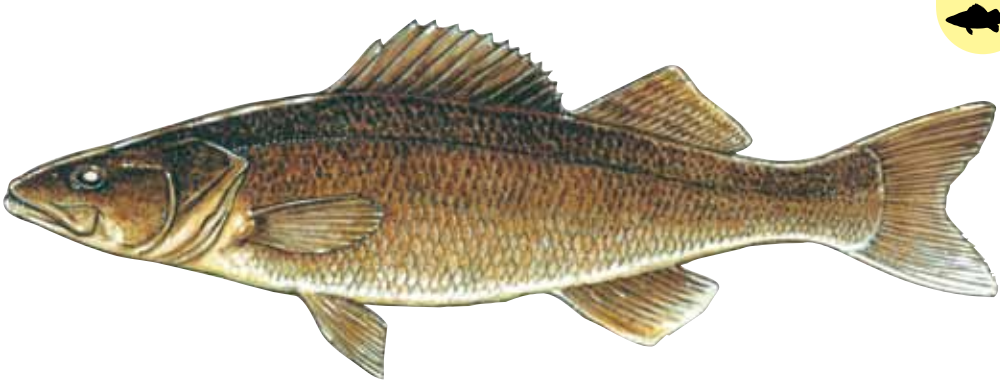
Life history: Almost all saugeyes begin life in a fish hatchery, where the eggs of one parent, either a walleye or sauger, are mixed with the milt of the other. In its spawning urge, it behaves similarly to its parents, and its feeding habits are about the same, feeding mainly on fish and insects.

Walleye *Sander vitreus*

Species overview: Walleyes are native to central North America and Canada, including the Ohio River and Great Lakes watersheds. Popular sport fish, they have been extensively stocked. In Pennsylvania they are now found throughout the state, including the Susquehanna and Delaware River watersheds, as well as their original Allegheny River and Lake Erie watershed homes. One of the walleye's nicknames is "Susquehanna salmon." It has also been called "yellow pike" and even "pickerel." All these nicknames put it in the wrong fish family–it's neither a pike cousin nor a salmon. It's the biggest, toothiest member of the perch family. The name "walleye" refers to the fish's large, milky eye that looks luminous when light is shined on it. The eye has a reflecting membrane behind the retina, which causes this effect. The species name "*vitreum*" means "glassy," and refers to the luminous eye.

Identification: Walleyes have a long, roundish body, a forked tail and sharp canine teeth in their jaws. The large eye is glassy and reflects light at night. The dorsal fin is separated into two parts, the front portion with 12 to 16 spines, the rear portion with one or two short spines and the rest, soft rays. The anal fin has one or two spines.

Walleyes vary in color, ranging from a bluish gray to olive-brown to golden-yellow, with dark-on-light mottling. Side scales may be flecked with gold. Irregular spots on the sides can join to make a vague barred pattern. The belly is light-colored or white.



One way to distinguish a walleye from its cousin, the sauger, is to look for the walleye's dark spot at the rear edge of the front (spiny) section of its dorsal fin. Also, on the walleye, the lower portion of the tail fin is whitish, and so is the bottom margin of its anal fin.

Habitat: Walleyes live in large lakes, big streams and rivers. They are rarely found in lakes smaller than 50 to 100 acres. Walleyes are abundant in water that is cool and moderately deep, with a gravelly, sandy or rocky bottom. They tolerate turbid and clear water conditions. Walleyes also need relatively cool water, where summer temperatures do not exceed 85 degrees. They use extensive gravel or rubble areas for spawning, and typically inhabit lakes or rivers that have expansive areas deeper than 10 feet.

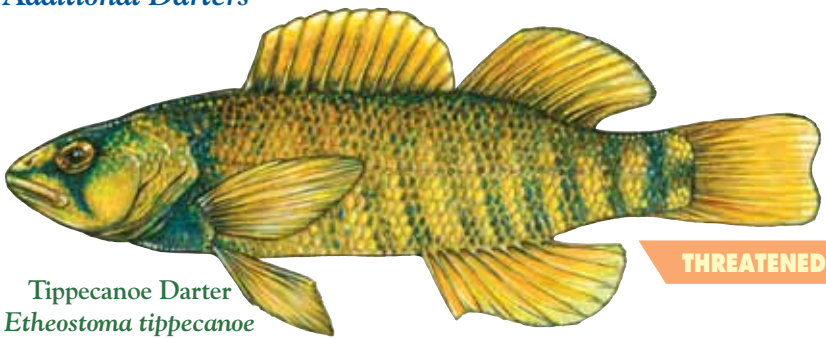
Life history: Walleyes travel, feed and spawn in schools. They range widely in their home lakes or rivers. Walleyes are one of the first fish to spawn in the spring, sometimes even before the ice has completely melted from the surface or around the shoreline. They return year after year to their spawning sites, sometimes traveling a long distance, so they truly make a "spawning run." The spawning site may be rocky or gravelly shoals or shallows in a lake or river cove at the base of dams or riffles, or the walleyes may travel up a tributary stream to spawn over flooded marsh grass.

The females move into the spawning area first, when water temperatures reach 45 to 50 degrees. The eggs are scattered randomly. The females spawn with several males, usually at night. Eggs are commonly deposited where there is some water movement, whether from stream flow or wave action near the edges of the lake. After they are extruded, the eggs fall into protective spaces in the rocks and gravel. Walleye eggs hatch in about 12 to 18 days, depending on water temperature. Females produce 25,000 eggs per pound of body weight, so a single large female could spawn 500,000 minute eggs or more. When they hatch, walleye fry are about a half-inch long and paper-thin. At first they drift about, absorbing the yolk sac.

Young walleyes feed on microscopic animals, or zooplankton. When they reach several inches long, walleyes switch to other small fish as their primary food. Like the adults, they spend much of their time in deep

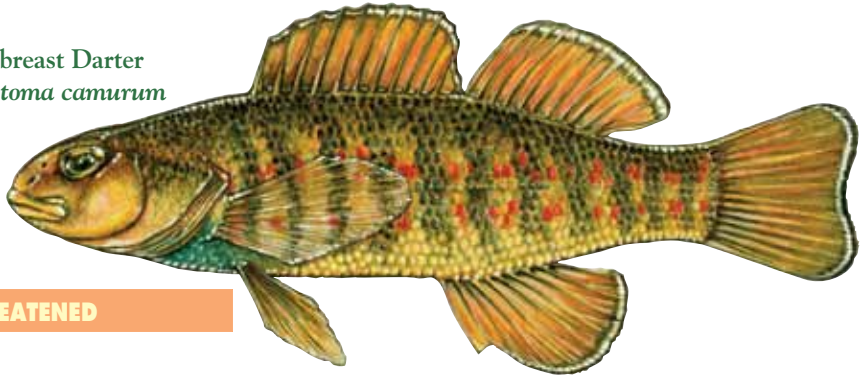
water, moving closer to shore during mornings and evenings to feed. Typically, adult walleyes feed at dusk during the cooler months and at night during the summer. In turbid water, walleyes can be active during the day. The light-reflective coating behind the walleye's retinas, which gives the eye the glowing appearance, is an adaptation to feeding at night and in dim

Additional Darters



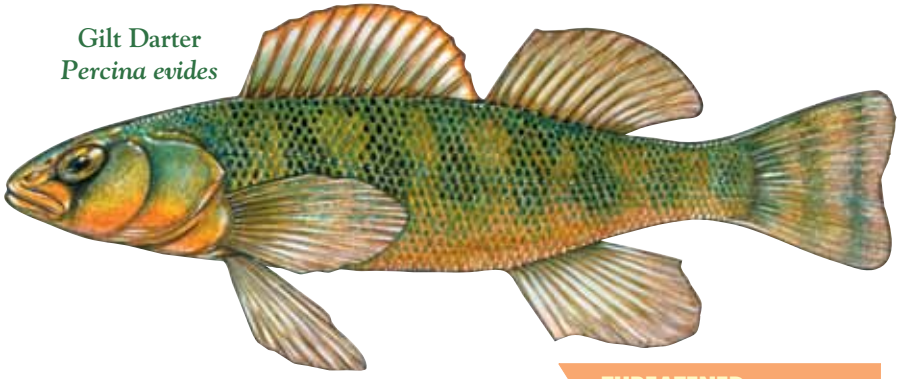
Tippecanoe Darter
Etheostoma tippecanoe

THREATENED



Bluebreast Darter
Etheostoma camurum

THREATENED

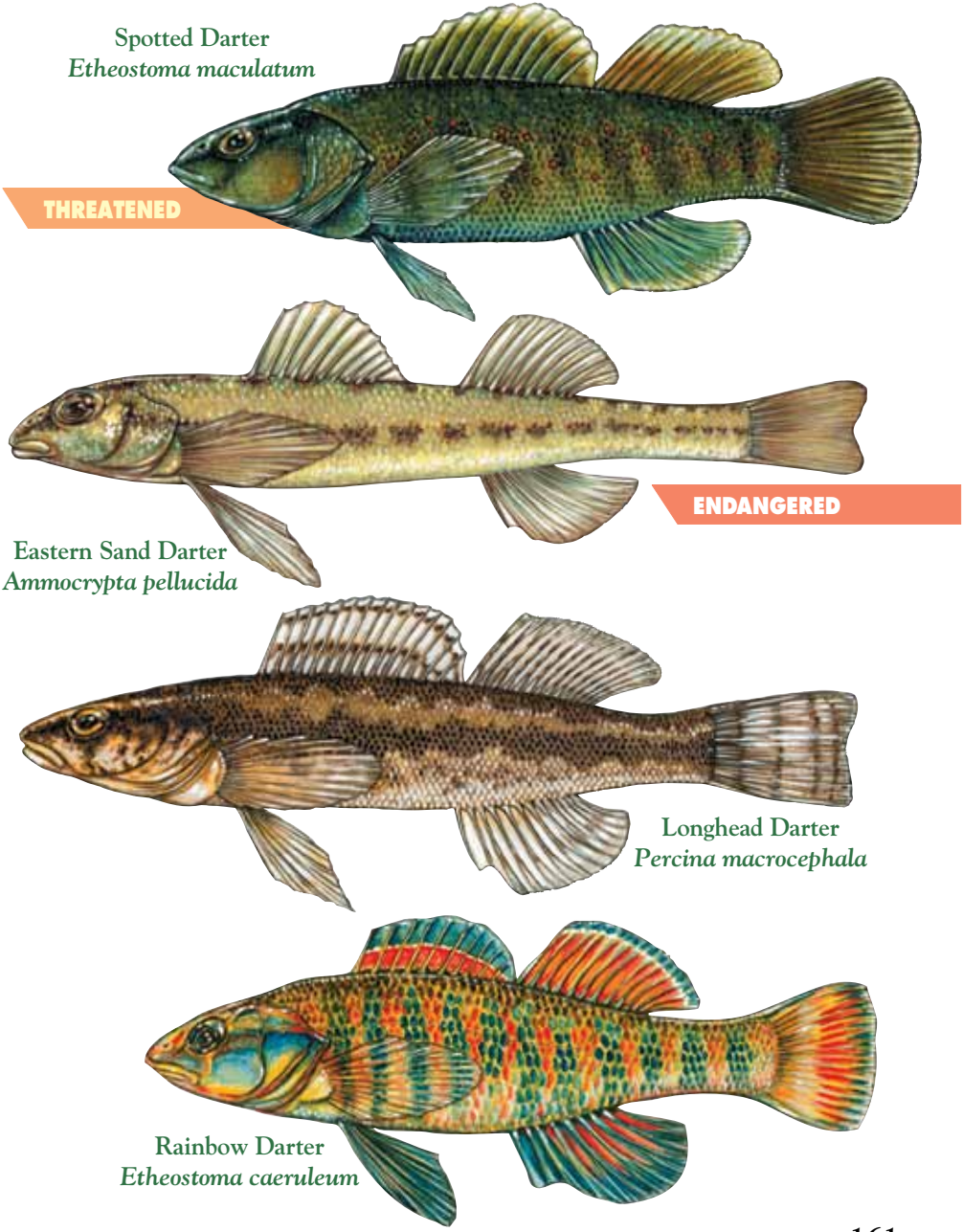


Gilt Darter
Percina evides

THREATENED

light. Walleyes are often the top predator fish in their habitat, eating other fishes, as well as frogs, crayfish and large insect larvae.

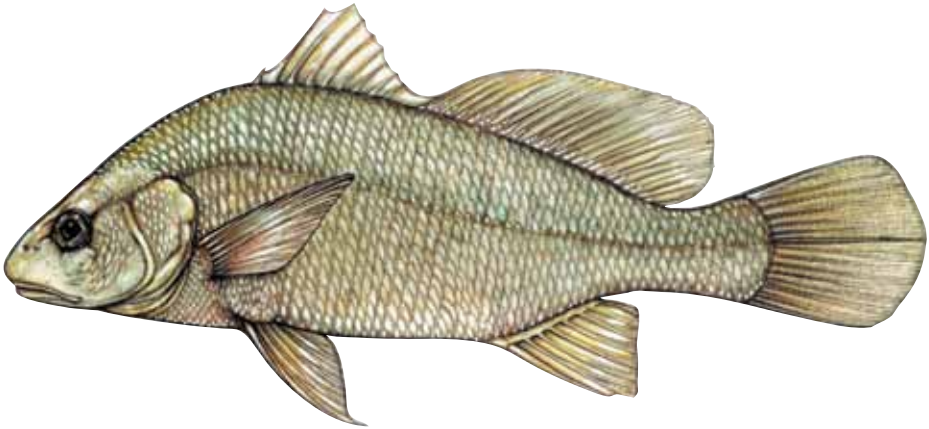
Walleyes can grow to 36 inches. The state record is over 17 pounds. Although walleyes can be caught at any time of day, night fishing or fishing the dim depths with live bait or fishlike lures and jigs is effective for catching walleyes.



Drums and Croakers

Family Sciaenidae

Family overview: The freshwater drum (*Aplodinotus grunniens*) is Pennsylvania's only fulltime freshwater representative of this large and mostly marine family. The lower pharyngeal (throat) arches are heavy and fused, and they bear flat, molar-like teeth. The spiny and soft-rayed portions of the dorsal fin are narrowly joined. The spiny-rayed portion is shorter that the spinous section. The lateral line continues to the end of the tail fin. In Pennsylvania, the freshwater drum occurs in Lake Erie, and in the Allegheny, Ohio and Monongahela rivers.



Identification: The freshwater drum is dark-green to olive-brown on the upper part of the head, back and sides, shading to silvery on the sides. The belly is white. The anal fin has two spines, the first, very small and the second, quite large. The body is sharply arched.

Life history: Some of the marine members of this family are called "croakers" because of the sounds they produce. As in the marine species, Pennsylvania's freshwater drum produces a drumming sound by using muscles attached to the air bladder. These sounds are produced most often during the summer breeding season. Spawning takes place in relatively shallow portions of lakes or in the backwaters of streams. The eggs are very small. Freshwater drum are unique among freshwater fishes because their eggs are so buoyant, they float.

The young grow rapidly at first, but most Pennsylvania freshwater drum do not reach 20 inches even after more than 10 years of growth. The pharyngeal teeth allow it to feed on mollusks, but it also feeds on insects and other invertebrates.

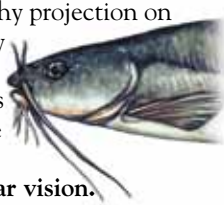
Glossary

Adipose fin. Small, fleshy fin on the back and near the tail of certain fishes.

Anadromous fish. Fishes living in the ocean (or other large waterway) but which enter fresh water (in the case of lake-dwellers, smaller) streams to spawn.

Anal fin. Single fin on underside of fish between the vent and tail.

Axillary process. Elongated, membranous material occurring at base of pectoral and pelvic fins.



Barbel. Slender, fleshy projection on the head, usually around the mouth; includes tactile (sensitive to touch) organ.

Binocular, monocular vision. Binocular vision means using two eyes. Monocular vision means using only one eye.

Bony plates. Hard, heavy scales.

Brackish. Somewhat salty.

Branchiostegal rays. Small, slender bones that support the gill membranes.

Candidate. Species that may become threatened or endangered.

Catadromous fish. Fishes living in freshwater streams, but which return to the ocean to spawn.

Caudal fin. Tail of a fish.

Ctenoid. Having a toothed (rough) margin (refers to fish scales).

Cycloid. Smooth, with circular or concentric lines of growth (refers to fish scales).

Diatoms. A kind of algae.

Diurnal, nocturnal feeders. Diurnal feeders eat during the day. Nocturnal feeders eat at night.

Dorsal fin. Fin on the back of a fish: may be divided into parts on some species.

Endangered. Might become extinct or extirpated.

Eutrophy. Material in the water, mostly on the bottom, that is rich in nutrients.

Extirpated. Cannot be found in Pennsylvania anymore, but might be found in other places.

Estuary. Mouth of a river where its fresh water mixes with salt water and is affected by tides.

Extinct. No living species. The animal doesn't exist anywhere anymore.

Fauna. Animals living in a particular area.

Fingerling. A young fish, older than fry but usually not more than one year old.

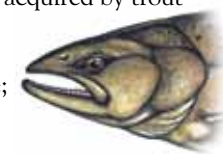
Fry. Newly hatched fish; usually in various stages of progression: sac fry, swim-up fry, fry, fingerling. Length of stages may vary with species.

Gill arches. Bony structures that give internal support to the gills; also called pharyngeal arches.

Gills. Organs through which oxygen is absorbed from the water; protected by gill cover called opercle or operculum.

Hybrid. Offspring resulting from breeding between parents of two different species.

Invertebrates. Animals without a spinal column (backbone).



Kype. Hooked jaw acquired by trout and salmon, especially at spawning time; it is comprised of cartilage.

Lamellae. Membranes of a fish's gills that look like teeth on a comb supported by bony arches.

Lateral line. Line of scales running lengthwise on each side of a fish with openings or pores connected to a sensory canal.

Maxillary. Hindmost corner bones of the upper jaw.

Migrate. Move periodically from one area to another to live, spawn or feed.

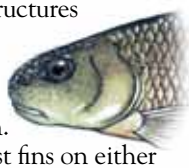
Nares. Nasal cavities, nostrils.

Olfactory. Of or relating to the sense of smell.

Opercle or Operculum. Gill cover.

Otolith. Ear bone.

Pearl organs. Horny structures protruding from the head or scales; developed during the breeding season.



Pectoral fin. Uppermost fins on either side of the body and usually just behind the gill.

Pelagic. Of or relating to open water or the open sea; not near-shore.

Pelvic fin. Fins on either side of the body, below and often behind the pectoral fins.

Pharyngeal arches. See gill arches.

Pharyngeal teeth. Teeth-like structures found in the throat, attached to the gill arches. See gill arches.

Protractile. To be thrust outward or extended.

Ray. Bony structure supporting the membranes of the fin.

Soft ray. Flexible, jointed ray supporting a fin.

Scute. An external bony or horny plate, or large scale.

Spine. Sharp, pointed structure.

Spiny ray. Flexible, jointed ray supporting a fin.

Swim-up fry. Newly hatched fry in early stage of swimming up for feed after absorption of egg or yolk sac is complete.

Threatened. Might become endangered.

Tooth patch. Group of small teeth located on the base of the tongue.

Triploid. Having a chromosome number three times the monoploid number.

Tubercle. A small, knobby nodule on a fish's head, body or fins (see pearl organs).

Turbid. Opaque; muddied; caused by suspended matter, usually sediment or the result of rain runoff.

Vertebrae. Spinal column; the backbone.

Vertebrate. Animal having a spinal column or backbone.

Vermiculation. Irregular, wavy, worm-like lines.

Zooplankton. Very small animal life in water.

Index

Bold numbers indicate page numbers of illustrations.
Italicized words are scientific names.

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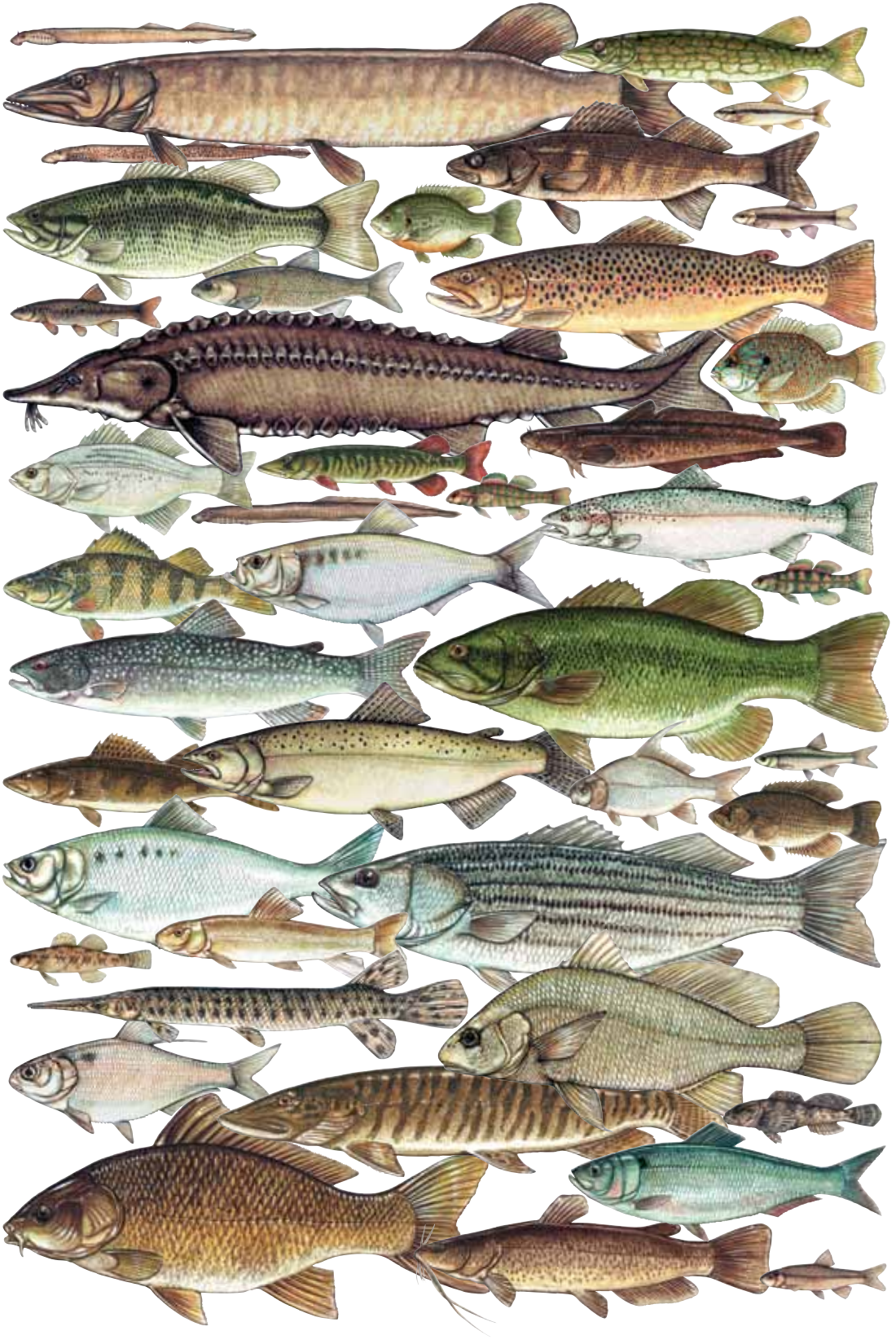

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