

A NANFA EDUCATION GRANT REPORT

Freshwater Fishes of the Northeastern United States, With Special Reference to Species of the Passaic River Drainage and Great Swamp Wetlands

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In June 2004, I was awarded NANFA's Gerald C. Corcoran Education Grant to mount an educational exhibit on North American fishes at the Somerset County Environmental Education Center in Basking Ridge, New Jersey. The ensuing exhibition, "Freshwater Fishes of the Northeastern United States, With Special Reference to Species of the Passaic River Drainage and Great Swamp Wetlands," comprised 25 mounted and framed large format photographic color prints (roughly 20" x 24" to 30" x 40"), accompanied by descriptive wall texts.

Consistent with NANFA's stated mission, and the spirit of the aforementioned grant, the purpose of this exhibition was expressly to promote an awareness and appreciation of North American fishes among the general public, and to provide a perspective from which such an awareness will have some practical consequences when viewers are confronted with local conservation issues.

The presentation of a large and taxonomically diverse group, with emphasis on local nongame species, implicitly made the point that it is not only the high-profile species in national parks or other such locations that warrant our concern, and it is certainly not only those species that are of interest to anglers that deserve to be protected—that we also need to be aware of and sensitive to the plight of local species in the face of land and water use, pollution, and other activities and practices that impact the ecosystems in which they live.

In proposing this exhibition to the staff at the Environmental Education Center, my guiding principle was

the general obscurity of fishes—not merely to the public at large, but even to people with some considerable environmental awareness. Many of the visitors to the Great Swamp are very well versed in the birds, reptiles and amphibians, small mammals, plants, and even fungi of the area, yet most probably couldn't name three fishes extant in the entire watershed area, and among those, probably not even a single nongame species. Indeed, the fishes that swim in the bodies of water that traverse our own neighborhoods are essentially invisible until someone takes the time to show them to us. The purpose of an exhibition such as this is precisely to show people the fishes that are all around them—in the streams that run through their backyards, in the bays adjacent to the beaches where they vacation, and especially in the natural areas, such as the Great Swamp, where they go to familiarize themselves with the natural world.

The audience for this exhibition was a very large and diverse population in the New York metropolitan area. The Environmental Education Center at Lord Stirling Park, featuring eight miles of trails within the Great Swamp wetlands, was considered an optimum venue for such an exhibition since it satisfies two separate concerns: It is located in a wildlife setting of breathtaking natural beauty, while at the same time being accessible by major highways to one of the most densely populated areas in the country. Actual 2003 attendance at the Environmental Education Center was 28,268. There are no available attendance data for the specific five-week period of this exhibition.

Selected photographs (in black-and-white) and exhibit text (edited for *American Currents*) are presented herein. In addition to photographs of fishes, photographs also depicted New Jersey Pine Barrens habitat, Burlington County; New Jersey salt marsh habitat, Ocean County; and fishwatching in a sculpin stream (Allegheny River drainage), Potter County, PA.

Ohio Lamprey *Ichthyomyzon bdellium* (Jordan 1885)

(Fig. 1)

Lampreys are among the most primitive fish-like vertebrates, lacking jaws, paired fins, and a bony skeleton. They are found in fresh and marine waters in both hemispheres, excluded only from tropical waters by their preference for cooler temperatures. Because of their superficially similar appearance, lampreys are sometimes referred to as “lamprey eels,” an erroneous conflation, since lampreys and eels are really not very closely related.

Contrary to popular belief, about half of all lamprey species are non-parasitic, spending most of their existence as filter-feeding larvae buried in the mud bottoms of freshwater rivers and streams. Emerging as non-feeding adults with degenerate dentition and an atrophied digestive tract, they live only long enough to reproduce. Parasitic species share a similar larval phase, but as adults possess numerous, well-developed teeth which they use to feed upon the body fluids of the host fishes to which they attach. The prominent disc teeth of the Ohio lamprey betray its predaceous habits.

Some parasitic lamprey species, such as the infamous sea lamprey (*Petromyzon marinus*), are anadromous; that is, they descend the freshwater rivers and streams where they developed as larvae to live and feed in the sea. Some other parasitic species, including the Ohio lamprey, exhibit analogous, albeit less extensive, up- and downstream movements within a given river system, living out their entire life histories in fresh water. This foot-long specimen was taken in western New York’s Allegheny River, where it was found feeding inside the gill chamber of a living white sucker (*Catostomus commersonii*) approximately twice its size. The species is widespread in the Ohio River basin, with a disjunct population in western New York and Pennsylvania.

Longnose Gar *Lepisosteus osseus* Linnaeus 1758

Seven living species of gars, ranging from Costa Rica through midwestern and eastern North America, represent an archaic lineage with a more diverse and widely distributed

fossil record. All are rather awkward predators that rely not on speed but on stealth to capture their prey. One species, the formidable alligator gar (*Atractosteus spatula*) from the Mississippi River drainage and Gulf Coast, is reported to reach 10 feet in length and weights exceeding 300 pounds. Gars possess a heterocercal caudal fin, along with certain other primitive features, the most prominent among these being the armor-like ganoid scales that constitute a hard protective sheath surrounding the fish. Gars also possess a highly vascularized swim bladder that is connected to the esophagus, allowing branchial respiration to be augmented with air gulped at the water’s surface. Some species may occur in brackish waters, and the alligator gar occasionally enters sea water.

The longnose gar’s greatly elongated snout distinguishes it from the other family members with which it may occur over its extensive range. The species inhabits sluggish or standing waters in the midwest and eastern United States, where it feeds mostly on other fishes. On the east coast, it has the most northerly range of the family, reaching the Delaware River drainage in New Jersey.

Appearing to float like a twig, the longnose gar drifts nearly motionless toward its unsuspecting prey, which it snares in jaws lined with needle-like teeth. Very young individuals, like this two-inch Louisiana specimen, are beautifully marked and also display a distinctive upper caudal filament that atrophies with age. With eggs that are toxic to humans, and flesh that is poorly regarded, the longnose gar is disdained by fishermen and typically considered to be a “trash fish” throughout its range. Maximum length is reported to exceed six feet.

Common Shiner *Luxilus cornutus* (Mitchill 1817) Rosyside Dace *Clinostomus funduloides* Girard 1857 (Fig. 2)

Southern Redbelly Dace *Phoxinus erythrogaster* (Rafinesque 1820)

Although the term “minnow” is often uncritically (and erroneously) applied to any small fish, true minnows are members of the large and widely distributed family Cyprinidae—at more than 2,000 species, one of the largest vertebrate families. And while they are not always small—the largest North American species grows to a length of six feet—many cyprinids have considerable economic and social value. Carp (*Cyprinus carpio*) have been cultivated in China since before the third century B.C., and remain an important food and

Fig. 1.
Ohio lamprey,
Ichthyomyzon bdellium.





Fig. 2.
Rosyside dace, *Clinostomus funduloides*.

ornamental fish worldwide. Other Asian minnows—most notable among them the goldfish (*Carassius auratus*)—represent an important part of the aquarium fish trade. Because of their collective abundance over an extensive range, perhaps their greatest—albeit unseen—importance is as forage for species higher up in the food chain. On the negative side, exotic introductions such as the grass carp (*Ctenopharyngodon idella*) have had a negative impact upon some native ecosystems where they have been used to control vegetation. More than 200 species of minnows are native to North America.

As its name implies, the common shiner is a locally abundant species over much of its range, flourishing in most creeks and small streams throughout the northeastern and upper midwestern states. The dramatic transformation in appearance that occurs as the breeding season approaches includes not only enhanced coloration but also the emergence of contact organs on the head, nape, and certain other body sites of the male. These contact organs, also called tubercles, are believed to facilitate contact between the sexes during

courtship and spawning, and to aid males in battles with each other. Both coloration and the prominence of contact organs are diminished during periods of sexual quiescence. The three-inch, sexually active male in the exhibition was collected late in the month of May in a small stream in the Passaic River drainage in Essex County. *Luxilus cornutus* is one of several minnow species found in the Great Swamp.

The rosyside dace and southern redbelly dace are particularly attractive species inhabiting small streams in the middle and eastern portions of the country. They are frequently kept by aquarists specializing in North American species. Habitat alteration and degradation of water quality resulting from agricultural activities and clearing of forests have caused both species to decline in abundance over the past century.

White Sucker *Catostomus commersonii* (Lacepede 1803)

The suckers, family Catostomidae, are superficially similar in salient physical characteristics to the minnows, family

Cyprinidae. Although the underslung mouth parts of most suckers distinguish them at a glance from the latter group, they are diagnosed on the basis of several features of their internal anatomy—notably the presence of teeth on the pharyngeal arches. Like minnows, suckers also share a preference for the relatively cool, clear water of rivers and streams. Many western species are considered to be endangered or threatened due to restricted range, habitat alteration, and the introduction of exotic species.

Despite its ubiquity over most of northern North America, and large size (to two feet), the white sucker is held in low esteem by anglers because of its bony, poor-tasting flesh. It is one of two catostomid species reported to occur within the Great Swamp.

Yellow Bullhead *Ameiurus natalis* (Lesueur 1819)

A resident fish of the Great Swamp, the yellow bullhead catfish is native to American fresh waters east of the Rocky Mountains. It has also been introduced extensively outside of its native range. Like catfishes generally, this voracious and indiscriminate nocturnal scavenger is guided by extremely sensitive chemoreceptors in the fleshy structures (called barbels) that surround its mouth. It is the white color of the lower barbels that most readily distinguishes *Ameiurus natalis* from a handful of similar species within the genus. Growing to about 18 inches, the yellow bullhead is a modestly sized member of the family Ictaluridae. One species, the blue catfish (*Ictalurus furcatus*), can grow to more than four feet in length and attain weights in excess of 100 pounds. Bullhead catfishes are very tenacious, and are further protected from predation by erectile pectoral spines, to which anglers must also pay particular attention. Scales are absent over the entire body.

Chain Pickerel *Esox niger* Lesueur 1818

The pikes and pickerels are highly specialized predators with a circumboreal distribution. All are solitary piscivores that inhabit vegetated standing or sluggish waters where they lie motionless in wait for their prey. They are among the most impressive fishes to watch feed, as they lunge in remarkable bursts of acceleration to easily overtake any suitably sized fish that ventures to within striking distance. The unlucky fish is precisely manipulated in its captor's jaws to be consumed in a head-first position, an orientation that ensures that its fins will not offer resistance as it is swallowed whole.

Growing to only three feet in length, the chain pickerel is not as highly prized by anglers as the revered northern pike (*Esox lucius*) and muskellunge (*E. masquinongy*), although it is nevertheless a popular game fish. Adults are identified by their distinctive chain-like markings, and all age groups by their relatively long, bill-like snout. The 10-inch specimen in the exhibition was taken in the New Jersey Pine Barrens, where it is extremely common, foraging in quiet streams and impoundments for the numerous pirate perch (*Aphredoderus sayanus*), creek chubsuckers (*Erimyzon oblongus*), and other small fishes that constitute the bulk of the piscine biomass. This resident of the Great Swamp is found in fresh water along the entire east coast, from Nova Scotia to Florida; along the Gulf coast to Louisiana; and northward in the Mississippi drainage to Missouri.

Eastern Mudminnow *Umbra pygmaea* (DeKay 1842)

Five species of umbrids have a wide but sporadic distribution in the Northern Hemisphere. All prefer well-vegetated standing waters of swamps and bogs over a substrate of soft mud and organic debris, as well as low-gradient streams of comparable quality. Tolerant of low levels of dissolved oxygen, *Dallia* and *Umbra* species may also be found in the stagnant waters of drainage ditches, culverts, and other marginal habitats. They are also among the most cold-tolerant fishes. Only one species, the European *Umbra krameri*, does not occur in North America.

While part of a characteristic piscine fauna of the bogs, swamps, and sluggish streams of the low-lying eastern coastal plain, the eastern mudminnow can also be found in highland streams with an entirely different assemblage of fishes, including trout, sculpins, and lampreys. It occurs extensively within the Passaic River drainage, from the highlands of Passaic County to the waters of the Great Swamp. It is a very distinctive fish that is not easily confused with any other species in this area. It is likely an important forage fish throughout its range.

Brook Trout *Salvelinus fontinalis* (Mitchill 1815)

Originally endemic to North America, the brook trout has been introduced widely over several continents, as well as into waters outside of its native range in North America—historically from northeastern Manitoba to Labrador, and southward as far as the Appalachian Mountains of northern Georgia. Because of its requirement for clear, cold water, it is

mostly restricted to spring-fed headwater streams and deep lakes. Some coastal populations of brook trout descend to the sea to grow, and subsequently return to fresh water to spawn. Even those populations that carry out their entire life histories in fresh water typically move upstream to their shallow headwater spawning grounds. Eggs are laid in the fall and hatch with rising water temperatures the following spring. The diet of this fairly large (up to three feet) carnivorous species consists of a wide variety of organisms, both aquatic and terrestrial. The specimen in the exhibition represents a naturally reproducing population from a tiny spring-fed creek in New Jersey's Raritan River drainage. This species is also known from the Great Swamp.

Pirate Perch *Aphredoderus sayanus* (Gilliams 1824)

With no close living relatives, the secretive pirate perch alone occupies the family Aphredoderidae. Inactive during daylight hours, this species emerges from vegetation and organic debris at twilight to hunt for small fishes, insect larvae, and other aquatic invertebrates which it ingests whole with a lightning-quick sideways thrust of its head. In fact, the species' common name was derived from the propensity of captive individuals to make their smaller tankmates disappear. An interesting anatomical feature of this species is the jugular position of the anus and urogenital opening in the adult.

Notwithstanding its local abundance and wide distribution in the midwestern and eastern United States, the pirate perch is a protected species in some states. Preferred habitats include sluggish streams and standing waters over a substrate of soft mud and organic material. The three-inch male specimen in the exhibition was taken from just such a habitat in the New Jersey Pine Barrens.

Northern Mummichog

***Fundulus heteroclitus macrolepidotus* (Walbaum 1792)**

Collectively, the killifishes of North America inhabit a bewildering diversity of habitats, from desert springs in the Death Valley basin to stagnant swamps of the Okefenokee to frozen bays of the north Atlantic. Killifishes make up a significant component of the North American fish fauna, especially in the southern part of the continent, where they rank among the dominant fish groups. Almost a dozen North American species have become extinct in recent decades, and many others are imperiled, particularly in arid regions where water resources have been highly modified.

The mummichog is an attractive, albeit highly variable, member of the large and diverse killifish family Fundulidae. Two subspecies, *Fundulus heteroclitus heteroclitus* and *F. h. macrolepidotus*, collectively range along the Atlantic coast, from Canada to northern Florida. The mummichog tolerates both sea water and fresh water, and can be found at virtually any salinity level in between. It is also tolerant of polluted waters with low levels of dissolved oxygen. Its ubiquity, extreme hardiness, and ease of captive propagation account for its popularity as a laboratory animal as well as a bait fish. It is also prized abroad as an aquarium fish. In the lower Passaic River drainage this species is common in tidal water, and is represented by at least one population that has become restricted to fresh water above tidal influence. The four-inch male specimen in breeding colors in the exhibition was taken from brackish water in southern New Jersey.

Threespine Stickleback

***Gasterosteus aculeatus* Linnaeus 1758**

Although it contains only six species, the family Gasterosteidae has an extensive circumpolar distribution in the temperate and sub-arctic waters of the Northern Hemisphere. *Gasterosteus aculeatus* is the most widespread of these species, occurring in fresh, brackish, and marine waters in Europe, Asia, and North America, as well as on the Mediterranean coast of northern Africa. In North America, the species is restricted to the Atlantic and Pacific coasts—from Chesapeake Bay northward in the east, and from Baja California northward in the west.

In lieu of scales, sticklebacks possess a series of bony lateral plates; the prominence of these plates in the threespine stickleback generally corresponds positively to the salinity of the water that the population inhabits. Sticklebacks are well known for their highly ritualized spawning behavior that involves the construction of a nest by the male. The three-spine stickleback's tubular nest is built from bits of plant material glued together with a sticky kidney secretion. The male performs a zigzag dance to lure the receptive female into the nest, where the eggs are deposited. Notwithstanding the stickleback's small size (to about three inches), this nest and surrounding territory are aggressively defended by the resident male against all intruders, piscine and otherwise. Outside of the breeding season, the male threespine stickleback loses his bright colors. The nuptially colored male in the exhibition was taken from a salt marsh in southern New Jersey.



Fig. 3.
Slimy sculpin, *Cottus cognatus*.

Slimy Sculpin *Cottus cognatus* Richardson 1836
(Fig. 3)

The freshwater representatives of the predominantly marine family Cottidae are widely distributed in the temperate and arctic waters of the Northern Hemisphere. Their collective requirement for clean, well-oxygenated water restricts them primarily to cool, clear-flowing streams and cold, deepwater lakes. Because of their ecological requirements, freshwater sculpins serve as very sensitive indicators of chemical and thermal pollution, siltation, and other forms of habitat degradation.

The slimy sculpin is a common bottom-dwelling species throughout its extensive range in the northeastern United States. While it has been recorded from depths in excess of 300 feet in Lakes Michigan and Superior, it is also an easy fish to observe in shallow rocky streams. The clean water and interesting coldwater assemblage of fishes (which may include trout, dace, lampreys, and darters) make fishwatching in sculpin streams a pleasurable activity in late winter and

early spring (back cover photo). A simple face mask, water scope, or similar instrument for breaking the water's surface is all that is needed. Spawning occurs early in the season when both air and water temperatures are still quite low. This three-inch female from a cold, spring-fed stream in New Jersey's Raritan River drainage is already bloated with eggs in the first week of March. She is further distinguished from her mate by her lack of color or dark pigmentation. Slimy sculpins feed primarily on benthic invertebrates, and may themselves be included in the diet of the brook trout with which they often share their habitat.

- Pumpkinseed *Lepomis gibbosus* Linnaeus 1758**
Blackbanded Sunfish *Enneacanthus chaetodon* (Baird 1854)
Bluespotted Sunfish *Enneacanthus gloriosus* (Holbrook 1855)
Banded Sunfish *Enneacanthus obesus* (Girard 1854)

The sunfish family, Centrarchidae, contains approximately 30 species, including some of the most popular sport fishes, such as the basses, crappies, pumpkinseed, and bluegill.

While many North American species are imperiled by the introduction of exotic species into their habitats, it is the pumpkinseed that threatens the biodiversity of many areas inside and outside of North America as a result of its widespread and often injudicious introduction. Male pumpkinseeds in breeding coloration are among the most colorful of all North American fishes, even surpassing most species of darters for sheer gaudiness. Although smaller than basses and crappies, the pumpkinseed and several other members of the genus are commonly fished for with hook and line. Pumpkinseed nests built in shallow water in pond margins are conspicuous as circular areas cleared by the resident male.

The dwarf sunfishes of the genus *Enneacanthus* are representative inhabitants of the sluggish streams and bogs of the eastern coastal plain. One particular stronghold for these species are the tea-colored, highly acidic "cedar waters" of the New Jersey Pine Barrens, where all three species may occur in a single body of water. Shunning open water for dense stands of aquatic vegetation, and too small to be of interest to fishermen, these species remain largely unknown even where they occur in abundance. To the naturalist willing to seek them out, they appear as glittering jewels punctuating the dark, nutrient-poor waters that characterize their pinelands habitats. The banded and bluespotted sunfishes are less restricted in their habitat preference than the blackbanded sunfish, and may be found within the Great Swamp.

Rainbow Darter *Etheostoma caeruleum* Storer 1845

Spotted Darter *Etheostoma maculatum* Kirtland 1841

Banded Darter *Etheostoma zonale* (Cope 1868)

The darters are an unusually large, uniquely North American tribe within the perch family. They typically occupy the areas of swiftest current in streams and small rivers. Like sculpins, most darter species are sensitive to changes in water quality, siltation, or even a mere slowing of the water flow in their streams. Among the 180 species, darter diversity reaches its zenith in the southern and middle Atlantic states, particularly in the Ozarks and southern Appalachians. Only three species are known from New Jersey, one of which, the swamp darter (*Etheostoma fusiforme*), is very unusual among darters in its preference for sluggish or even standing water in swamps and small streams. The males of many species sport brilliant seasonal (breeding) colors for which they are very highly regarded by aquarists specializing in coldwater fishes. The three species in the exhibition are found in the northeastern and midwestern United States, although none extend into New Jersey.

Hogchoker *Trinectes maculatus* (Bloch & Schneider 1801)

(front cover)

Barely qualifying as a freshwater fish, the hogchoker is illustrative of many marine taxa containing members that freely enter fresh water, or that remain in estuarine waters of relatively low salinity. The names "sole," "flatfish," and "flounder" are often indiscriminately applied to this and other superficially similar fishes of a large order that includes many commercially important and sport fishes such as the Atlantic halibut (*Hippoglossus hippoglossus*), and winter flounder (*Pseudopleuronectes americanus*). By contrast, the hogchoker's small size limits its importance to that of an interesting aquarium inhabitant. This three-inch specimen from a New Jersey tidal marsh is viewed from above as it rests on the bottom of its aquarium. Since flatfishes spend their lives with one side of the body perpetually turned toward the substrate, both eyes are situated on the pigmented, upward-facing surface of the body. This species has an extensive coastal distribution in the western Atlantic, from New England to South America. ●

Publication sale

Captive Breeding Guidelines

&

Aquatic Survival

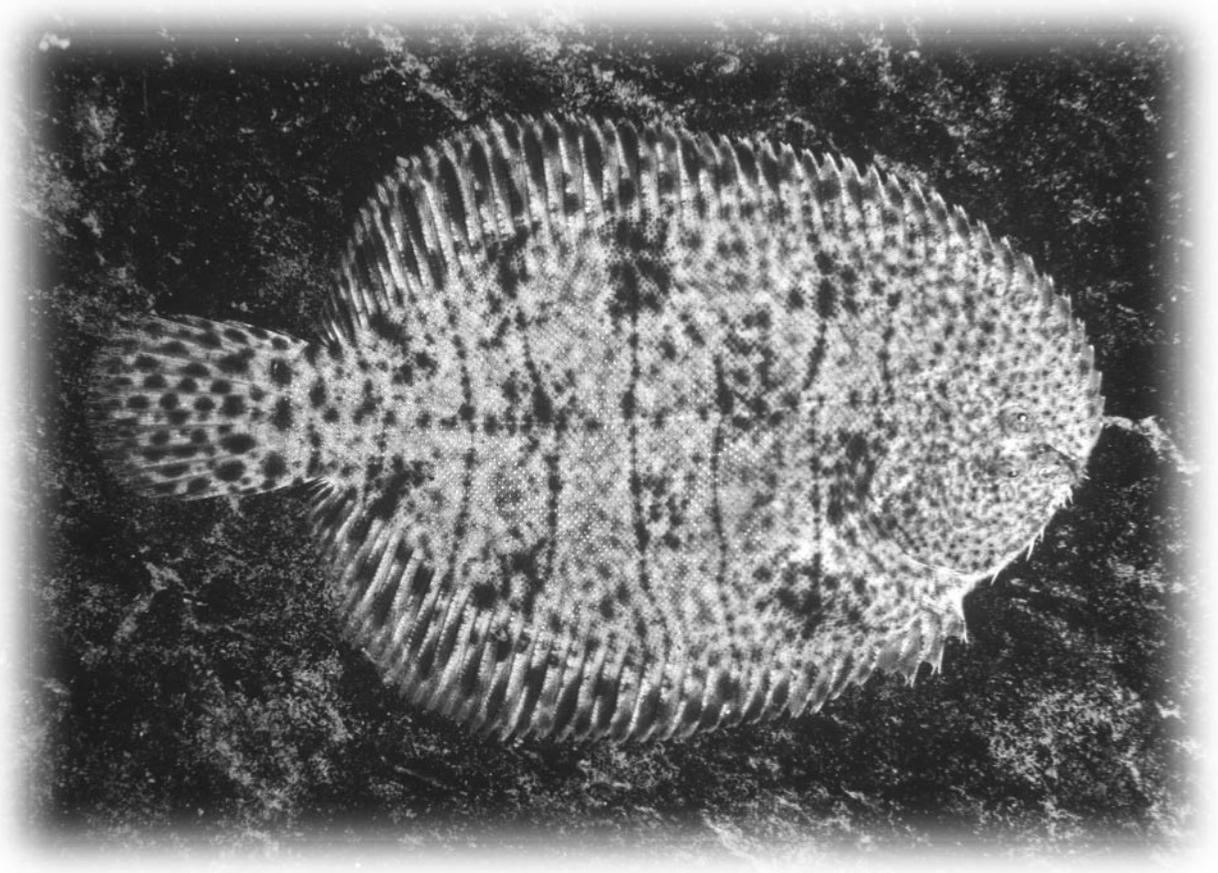
Bulletin of the Aquatic Conservation Network

Thanks to Rob Huntley, former director of the Aquatic Conservation Network (ACN), NANFA has acquired the remaining stock of ACN's publications and is offering them for sale to NANFA members.

- *Captive Breeding Guidelines* (64 pp.) is the publication Peter J. Unmack wrote about in his Spring 2005 AC article, "The Role of Aquarists in Aquatic Conservation." The purpose of the book is to establish ground rules for implementing and running a species captive breeding program amongst aquarists. Price is \$11.75 postpaid.

- A near-complete set (around 20 issues) of *Aquatic Survival*, the ACN's quarterly bulletin (1992-1997). Two missing issues are replaced by photocopies. Price is \$20 postpaid.

Quantity is extremely limited. Availability is on a first-come, first-served basis. Mail check or money order to NANFA, 1107 Argonne Dr., Baltimore, MD 21218.



hogchoker

Trinectes maculatus (Bloch & Schneider 1801)

Family: Achiridae

Photograph by John Brill, one of 25 featured in his 2004 NANFA Corcoran Grant-winning educational exhibit, "Freshwater Fishes of the Northeastern United States, With Special Reference to Species of the Passaic River Drainage and Great Swamp Wetlands."



Fishwatching in a sculpin stream (Allegheny River drainage), Potter County, PA. This photograph by John Brill is one of several featured in his 2004 NANFA Corcoran Education Grant-winning exhibition, "Freshwater Fishes of the Northeastern United States, With Special Reference to Species of the Passaic River Drainage and Great Swamp Wetlands." See the report on pp. 17-24.