



# Pennsylvania's Dynamic Darters

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Darters are among the most vividly colored, behaviorally complex, ecologically important and abundant fishes found in Pennsylvania. Yet, how many visitors to the Commonwealth's waterways have ever seen a darter in the wild or even realize that such creatures exist? As the smallest members of the perch family, they rarely exceed four inches in length. For this reason, no one looks at them as table fare, as we see the yellow perch and walleye. Although they are sometimes used as bait by anglers, they are not as popular as blacknose dace, shiners or stonecats. Still, darters are arguably the most attractive of all Pennsylvania fishes in terms of physical appearance. This is especially true of the males during the breeding season.

Darters are also an important biological component of the waterways they inhabit. Each species has evolved to occupy a specific niche, which allows partitioning of available habitat and food resources among other fishes. Darters prey on insects and crustaceans, and in turn are preyed on by species such as smallmouth bass and walleyes. Thus, darters are one link in the larger chain of their aquatic environment. The presence of darters in a waterway reflects good water quality and diversity of appropriate habitat.

Attractive or not, we are learning more about the various darter species and their interactions in Pennsylvania's waterways. The roles that darters play and the functions they perform continue to emphasize their importance.

## Description

The taxonomic classification of darters is a continuing process. New species and/or subspecies continue to be described by ichthyologists using advanced techniques to discern differences and similarities among isolated or nearby populations. Darters are perch-like fishes grouped into the Percidae family and are restricted in distribution to North America. Three genera of darters comprise over 150 North American species. They represent greater than 20 percent of the 750 species of freshwater fish found in the United States and Canada. Currently, two genera of darters are recognized as occurring in Pennsylvania. Twenty-one darter species are split between the genus *Etheostoma* (13 species) and the genus *Percina* (8 species). Until recently, the genus *Ammocrypta* was represented in Pennsylvania by a single species, the state endangered Eastern Sand Darter. However, this species, formerly known as *Ammocrypta pellucida*, was recently renamed by taxonomists and is now named *Etheostoma pellucida*--that is, at least until another researcher can make a more compelling case for it to return to the genus *Ammocrypta*.

## Why they're "darters"

A darter's ability to maneuver in, around and under rocks and substrate gives it an advantage as a bottom forager. Riffles and swift currents provide protection for darters because few predators can live there. Many darters such as the johnny darter do not possess a swim bladder. This lack of buoyancy allows them to stay near the bottom and facilitates their rapid darting movements. In addition, bottom-dwelling darters possess flattened, downward-sloping heads. This feature lets them take advantage of water flowing to help plane or push down on the fish's head, thereby helping the fish to remain near the bottom. Conversely, mid-water darter species such as the blackside darter do possess a swim bladder to help them remain suspended in the water column.

Overall, darters are small. However, there is considerable variation in maximum length among the species found in Pennsylvania. The Eastern sand darter (2.0 inches) and the Tippecanoe darter (1.8 inches) are the smallest Pennsylvania darters. The logperch and greenside darter can each reach lengths of 6.5 inches and are the largest darters in the Commonwealth.

In nature, it is usually true that "form follows function." So it is not surprising that the Eastern sand darter has a different body shape than its stream-dwelling cousins. This species lives primarily in lakes or slow-moving waters and burrows into the sand for protection. The sand darter is proportionally much longer and thinner than its flowing water relatives. This lets it quickly wriggle into the sand, leaving only its eyes exposed. This tactic provides the sand darter with protective cover in areas where rock or gravel substrate does not exist.

## Feeding

Darters are mid-depth and bottom-dwelling fishes. Their location and movements depend on substrate type as well as the velocity, chemical and thermal composition of their liquid environment. They seek their prey among the rocks, gravel or sand along the stream or lake bottom. Prey items typically range in size up to approximately 3/16-inches.

Prey selection varies with the lifestage of the fish. Juvenile darters consume small crustaceans such as cladocerans, copepods and ostracods. Adults prefer chironomids (midge larvae), simuliids (blackfly larvae), ephemeropterans (mayflies) and trichopterans (caddisflies). Large darter species such as the longhead darter may also eat amphipods (freshwater shrimp), isopods (sowbugs) and crayfish.

Darters rarely compete with most minnow species because the minnows often occupy the upper levels of the water column. Food availability and water velocity help to determine the activity levels of darters' foraging. For example, in pools or areas of slower current, darters range farther to procure food. Similarly, when flow rates are high, travel is reduced. Feeding is primarily by sight, so darters are daytime feeders. Still, peaks in feeding activity typically occur early and late in the day.

## Reproduction

Reproduction in darters generally takes place during the spring and summer. Day length, or photoperiod, is important in initiating reproductive activity among darters. Water temperature plays a larger role in termination of spawning activity. For many darter species spawning has been reported to occur over extended periods of several months. Also, there is evidence that females of some species may spawn several times during the reproductive season. Sexual maturity for many species can occur at age one. However, egg production increases with age. Mature female darters can produce between 230 and 1,000 or more eggs, depending on the species.

Spawning by darters is accomplished in one of three ways, depending on the species. All members of the genus *Percina* and some *Etheostoma* bury their eggs in the substrate. The eggs are abandoned and there is no parental care.

Using a different approach, some *Etheostoma* species, such as the greenside darter, attach their eggs to submerged vegetation or rocks and then abandon them. In this case the female releases one to three eggs at a time and attaches them to a rock, stick or plant.

The most complex and energetically demanding strategy is used by species such as the johnny darter and fantail darter. These darters engage in nest building and cluster spawning. The male digs out a nest underneath a flat rock in preparation of mating with one or several females. After mating, the female attaches the adhesive eggs to the underside of the rock. The male then provides care and protection for the eggs until they hatch.

Generally, in darters and many other fishes, the colorful appearance and perhaps courtship dance of the male is sufficient to attract a female for breeding. However, the male fantail darter attempts to improve his chances by displaying an additional feature that is especially attractive to females. Female fantail darters prefer to mate

with males that already have eggs. To the female this is probably a signal that the prospective male is a good "risk." That is, he has already demonstrated that he has the physical fitness to protect a clutch of eggs to their maturity. But what if the male has not previously mated with another female or has been unable to commandeer a clutch of eggs from another male? Theoretically, he would not be selected by the female for breeding.

In response, male fantail darters develop fleshy knobs consisting of modified epidermal cells at the tips of the spines on their first dorsal fin. These knobs, also known as egg mimics, resemble the shape and color of actual darter eggs. Researchers have shown that female fantail darters prefer to breed with males that display egg mimics. Even though these fleshy knobs may also be useful as tools in housekeeping of the nest, their primary function is as a female attractant.

## **Distribution**

Darter species are neither randomly nor evenly distributed throughout the Commonwealth's waterways. Before man-induced changes on the North American landscape, fishes were distributed by natural forces. Glacial advances and retreats, emergence of mountain ranges and erosion of watershed-separating barriers all contributed to present-day fish distributions.

Today, the greatest concentration of darter species occurs in northern Alabama and eastern Tennessee. The number of darter species declines in North America as the geographic distance from that region increases. Tributaries of the Mississippi River were the main routes of darter dispersal throughout the eastern United States. However, the Appalachian Mountains apparently served as enough of a physical barrier to reduce the dispersal of species eastward. As a result, Pennsylvania waters in the Ohio River Basin contain a greater diversity of darters than the Susquehanna River Basin and Delaware River Basin, respectively.

In many cases the headwater areas of Pennsylvania streams in the Ohio River Basin represent the northern or eastern limits of the range for a particular species in North America. Some of these darters are listed as state endangered, threatened or candidate species because of their rarity within the borders of Pennsylvania. As such they are protected by special regulations. In addition, projects involving activities that may adversely affect these species are reviewed by Commission staff in an effort to conserve the remaining populations.

Often species are present in a watershed because of human activities. At least one species, the banded darter, appears to have been introduced to a watershed where it is non-native by way of unintentional stocking or a bait bucket introduction. Historic fisheries surveys in the Susquehanna River watershed did not reveal the presence of this species. However, in the 1960s it was discovered in an upper Susquehanna River watershed tributary.

This species is currently well-established particularly in the main stem of the Susquehanna River. Since this species occupies a niche similar to darters native to the Susquehanna River Basin, adverse interspecific competition may result. This situation is currently being studied.

## **Ecological interactions**

Besides the role that darters play as both predator and prey, there are undoubtedly other interactions that remain to be discovered. An important relationship still under investigation involves darters and freshwater mussels. Some fish species, including darters, are integral to the reproductive cycle of native Pennsylvania mussels. After a female freshwater mussel has mated and developed larvae, they must be dispersed into the aquatic environment where they eventually settle to the bottom to mature into adults. These microscopic larvae, which are also known as glochidia, are released into the water column and attach to the gills of certain fish species.

Typically, only one or a few fish species are suitable for attachment by the glochidia of a given mussel. Mussels cannot swim, so the fish provides a means of transport for distribution of the larvae into other areas of the stream. Some Pennsylvania streams that contain endangered, threatened or candidate darters also contain endangered mussels. Therefore, the continued existence of the mussels is directly linked to the survival of the

host fish. It is probable that specific darter/mussel relationships will become apparent as the research continues.

## **Regulations**

Anyone wishing to capture or study darters in the Commonwealth's waters should consult the *Summary of Fishing Regulations and Laws* or contact the nearest Fish and Boat Commission Regional Law Enforcement Office. Species that are not listed as endangered, threatened or candidate can be captured with the same gear that is legal for gathering baitfish. However, it is unlawful to catch, take, kill or possess protected species. Because identification of darters can be difficult, especially for the amateur, study these fishes in their own environment without removing them.

Provided that state or local regulations allow it and adequate safety measures are taken, snorkeling is a great way to observe and gain an appreciation for these beautiful fish. Their colors and interesting behaviors can rival that of fishes in more exotic locations, such as the Caribbean. Various field guides are now available to aid in species identification, and many university libraries contain more advanced texts on darter ecology.

## **Protection and conservation**

Darters thrive in clean, unpolluted water. Threats to their survival include habitat alteration or loss, point and nonpoint source pollution, and competition in the form of exotic species introductions. Acid mine drainage, particularly in streams of the Ohio River Basin, has degraded or eliminated many miles of darter habitat.

Sedimentation is especially harmful to darters. Excessive sediment and silt can smother eggs or reduce populations of forage items. For example, mayfly nymphs are a staple in their diet. However, many species of mayflies are susceptible to the harmful effects of sedimentation. Thus, if the forage declines, the darters must select another forage or begin to suffer. As diversity of prey declines, so does the diversity of predators until eventually the chain begins to break down.

Water quality protection strategies that effectively address habitat loss, alteration and pollution must keep pace as increased demands are continually placed on Pennsylvania's aquatic resources. Darters will remain a dynamic part of Pennsylvania's aquatic heritage as long as the quality of their habitat is sufficient to support them. Appreciation of darters and their habitat will increase as more Pennsylvanians discover these seldom seen but very important fishes.

## **French Creek, Where Darters Go with the Flow**

Although darters occur throughout Pennsylvania, one waterway contains an exceptional diversity of darters and other aquatic species. Beginning in southwestern New York, French Creek flows 117 miles to its confluence with the Allegheny River in Franklin, Pennsylvania. Almost 1,270 square miles of land in Chataouqua County, New York in addition to Erie, Crawford, Mercer and Venango Counties in Pennsylvania are drained by French Creek.

Stream flow reversals resulting from glacial activity changed the prehistoric course of French Creek to its present-day southerly flow in the Ohio River basin. Previously, French Creek flowed north into the Atlantic Ocean via the St. Lawrence River system. Glacial activity caused aquatic species present in the St. Lawrence River system to be "captured" and added to those species present in the Ohio River system.

When stream flows changed direction, the darters and other species had no choice but to "go with the flow." Consequently, French Creek exhibits an unusually high number of fish and invertebrate species. With 70 species of fish and 26 freshwater mussel species, French Creek is the single most diverse waterway in Pennsylvania. Thirteen (61 percent) of the 21 darter species found in Pennsylvania are known to occur in French Creek. Biologically speaking, French Creek may be the most important stream in the state.

## **Pennsylvania Darters**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Drainage Basin Occurrence</b>	<b>Species * Status</b>
Greenside darter	<i>Etheostoma blennioides</i>	E, O, S, P, G	Common
Rainbow darter	<i>Etheostoma caeruleum</i>	E, O	Common
Bluebreast darter	<i>Etheostoma camurum</i>	O	Threatened
Iowa darter	<i>Etheostoma exile</i>	E, O	Candidate
Fantail darter	<i>Etheostoma flabellare</i>	E, O, S, P, G	Common
Swamp darter	<i>Etheostoma fusiforme</i>	D	Extirpated
Spotted darter	<i>Etheostoma maculatum</i>	O	Endangered
Johnny darter	<i>Etheostoma nigrum</i>	E, O, G	Common
Tessellated darter	<i>Etheostoma olmstedi</i>	S, D, P	Common
Eastern sand darter	<i>Etheostoma pellucida</i>	E, O	Endangered
Tippecanoe darter	<i>Etheostoma tippecanoe</i>	O	Endangered
Variagate darter	<i>Etheostoma variatum</i>	O	Common
Banded darter	<i>Etheostoma zonale</i>	O, S	Common
Logperch	<i>Percina caprodes</i>	E, O	Common
Channel darter	<i>Percina copelandi</i>	E, O	Threatened
Gilt darter	<i>Percina evides</i>	O	Threatened
Longhead darter	<i>Percina macrocephala</i>	O	Endangered
Blackside darter	<i>Percina maculata</i>	E, O	Common
Sharpnose darter	<i>Percina oxyrhynchus</i>	O	Extirpated
River darter	<i>Percina shumadri</i>	O	Common
Shield darter	<i>Percina peltata</i>	S, D	Common

**Abbreviations:** E = Lake Erie, O = Ohio River, G = Genesee River, P = Potomac River, S = Susquehanna River, D = Delaware River.

\* **Species Status:** Protected status as of January 1, 1997.