

Biodiversity on the (Blue) Line

The DNR's South Carolina Stream Assessment provides a bellwether for scientists monitoring the health of the state's waterways, both large and small

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Cathy Foster



Students in the Pickens County Junior Naturalist program examine the morning's catch on the bank of Sixmile Creek in the Clemson Experimental Forest.

Troy Cribb stands ankle deep at the head of a cobble-strewn riffle, eyeing a promising spot where the stream hugs the roots of a towering beech before settling out into a placid pool. The dark, undercut bank has fish written all over it. But Cribb isn't casting spinners for scrappy sunfish or drifting dry flies over rising trout. Today, Sixmile Creek is a classroom. An excited group of eight- to twelve-year old girls and boys in the Pickens County Junior Naturalist program lines the sandbar and watches eagerly as Cribb and Drew Gelder, fisheries technicians with the S.C. Department of Natural Resources' Stream Team, make some final adjustments to the electrofishing unit on Cribb's back. Moments later, at the push of a button, the piedmont stream comes to life. With surgical precision, Gelder begins netting emerging critters from the crevices between rocks as Cribb sweeps the electrode through the water and herds the silvery school towards a seine held a few yards downstream. The broad net is hoisted out of the water, revealing dozens of lively fish, a crayfish and an assortment of aquatic insects. Soon a catch bucket boils with fins and claws — a biological report card for the stream and, more importantly, its watershed.

Electrofishing is just one of many techniques used by DNR freshwater fisheries crews working on the South Carolina Stream Assessment, an effort to measure the condition of streams in the state and study the link between these streams and their watersheds. Approximately 35,000 miles of freshwater streams, rivers

and swamps course through the Palmetto State. Unwound and placed end to end, they would reach all the way around the earth at the equator and nearly halfway again. They might not wear reflective green name tags or carve the boundaries of counties and states like their larger counterparts, but wadeable streams — creeks generally less than waist deep and narrower than thirty feet in most places — make up about 90 percent of all stream and river miles in South Carolina. Such streams are the threads that bind land to river, collectively influencing the quantity and quality of virtually all waters downstream — from rivers and lakes to coastal estuaries.



Phillip Jones

The Stream Team samples a highly urbanized creek in Columbia

Spilling off the Blue Ridge Mountains at more than 3,000 feet in elevation, or snaking through flat woods flirting with sea level, South Carolina's streams drain a diverse landscape via four major Atlantic river basins: the Savannah, Santee, Pee Dee and Ashepoo-Combahee-Edisto (ACE). Thanks in large part to this wide range of settings and the long isolation of species in different river basins, these waters teem with an equally rich array of life. All told, the fresh waters of the state and their associated habitats support about 140 native species of fish (see checklist pages 4-7), 39 crayfish (several of which have only been found in the Palmetto State), 33 mussels and countless other invertebrate groups. Depending on factors such as size and location, a given stream may hold ten, twenty, even upwards of thirty fish species, and a far greater variety of invertebrates. But more importantly, most streams harbor several widespread species plus a handful of localized types unique

to certain river basins, regions and habitats. These sets of species, or assemblages, define South Carolina's wealth of landscapes and streamscapes. Preserving this biodiversity is at the core of the DNR's Comprehensive Wildlife Conservation Strategy.

On the bank of Sixmile Creek, the Junior Naturalists soak up a diverse world which only minutes earlier was hidden beneath the ripples of the humble stream. What began in the net as a mass of flickering fins has taken shape in two aquariums as a stunning collection of native fish: Yellowfin Shiners, Bluehead Chubs, Striped Jumprocks, Speckled Madtoms, Mottled Sculpins, Rosyface Chubs and Turquoise Darters, just to name a few. A miniature gladiator match unfolds as a crayfish tangles with a dobsonfly larva, or hellgrammite, a fearsome yet reclusive bottom-dwelling insect. Though most are small in size, these animals are part of a much larger picture. Each species has a distinct niche in the stream ecosystem and forms a critical link in the food web, converting energy into larger predators, both terrestrial and aquatic (a young Largemouth Bass lurks in the corner of one tank, sizing up a few shiners). They are valuable indicators of watershed health. Since certain species are more sensitive to changes in the environment, the fauna can say a lot about what's happening upstream — and on the land.

are also becoming imperiled at an accelerated pace when compared with most other groups. The need for a proactive approach to conserving these resources is greater than ever."



Kevin Kubach

Streams in the piedmont or "foothills" are of moderate topographic relief between the Blue Ridge and the coastal plain.

In order to understand relationships between watersheds and stream quality, it is necessary to see the good, the bad and the ugly. Enter the Stream Team. This crew of biologists and technicians within the DNR's Freshwater Fisheries Research unit, along with collaborators from Clemson University, scours the state collecting data — everything from water quality and habitat to fish, crayfish and insects — in streams chosen randomly by a computer program. The list, which stands at about 400 sites, covers the entire spectrum, from unspoiled blackwater beauties to urban channels stripped of trees and surrounded by concrete. Sadly, many are in stark contrast to the model reference streams.



Kevin Kubach

Streams in the Blue Ridge are characterized by relatively steep gradient and swift currents. They support many coldwater species.

Fortunately for these animals, Sixmile Creek has a good report card. It is a reference stream, one of ninety such creeks across the state selected to represent highest quality watersheds in each of the state's freshwater ecoregions and river basins. Reference streams are sampled annually by DNR regional freshwater fisheries crews to help provide benchmarks — pictures of what streams should look like with minimal human disturbance to the watershed. Most of the land draining into Sixmile Creek, for example, is forested, and there is little urban development upstream or along its banks.

But as DNR fisheries research biologist Dr. Mark Scott knows, this could change, just as it already has in many other areas of South Carolina. Sprawling development often brings alterations to aquatic ecosystems and decline, or even loss, of native species. This is precisely why Scott and his colleagues drew up the plans for the Stream Assessment, which began in 2006.

"Aquatic biodiversity in the southeastern United States is incredibly high — greater than any place outside the tropics," says Scott, whose experience includes stream conservation projects in Maryland and the southern Appalachians. "But freshwater faunas



Kevin Kubach

Streams of the coastal plain span more than two-thirds of the state and includes a wide range of aquatic habitats, from sandhills streams to blackwater swamps.

Whereas habitat loss from development on the land is often apparent, the effect of these activities on streams and rivers is not as easy to see. The clearing of natural vegetation renders land susceptible to increased erosion, and resulting sediment can smother stream habitats. Impervious surfaces, such as parking lots and rooftops, further reduce the land's ability to absorb rainfall, leading to rampant runoff. Consider all the water running across hot

pavement and down storm drains during an August downpour, carrying a slew of urban pollutants and sparking surges in stream flow and temperature. Especially damaging is the clear-cutting of trees in the riparian zone, the area bordering the stream channel itself. Riparian cover not only provides shade and buffers streams against runoff, but also supplies aquatic ecosystems with crucial energy and habitat in the form of fallen leaves and wood. Perhaps nowhere is this proving more apparent than in the South Carolina coastal plain, a complex region that blankets two-thirds of the state and is home to scores of unique species. DNR fisheries biologist Cathy Marion sees it on the streams and in the data. Her research shows a key connection between forests and fish.

“Where natural forested coastal plain landscapes are lost, we observe less large wood in streams,” explains Marion. “Large wood provides vital habitat and supports food sources for coastal plain fish assemblages. The decrease in large wood habitat leads to lower fish diversity and especially the decline of endemic southeastern coastal plain species such as Swampfish, Sawcheek Darter and Lowland Shiner.”

Marion’s research underscores one of many challenges to preserving biodiversity. The endemics — those localized species that set certain places apart — are often the first to succumb to the pressures wrought by an ever-expanding human population. If habitat alteration and other threats such as non-native species and pollution continue to take their toll on streams, we risk losing the very elements that make these waters unique. The Stream Assessment is essential to pinpointing the levels of land-use change, such as forest loss or urban development, at which streams become

impaired. “This work will provide an invaluable conservation guidance tool for land management and development decisions,” adds Marion.

Conserving streams is a win-win situation. “Water runs downhill,” says Mark Scott. “While that may seem like a silly thing to point out, actually there are huge implications. Every tiny headwater contributes to a bigger stream, and these combine in river networks. So the quality of our rivers, reservoirs and estuaries is directly related to how we treat the lands they drain. Adopting land management practices that protect headwaters can accumulate benefits downstream for a multitude of our most cherished resources.”

Toward the end of the Sixmile Creek outing, the Junior Naturalists spread out to do some sampling of their own. Not five minutes into the foray, excitement erupts from a small group exploring a riffle upstream. A boy is standing at the fringe of the water, proudly examining his prize as other students make their way over. Clamped firmly between his thumb and forefingers is a picture-perfect dusky brown crayfish with stout, orange-rimmed claws — a gem, whether you’re a kid, naturalist, or both. The sounds of rocks being shuffled in the shallow water steadily pick up.

Kevin Kubach is a fisheries research biologist working on the DNR’s South Carolina Stream Assessment. He and the other Stream Team members would like to thank the landowners who provide access to streams across the state for helping to ensure that these fascinating resources — and those downstream — are preserved for all who value South Carolina’s natural diversity.

Species checklist of South Carolina’s habitat zones.

Key: Φ - non-native. Lower case “x” - uncommon in habitat zone. ▲ - see image on pp. 16-17 and back cover.

Family	Common Name	Scientific Name	Blue Ridge	Piedmont	Coastal Plain
Amblyopsidae - Cavefishes	Swampfish ▲	<i>Chologaster cornuta</i>			X
Amiidae - Bowfins	Bowfin ▲	<i>Amia calva</i>		x	X
Anguillidae - Freshwater Eels	American Eel	<i>Anguilla rostrata</i>		x	X
Aphredoderidae - Pirate Perches	Pirate Perch ▲	<i>Aphredoderus sayanus</i>		x	X
Atherinopsidae - New World Silversides	Brook Silverside ▲	<i>Labidesthes sicculus</i>			X
	Inland Silverside	<i>Menidia beryllina</i>			X
Catostomidae - Suckers	Quillback	<i>Carpionodes cyprinus</i>	X	X	X
	Highfin Carpsucker	<i>Carpionodes velifer</i>		X	X
	White Sucker	<i>Catostomus commersonii</i>	X	X	x
	Creek Chubsucker	<i>Erimyzon oblongus</i>		X	X
	Lake Chubsucker	<i>Erimyzon sucetta</i>			X
	Northern Hog Sucker	<i>Hypentelium nigricans</i>	X	X	x
	Spotted Sucker	<i>Minytrema melanops</i>	x	X	X
	Notchlip Redhorse ▲	<i>Moxostoma collapsum</i>	X	X	X
	Shorthead Redhorse	<i>Moxostoma macrolepidotum</i>		X	X
V-lip Redhorse	<i>Moxostoma pappillosum</i>	X	X		
Robust Redhorse	<i>Moxostoma robustum</i>		X	X	
Carolina Redhorse	<i>Moxostoma sp. cf. erythrurum</i>			X	
Striped Jumprock	<i>Scartomyzon rupiscartes</i>	X	X	x	
Brassy Jumprock	<i>Scartomyzon sp.</i>	X	X	x	

Species checklist of South Carolina's habitat zones continued.

Family	Common Name	Scientific Name	Blue Ridge	Piedmont	Coastal Plain
Centrarchidae - Sunfishes	Mud Sunfish ▲	<i>Acantharchus pomotis</i>		x	X
	Flier	<i>Centrarchus macropterus</i>		x	X
	Blackbanded Sunfish	<i>Enneacanthus chaetodon</i>			X
	Bluespotted Sunfish	<i>Enneacanthus gloriosus</i>		x	X
	Banded Sunfish	<i>Enneacanthus obesus</i>			X
	Redbreast Sunfish	<i>Lepomis auritus</i>	X	X	X
	Green Sunfish ①	<i>Lepomis cyanellus</i>	X	X	X
	Pumpkinseed	<i>Lepomis gibbosus</i>	X	X	X
	Warmouth	<i>Lepomis gulosus</i>	X	X	X
	Bluegill	<i>Lepomis macrochirus</i>	X	X	X
	Dollar Sunfish ▲	<i>Lepomis marginatus</i>		x	X
	Redear Sunfish	<i>Lepomis microlophus</i>	x	X	X
	Spotted Sunfish	<i>Lepomis punctatus</i>			X
	Redeye Bass	<i>Micropterus coosae</i>	X	X	
	Smallmouth Bass ①	<i>Micropterus dolomieu</i>	X	X	
	Largemouth Bass	<i>Micropterus salmoides</i>	X	X	X
	White Crappie ①	<i>Pomoxis annularis</i>	X	X	X
	Black Crappie	<i>Pomoxis nigromaculatus</i>	X	X	X
Cottidae - Sculpins	Mottled Sculpin	<i>Cottus bairdi</i>	X	x	
Cyprinidae - Minnows	Central Stoneroller	<i>Campostoma anomalum michauxi</i>	X	x	
	Rosyside Dace	<i>Clinostomus funduloides</i>	X	X	x
	Satinfish Shiner	<i>Cyprinella analostana</i>		x	X
	Greenfin Shiner	<i>Cyprinella chloristia</i>	x	X	x
	Whitetail Shiner	<i>Cyprinella galactura</i>	X	x	
	Thicklip Chub	<i>Cyprinella labrosa</i>	X	X	
	Bannerfin Shiner	<i>Cyprinella leedsii</i>			X
	Whitefin Shiner ▲	<i>Cyprinella nivea</i>	X	X	X
	Fieryblack Shiner	<i>Cyprinella pyrrhomelas</i>	X	X	X
	“Thinlip” Chub	<i>Cyprinella sp. cf. zanema</i>			X
	Santee Chub	<i>Cyprinella zanema</i>	x	X	
	Eastern Silvery Minnow	<i>Hybognathus regius</i>	x	X	X
	Highback Chub	<i>Hybopsis hypsinotus</i>	x	X	
	Rosyface Chub	<i>Hybopsis rubrifrons</i>	X	X	x
	Warpaint Shiner	<i>Luxilus coccogenis</i>	X	x	
	Bluehead Chub	<i>Nocomis leptcephalus</i>	X	X	X
	River Chub ①	<i>Nocomis micropogon</i>	X		
	Golden Shiner	<i>Notemigonus crysoleucas</i>	x	X	X
	Whitemouth Shiner	<i>Notropis alborus</i>		X	x
	Highfin Shiner	<i>Notropis altipinnis</i>		X	x
	Comely Shiner	<i>Notropis amoenus</i>			X
	Bridle Shiner	<i>Notropis bifrenatus</i>			X
	Ironcolor Shiner	<i>Notropis chalybaeus</i>			X
	Redlip Shiner	<i>Notropis chiliticus</i>		X	X
	Greenhead Shiner	<i>Notropis chlorocephalus</i>	X	X	x

Species checklist of South Carolina's habitat zones continued.

Family	Common Name	Scientific Name	Blue Ridge	Piedmont	Coastal Plain
Cyprinidae - Minnows	Dusky Shiner	<i>Notropis cummingsae</i>		x	X
	Spottail Shiner	<i>Notropis hudsonius</i>	x	X	X
	Tennessee Shiner	<i>Notropis leuciodus</i>	X		
	Yellowfin Shiner	<i>Notropis lutipinnis</i>	X	X	X
	Taillight Shiner	<i>Notropis maculatus</i>			X
	Coastal Shiner	<i>Notropis petersoni</i>		x	X
	Swallowtail Shiner	<i>Notropis procne</i>		X	x
	Sandbar Shiner	<i>Notropis szepticus</i>	x	X	x
	Mirror Shiner	<i>Notropis spectrunculus</i>	X		
	Pugnose Minnow	<i>Opsopoeodus emiliae</i>			X
	Lowland Shiner ▲	<i>Pteronotropsis stonei</i>		x	X
	Longnose Dace	<i>Rhinichthys cataractae</i>	X		
	Western Blacknose Dace	<i>Rhinichthys obtusus</i>	X	x	
	Creek Chub	<i>Semotilus atromaculatus</i>	X	X	x
	Sandhills Chub	<i>Semotilus lumbee</i>			X
Elassomatidae - Pygmy Sunfishes	Carolina Pygmy Sunfish ▲	<i>Elassoma boehlkei</i>			X
	Everglades Pygmy Sunfish	<i>Elassoma evergladei</i>			X
	Bluebarred Pygmy Sunfish	<i>Elassoma okatie</i>			X
	Banded Pygmy Sunfish	<i>Elassoma zonatum</i>			X
Eleotridae - Sleepers	Fat Sleeper ▲	<i>Dormitator maculatus</i>			X
Esocidae - Pikes	Redfin Pickerel ▲	<i>Esox americanus</i>		X	X
	Chain Pickerel	<i>Esox niger</i>	x	X	X
Fundulidae - Topminnows	Golden Topminnow	<i>Fundulus chrysotus</i>			X
	Banded Killifish	<i>Fundulus diaphanus</i>			X
	Mummichog	<i>Fundulus heteroclitus</i>			X
	Lined Topminnow	<i>Fundulus lineolatus</i>			X
	Bluefin Killifish Ⓢ	<i>Lucania goodei</i>			X
	Rainwater Killifish	<i>Lucania parva</i>			X
Ictaluridae - North American Catfishes	Snail Bullhead	<i>Ameiurus brunneus</i>	X	X	X
	White Catfish	<i>Ameiurus catus</i>	x	X	X
	Black Bullhead Ⓢ	<i>Ameiurus melas</i>	x	x	x
	Yellow Bullhead	<i>Ameiurus natalis</i>	x	X	X
	Brown Bullhead	<i>Ameiurus nebulosus</i>	X	X	X
	Flat Bullhead	<i>Ameiurus platycephalus</i>	X	X	X
	Channel Catfish	<i>Ictalurus punctatus</i>	X	X	X
	Tadpole Madtom	<i>Noturus gyrinus</i>		x	X
	Margined Madtom	<i>Noturus insignis</i>	X	X	X
	Speckled Madtom ▲	<i>Noturus leptacanthus</i>		X	X
	Broadtail Madtom	<i>Noturus sp. cf. leptacanthus</i>			X
Lepisosteidae - Gars	Longnose Gar ▲	<i>Lepisosteus osseus</i>	x	X	X
Moronidae - Temperate Basses	Striped Bass ▲	<i>Morone saxatilis</i>	x	X	X
Percidae - Perches	Carolina Darter	<i>Etheostoma collis</i>		X	
	Carolina Fantail Darter	<i>Etheostoma flabellare brevispina</i>	X	X	
	Savannah Darter ▲	<i>Etheostoma fricksium</i>			X

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Following images provided by Fritz Rohde



Speckled Madtom



Swampfish



Notchlip Redhorse



Mud Sunfish



Redfin Pickerel



Longnose Gar



Pirate Perch



Carolina Pygmy Sunfish

Following images provided by Dustin Smith



Savannah Darter



Brook Silverside



Whitefin Shiner



Dollar Sunfish



Lowland Shiner



Christmas Darter