GIOCALDE/SHUTTERSTOCK

What do these three very different species have in common? They're all invasive in North Carolina. The red-swamp crayfish has spread into every river basin in North Carolina over the past 40 years. Unauthorized angler introductions of Alabama bass have threatened many of the state's smallmouth and spotted bass fisheries. Feral swine can cause destruction to farmlands, wildlife and natural areas.

CHASE D'ANIMULLS/SHUTTERSTOCK

UNWELCOME VISITORS

The introduction of invasive species in North Carolina threatens many native species and could forever change our natural landscape

WRITTEN BY COMMISSION STAFF

Invasive species come in all shapes and sizes and vary in types of animals and plants. They can be small, like the emerald ash borer (a beetle that has devastated ash trees across the country and in North Carolina) and zebra mussel (a fingernail-sized mollusk that can clog water filtration pipelines and alter water quality). Invasive species can be large, like flathead and blue catfish (which have outcompeted native catfish species in North Carolina waters) and tree of heaven (a fast-growing plant that can overwhelm and displace native species).

Invasive species are introduced to an area outside of its original range, sometimes through natural migration but more commonly through human activities, like freight shipping, pet trade and accidental release. Once established, they can be difficult to control and have a dramatic impact on humans, wildlife and the environment. Approximately 42 percent of Threatened and Endangered species in the United States are at risk due to invasive species.

In this article, we highlight three of the many invasive species that are a concern in North Carolina: Alabama bass, feral swine and red-swamp crayfish. Although this article focuses on these three species, many of the lessons learned and tips for limiting their spread can relate to many other invasive species, from avoiding releasing or relocating to learning how to identify species.

To learn more about our native species and what can be done to help protect them, visit ncwildlife.org/learning.

FERAL SWINE

Below: Feral swine can rapidly reproduce, making efforts to control their populations difficult. Right: They often travel in groups of 70 or more and voraciously consume any living thing in their path, above or below ground.

SLATAN/SHUTTERSTOCK

FERAL SWINE AND NATIVE WILDLIFE

A shorebird biologist in Georgia arrives at a beach to find a wide swath of overturned sand and pig tracks where several active bird nests had been just a few days before. A landowner in Davie County notices how wild turkeys were abundant until a neighbor illegally released wild hogs in the area for something new to hunt. A marine ecologist struggles to piece together why the estuaries he's been studying that are known to have feral swine aren't bouncing back after a drought.

Over the past several decades, evidence has been mounting that free-roaming pigs are extremely destructive and costly. Recent tallies show that they're responsible for at least $2.5 billion in damage across the United States each year. As astonishing as that number is, it's only part of the story.

Farmers intimately understand the value of their crops, so measuring crop damage from feral swine is relatively easy. Putting a dollar amount on damage to wildlife and natural areas, however, is much more difficult.

Unlike asking a farmer how many acres of corn they lost, or how many times they had to replant the same field, measuring damage to natural areas or native species usually requires dedicated funding, years of planning and labor-intensive measurements over time. Despite these challenges, the research findings on feral swine impacts are accumulating, and the picture doesn't look good for wildlife.

What Are Feral Swine?

But wait, don't wild pigs count as wildlife? They've roamed North Carolina since they were first released in the early 1500s. Despite their outward traits, feral pigs are the same species as their pink, nearly hairless domestic relatives. In fact, when domestic pigs escape, they quickly revert to the habits and physical characteristics of their wild ancestors, developing coarse hair, long tusks and fierce aggression toward humans in a matter of months. That's why by law, any free-roaming pig is classified as feral swine, regardless of its appearance.

SLATAN/SHUTTERSTOCK

What's at Stake?

Like voracious bulldozers, a group of feral pigs, which may include 70 or more individuals, will plow through an area consuming any living thing they can reach, above or below ground. The resulting damage impacts a variety of species, including ground nesting birds. Biologists in Texas found that feral swine destroy nearly one in three wild turkey nests, making them a top turkey predator. A study in Alabama found that turkey abundance increased when feral swine were removed from an area.

Feral swine are not selective when it comes to preying on wildlife. They are known to target white-tailed deer fawns. In coastal Georgia, they've caused enough damage to nesting shorebirds and sea turtles that land managers have been forced to allocate funding to remove the wild pigs. Elsewhere in Georgia, a biologist found frogs and bats in feral pig stomachs. When considering the number of sensitive wildlife species that live on, near or under moist soil that feral pigs prefer, the potential impacts are concerning.

Feral pigs also pose an indirect threat to wildlife by consuming the food native species depend on for survival. All three of our big game species in North Carolina rely on a limited supply of plant mast like acorns and fruit to survive the colder months. Groups of feral pigs sweeping through an area can consume the majority of those crucial foods and also uproot and destroy most of the tender plants and small creatures they find along their path.

Feral swine's tendency to disturb the soil and consume everything in their path also leads to damage to sensitive habitats. Legal protections that prevent humans from denuding sensitive natural areas along waterways do little to stop roaming feral pigs from having the same effect as they root and wallow. The vegetation in these areas play an important role in stabilizing soil and slowing the flow of water, which prevents erosion and flooding. This, in turn, helps keep our waterways clean, clear and healthy.

Even more subtle have been recent findings that feral swine can impact key species that literally hold entire ecosystems in place. In coastal Georgia, voracious consumption of striped mussels by feral swine has led to estuaries that don't bounce back after being damaged by severe weather. The mussels, which grow together in anchoring clumps, provide crucial scaffolding that supports and stabilizes

PETER VANCO/SHUTTERSTOCK

marsh plants and even provides fertilizer that keeps them healthy. When feral pigs sweep through and destroy these clumps for the tasty mussels they contain, what vegetation remains is then at the mercy of severe weather that can sweep it away.

Protecting Wildlife From Pigs

Though there is no silver bullet for controlling feral pigs, other states have learned the hard way that we can't hunt our way out of the problem. Pigs can easily out-reproduce and out-evade any attempts at removing them a few at a time. In fact, decades of evidence reveals that increased interest in sport hunting for feral swine leads to more pigs on the landscape, not fewer, as well as an increased desire to maintain them on the landscape. Shooting can certainly be part of a larger management strategy that focuses on whole-group removal, such as corral trapping, but it's a secondary support tool at best.

The science of controlling feral swine has a long way to go, but judging by the harm being done to our native wildlife, we can't afford to keep putting our faith in methods we know don't work.

—Falyn Owens, Extension Wildlife Biologist

Commission biologists use a shocking boat on Lake James to study smallmouth bass and Alabama bass. Opposite: Biologists Doug Besler (left) and Chris Wood (right) take fin clippings as part of genetic testing to determine the extent of hybridization between smallmouth bass and Alabama bass.

MELISSA McGAW/NCWRC

A BASS OF MISTAKEN IDENTITY Since the 1970s, Alabama bass *(Micropterus henshalli)* have been moved and become established outside their native range of the Mobile River Basin in central Alabama, northwestern Georgia, eastern-central Mississippi and the southeastern corner of Tennessee. Unauthorized angler introductions represent most Alabama bass translocations across the Southeast, including many confirmed introductions in North Carolina.

Alabama bass were mistakenly identified as spotted bass *(Micropterus punctulatus)* for over 30 years due to their similarity of appearance. Around 2008, confirmation that these two bass are different species was accepted among university researchers and resource agencies when identification of these two species was verified with detailed anatomical counts and measurements and confirmed with genetic testing.

To date, N.C. Wildlife Resources Commission fisheries staff have genetically tested and confirmed Alabama bass are established in 30 waterbodies in the Tar Heel state, mostly in the Mountains and Piedmont. Sadly, this invasive, non-native bass is likely making its way eastward with recent reported occurrences in the Roanoke and Tar rivers.

History of Alabama Bass in North Carolina

The first known occurrence of Alabama bass in North Carolina was in the early 1980s along the North Carolina-Georgia border in Lake Chatuge. In the two decades that followed, Alabama bass were illegally moved by anglers into many nearby impoundments in western North Carolina (e.g., Apalachia, Fontana, Glenville, Hiwassee, Julian, Nantahala, Santeetlah), with Lake Chatuge and the upper Savannah River Basin impoundments (Jocassee, Keowee, Hartwell) in South Carolina as the likely sources.

By 2001, Alabama bass introductions were documented in the Piedmont in Lake Norman. Alabama bass then were transported to other Catawba River lakes (e.g., James, Rhodhiss, Hickory, Lookout Shoals) upstream of Lake Norman in the early-to-mid 2000s, before being spread into central Piedmont impoundments in recent years.

Irreversible Consequences

Smallmouth bass *(Micropterus dolomieu)* and spotted bass are native to drainages in western North Carolina that flow into the Mississippi River Basin. In every reservoir or river system where Alabama bass have been spread, native smallmouth bass and spotted bass populations have been dramatically impacted.

Commission staff have learned through genetic testing that Alabama bass rapidly hybridize with smallmouth bass and spotted bass. The rate of hybridization is alarming. Within 10 to 15 years after Alabama bass become established, hybridization occurrence with smallmouth bass and spotted bass is 50–60%; 20 to 30 years out from the initial introductions, hybridization rates increase to 80–90%. Over time, the proportion of Alabama bass genes swamp-out smallmouth bass and spotted bass genes, and the two native species are irreversibly replaced.

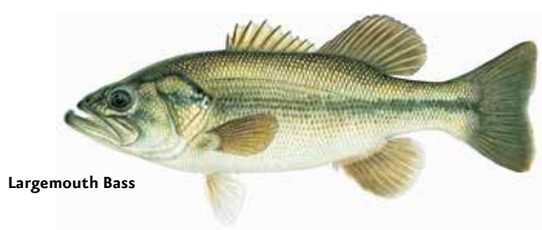
Largemouth bass *(Micropterus salmoides)*, also native to North Carolina, are impacted by Alabama bass differently. Although hybridization between Alabama bass and largemouth bass does occur, the rate of hybridization is low. The primary impact to largemouth bass is through resource competition. Largemouth bass are efficient at what they do, but Alabama bass have a wider range of habitat and feeding tolerances and operate more successfully in the margins that are limiting to largemouth bass (e.g., deeper water, open water, low productivity zones, etc.). Therefore, largemouth bass are impacted by direct competition for available resources, which ultimately lowers their abundance over time. The outcome is that largemouth bass will be replaced to varying degrees by smaller, less-desirable Alabama bass.

MELISSA McGAW/NCWRC

ALABAMA BASS

Alabama Bass

Spotted Bass



Largemouth Bass

Smallmouth Bass

ILLUSTRATIONS BY JOSEPH R. TOMELLERI

What Can Be Done?

It is illegal to move or stock fish into public waters without a stocking permit from the Commission. If you observe or have knowledge of illegal Alabama bass stockings, report it by calling 800-662-7137.

If you catch an Alabama bass in a waterbody where they have not been previously documented, take photographs and report it at PublicInquiry-FishWildlife@ncwildlife.org.

It is not possible to eradicate Alabama bass where they become established, but reducing their numbers as much as possible will minimize their impacts on native species. There is no size or creel limit for Alabama bass, and anglers are encouraged to harvest unlimited numbers of them of any size.

Publicity and angler education efforts are ongoing, so be on the lookout for the updated black bass webpage, news stories and informational signage to be posted at public fishing and boating access areas.

—David Goodfred, District 8 Fisheries Biologist
—Kin Hodges, District 7 Fisheries Biologist
—Scott Loftis, Mountain Aquatic Habitat Coordinator

INVASIVE CRAYFISH

RED-SWAMP CRAYFISH

MASA44/SHUTTERSTOCK

JORDAN COOK/FLICKR

The red-swamp crayfish (top) is the most harmful of invasive crayfish that have become established in North Carolina and are a threat to many native crayfish species, including the variable crayfish (opposite bottom) and an undescribed Cambarus species C (opposite top). Other invasive species include the virile crayfish (above).

NATURE'S WAYS

"Why Are Crayfish So Hard to Catch?"

See Nature's Ways, page 51.

NATIVE CRAYFISH FACE UNWANTED CHALLENGE Crayfish, crawdads, mudbugs. You may have heard these names before, and if you've spent time in a North Carolina stream, you've probably seen what looks like a small lobster crawling along the creek bottom. But did you know North Carolina has almost 50 different species of native crayfish?

Our native crayfish come in many sizes and colors, from mottled brown beasts the size of your hand to vibrant blue critters as small as a thumb. They're found from the mountains to the coast and are adapted to every type of freshwater habitat there is, typically living under large rocks or nestled within woody debris. Some make their homes on the floodplain where they dig tunnels in the soil. North Carolina even has endemic crayfish that are found nowhere else on Earth.

Unfortunately, our native crayfish face many threats. Habitat destruction and poor water quality are pervasive dangers to all aquatic wildlife, but the greatest threat to our crayfish comes from invasive crayfish. Invasive crayfish arrived in North Carolina waters because they have too often been unintentionally introduced through live bait release, the pet trade or aquaculture. N.C. Wildlife Resources Commission biologists have documented at least four species of invasive crayfish in our waters: rusty crayfish *(Faxonius rusticus)* and Kentucky River crayfish *(Faxonius juvenilis)* in the mountains; virile crayfish *(Faxonius virilis)* in the Piedmont; and the most menacing species: red-swamp crayfish *(Procambarus clarkii)* throughout the state.

Identifying the Threat

Red-swamp crayfish are native to the central Gulf Coast states and were first found in North Carolina in 1983. They have spread into every major river basin in North Carolina over the last four decades. Like many invasive species, red-swamp crayfish became established because they quickly outgrow native species, adapt to a variety of habitats, tolerate poor water quality, reproduce quickly and can live together in very high densities. These characteristics allow them to easily drive our native species from their homes. For example, the Carolina Sandhills crayfish *(Procambarus pearsei)* was once found in a dozen eastern North Carolina counties but is now restricted to just two; most of its former habitat has been overrun with red swamp crayfish.

Another reason red-swamp crayfish are perilous invaders is that they're a known vector for crayfish plague, a disease that has already decimated native crayfish throughout Europe. Crayfish plague spreads many ways: through densely populated farmed crayfish, by using sick crayfish as bait and from purchasing sick crayfish at a pet store or online. Crayfish plague can be transmitted by diseased crayfish and contaminated waters, eventually making its way from ponds, reservoirs or ditches into streams with healthy native crayfish. So, even if invasive red-swamp crayfish don't escape into the wild, they could still hurt native species by making them sick.

MELISSA McGAW/NCWRC

What Can You Do?

Help stop the spread of invasive crayfish. It's not too late to protect our native crayfish and their habitats from invaders. There are some easy ways to minimize the impact of red-swamp crayfish and other nonnative crayfish on our wildlife communities. Here are a few options:

- Learn more about native crayfish species and invasive species at ncwildlife.org.
- Be aware that it is illegal in North Carolina to possess some live invasive crayfish species.
- If you have pet crayfish, never release them into the wild or pour the aquarium water outside.
- Never release live crayfish purchased from online suppliers, pet stores or local producers.
- If you use crayfish as live bait, consider only using crayfish caught from that waterbody. If you're not sure where they came from, de-head them so if they escape, they don't become established.
- Never release unused live bait following a fishing trip.
- Be aware that it is illegal to stock fish or crayfish into public waters of North Carolina without a permit.

You can help educate others about the risks of invasive crayfish and protect our waters!

—Mike Perkins, Foothills Region Aquatic Wildlife Diversity Biologist