

BEFORE THE SECRETARY OF COMMERCE

**PETITION TO LIST THE ALABAMA SHAD (*Alosa alabamae*) UNDER
THE ENDANGERED SPECIES ACT AS AN ENDANGERED OR
THREATENED SPECIES AND TO CONCURRENTLY DESIGNATE
CRITICAL HABITAT**



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MARCH 7, 2024

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Pursuant to Section 4(b) of the Endangered Species Act (“ESA”), 16 U.S.C. § 1533(b); Section 553(e) of the Administrative Procedure Act, 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity, the Miccosukee Tribe of Indians, and their partners hereby petition the U.S. Department of Commerce, through NOAA Fisheries, to protect the Alabama shad (*Alosa alabamae*) as an endangered or threatened species.

The Alabama shad belongs to the family Alosidae (formerly Clupeidae) and is closely related to and similar in appearance and life history to the American shad (*A. sapidissima*). It is threatened with extinction by all five factors listed in ESA Section 4(a)(1). Currently, the Alabama shad occurs in approximately 10% of its historic freshwater range, and it is extirpated from 60 rivers across the Southeastern and Midwestern United States.

Few Alabama shad remain — for example, in 2015, there were an estimated 324 individual Alabama shad in the Apalachicola river system, a 99.8% decline of the species' last population stronghold.¹ The Alabama shad has experienced a long-term population decline of up to 70%,² with its range contracting by at least 90%, and the species is becoming rare where still extant. Loss of even one Alabama shad stream or local population would result in a significant gap in the range of *Alosa alabamae* and jeopardize the survival of the entire once-abundant species. The Alabama shad requires immediate and complete protection as a federally endangered or threatened species with concurrently designated critical habitat.

NOAA Fisheries has jurisdiction over this petition. Section 3(16) of the Endangered Species Act states that “the term ‘species’ includes any subspecies of fish or wildlife or plants.” *Alosa alabamae* is a species eligible and warranted for protection under the Endangered Species Act.

This petition sets in motion a specific process, placing definite response requirements on NOAA Fisheries. Specifically, NOAA Fisheries must issue an initial finding as to whether the petition “presents substantial scientific or commercial information indicating that the petitioned action may be warranted.” FWS must make this initial finding “[t]o the maximum extent practicable, within 90 days after receiving the petition” (16 U.S.C. § 1533(b)(3)(A)).

The Center for Biological Diversity, the Miccosukee Tribe of Indians, and their partners also request that critical habitat be designated for the Alabama shad concurrently with the subspecies being listed, pursuant to 16 U.S.C. § 1533(a)(3)(A) and 50 C.F.R. § 424.12. Critical habitat is essential to protecting the Alabama shad from further harm, population decline, and possible extinction. Alabama shad critical habitat consists of coastal areas and rivers which are essential to the species' long-term genetic and ecological health and survival as a species.

This petition is submitted by the Center for Biological Diversity, the Miccosukee Tribe of Indians, Alabama Rivers Alliance, American Whitewater, Black Warrior Riverkeeper, Cahaba Riverkeeper, Chattahoochee Riverkeeper, Choctawhatchee Riverkeeper, Coosa Riverkeeper, Forest Keeper, Healthy Gulf, Healthy Oceans Coalition, Mobile Baykeeper, and Pearl Riverkeeper. The Center for Biological Diversity is the lead petitioner.

The **Center for Biological Diversity** (“Center”) is a nonprofit, public interest environmental organization dedicated to protecting imperiled species and the habitat and climate they need to survive through science, policy, law, and creative media. The Center is supported by more than 1.7 million members and online activists nationwide. The Center works to secure a future for all species, great or small, hovering on the brink of extinction. The Center submits this petition on

¹Travis Ingram, Fisheries Biologist, Georgia Department of Natural Resources, September 2022.

²Nature Serve 2023.

its own behalf and on behalf of its members and staff with an interest in protecting the Alabama shad and its habitat.

The **Miccosukee Tribe of Indians** is a federally recognized Native American Tribe. Historically, the Miccosukee inhabited present-day Georgia and Florida, with an extended range for hunting, fishing, and trading expeditions stretching from the Appalachian Mountains to the Florida Keys. The Miccosukee's ancestral lands include significant portions of the Alabama shad's historic and current habitat.

Alabama Rivers Alliance is a statewide network of organizations working to protect and restore Alabama's 132,000 miles of biologically diverse streams and rivers, which are home to more species than any other state in the nation.

American Whitewater is a national nonprofit river conservation organization with 7,000 members and 85 local-based affiliate clubs working to protect and restore America's rivers and to enhance opportunities to enjoy them safely.

Black Warrior Riverkeeper protects and restores the Black Warrior River and its tributaries. Black Warrior Riverkeeper is a citizen-based nonprofit organization dedicated to promoting clean water for public health, recreation, and wildlife habitat throughout the Black Warrior River watershed. This vital river basin is entirely contained within Alabama, which leads the nation in freshwater biodiversity.

Cahaba Riverkeeper is a nonprofit organization defending the ecological integrity of the Cahaba River and its watershed. Cahaba Riverkeeper works to protect clean water, a healthy aquatic environment, and the recreational and aesthetic values of the river basin.

Chattahoochee Riverkeeper helps to educate, advocate and secure the protection and stewardship of the Chattahoochee River, including its lakes, tributaries and watershed, in order to restore and conserve their ecological health for the people and wildlife that depend on the river system and in recognition of the important ecosystem functions provided throughout the region and planet. The group includes 10,000 members throughout the watershed.

Choctawhatchee Riverkeeper protects and restores the ecological health of the Choctawhatchee River, its tributaries, and the surrounding terrestrial systems that constitute the watershed. Choctawhatchee Riverkeeper works with individuals, institutions, organizations, and agencies using a watershed approach to guarantee clean water, healthy aquatic ecosystems, and public access to and enjoyment of the recreational and aesthetic values of the river.

Coosa Riverkeeper is a community-based nonprofit organization working to protect and improve water quality, protect valuable habitat, and promote recreation and public health along the Coosa River in Alabama.

Forest Keeper is a nonprofit focused on protecting and restoring forests and ecosystems on public lands across the Southeast. It also focuses on protecting the species and ecosystems that depend on mature forests and healthy watersheds, which are responsible for making the Southeast a global biodiversity hotspot.

Healthy Gulf is a nonprofit focused on a just transition from extractive forms of energy production and political oppression toward resilient, regenerative, and equitable economies. Healthy Gulf advances climate justice, conserves Gulf resources, holds industries accountable, and protects clean water.

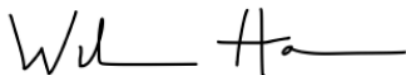
Healthy Ocean Coalition is a network of over 200 organizations, coastal inhabitants, scientists, and people who understand the ocean is central to life on Earth and are raising our unique voices to ensure federal ocean policy ensures a healthy ocean for today and generations to come.

Mobile Baykeeper is a nonprofit working towards to defend and revive the waters of coastal Alabama. They seek real and measurable improvements in the health of coastal waters, including the recovery of oyster beds, seagrasses, and safe, swimmable waters.

Pearl Riverkeeper is a nonprofit dedicated to improving the 8,760-square-mile Pearl River watershed through restoration, advocacy, and education. The Pearl River shelters 40 species of mussels and 130 species of native fish, endangered turtles and amphibians, and other rare and imperiled species.

Thank you for considering this petition. Please contact Will Harlan at 828-230-6818 or email wharlan@biologicaldiversity.org if you have any questions or need any clarification on the information in this petition.

Sincerely,



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EXECUTIVE SUMMARY



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The Alabama shad is a rare and highly imperiled fish. The Alabama shad has been extirpated from 90% of its historic range. In the few remaining rivers where the Alabama shad is found today, populations are small and fragmented. Surveys and fisheries that once yielded hundreds of Alabama shad now find one fish or none at all.

The anadromous Alabama shad migrates from Gulf coastal waters upriver to spawn, from Florida's Suwannee River to inland rivers of Arkansas and Missouri. Historically, its range stretched from Oklahoma to West Virginia, and as far north as Keokuk, Iowa, and south to Tampa Bay, Florida. Today, the Alabama shad has been extirpated from 60 of the 75 rivers in its historic range, and all of its remaining populations are in severe decline.

The Alabama shad is threatened by all five Endangered Species Act threat factors: modification or curtailment of habitat or range, overutilization, disease or predation, inadequacy of existing regulatory mechanisms, and natural and manmade factors, including climate change and invasive species. Mounting anthropogenic threats make the increasingly range-restricted species highly vulnerable to extinction.

At least 85 dams across the species' range have significantly reduced the Alabama shad's spawning habitat and range. Sedimentation, dredging, pollution, and changing water temperatures are also contributing to their decline.³ In the Gulf of Mexico, the Alabama shad is affected by an annual hypoxic zone, oil spills, increasingly frequent hurricane events, and changing salinity.⁴

³Rider *et al.* 2021. 150.

⁴Quinn *et al.* 2023. 14.

Industrial fisheries in the Gulf leave the Alabama shad vulnerable to bycatch. Historic outbreaks of wounds in Alabama shad showcase the species' vulnerability to disease when stressed — particularly in the event of environmental disasters like 2010's Deepwater Horizon Oil Spill and 2023's Main Pass Oil Spill in important Alabama shad habitat.

Alabama shad are considered Critically Imperiled in Kentucky, Arkansas, Louisiana, Mississippi, Georgia, and Florida, and Imperiled in Oklahoma, Missouri, and Alabama.⁵ However, no state or federal mechanisms currently exist to protect Alabama shad from further declines. There are no restrictions on Alabama shad harvest in the species' marine habitat, and Mississippi, Arkansas, and Missouri have no state regulations regarding Alabama shad harvest.

Climate change, genetic factors and unstable population biology, and invasive species also threaten the species' survival.⁶ The Southeast has experienced increasingly severe flood and drought events, lessening the likelihood of successful annual reproduction for this anadromous species⁷ sensitive to water temperatures, depth, and salinity. The Alabama shad's preference for cool waters limits the species' ability to adapt during drought or heat spells. Conversely, during heavy rainfall years, shad runs are weak or nonexistent. Exceptionally high-flow years may be linked to reduced spawning success and diminished numbers of migrating individuals.⁸

Climate change has also affected the temperature of the Gulf of Mexico, where the Alabama shad overwinters, and Southeastern rivers where the fish spawns. Changing temperatures threaten the availability of the Alabama shad's food resources. Such temperature shifts could initiate an earlier spawning run in the temperature-sensitive Alabama shad or drive the Alabama shad's energy demands outside their budget during migration, leading to mortality.⁹

Observed genetic variation, both in number of alleles and heterozygosity, is low among Alabama shad.¹⁰ The Alabama shad's reduced genetic diversity impedes its ability to adapt to changing environmental conditions and heightens its extinction risk.

Invasive species represent yet another potential threat to the declining Alabama shad. The Asian carp, introduced to the southeast in the 1970s via aquaculture to control algae, weeds and parasites, has spread throughout the Mississippi River system and poses a significant threat to Alabama shad.

As a result of these compounding threats, the Alabama shad has disappeared from 90% of its historic range, and all remaining populations are continuing to decline.

⁵NatureServe 2023.

⁶Rider *et al.* 2021. 150.

⁷Limburg and Waldman 2009. 962.

⁸Quinn, pers. comm. October 17, 2023.

⁹Paul Mickle, pers. comm. October 20, 2023.

¹⁰NOAA 2017. 4043.

In 2017, NOAA Fisheries concluded that the Alabama shad did not meet the criteria for listing under the ESA. In the years since the 2017 finding, new research and data reveal an even steeper decline in Alabama shad populations and habitat.

A State of Alabama study published in 2021 revealed that Alabama shad populations have recently plummeted across Alabama, one of the species' most important habitats and the species' namesake. The study reached stark conclusions:

1. The Alabama shad is now extirpated from the Mobile River Basin;
2. The Choctawhatchee River populations experienced a “precipitous decline in abundance” by 98% between 2011 and 2018.
3. Alabama shad populations in the Conecuh River are “severely depressed.”

The authors of the 2021 study — using targeted, intensive, and accurate sampling techniques — revealed that the second-largest population of *A. alabamae* is also on the verge of being extirpated. Critically, the authors noted that the Alabama shad could “become extirpated from Alabama in the near future, which is a significant portion of its range.”

Farther east down the Gulf Coast, the Apalachicola River basin, populations have crashed from 123,000 in 2012 to as few as 324 in 2015, nearing functional extirpation. No recovery has been observed in the massive spawning runs from more than a decade ago, and conservation locking has ceased.

Fisheries biologists and experts across the region agree that the Alabama shad is in steep decline. Jake Schaefer, an ichthyologist at the University of Southern Mississippi, confirmed the drastic declines observed in the Alabama shad's last and most important habitats. Targeted sampling efforts have harbored disappointing results — he and his research team “almost never see” Alabama shad and surveys in the past two decades have located just 2 or 3 individuals.

Patrick O'Neil, past Deputy Director at the Geological Survey of Alabama, described recent Alabama shad population numbers as “disturbing” — noting that declines are occurring in both dammed and free-flowing rivers.

The Alabama shad is in imminent danger of extinction across the entirety of its range and warrants immediate protection under the Endangered Species Act.

INTRODUCTION

The Alabama shad has disappeared across 90% of its range, and all of its remaining populations are declining towards functional extirpation.

The Alabama shad was once prolific and widespread. Reports detail the Alabama shad once numerous enough to support commercial fisheries in areas of its range where it is now extirpated.¹¹

Today, the Alabama shad is difficult or impossible to find even using targeted, intensive survey efforts. The Alabama shad is rarely found across most of its expansive historic range and has been in decline for much of the 20th and 21st centuries. Remaining populations face significant and compounding threats.

New research and data have emerged since NOAA Fisheries negative finding in 2017 indicating even more precipitous declines in Alabama shad populations. NOAA Fisheries rejected a petition to list the Alabama shad under the Endangered Species Act in 2017, heavily stressing the effectiveness of conservation locking. Conservation locking has yet to be implemented or occurs with extremely low frequency, which has had significant adverse consequences for populations of the Alabama shad. For example, in 2021, Alabama state fisheries biologists surveyed three of the previous population strongholds for Alabama shad and concluded:

- Alabama shad is extirpated from the Mobile River basin;
- Alabama shad experienced a “precipitous decline in abundance”¹² by 71% and 98% in the Choctawhatchee River;
- Alabama shad populations have severely declined in the Conecuh River.

Their authors observed that what was previously the second-largest population of *A. alabamae* is on the verge of extirpation. The authors noted that the Alabama shad could “become extirpated from Alabama in the near future, which is a significant portion of its range.” The Alabama shad appears to have disappeared from one of its last and most critical population strongholds, where even targeted and intensive surveying efforts have failed to locate the species.

Within the species’ largest population stronghold, the Apalachicola River, dam building has significantly impeded flow regimes, morphed habitat, and impeded the Alabama shad’s migration. Conservation locking, touted as an effective strategy for protecting the Alabama shad, is too infrequent or altogether absent, and therefore, the species cannot successfully migrate

¹¹NOAA 2017. 4052.

¹²Rider *et al.* 2021. Abstract.

upstream and downstream. The Alabama shad population has crashed from 123,000 to as few as 324 in the Apalachicola River, and it continues to decline in all other river systems and marine habitat.¹³

Oil spills in the Gulf also have likely affected Alabama shad populations. Their population in the Apalachicola River basin crashed after the Deepwater Horizon oil spill in 2011 and has not recovered. Alabama shad in the Apalachicola River basin were observed with lesions after the spill. In November 2023, the Main Pass Oil Spill, second-largest oil spill after Deepwater Horizon, spewed 1.1 million gallons of oil into key Alabama shad habitat near the mouth of the Mississippi River.

Compounding the threats posed by dams and oil spills are commercial fishing, disease outbreaks, pollution, and climate change. State and federal regulations have failed to adequately protect Alabama shad.

Even in the species' most vital habitats, fragmented populations consisting of few fish are barely hanging on. The current status of Alabama shad and its habitats make it highly susceptible to extinction. Protection under the Endangered Species Act is urgently needed to ensure the Alabama shad's survival.

¹³ Georgia Department of Natural Resources. Alabama shad survey and CPUE data 2007-2023.

BIOLOGICAL INFORMATION

Taxonomy

Kingdom	Phylum	Class	Order	Family	Genus	Species
Animalia	Chordata	Actinopterygii	Clupeiformes	Alosidae	Alosa	alabamae

David Starr Jordan and Barton Warren Evermann initially documented the Alabama shad (*Alosa alabamae*) in 1896 near Tuscaloosa, Alabama, in the Black Warrior River.¹⁴ Alabama shad was historically depicted as “white shad” by the U.S. Commission on Fish and Fisheries, and the species was commonly confused with other shad even after its description.¹⁵ HBelonging to the family Alosidae (formerly Clupeidae), Alabama shad are closely related to and similar in appearance and life history to the American shad (*A. sapidissima*). The Alabama shad also closely resembles the skipjack herring (*A. chrysochloris*), a species overlapping in range with the Alabama shad. However, Alabama shad do not reproduce with American shad, skipjack herring, or any other species.¹⁶

Alabama shad are defined by an upper jaw with a distinct median notch and gill rakers, numbered 41 to 48, on the lower limb of the anterior gill arch. Compared to other *Alosa* species with the same range, the Alabama shad differs morphologically with a distinct lower jaw that does not protrude beyond the upper jaw, black spots along the lower jaw, and a dorsal fin lacking an elongated filament. Based on mitochondrial DNA, molecular data, and physical differences, Alabama shad are considered a separate species from the closely related American shad.¹⁷ The two species show minimal genetic variation, suggesting a recent divergence from a shared ancestor.

The Alabama shad forms its distinct monophyletic branch within the Alosidae family, primarily due to the limited genetic distinctions resulting from allopatric speciation.¹⁸ Geographically, populations of Alabama shad have not displayed substantial genetic differentiation between drainages, and there is no evidence of hybridization with other *Alosa* species.¹⁹

¹⁴NOAA 2017. 4023.

¹⁵*Ibid.*

¹⁶Hershey *et al.* 2024. 23-24.

¹⁷NOAA 2017. 4023.

¹⁸*Ibid.*

¹⁹*Ibid.*

Appearance

The Alabama shad is a slender, silvery fish that grows to 30-46 centimeters (12-18 inches) in length and may reach 1.4 kilograms (3 pounds). It has approximately 55 to 60 scales along its side. Its dorsal fin typically features 15 to 17 rays, while the anal fin has around 18 to 19 rays. When alive, the Alabama shad exhibits a greenish-blue coloration on its back, with the rest of its body appearing silvery. The fins are generally transparent, but a slightly darker margin exists on the dorsal and caudal fins.²⁰



© Missouri Department of Conservation

The Alabama shad is a slender, silvery fish that once existed from the Ohio and Mississippi Rivers to the Suwannee River in Florida.

The male Alabama shad differs from the female only in that it is somewhat smaller. The species differs from *Alosa sapidissima* primarily in that it has fewer gill rakers, a sharper and more pointed snout, a small notch in the upper jaw, a more accentuated mandible, and a more slender maxillary.²¹

Behavior

The Alabama shad is a schooling fish. In freshwater environments, juveniles typically use sandbar habitats during the day. As the Alabama shad matures, individuals switch to open channel and steep bank habitats containing large woody debris, where the species often selects areas of cooler water temperatures.²² Limited information exists regarding the Alabama shad's behavior and habitat use in marine environments.

²⁰Evermann 1896. 204.

²¹Evermann 1896. 204.

²²Mickle 2010. 12.

Diet

The diet of Alabama shad undergoes a shift from juvenile to adult stages. With increased size, Alabama shad from the Pascagoula River displayed an increase in the proportion of both terrestrial and aquatic insects in their stomach contents. Alabama shad from the Apalachicola River had a diet dominated by terrestrial insects across all size classes.²³ The diet of Alabama shad from both rivers shifted as the fish grew larger, with insects gradually replacing organic matter. Ephemeroptera nymphs were the predominant food source for larger Alabama shad in both rivers. These aquatic insects are known to produce larvae that emerge in open water, consistent with the habitats where Mickle *et al.* (2013) collected Alabama shad. The observed shifts in diet throughout the growth stages of Alabama shad appear to correspond with changes in their habitat and align with a generalist feeding strategy. However, in a 2013 study conducted on individuals from the Pascagoula River, researchers found that the smallest juvenile Alabama shad (those under 50 millimeters) primarily consumed semi-decomposed algae and other organic material that could not be identified.²⁴ These findings suggest that young Alabama shad juveniles may engage in filter feeding or particulate feeding of smaller prey; or possibly, the lack of food items may have been an indicator of poor habitat, leading to early life mortality and the subsequent severe population declines.

Previous studies have also reported few or no stomach contents in Alabama shad collected from riverine environments. One study located a specimen with a full stomach, supporting the idea that Alabama shad may feed primarily in marine habitats, similar to other anadromous species.²⁵

While the Alabama shad exhibits a generalist diet strategy, food-item diversity is likely critical to compensate for ontogenetic changes occurring in the first year of the Alabama shad's lifecycle. The diverse, multiple food webs present within the species' native rivers are critical to the rare species' survival. While the species becomes a generalist and adaptable in its diet preferences as it ages, emigrates and switches from freshwater to marine existence, preserving the habitat, water quality, and diverse resources and food webs required by the species in its first year is vital to the Alabama shad's survival.²⁶

Life Cycle

Alabama shad are considered r-strategists as they are short-lived, small-bodied, early to mature sexually, and have a high natural mortality and growth rate.²⁷ They tend to adapt to unstable and unpredictable environments with an increased number of offspring, where one may observe highly erratic production levels year to year.²⁸ Clupeoids, (order Clupeiformes), to which the

²³NOAA 2017. 4023.

²⁴NOAA 2017. 4023.

²⁵NOAA 2017. 4025.

²⁶Mickle *et al.* 2013. 237.

²⁷Adams 1980. 2.

²⁸Adams 1980. 7.

Alabama shad belongs, have short life spans and a striking inter-annual or decadal variation in abundance and productivity.²⁹ While r-strategists like the Alabama shad can produce large numbers of offspring, populations comprised of a few age classes, like those of the Alabama shad observed in the Apalachicola River, tend to be less stable than populations consisting of many age classes and can be more easily extirpated under degraded environmental conditions.³⁰

The anadromous Alabama shad inhabits marine and estuarine environments much of the year; adults travel significant distances to spawn in freshwater environments in spring. This journey can be up to several hundred kilometers.³¹ The Alabama shad spawns from February to April at lower latitudes and from May to June in more northern latitudes.³² Alabama shad will abandon their upstream spawning efforts if environmental conditions are unfavorable.³³

The Alabama shad's close taxonomic relationship with the American shad suggests that their spawning requirements are likely similar; American shad are known to migrate far upstream for spawning and typically choose areas dominated by extensive flats with sand and rock substrates.³⁴ They primarily spawn in the main channel of rivers but can also be found in larger tributaries.

Habitat criteria suggest that unimpounded sections of riverine systems offer suitable conditions for the early life stages of these fish species. However, during periods of low discharge on dammed waterways, there may be areas where the depth and velocity conditions are unsuitable for incubating fish eggs. Managing and maintaining adequate discharge levels and ensuring suitable in-stream flows are crucial to the Alabama shad's conservation.³⁵ If spawning activities take place too close to impoundments or upstream reservoirs, there is a risk that eggs and larvae may not have adequate time to mature before they encounter reduced current velocities in the upper regions of the reservoirs. Consideration of the timing and location of spawning in relation to large river infrastructure projects is critical to ensure the successful development of young Alabama shad.

The Alabama shad is most prone to mortality in its egg incubation, hatch, and larval life stages, when poor habitat severely reduces probability of survival. Alosids generally have rapid embryo development and hatching and become passive drifting larvae that may travel substantial distances and require zooplankton for food. When advanced larvae become mobile, they conduct diel movements in which individuals alternate between feeding in the water column and finding

²⁹NOAA 2017. 4024.

³⁰Everhart and Youngs 1981.

³¹Rider *et al.* 2021. 136.

³²NOAA 2017. 4024.

³³Young 2010. 20.

³⁴Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008.

³⁵Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008.

cover to avoid predation. The zooplankton and macroinvertebrates that larval and juvenile Alabama shad eat are themselves extremely sensitive and vulnerable to habitat modifications.³⁶

The movement of both larvae and juvenile American shad, and likely Alabama shad as well, from spawning areas to nursery grounds appears to be influenced more by factors like the volume of water flow, the speed of the river currents, water temperature, and the stage of development, rather than specific habitat characteristics such as substrate type and cover.³⁷

Smaller and younger shad typically prefer somewhat shallower and more sheltered areas near sandbars. Specifically, sandbars within bends of rivers that are less than two meters in depth often provide habitat for young-of-year shad during the early summer.³⁸

As they grow, Alabama shad gradually transition to habitats along the riverbank, which tend to be deeper, usually exceeding 2.5 meters in depth, and the river channel, which typically ranges between 1.5 to 2.5 meters in depth.³⁹ This habitat shift serves several purposes for the juvenile shad. It may help them avoid predators, meet their foraging requirements, or access cooler water temperatures found within deeper parts of the river.⁴⁰

First-year (age-0) juvenile Alabama shad typically inhabit upriver freshwater environments until late summer or fall, after which they migrate downstream toward the Gulf of Mexico. Juveniles originating from rivers in more northern latitudes, like the Ouachita River in Arkansas, commence their downstream journey during the summer and typically reach the Gulf of Mexico by autumn. In contrast, juveniles from rivers in more southern latitudes, such as the Pascagoula River in Florida, tend to stay in their natal rivers as late as December before initiating their downstream migration toward the Gulf of Mexico. Alabama shad do not spend the winter in freshwater river systems.⁴¹

Young fish aged 2-3 years old migrate downriver to a marine environment after spawning, while fish older than four years die. Older spawners, those aged four and above, either succumb to natural mortality or become prey for different fish species with piscivorous feeding habits.⁴² The majority of Alabama shad from the Apalachicola River are semelparous, and post-spawn mortality events are a critical method of transferring nutrients from the marine to freshwater ecosystem.⁴³ Juvenile Alabama shad are also a crucial food link as they feed on phytoplankton

³⁶Shawn Young, pers. comm., December 18, 2023.

³⁷Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008.

³⁸Mickle *et al.* 2010. 112.

³⁹NOAA 2017. 4025.

⁴⁰NOAA 2017. 4025.

⁴¹NOAA 2017. 4025.

⁴²NOAA 2017. 4024.

⁴³Rider *et al.* 2021. 136

and zooplankton and are preyed upon by birds and other fish both in freshwater and marine environments.⁴⁴

Like many other Clupeid fishes, such as shad, herring, sardines, and menhaden, the timing of egg hatching and the growth of the resulting larvae can differ depending on the location and environmental conditions. Alabama shad hatching in the Apalachicola River have a more extended period of successful hatching, with an average of 58 days, in contrast to those hatching in the Pascagoula River, where the mean hatching period is shorter at 33.8 days.⁴⁵

Alabama shad grow rapidly, with typical juveniles increasing from 4.7 centimeters to 10.1 centimeters over the summer; growth rates can vary by drainage even when environmental conditions are constant.⁴⁶ In both the Apalachicola and Choctawhatchee Rivers, adult female shad are longer and heavier than the adult males,⁴⁷ with males averaging 250 grams and age 1–4 females averaging around 650 grams pre-spawning.⁴⁸

Maximum observed age is likely between 4 to 5 years.⁴⁹ Spawning males range in age from 1 to 5 years and females 2 to 6 years;⁵⁰ primary age classes for spawning are typically 2-3 years for males and 2-4 years for females.⁵¹

Males arrive at spawning sites initially, while females arrive slightly later in larger groups.⁵² There is a lack of clarity as to whether females come with ripened eggs or if gonads ripen as river temperatures increase.⁵³ Females release their eggs in late April to early May with water temperatures in the 20–21 °C range.⁵⁴ The fecundity of the Alabama shad is related to size, where larger females produce more eggs.⁵⁵ In the Apalachicola River, female Alabama shad typically produce a range of 26,000 to 250,000 eggs per individual. In the Choctawhatchee River, egg production by female Alabama shad varies between 36,000 and 357,000 eggs per individual.⁵⁶

The age range among spawning individuals suggests that the species may spawn more than once in a lifetime.⁵⁷ Approximately 35 percent of Alabama shad are likely to be repeat spawners.⁵⁸

⁴⁴Rider *et al.* 2021. 136.

⁴⁵NOAA 2017. 4024.

⁴⁶NOAA 2017. 4024.

⁴⁷NOAA 2017. 4024.

⁴⁸NOAA 2017. 4024.

⁴⁹NOAA 2017. 4024.

⁵⁰NOAA 2017. 4024.

⁵¹NOAA 2017. 4024.

⁵²NOAA 2017. 4024.

⁵³NOAA 2017. 4024.

⁵⁴NOAA 2017. 4024.

⁵⁵NOAA 2017. 4024.

⁵⁶NOAA 2017. 4024.

⁵⁷NOAA 2017. 4024.

⁵⁸NOAA 2017. 4024.

Spawning marks have been observed on the scales of 2 to 4-year-old males. Another study reported a similar rate of repeat spawners, ranging from 35 to 38 percent, with most individuals being age-3 individuals.⁵⁹ Apalachicola River populations also exhibited noticeable spawning marks on their scales.

Alabama shad collected from the Choctawhatchee River were repeat spawners.⁶⁰ In 1994-1995, age-3 and age-4 females constituted the majority of repeat spawners, while in 1999-2000, age-2 and age-3 females were the predominant repeat spawners.

Alabama shad appear to exhibit a degree of philopatry, returning to the same rivers for spawning, which results in slight genetic differences among different river drainages.⁶¹ These genetic variations may lead to different characteristics, such as faster growth rates and higher temperature tolerance, which could influence the variability in spawning strategies among these river drainages.

Slight genetic distinctions between populations from the Mississippi River basin and the coastal Gulf of Mexico drainages have been observed, attributed to some Alabama shad straying from their natal rivers occurring at an estimated rate of around ten migrants per generation.⁶²

Habitat

The Alabama shad is an anadromous species, carrying out life stages in both marine and freshwater environments. In its marine life stages, the species occurs in the Gulf of Mexico from Louisiana to Tampa Bay.⁶³

In March 2013, during a fishery-independent monitoring survey, researchers found an adult female Alabama shad 15 kilometers south of the Pascagoula River, just north of Petit Bois Island in Mississippi Sound. It was situated roughly five kilometers east of Horn Island Pass, which leads to the open Gulf of Mexico. Microsatellite DNA analysis indicated that this fish was genetically similar to Alabama shad originating from the Pascagoula River. This particular female had well-developed ovaries, suggesting that she might have been preparing for a spawning run.⁶⁴ Analysis of her stomach contents revealed the presence of small invertebrates.

⁵⁹NOAA 2017. 4024.

⁶⁰NOAA 2017. 4024.

⁶¹NOAA 2017. 4024.

⁶²NOAA 2017. 4024.

⁶³Fishnet2 2016, Catalogue #14540.07.

⁶⁴NOAA 2017. 4025.



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The anadromous Alabama shad once supported a commercial fishery, but today it is rarely detected in surveys across its range.

The Alabama shad's spawning habitat consists of sand and pebble substrate alongside submerged limestone outcroppings in rivers with moderate to fast current velocities.⁶⁵ In a life history investigation conducted in the Pascagoula River drainage, researchers found young Alabama shad predominantly located in three distinct habitat types. The study encountered Alabama shad in sandbar habitat, which consists of gently sloping sand deposits, typically found within the river's bends, with angles of less than 30 degrees. The water depth in these areas is usually less than 2 meters.

Alabama shad occur in channel habitats characterized by open water or pelagic zones located between two sides of the river. Water depths in these channel habitats typically range from 1.5 to 2.5 meters. The Alabama shad was also found in bank habitats, typically situated on the outer edges of river bends and featuring steep slopes with angles greater than 45 degrees. The water in these areas is deeper, exceeding 2.5 meters in depth.⁶⁶

Young Alabama shad initially prefer sandbar habitat in the early summer. However, by mid-summer (around July), these young shad shift their habitat preference towards channels and banks. These three types of habitat—sand bars, channels, and banks—were recognized as crucial for recruiting young Alabama shad and are considered Essential Fish Habitat (EFH). Additionally, physicochemical factors, with a primary focus on temperature, were identified as indicators of the presence or absence of Alabama shad in this particular ecosystem.⁶⁷

⁶⁵NOAA 2017. 4024.

⁶⁶Mickle NOAA 2017. 4025..

⁶⁷Mickle *et al.* 2010. 112.

Spawning is typical in waters 19-23 °C, in gentle current near sandbars, limestone outcrops, or over sand substrate.⁶⁸ The Alabama shad prefers cool river waters with high dissolved oxygen (DO) and pH levels.⁶⁹ Other *Alosa* species cannot tolerate waters warmer than 32°C; most likely, the Alabama shad displays a similar tolerance threshold.⁷⁰ Surveys have found individuals in waters ranging from 10 to 32°C.⁷¹ Temperature also provides a phenological cue for the Alabama shad.⁷²

The Alabama shad also displays preferences for a specific water velocity—rarely found in still portions of rivers, the species relies heavily upon spring floods to cue spawning adults and hatching juveniles. Juveniles prefer fast-moving, shallow, and clear waters with minimal benthic algal growth.⁷³

⁶⁸Rider *et al.* 2021. 136.

⁶⁹NOAA 2017. 4025.

⁷⁰NOAA 2017. 4025.

⁷¹Mickle *et al.* 2010, Young 2010.

⁷²NOAA 2017. 4050.

⁷³NOAA 2017. 4025.

CURRENT AND HISTORICAL DISTRIBUTION

The Alabama shad historically ranged across at least 14,225 river miles from the Mississippi River basin eastward to the Suwannee River.⁷⁴ The species occurred in 13 states—as far west as Oklahoma, north to Iowa, east to West Virginia, and across the Southern Gulf to Florida. It is now presumed extirpated in Indiana, West Virginia, and the uppermost reaches of most of its native rivers; the species is likely extirpated in Illinois, Iowa, and Tennessee. It is Critically Imperiled in Kentucky, Arkansas, Louisiana, Mississippi, Georgia, and Florida, and Imperiled in Oklahoma, Missouri, and Alabama.⁷⁵

Based on recent surveys, sampling efforts, and estimates by state biologists, the freshwater range of the Alabama shad has contracted by 90% percent. Using the most upstream known occurrence of currently occupied rivers, GIS anchor statistic analysis shows that Alabama shad presently occurs in approximately 1,378 of 14,225 historically occupied river miles.⁷⁶

Small populations of Alabama shad remain in 15 of 75 previously inhabited rivers. These rivers include the Suwannee, Santa Fe, St. Marks, Apalachicola, Flint, Chipola, Choctawhatchee, Escambia, Conecuh, Pascagoula, Leaf, Chickasawhay, Pearl, Ouachita, Meramec, and Gasconade Rivers.⁷⁷

The Apalachicola River is home to the Alabama shad's most reliable spawning grounds for recruitment, still supporting one the species' last reproducing populations. However, its population dropped to as low as 324 individuals in 2015.⁷⁸

⁷⁴Rider *et al.* 2021. Abstract.

⁷⁵NatureServe 2023.

⁷⁶Published and unpublished data from USFWS, NOAA Fisheries 1955-2010, Rider, Mickle, Hrabik, Ingram, Quinn, *et al.* 2023.

⁷⁷NOAA 2017, Sammons *et al.* 2021.

⁷⁸Travis Ingram, Fisheries Biologist, Georgia Department of Natural Resources, September 2022.

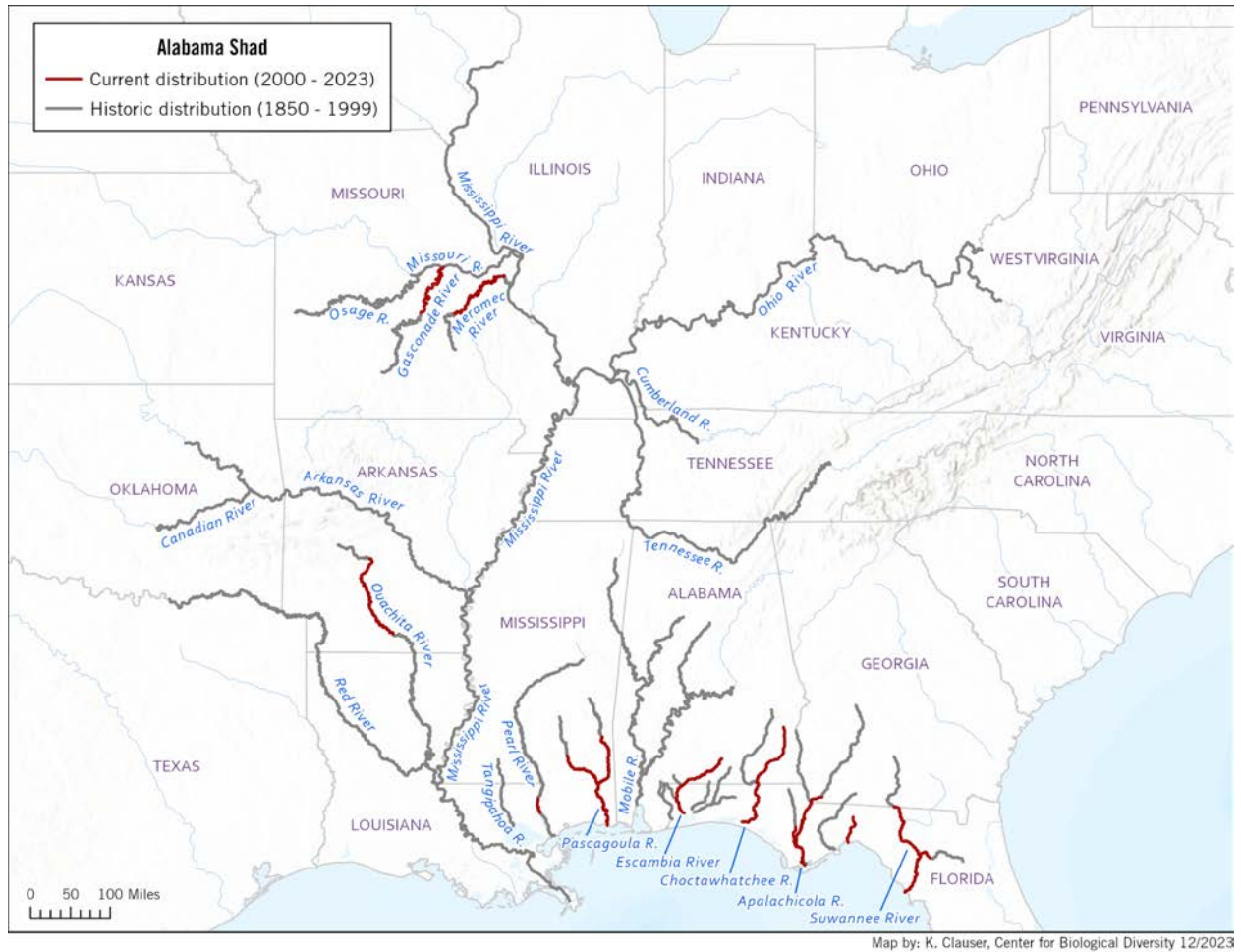


Figure 1. Current distribution (red) and historical distribution (gray) of Alabama shad. The Alabama shad’s range has been reduced by 90 percent.

Figure 2. The Alabama shad remains in only 15 of 75 rivers it once inhabited.

Apalachicola River	Bouie River	Ochlockonee River
Chipola River	Bourbeuse River	Ohio River
Chickasawhay River	Cahaba River	Osage River
Choctawhatchee River	Canadian River	Pea River
Escambia-Conecuh River	Chattahoochee River	Perdido River
Flint River	Chunky River	Poteau River
Gasconade River	Clinch River	Red River
Leaf River	Comite River	Styx River
Meramec River	Coosa River	Sepulga River
Ouachita River	Cumberland River	Sipsey River
Pascagoula River	Dugdemona River	Stones River
Pearl River	East Fork Amite River	Strong River
St. Mark's River	Econfina River	Tangipahoa River
Santa Fe River	Escatawpa River	Tchefuncte River
Suwannee River	Fish River	Tickfaw River
Allegheny River	Homochitto River	Tennessee River
Amite River	Illinois River	Tensas River
Arkansas River	Kanawha River	Tensaw River
Alabama River	Little River	Tombigbee River
Atchafalaya River	Mississippi River	Walhonding River
Big River	Mobile River	West Pearl River
Black Warrior River	North River	White River
Blackwater River	Old River	Withlacoochee River
Boeuf River	Monongahela River	Wolf River
Bogue Chitto River	Mulberry River	Yellow River

Limited data exists about the Alabama shad's distribution in marine waters. Historic records indicate that one individual was caught 80 miles south of Choctawhatchee Bay, Florida, in 1957;⁷⁹ researchers caught another individual off of Dauphin Island in Alabama in 1960.⁸⁰ In November 2007, two surveys collected Alabama shad 115 kilometers southwest of Cape San Blas, Florida.⁸¹ A survey collected another Alabama shad in a trawl located approximately 40 kilometers offshore of Florida, situated between Tampa Bay and the Charlotte Harbor Estuary.⁸² Records collected within the last 20 years indicate that young Alabama shad utilize an area extending a few miles from the mouth of the Suwannee River. Alabama shad also occur in Apalachicola Bay, Choctawhatchee Bay, Escambia Bay, Pascagoula Bay and the adjacent Mississippi Sound from Dauphin Island, Alabama to Horn and Petit Bois Islands, Mississippi.

The most recent observational data suggests that key marine habitat and for Alabama shad includes the mouth of the Suwannee River (FL), Apalachicola Bay (FL), Choctawhatchee Bay (FL), Escambia Bay (FL), Perdido Bay (FL), Pascagoula Bay and coastal areas behind its barrier islands (AL), and the mouth of the Mississippi River (LA).

Coastal distribution of Alabama shad has also decreased substantially across the Gulf of Mexico. Previous observations in coastal waters were significantly more numerous, frequent, and abundant. U.S. Fish and Wildlife and NMFS records not previously considered in the 2017 Negative Finding show significantly more observations of Alabama shad in coastal waters from 1970-1990 than in the past two decades. Trawl surveys also indicate larger numbers of Alabama shad in greater densities from 1970-1990 than in the past two decades.⁸³

While less is known about the Alabama shad's marine life stage, it is clear that the species faces several mounting threats within the heavily impacted Gulf of Mexico. Several fisheries biologists emphasized the lack of existing information on the Alabama shad's marine life stage, their concern over the threats the species likely faces in the Gulf of Mexico, and the necessity of further study efforts. State of Georgia fisheries biologist Travis Ingram described the Alabama shad's marine life stage as a "black box."⁸⁴ Ingram voiced his concern over the dangers the Alabama shad may face in its marine habitat, particularly after Alabama shad displayed notable lesions following the 2010 Deepwater Horizon oil spill. Ingram also added that the progeny of the 2012 year class of over 100,000 Alabama shad adults did not return from the Gulf of Mexico in subsequent years, suggesting the population was negatively impacted within its marine habitat. Sammons confirmed these conclusions, saying it would be "risky to assume" that the Alabama

⁷⁹Fishnet2 2015, Catalogue #28671.

⁸⁰Fishnet2 2015, Catalogue #293755.5174309.

⁸¹Fishnet2 2015, Catalogue #20627.

⁸²Fishnet2 2016, Catalogue #14540.07.

⁸³ FWS data table all Alabama shad records 1970-2020.

⁸⁴Travis Ingram, pers. comm., December 2023.

shad is stable within its marine habitat — particularly in light of the species’ population crash after 2012.⁸⁵

Other fisheries biologists underscored that commercial fishing, warming temperatures, and the Gulf of Mexico’s annual hypoxic zone⁸⁶ could pose major threats to populations of Alabama shad. As we lack extensive information on the species’ range and habitat requirements within the Gulf of Mexico, to what extent the Alabama shad could be negatively impacted during its marine life stage remains a concerning question.

⁸⁵Steve Sammons, pers. comm., December 13, 2023.

⁸⁶Paul Mickle, pers. comm., October 20, 2023.

POPULATION STATUS

The Alabama shad has declined for most of the 20th and 21st centuries, and today it is rarely collected from streams in the majority of its range. Only very small populations of Alabama shad remain in 15 rivers, and most recent observations were only single individuals. The Alabama shad has been extirpated from 60 rivers, and it has disappeared from 90% of its freshwater range. The species is so rare that many consider even scant collections notable.⁸⁷

Even within their last Gulf population strongholds in the Apalachicola River and Pascagoula River, the species is today found in only a select few of its original population sites in very low numbers.⁸⁸ Steve Rider, River and Stream Fishes Program Supervisor for the Alabama Division of Wildlife, noted that the “species is not widespread,” and that “there is no doubt that numbers have declined.”⁸⁹

In the Apalachicola River basin, populations have crashed from 123,000 spawning adults in 2012 to as few as 324 adults in 2015. No recovery has been observed in the massive spawning runs from more than a decade ago.⁹⁰

The Alabama shad has experienced a long-term population decline of approximately 70%.⁹¹ The species’ extent of occurrence decreased by 90%.⁹² All Alabama shad populations are in decline or locally extinct.⁹³

Historical data from the Library of Congress substantiates the previous commercial fisheries and large populations of Alabama shad. Historical records reveal that this species was clearly once abundant enough to support commercial fisheries. Comparing past accounts of robust Alabama shad abundance to today’s comparatively scarce records, Alabama shad populations have experienced significant long-term declines.

Newspaper articles from Georgia in the late 1800s to early 1900s suggest that eels,⁹⁴ shad, and sturgeon⁹⁶ historically migrated up the Flint River in significant numbers before the Jim Woodruff Lock and Dam blocked these now rare anadromous species’ migrations. Such accounts

⁸⁷Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008.

⁸⁸Steven Rider, pers. comm. November 3, 2023.

⁸⁹Steven Rider, pers. comm. November 3, 2023.

⁹⁰Travis Ingram, pers. comm. December 10, 2023.

⁹¹NatureServe 2023.

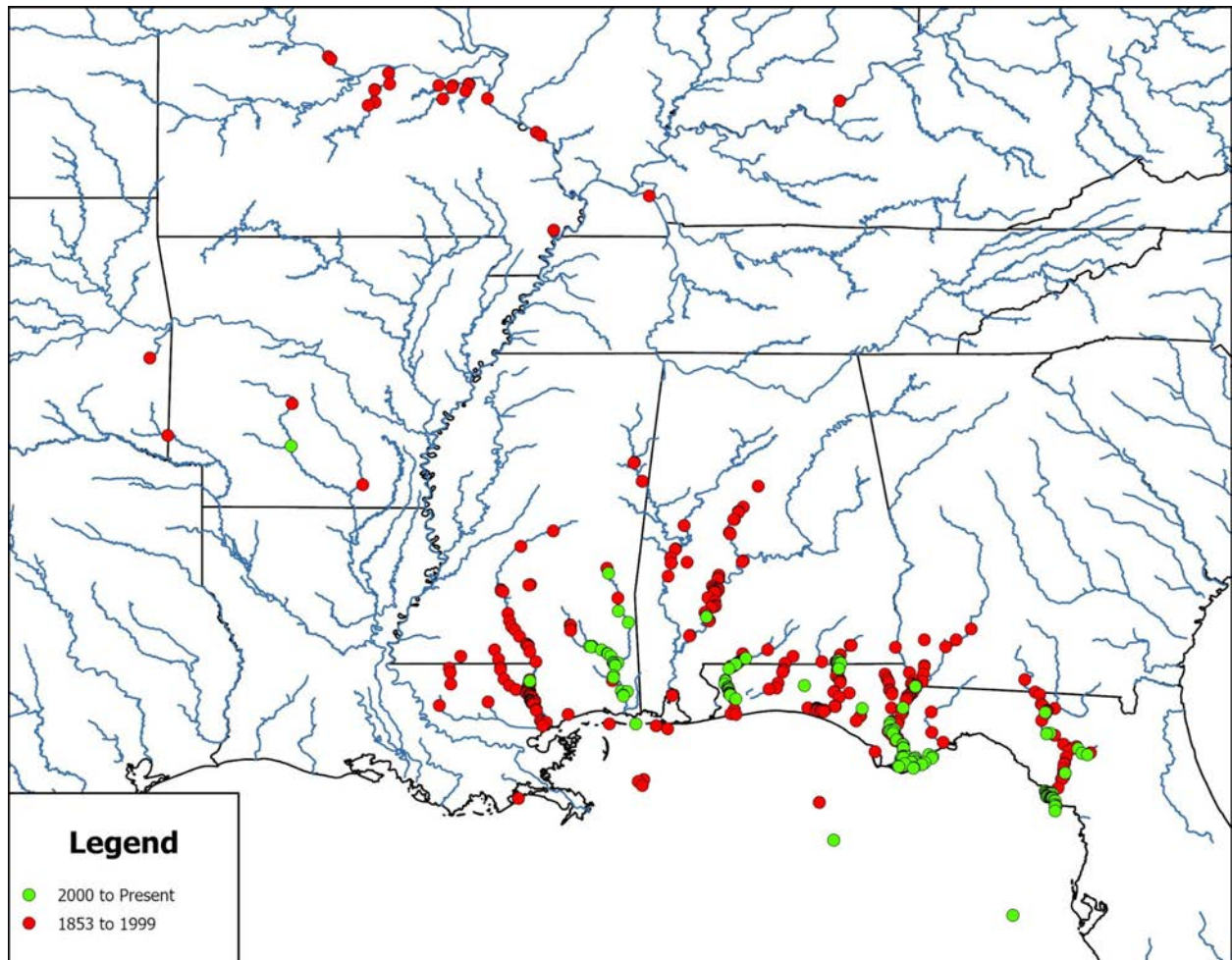
⁹²NOAA Fisheries and U.S. Fish and Wildlife Records: Georgia, Florida, Alabama, Mississippi, Louisiana, Oklahoma, Arkansas, Missouri state records and pers. comm. 2023.

⁹³Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008.

⁹⁴*The Leader Enterprise and Press*, Thursday, April 21, 1921.

⁹⁵*The Marietta Journal*, Thursday, November 1st, 1883.

⁹⁶*The Americus Times Recorder*, Wednesday, September 21st, 1921.



Map by Jim Williams

Figure 3. Alabama shad once supported commercial fisheries. In the past two decades, populations have plummeted across its range. Remaining populations are small and steeply declining.

provide a valuable and jarring glimpse into these species' robust population numbers before river modification and impoundment. Newspapers describe shad migrations up the Flint River as "plentiful."⁹⁷ The accounts also note "thousands of shad in the Flint River,"⁹⁸ and that shad were observed to "accumulate in large numbers."⁹⁹ Other accounts describe shad as "so abundant in the Flint River that a fishery, properly equipped, would reap a harvest at this season of the year"¹⁰⁰ and that "quite a number of shad"¹⁰¹ were caught in the Flint River near Albany. The species described in such accounts are now rare or impossible to find, showcasing the drastic

⁹⁷The Americus Times Recorder, 1901.

⁹⁸The Dawson News, March 25th, 1908.

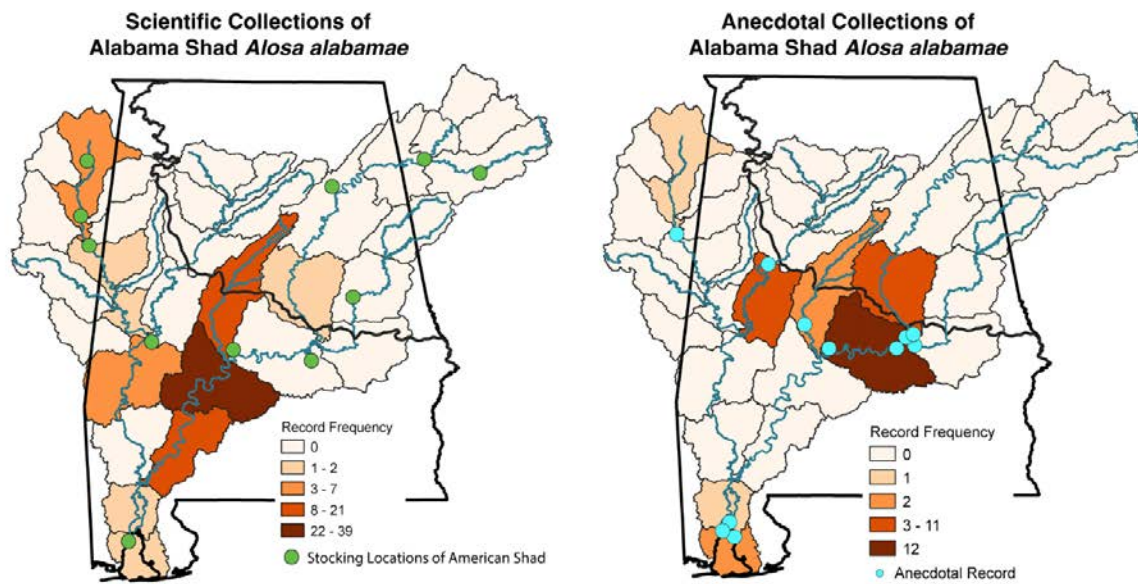
⁹⁹The Dawson News, March 25th, 1908.

¹⁰⁰The Dawson News, March 25th, 1908.

¹⁰¹The Marietta Journal, April 3rd, 1879.

declines among Alabama shad and similarly sensitive species affected by habitat modification and fragmentation.

Historically, Alabama shad were previously abundant in Alabama's Mobile Basin as well. An article in the *Florence Gazette* from May 1878 stated that "great quantities of young shad have been caught this spring in the Coosa, Etowah, and Oostanaula rivers, in traps and nets."¹⁰² An 1878 article in the *Livingston Journal* reported that over a thousand pounds were caught in the Coosa in one week, and that "our market is so glutted with these delicious fish that they are selling for only 5 to 7 cents a pound."¹⁰³ Catches of Alabama shad were also being reported in the Black Warrior River at Tuscaloosa, and in the Alabama River at both Selma, and Montgomery.¹⁰⁴



Hershey et. al. 2024

Figure 4. Scientific and anecdotal accounts indicate that Alabama shad once occurred in large numbers throughout the Mobile Basin.

One newspaper article from the *Montgomery Advertiser* in 1897 stated, "About two years ago there was a remarkable catch of shad at Tuscaloosa. At the foot of the lock works going on in the Warrior River it was no trouble to catch large quantities of them."¹⁰⁵ Another article from 1860 in the *Independent American* (Troy, Ala.) suggests that Alabama shad were once abundant,

¹⁰² Hershey et al. 2024. 23-24.

¹⁰³ *Ibid.*

¹⁰⁴ *Ibid.*

¹⁰⁵ *Ibid.*

but had declined to the point that conservation was required: “The shad [sic. *Alosa alabamae*] [were] formerly caught in large numbers in the Chattahoochee River.... We suggest to fishermen, that no more shad be taken from our waters, until they become more plentiful. When caught they should be returned alive to the water.”¹⁰⁶

Ichthyologist Dr. Jake Schaefer confirmed these observations, stating that historical populations were “enormous” enough to support commercial fisheries. For decades, researchers have failed to observe massive populations described by the historical record. Even with the use of Alabama shad-specific targeted sampling methods, it has been difficult or impossible for researchers to locate the species. Steve Rider of the Alabama Division of Wildlife and Freshwater Fisheries further described that Alabama shad populations are not experiencing mere fluctuations but rather “low levels of fish” with no recent records resembling those of historical observations. Reported commercial landings of Alabama shad were 3,165 kg in 1889 and 48 kg in 1902; no commercial landings have since been reported.¹⁰⁷

Records of Alabama shad captures in the 1970s, particularly in the Apalachicola River and its major tributary, Chipola River, describe several hundred Alabama shad in gill nets.¹⁰⁸ A 1978 U.S. Fish and Wildlife Service report from Florida described Alabama shad as “the most abundant anadromous fish found on the Gulf coast”¹⁰⁹ and that the species “occurs in the greatest numbers in the Apalachicola River.”¹¹⁰ The same report describes spring migrations of Alabama shad as “numerous enough to be caught by anglers,”¹¹¹ and that “a commercial fishery for Alabama shad does not exist in Florida, even though the population appears large enough to support one.”¹¹² The report resoundingly reveals that the Alabama shad was once highly abundant in the ACF river basin and that populations were once large enough to support a commercial fishery.

Records from the Missouri Department of Conservation also indicate the presence of Alabama shad in great numbers no longer observable today. In the early 20th century, the Alabama shad was reported in the Mississippi River system from the Ohio River at Louisville, from the Mississippi River near Keokuk, and from Oklahoma. At that time, the species was common enough to support a limited commercial fishery.¹¹³

Coastal observations of Alabama shad have also decreased significantly in the past two decades. According to Fish and Wildlife Service records and trawl survey data not previously analyzed in

¹⁰⁶ Hershey *et al.* 2024. 23-24.

¹⁰⁷ NOAA 2017. 4052.

¹⁰⁸ Jim Williams, pers. comm. October 22, 2023.

¹⁰⁹ U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

¹¹⁰ U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

¹¹¹ U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

¹¹² U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

¹¹³ Missouri Department of Conservation. 2022. "Alabama Shad: Habitat and Conservation. <https://mdc.mo.gov/discover-nature/field-guide/alabama-shad>

the 2017 Negative Finding, significantly more numerous and abundant Alabama shad observations were recorded in the 1970s to 1990s than in the past twenty years.¹¹⁴

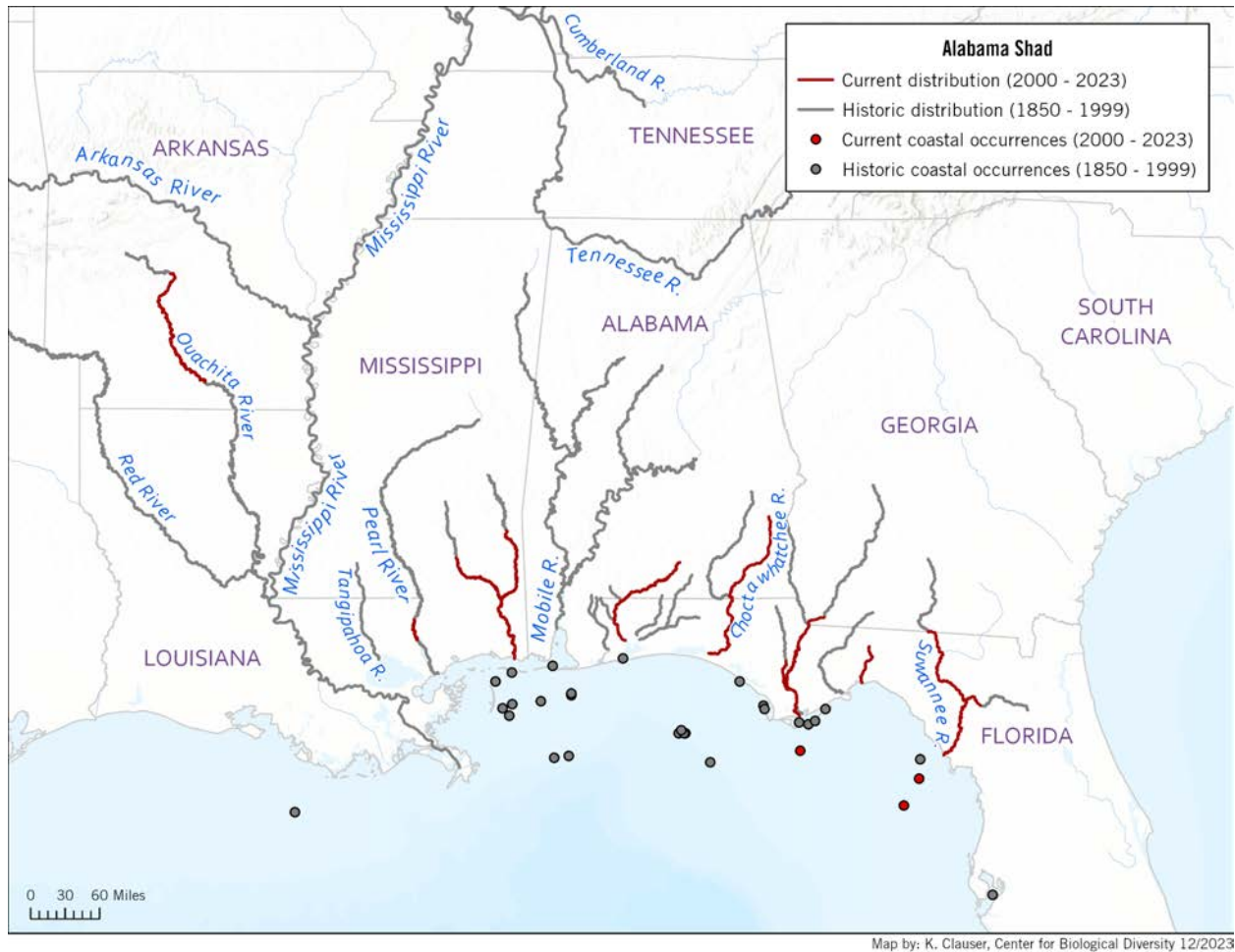


Figure 5. Historic and current distributions of coastal observations of Alabama shad. Observations of Alabama shad in marine habitat have declined steeply in the past two decades.

The International Union for the Conservation of Nature (IUCN) describes Alabama shad populations as decreasing and threatened by dams and natural system modifications, pollution from agriculture and forestry effluents, shipping lanes, and climate change.¹¹⁵

¹¹⁴FWS/NOAA Fisheries trawl survey data 1970-2020.

¹¹⁵IUCN 2021.

According to the IUCN, the Alabama shad historically occupied a widespread distribution in the coastal waters and rivers associated with the Gulf of Mexico. However, limited information is available about this species in its marine habitat. Due to the species' anadromous nature, it has been significantly affected by changes in habitat and the construction of dams, preventing it from reaching its natal spawning grounds across its range. Consequently, the global population has declined significantly compared to historical levels.¹¹⁶

To address the existing restrictions on spawning and provide more access to suitable habitats, the IUCN recommends additional conservation measures. The IUCN also recommends urgent research to determine the population abundance of this species and to consider effective fish passages, restoration of hydrologic regimes, migrations, feeding, bycatch, spawning, rearing, and other habitat needs. The IUCN also underscores the importance of restoring spawning habitats and access to spawning habitat in the Flint River, which under current conservation locking protocols, is not being carried out.¹¹⁷

Alabama

The Alabama Division of Wildlife and Freshwater Fisheries (ALDWFF) lists *Alosa alabamae* on the State's Nongame Species Regulation (220-2-.92), the State of Alabama's rare and endangered species list. *A. alabamae* was considered a species of highest conservation concern after discussion at the Alabama Nongame Symposium.¹¹⁸

In Alabama, *A. alabamae* were historically collected in the Mobile River basin, within the Tombigbee, Black Warrior, Cahaba, Coosa, and Alabama rivers, as well as Gulf Coastal Plain rivers such as the Conecuh, Yellow, and Choctawhatchee rivers. Historical records indicate that the Tombigbee, Cahaba, and Alabama rivers supported larger numbers of *A. alabamae* than the Coosa or Black Warrior rivers. Surveys have yielded only five *A. alabamae* in the Mobile River basin since 1994.¹¹⁹ Researchers located two *A. alabamae* below Miller's Ferry Lock and Dam in 1995 and 1997, and collected another from below Seldon Lock and Dam in 1998 — the first collected from this system in over 100 years. Surveys have located only four Alabama shad in the Black Warrior River; the species has not been collected nor observed from the Tombigbee River since the late 1950's. One *A. alabamae* has been located in the Coosa River, collected in 1878, 16 km upriver of the confluence with the Tallapoosa River. No *A. alabamae* exist in the Tallapoosa River. Almost 800 surveys located *A. alabamae* adult and juvenile specimens in the Cahaba River from 1954 to 1965; however, researchers collected the last specimen in 1968. In the Cahaba River, spawning runs of Alabama Shad were blocked by construction of two dams — Claiborne and Millers Ferry — on the Alabama River, which were completed in the early 1970s.

¹¹⁶IUCN 2021.

¹¹⁷IUCN 2021.

¹¹⁸Rider *et al.* 2021. 138.

¹¹⁹Rider *et al.* 2021. 137.

In the eastern Gulf Coastal Plain rivers of Alabama, there have been five documented specimens collected in the Yellow River — three in 1961, two in 1971, and 13 more between 1961 and 1977. Within the Conecuh-Escambia River, there are very few instances of *A. alabamae* — before the year 2000, specimen counts were as follows: 12 in 1957, 113 in 1958, 1 in 1976, 1 in 1988, and 1 in 1993. A total of 10 Alabama shad were caught from 2003 to 2015.

A focused survey for *A. alabamae* between 1992 and 1995 resulted in the capture of 11 adult fish in the Conecuh-Escambia River.¹²⁰ In the case of the Choctawhatchee River, considered the second-largest population of *A. alabamae*, 400 fish were collected between 1994 and 2001. These studies also suggested that the small populations in the Choctawhatchee and Conecuh rivers were self-sustaining.¹²¹

While historic surveys have reported on the lack of *A. alabamae* specimens, these have been general faunal surveys not targeting *A. alabamae* specifically.¹²² A 2021 study — using refined, targeted sampling methods — in the Alabama, Tombigbee, Conecuh, and Choctawhatchee rivers during the fish’s spring spawning migration still located Alabama shad specimens in worryingly low numbers. The study failed to locate *A. alabamae* in the Alabama River or Tombigbee River.¹²³ Researchers noted only four Alabama shad on the Conecuh River¹²⁴ and seven on the Choctawhatchee River.¹²⁵

Sampling efforts on the Choctawhatchee River in 2022 yielded three Alabama shad over the course of 11.4 hours of sampling efforts, for a rate of .26 catches per hour.¹²⁶ Sampling was targeted for Alabama shad at the location and time period conducive to locating the species.¹²⁷ Such numbers suggest that the historical distribution and relative abundance of the Alabama shad in Alabama have “decreased drastically”¹²⁸ and that the species has been extirpated from the Mobile River basin.

Surveys have located only 26 *A. alabamae* specimens in the Conecuh-Escambia River system since 1992 and none since 2015. Mortality may be higher than recruitment, and “severe imperilment of this population is evident.” The viability of a self-sustaining population is in doubt.¹²⁹

¹²⁰Rider *et al.* 2021. 137.

¹²¹Rider *et al.* 2021. 137.

¹²²Rider *et al.* 2021. 138.

¹²³Rider *et al.* 2021. 142.

¹²⁴Rider *et al.* 2021. 142.

¹²⁵Rider *et al.* 2021. 143.

¹²⁶Rider, pers. comm. November 3, 2023.

¹²⁷Rider, pers. comm. November 3, 2023.

¹²⁸Rider *et al.* 2021. 143.

¹²⁹Rider *et al.* 2021. 149.

While researchers have conducted no population estimates in the Choctawhatchee River, the Alabama shad's relative abundance (CPUE) has declined 50-fold, which translates to a decline in numbers by 98% in just over 20 years.¹³⁰

No females collected within the same 2021 survey were between the ages of 5-6, the stage at which the Alabama shad is most fecund. The construction of navigation locks and dams has accelerated population declines observed among the Alabama shad. In the Mobile River basin, 22 hydroelectric dams and navigation locks exist within Alabama's region of the basin — a fragmented habitat that has warranted listing under the Endangered Species Act for at least 32 aquatic animals and plants.¹³¹ Habitat fragmentation in the Mobile River basin also has led to declines among fish species like the Mooneye, *Hiodon tergisus*, and Southeastern Blue Sucker, *Cycleptus meridionalis*.

The construction of navigation dams and locks is not the sole factor contributing to the decline of the Alabama shad. The Choctawhatchee River, for example, is unimpounded along its 227 km length and is a relatively unimpounded river — 274 km of free-flowing river exists below Point A Reservoir. However, Alabama shad have not been observed in the Choctawhatchee in the past two decades. Therefore, other factors aside from habitat fragmentation are likely to be influencing the decline of *A. alabamae* in this drainage.¹³²

Patrick O'Neil, past Deputy Director at the Geological Survey of Alabama (GSA), surveyed the Alabama shad in the Choctawhatchee River in the early 2000s, where he observed what seemed to be healthy shad populations. O'Neil described the findings of Rider *et al.*'s 2021 study as “disturbing” and attributed declines or disappearance of the Alabama shad within the Choctawhatchee River to significant sedimentation in river channels.¹³³

O'Neil also noted that the existence of unpaved roads, agriculture, and forestry has caused significant silt and pollution to enter waterways like the Choctawhatchee, reducing the extent of viable spawning habitat for the species. Similarly, the Saline River in Arkansas is the only free-flowing river left in the state, yet there have been no recent reports of the Alabama shad in the river.¹³⁴

The Alabama shad has been extirpated from or declined within some of its most important strongholds in the state of Alabama. Dam construction and changing habitat conditions in free-flowing waterways pressure the species in some of its most crucial native river systems.

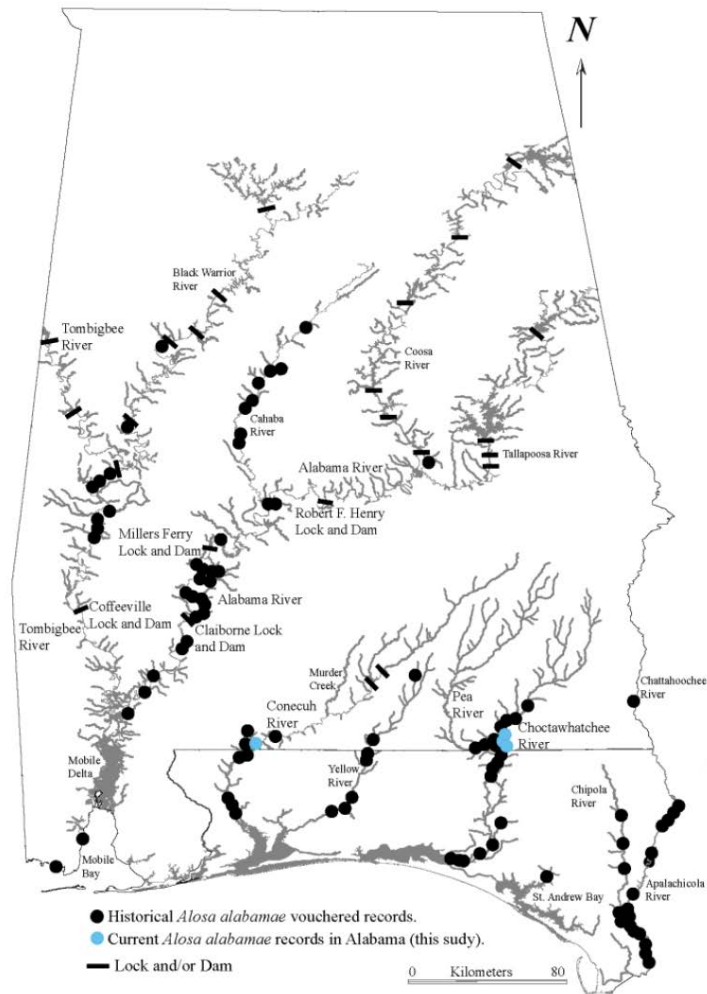
¹³⁰Rider *et al.* 2021. 149.

¹³¹Rider *et al.* 2021. 150.

¹³²Rider *et al.* 2021. 150.

¹³³O'Neil, pers. comm. Oct. 6, 2023.

¹³⁴Buchanan 1999. 25.



Rider et al. 2021 / Robins et al. 2018

Figure 6. Historical and current records of Alabama shad in Alabama and northwest Florida.

Florida

In Florida, the Alabama shad has declined precipitously in the Apalachicola, Choctawhatchee, and Escambia rivers — estimates indicate a greater than 90% decline over historical levels.¹³⁵

NOAA Fisheries’ 2017 negative finding failed to assess crucial references to the abundance of Alabama shad in Florida. Historical records reveal significant captures of Alabama shad in the Apalachicola River and its major tributary, the Chipola River, far surpassing current population

¹³⁵ NOAA Fisheries and USFWS Records 1900-2023.

levels. Reports document the presence of several hundred Alabama shad in gill nets in the Chipola River, with a record from Dead Lakes in 1978 noting 419 individuals and another from the Chipola River in 1954 capturing 157 individuals. Another report noted the Alabama shad to be “the most abundant anadromous fish found on the Gulf coast” and that the species “occurs in the greatest numbers in the Apalachicola River.”¹³⁶ The report also describes spring migrations of Alabama shad as “numerous enough to be caught by anglers,” and that “a commercial fishery for Alabama shad does not exist in Florida, even though the population appears large enough to support one.”¹³⁷ These historical figures, specifically from the Chipola watershed, highlight a stark contrast in the former abundance of Alabama shad when compared to recent observations, indicating a notable decline in their population in the Chipola River today.¹³⁸

Georgia

Alabama shad once occupied the Chattahoochee River, the most extensively used water resource in Georgia. Along the main channel of the river, there are thirteen dams, and at its terminus, the Jim Woodruff Lock and Dam (JWLD) impounds the Apalachicola River. River modification has altered natural flow patterns as different operational practices are used at numerous hydropower projects to maintain reservoir storage capacity.¹³⁹ To showcase the drastic effects of the Jim Woodruff Lock and Dam upon the Alabama shad, in 2015, there were only an estimated 324 individuals of the species in the Apalachicola river system.¹⁴⁰ Alabama shad appear to have crashed from historically large populations in the Apalachicola river system — since a year class of an estimated 122,578 individuals in 2012, population estimates have been low or unknown, and the species has not rebounded. While in 2011, 148 Alabama shad were caught in a gillnet, 19 were caught in 2012, 11 in 2013, 20 in 2014, none in 2015, 25 in 2016, 5 in 2017, and from 2017-2021, no individuals were caught or data is missing. While 19 individuals were caught in gillnets in 2022 and 37 in 2023, populations have not rebounded to levels recorded a decade ago — even with targeted survey efforts.¹⁴¹

A substantial portion of the available Alabama shad spawning habitat in the Chattahoochee River has been submerged by reservoirs. Out of the total river length of 560 river kilometers (348 river miles) extending from Buford Dam to the confluence with the Flint River, a significant stretch of 208 river kilometers (129 river miles) lies beneath eight major impoundments that cover more

¹³⁶U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

¹³⁷U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

¹³⁸Williams, pers. comm. December 7, 2023.

¹³⁹Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 25.

¹⁴⁰Ingram, Fisheries Biologist, Georgia Department of Natural Resources, September 2022.

¹⁴¹Alabama shad passage at JWLD. GADNR, Florida Fish and Wildlife Commission, USFWS, USGS, USACE, TNC, and Clemson University.

than 202 hectares (500 acres) each. The entire length of the river is significantly impacted by these impoundments, including Lake Seminole on the Apalachicola River.¹⁴²

Surveys have only collected the Alabama shad within the last ten years in Ichawaynochaway Creek, a tributary of the Flint River.¹⁴³ Dam construction in Georgia began in the early 1800s with the City Mills Dam and Eagle & Phenix Dam in the Fall Line Area. The Eagle & Phenix dam is impassable to the Alabama shad; the species' migration has been affected further by the construction of three USACE locks and dams — Jim Woodruff, George W. Answers, and Walter F. George. On Georgia's Flint River, two dams were constructed below Fall Line that blocked Alabama shad migrations to upstream habitats.¹⁴⁴

Mississippi

The Alabama shad was historically widespread throughout all major drainages in Mississippi. The Alabama shad has experienced a 50% decline in distribution in the state.¹⁴⁵ The species is now likely extirpated from the Tombigbee River.¹⁴⁶ The Pascagoula River may contain the only remaining population in Mississippi.¹⁴⁷

Dr. Jake Schaefer, an ichthyologist at the University of Southern Mississippi, said the species occurred historically in the Pearl, Arkansas, and Pascagoula rivers. The shad is now extirpated from the Pearl River due to damming, while populations likely persist in the Pascagoula as the river provides a clear, clean migration route for the species. He noted that targeted sampling efforts occurring from 2006-2011, in addition to general sampling since that period, have yielded very few Alabama shad. Schaefer said that he and his research team “almost never see them” and that numerous surveys over the past decade have located just 2 or 3 individuals.¹⁴⁸ Robert Ellwanger, an ichthyologist and Curator of Fishes and Mussels at the Mississippi Department of Wildlife, Fisheries, and Parks, noted that historical voucher records indicate that the Alabama shad was once “prevalent” in Mississippi rivers, yet today surveyors rarely see the species. Ellwanger said that damming on the Pearl River is likely to have driven declines of both the Alabama shad and the skipjack herring. In the Pascagoula, a relatively free-flowing river system, records of Alabama shad have also dwindled, highlighting that factors other than river modification and damming are also driving the decline of the species.¹⁴⁹

¹⁴²Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 25.

¹⁴³Georgia Department of Natural Resources 2022.

¹⁴⁴Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008.

¹⁴⁵IDNR 2015

¹⁴⁶Mississippi Natural Heritage Program 1999.

¹⁴⁷Mickle 2010. 1.

¹⁴⁸Schaefer, pers. comm., October 13, 2023.

¹⁴⁹Ellwanger, pers. comm., October 24, 2023.

Louisiana

The Alabama shad was thought to be extirpated from Louisiana's Pearl River, but one individual was collected in 2004.¹⁵⁰ A 1990 study involving 299,829 fish collections over 16 years on the Pearl River located 84 species of fish but took no Alabama shad specimens.¹⁵¹

Tennessee

The Alabama shad occurred historically in the Clinch and Stones Rivers in Tennessee, and researchers considered it to be widespread in rivers throughout the state prior to their impoundment. The species has not been collected or observed in the state since the early 1990s.¹⁵²

Oklahoma

The Alabama shad historically occurred within the Poteau and Illinois river drainages, as well as the Little River in McCurtain County. A small population could exist in the lower Illinois River, but it is likely to be extirpated from the state.¹⁵³

Missouri

Missouri may host the final spawning populations of the Alabama shad within the Mississippi River system. Between 1980 and 1995, 88 juveniles and eight adults were documented in 14 collections from various rivers in Missouri, including the lower Mississippi, Missouri, Meramec, Gasconade, and Osage Rivers. This count encompassed three locations in the Big River and one in the Bourbeuse River. Thirteen specimens were gathered from the Osage River in 1962. Since 1995, a total of 270 specimens have been collected from 76 locations, primarily in the Gasconade (119 specimens), and Meramec (134) Rivers. Notably, there have been no collections from the Big, Bourbeuse, and Osage Rivers during this period. The majority of Gasconade and Meramec River collections resulted from extensive sampling efforts during master's and doctoral thesis investigations (Pherigo 2019; Dunn *et al.* 2018; Dunn 2020). Interestingly, despite evidence of continued reproduction in the Gasconade and Meramec Rivers, this species went undetected in intensive monitoring and other research projects in the Middle Mississippi River, the region between the confluences of the Missouri and Ohio Rivers.¹⁵⁴

¹⁵⁰NatureServe 2023.

¹⁵¹Gunning and Suttikus 1990. 3.

¹⁵²NatureServe 2023.

¹⁵³NatureServe 2023.

¹⁵⁴Hrabik, pers. comm. Alabama Shad species account, *In prep.*; *Fishes of Missouri*, 3rd ed. Missouri Department of Conservation.

Robert Hrabik, ichthyologist at the Missouri Department of Conservation, noted that since 1995, survey efforts have only yielded 207 Alabama shad specimens in the state of Missouri. Hrabik added that a “very intensive monitoring program” on the Mississippi River — with research crews surveying five days a week — has to date failed to locate any Alabama shad individuals. He also noted that the species has seen a “shrinkage” of its range in the state. Intensive survey efforts, he noted, have successfully detected many rare and endangered species, but the Alabama shad remains difficult or impossible to find. Hrabik said that the species “seems to be hanging on by a thread.”¹⁵⁵

Kentucky

The last observation of an Alabama shad in Kentucky was in the Mississippi River in 1995.¹⁵⁶ The entire state has very few records, half of which are historical (pre-1900). No Alabama Shad records have been reported during the past ten years, and none have been reported from the Mississippi River bordering western Kentucky.¹⁵⁷

The Alabama Shad may still occur periodically in the Mississippi River bordering western Kentucky during spawning migrations. Its former abundance and presumably spawning activity in the Ohio River basin has long since ceased. The last record for the Ohio River basin was in 1986 from the lower Tennessee River; all records from the Ohio River pre-date 1900.

Arkansas

There are only 35 accounts of the species in Arkansas since 1879; since the 1990s, most records come from the Ouachita River system. There are no recent reports of Alabama shad in the Arkansas reach of the Mississippi River or the Arkansas River basin in more than a century.¹⁵⁸

Isolated records from the Mississippi River of Missouri, Kentucky, and Illinois in the 1970s, 1980s, and 1990s indicate that adult shad migrated through Arkansas during those decades. While Buchanan *et al.* reported some successful spawning in the Ouachita River drainage, the authors noted the potential detrimental effects on spawning due to the variability of dam discharge.

A 1999 study reported that the Alabama shad still ascended the Ouachita River from the Mississippi and Ouachita rivers despite “drastic declines” throughout the species’ range. Within the only free-flowing river in Arkansas, the Saline, surveys in 1971, the early 1980s, 1997, and

¹⁵⁵Hrabik, pers. comm. December 1, 2023.

¹⁵⁶NatureServe 2023.

¹⁵⁷Matt Thomas, pers. comm., October 13, 2023.

¹⁵⁸Eggleton *et al.* 2017. 1.

1998 failed to locate any Alabama shad specimens. The authors noted that 25 years of sampling by various methods commonly yielded *Alosa chrysichloris* but no *A. alabamae* specimens.

The study noted the “scarcity of records” of Alabama shad in Arkansas, citing the detrimental effect of dams preventing upstream migration in the state, with barriers at the Rammel Dam and Narrows Dam.¹⁵⁹ The study noted that variability in the water releases from the dams leads to significant fluctuations in discharge, current speed, and water temperature in the spawning areas; below the dams, river water levels can fluctuate as much as 1-2 meters daily, and water temperatures can vary by as much as 27 degrees Celsius daily. Authors noted that the species’ unusual reproduction pattern, the difficulty of sampling efforts, and the difficulty of distinguishing the species from the close skipjack herring could have contributed to scant records.

The majority of specimens collected in Arkansas have been juveniles, primarily during summer seining. Only a few adults have been found in Arkansas despite claims of annual spawning migrations. Most of the specimens in Arkansas (over 95%) were collected since 1997 and concentrated in the middle stretches of the Ouachita River system, between Rammel Dam and Camden, and the lower stretches of its largest tributary, the Little Missouri River, downstream of the Antoine River confluence. Due to the limited information available on Alabama shad in Arkansas, a study was conducted from 2019 to 2021 to assess its current distribution and status.¹⁶⁰

The study primarily focused on the Ouachita River over three years, with 75% of the sampling efforts concentrated within sections where historical collections had been more successful. The remaining efforts were divided between the Arkansas River (below dams 2-5) and the White River (below dam two downstream to Newport). Over three years, 274 10-minute boat electrofishing samples (equivalent to 46.3 hours of effort) and 447 seine hauls were conducted across all three rivers. Despite the substantial effort, surveys yielded only one adult Alabama shad specimen during the April 2019 collections, with no juveniles found in subsequent summer sampling.¹⁶¹

Anecdotal information suggests that researchers collected juvenile Alabama shad at three different locations in the Ouachita and Little Missouri rivers, but only during one year of the study, 2021. These surveys stand as one of the most extensive efforts ever made to collect the species in Arkansas.

While it is clear that fish passage at the Ouachita River dams is feasible, it is also evident that the construction of large dams on the Red River has led to the extirpation of Alabama Shad from a

¹⁵⁹Buchanan *et al.* 1999. 25.

¹⁶⁰Distribution and Status of Alabama Shad (*Alosa alabamae*) in Arkansas Rivers 2021 Final Report

¹⁶¹Distribution and Status of Alabama Shad (*Alosa alabamae*) in Arkansas Rivers 2021 Final Report

significant portion of the Red River system.¹⁶² These larger dams present an opportunity for the implementation of enhanced fish passage systems, but one must design these passage structures meticulously, or they may prove ineffective.¹⁶³ Before the construction of Millwood Dam, there was a population of Alabama Shad in Oklahoma's Little River.¹⁶⁴ To restore connectivity for migratory fishes, passage is required along the entire Red River navigation system.¹⁶⁵ It is undeniable that the range of the Alabama shad has been significantly reduced. Historical records from the 1940s and 1950s show the presence of *A. alabamae* in the Illinois, Poteau, and Little Rivers in Oklahoma, confirming its occurrence in the Mississippi, Arkansas, and Red Rivers of Arkansas. However, dams on the Illinois and Little rivers now block upstream access to those rivers.¹⁶⁶ Flow and temperature conditions within the system encompassing the Rempel Dam, DeGray Dam, and Narrows Dam exhibit significant variability, and it remains unknown how daily and annual fluctuations might interfere with typical migratory cues and potentially result in variations in recruitment.¹⁶⁷

¹⁶²Robison and Buchanan 2020. 181-183.

¹⁶³Quinn *et al.* 2023. 15.

¹⁶⁴Quinn *et al.* 2023. 15.

¹⁶⁵Quinn *et al.* 2023. 15.

¹⁶⁶Quinn *et al.* 2023. 15.

¹⁶⁷Quinn *et al.* 2023. 14.

THREATS

Present or threatened destruction, modification, or curtailment of habitat or range

U.S. rivers have become some of our planet's most impacted ecosystems within the last century; with rapidly-growing human populations and subsequent water demands, pressures on our nation's freshwater ecosystems will only increase. River systems have been heavily impacted by decreasing water quality, impoundments, and other navigational structures — threatening the viability of rare or declining species like the Alabama shad. As the Alabama shad inhabits both marine and freshwater environments, it faces threats in both ecosystems.¹⁶⁸

While it is often challenging to anticipate the population-level consequences of habitat loss or deterioration, the availability of habitat unquestionably sets a maximum threshold for reproduction. Any reduction in habitat diminishes the potential for reproduction. Even when specific information about population trends is unavailable, the widespread loss or conversion of habitat, evident in the case of the Alabama shad, can serve as a clear indicator of significant risk to the long-term viability of natural populations.¹⁶⁹

Reservoir construction on major tributaries

Perhaps the single most significant driver of the Alabama shad's decline and the most significant threat to its viability is the construction of dams on major tributaries. At least 85 dams have been built within the Alabama shad's historic range in the last century.

Water modification projects increased rapidly in the 1930s due to the Flood Control Act of 1928 and continue today — most rivers within the Alabama shad's historic range have been impounded, particularly those over 1,000 km in length.¹⁷⁰ Alabama shad migrate far upstream to spawn, so the effects of such habitat modification are particularly severe.

Dams have negatively affected fish populations around the world by impeding migration for spawning, feeding, and refuge and can concentrate adults in their tailwaters.¹⁷¹ Dams alter flow dynamics, disturb thermal patterns, alter sediment patterns, sever downstream habitat from previously contiguous habitat, and modify both aquatic and terrestrial habitats.¹⁷² Dams can also block the movement of resident fish interacting with migratory fishes, cause microevolution of

¹⁶⁸Limburg and Waldman 2003. 955.

¹⁶⁹Wainwright and Kope 1999. 446.

¹⁷⁰Smith *et al.* 2011. 27.

¹⁷¹McKee 2019. Abstract.

¹⁷²McKee 2019. 1.

fish obstructed by barriers, and impose a detrimental need for fish species to cross significant, unnatural stillwater habitats.¹⁷³ Delays due to dam presence can cause unsuccessful fish migration, and more direct effects like turbine death, gas bubble disease, and spillway passage can damage or kill migrating fish.

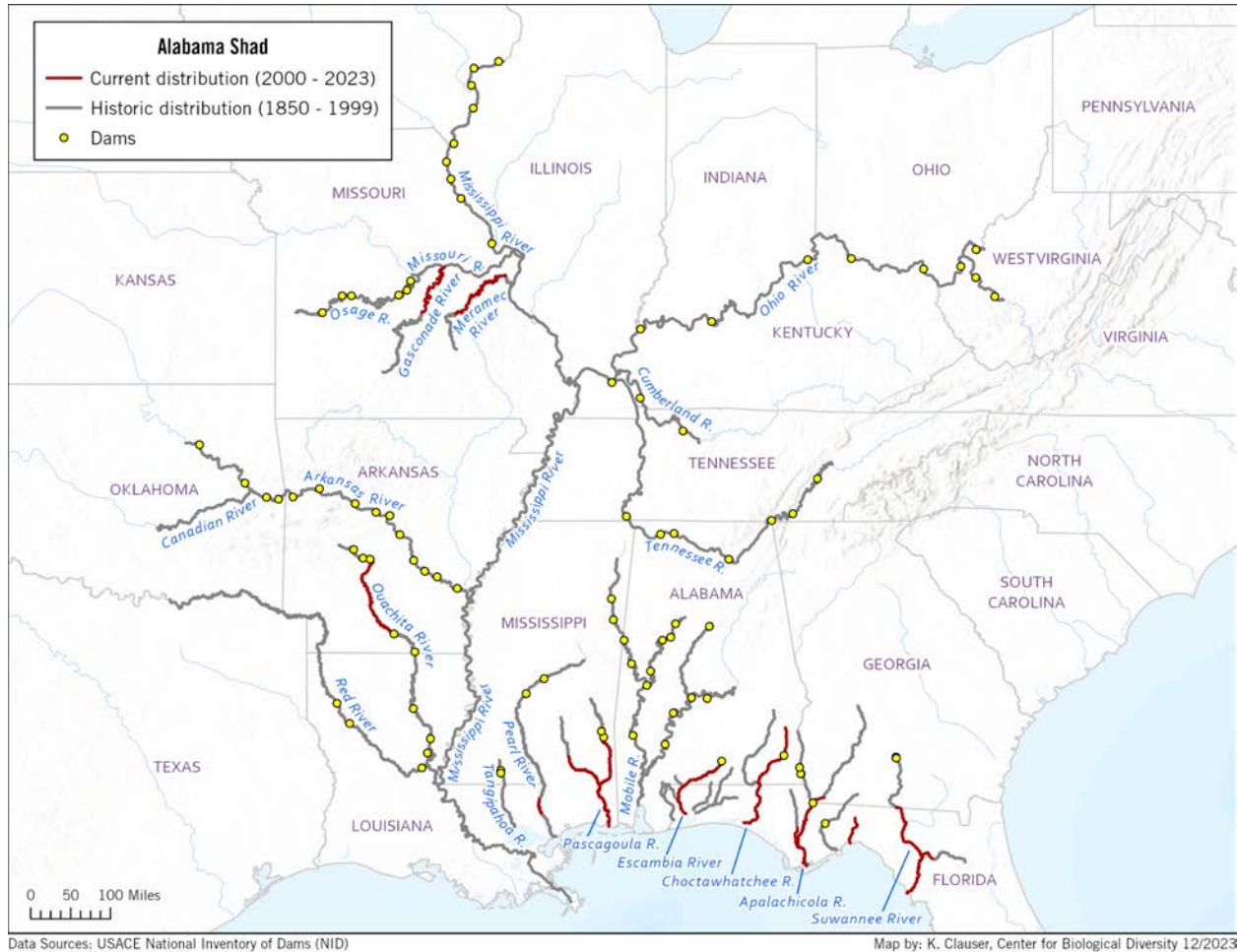


Figure 7. At least 85 dams have been built in the Alabama shad’s historical range. Dams impede Alabama shad and other anadromous fish on their spawning runs upriver.

Additionally, dams are a major negative impediment to the survival of species dependent on the Alabama shad. The Alabama shad is a host for a mussel species — *Elliptio crassidens* (Elephantear), as the shad were shown to yield a substantial number of juvenile mussels.¹⁷⁴ Out of the 12 fish species tested in a study, no others were found to be suitable hosts for this mussel

¹⁷³Limburg & Waldman 2009. 961.

¹⁷⁴Hart *et al.* 2018. 10.

species. This mussel species is likely to specialize in the *Alosa* genus. Confirmation of *Alosa* spp. as primary hosts for *E. crassidens* supports the notion that human-made structures like dams, which disrupt the migrations of these fishes, also play a pivotal role in the limited geographic range of these mussel species.¹⁷⁵

Most historical studies of the Alabama shad have relied on specimens gathered below dams; collection records from both state and federal agencies, as well as ichthyological collections, show that there have been few instances of collecting specimens upstream of dams.¹⁷⁶ Additionally, hydropeaking power-producing operations may lead to intermittent reductions in discharge levels that are essential for the survival of Alabama shad eggs.¹⁷⁷ These factors collectively pose challenges to the conservation of Alabama shad populations. Closely related American shad populations have also experienced declines due to dam construction.

Jim Woodruff Lock and Dam (JWLD)

The Apalachicola River below Jim Woodruff Lock and Dam (JWLD) in Northwest Florida supports the largest extant spawning population of the Alabama shad;¹⁷⁸ severely reduced populations of *A. alabamae* face the annual challenge of navigating this lock and dam. One study found passage efficiency of Alabama shad through the JWLD to be 59% when locks were in operation seven days per week between 0800-1600 hours.¹⁷⁹ Passage efficiency for American shad in Cape Fear River was 33% in 1996-1997, improving to 61% in 1998,¹⁸⁰ while efficiency was 53% in the Savannah River in 2001, declining to 9% in 2002.¹⁸¹ During a period of conservation locking, acoustically-tagged Alabama shad passed through locks with 45 percent efficiency.¹⁸²

¹⁷⁵Hart, Michael *et al.* 2018. 10.

¹⁷⁶Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 20.

¹⁷⁷PGEC 2005.

¹⁷⁸Young *et al.* 2012. 882.

¹⁷⁹Ely 2007. Abstract.

¹⁸⁰Moser *et al.* 2000. Abstract.

¹⁸¹Young *et al.* 2012. 887.

¹⁸²NOAA 2017. 4028.



USGS

The Jim Woodruff Lock and Dam (JWLD) is located on the Apalachicola River at the border of Georgia and Florida.

While NOAA’s 2017 negative finding claimed that Alabama shad can “easily access” over 150 mi (241.4 km) of historical habitat due to regular lock operation aligned with spawning, recent records suggest conservation locking activity to be inadequate for the conservation of the species. In the past, JWLD operated 24 hours a day, primarily to facilitate commercial barge traffic.¹⁸³ However, with the decline of commercial traffic in the late 1970s, the operation of the lock has been scaled back to just 8 hours per day, primarily to provide on-demand passage to recreational boats.¹⁸⁴ This reduction in operating hours led to a significant decrease in the number of lockages, which dropped to less than 100 per year, down from a peak of 1,200 lockages during the height of commercial usage.¹⁸⁵ Furthermore, the decline in barge traffic and the discontinuation of navigational dredging in 2001 further reduced the frequency of lock operation.¹⁸⁶

¹⁸³NOAA 2017. 4026.

¹⁸⁴NOAA 2017. 4026.

¹⁸⁵NOAA 2017. 4026.

¹⁸⁶NOAA 2017. 4026.

Passage efficiency of the Alabama shad through lock systems is variable, related to passage structure, current velocity, the seasonal and diel timing of locking procedures, and extreme water temperatures.¹⁸⁷ Diel timing of fish lockages is vital to the successful passage, with the highest success during daytime.¹⁸⁸ More frequent operation of lockages per day is positively correlated with passage efficiency.¹⁸⁹ Even when lockages are operated with sufficient frequency to permit upstream migration, juvenile Alabama shad must be provided passage downstream after hatching, adding another obstacle to the conservation of this sensitive species.

A 2007 study of Alabama shad below the JWLD found a higher percentage of age-1 males and no age-4 males;¹⁹⁰ fewer age classes and earlier age of maturation are consistent with declining or overexploited populations.¹⁹¹ This study also found lower average fecundity among Alabama shad populations than in previous studies, as well as an absence of spawning marks on individuals taken from the Apalachicola River.¹⁹² The authors suggested that discrepancies in spawning marks could be due to the long-term detriment of impeded migration and modified flow regimes.¹⁹³ Warmer temperatures below the dam could also increase mortality in low-flow years.

Other diadromous fish like the Alabama shad have been affected by the construction of the JWLD and similar dams. Before the construction of the JWLD, diadromous fish species had the freedom to migrate between the Gulf of Mexico and the ACF rivers to complete their life cycles. Since the dam's construction, access to crucial spawning, nursery, and adult habitats, both upstream and downstream of the dam, has been severely restricted or entirely blocked. This disruption in connectivity between the ACF rivers and the Gulf of Mexico has played a significant role in the severe declines observed in diadromous fish populations within this drainage.

JWLD also restricts the natural migrations of various other fish species, including American eel, skipjack herring, Apalachicola redhorse, mountain mullet, Atlantic needlefish, and hogchoker.¹⁹⁴ The Apalachicola River is home to a small but viable population of Gulf sturgeon,¹⁹⁵ The river also is home to one of the last naturally reproducing populations of Gulf Coast striped bass, historically valuable to commercial and recreational fisheries in the Gulf of Mexico estuaries and rivers. Unfortunately, these species have suffered significant declines due to various factors, including the blocking of upriver spawning and cool-water refuge habitats by dams, habitat loss,

¹⁸⁷Ely 2007. 1-2.

¹⁸⁸Ely 2007. 23.

¹⁸⁹Ely 2007. 23.

¹⁹⁰Ingram 2007. 21.

¹⁹¹NOAA 2017. 4028.

¹⁹²Ingram 2007. 22.

¹⁹³Ingram 2007. 22.

¹⁹⁴Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 15.

¹⁹⁵Wakeford 2001. 5.

and water quality degradation.¹⁹⁶ The river’s small Gulf sturgeon population, for example, faces challenges in terms of reproduction and recruitment. The inability to access other spawning or nursery habitats historically located upstream of JWLD hampers the recovery of this federally threatened species and other imperiled species like it.¹⁹⁷

Inadequacy of conservation locking regimes

While NOAA’s 2017 negative finding repeatedly cited the positive effects of conservation on the Alabama shad, particularly within the ACF River system, a closer look reveals that such conservation locking occurs infrequently or not at all — negating the possible positive effects of the action.

From 2017-2020, there were a total of 167 lock openings on the Jim Woodruff Dam, none of which were explicitly purposed for fish passage. From 2021-2022, records indicate that 14 lock openings took place, none noted to be conservation locking. A lockage information sheet for the ACF River system noted that locks would be operated only by appointment in an effort to reduce the costs of operation nationwide, a sure indicator that locking — aimed at conservation or otherwise — is waning. The rapidly declining frequency followed by outright discontinuation of conservation locking within the Alabama shad’s most critical habitat is of great concern for the anadromous species reliant on daily lockings aligned with its upstream and downstream migration windows. It is clear that current conservation locking regimes and implementation are vastly inadequate to support migration of the Alabama shad. NOAA’s 2017 negative finding leaned heavily on the merit and presumption of conservation locking to facilitate the Alabama shad’s conservation, yet the argument fails to hold water as conservation locking is occurring with extreme infrequency or not at all.

The aging Jim Woodruff dam is barely operational, and all but one of its locks gates are in need of repair. As a result, operators are limiting operations of its locks. Conservation locking has effectively ended at Jim Woodruff Dam for the foreseeable future.

Further, a study conducted on the Alabama River examined conservation locking regimes within the Claiborne and Millers Ferry Dams — lock gates on both dams are rarely used as commercial boat traffic has declined since the late 1970s. Even after the institution of a conservation locking program, fish rarely used the locks. The fixed crest spillways in place on the Claiborne Dam are only accessible to fish during flooding events and require strong-swimming fish like the paddlefish for passage.¹⁹⁸ The study concluded conservation lockages were not a “broadly successful conservation strategy.”

¹⁹⁶USFWS 1995; Wakeford in 2001; ACF SBTC (Apalachicola-Chattahoochee-Flint Sustainable Basingstoke and Deane Tidal Commission) 2004.

¹⁹⁷USFWS 1995; Wakeford 2001. 24.

¹⁹⁸Cromwell, Sydney. 2022. *River, interrupted*. August 6th: Southern Science: <https://southern-science.com/2022/08/06/dam-disconnect/>

Finally, during low flow or drought conditions — which are becoming more common throughout the Alabama shad’s range — there may be no fish passage under certain flow levels. If drought conditions occur in the Alabama shad’s native river basins during the spring, there may be no conservation lockage activity to permit passage of the Alabama Shad.¹⁹⁹

Dredging

Efforts to maintain a navigation channel in the Apalachicola River date back to the 1820s. In 1939, Congress authorized the US Army Corps of Engineers (USACE) to maintain a navigation channel measuring 2.7 meters wide by 30.5 meters long (9 feet by 100 feet) in the river. The construction of this navigation channel began in 1956, and maintenance dredging was typically conducted annually until 1999. Each year, approximately 800,000 cubic meters (1.05 million cubic yards) of sand were dredged from the river channel.²⁰⁰ Limited dredging took place in 2001, but since then, no dredging and snag removal activities have occurred in the Apalachicola River.²⁰¹

The construction and maintenance of the navigation channel led to the accumulation of a significant amount of dredged material in disposal sites located in upland areas, hardwood floodplains, and within riverbanks. This within-bank disposal impacted more than 40 kilometers (25 miles) of natural riverbank habitat, and during periods of high water, sand material was transported to various areas of the floodplain.²⁰² Between 1963 and 1970, a total of 29 training dikes or groins were constructed, mainly in the upper reaches of the river. These dikes were built to increase current velocities, aiming to reduce the need for dredging. Additionally, six cutoffs, mainly in the middle section of the river, were completed between 1956 and 1969. These cutoffs resulted in the loss of approximately 3.2 kilometers (2.0 miles) of river length. However, after their construction, increased meandering in the upstream reaches allowed the river to regain much of this lost length.²⁰³

The process of entrenchment, particularly in the upper river, caused the riverbed to lower and a decrease in water level by 1.5 meters (4.8 feet) at the US Geological Survey Chattahoochee Gage located at NM 105.7.²⁰⁴ Furthermore, limestone rock formations and rock shoals found only in the river’s upper 55 kilometers (34 miles) were removed from 10 locations between 1957 and 1984. Some of the extracted rock was placed on old within-bank disposal sites in an attempt to rehabilitate the unstable sand habitat. However, this rejuvenation was not explicitly assessed for its impact on Alabama shad spawning habitat. Removing rock shoals may have also affected the

¹⁹⁹Williams, pers. comm. November 14, 2023.

²⁰⁰Leitman *et al.* 1991. 223-246.

²⁰¹Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 12.

²⁰²Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 20.

²⁰³USACE 1986; Leitman *et al.* 1991; U.S. Geological Survey.

²⁰⁴Light *et al.* 2006.

available spawning habitat for Alabama shad and Gulf sturgeon. The last remaining rock shoal in the Apalachicola River is situated just downstream of JWLD, near NM 105.4. Alabama shad are presumed to be spawning at this location, as their access to other shoals upstream in the Chattahoochee and Flint rivers is restricted by JWLD.²⁰⁵

Modification and impoundment of riverine systems

Floodplains are critical to supporting riverine primary production, mitigating seasonal flood events, and maintaining the life cycles of lotic fish species.²⁰⁶ Floodplains serve as migration corridors for spawning species, as nursery grounds for juvenile fish, and are critical for fostering increased plant production and animal diversity. Dams and levees significantly disrupt the hydrology of floodplain and mainstem habitats, eliminating or modifying habitat and material essential for feeding, spawning, and rearing activities of riverine fish.

Flows in the Apalachicola River, home to the Alabama shad's largest populations, have been significantly impacted by dam building. The river has seen a reduced hydro-period over time, as well as reduced peak flows and peak river stages. The Apalachicola has also lost more water in its upper reaches than its lower reaches.²⁰⁷ These changes in flow will severely impact sediment transport and ecological processes along the river critical to the formation of Alabama shad spawning and migration habitat. The increased temperatures associated with climate change will also increase the evapotranspiration rate on reservoirs throughout the ACF system, further reducing the available water passing downstream — especially during drought years.

Increased sedimentation

The Choctawhatchee River supports the second largest population of Alabama shad; unfortunately, sediment pollution heavily impacts the river system. More than 25 % of the roads in the Choctawhatchee, Pea, and Yellow River watersheds consist of an unpaved or gravel surface of sandy to sandy clay loam soil material. These road surfaces and ditches can quickly erode and degrade, leading to sedimentation within watercourses, streams, and rivers.²⁰⁸

Heavy sediment loads cause excess turbidity and can impact fish physiology, behavior, habitat, growth, reproduction, and survival significantly. Anthropogenic turbidity can alter underwater visual environments with several behavioral consequences, such as diet shifts. Shad in turbid conditions, for example, are more likely to swim higher in the water column and are thus more vulnerable to predation.²⁰⁹ Turbid waters particularly impact insectivorous fish like the Alabama

²⁰⁵Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 20.

²⁰⁶Burgess *et al.* 2012. Abstract.

²⁰⁷Joshi 2019. 0157.

²⁰⁸Choctawhatchee, Pea, and Yellow Rivers Watershed Management Authority 2000.

²⁰⁹Nieman *et al.* 2020. 594.

shad, where suspended sediments significantly reduce their foraging success. Turbidity can physically damage a fish's gill structures.

Robert Hrabik, ichthyologist with the Missouri Department of Conservation and author of the *Fishes of Missouri*, expressed concern over the impact of urbanization and sprawl on the Alabama shad's riverine habitat, especially in the Meramec River near St. Louis, Mo. Alabama shad have regularly been observed upstream in the Meramec, but few to no observations of Alabama shad have occurred in the sprawling urban and exurban corridor of the Meramec as it approaches St. Louis and the Mississippi River. Alabama shad also have not been detected downstream of metropolitan St. Louis in the Mississippi River. Increased sedimentation, pollution, and turbidity may prevent Alabama shad from inhabiting sprawling urban and industrial corridors.²¹⁰

Disrupted flow regimes

Reservoirs have had a general impact on the flow regime of the Alabama shad's native river habitats, disrupting the cues necessary for the species' reproduction and survival.

Dam building has caused disruptions to the Chattahoochee River by flattening its hydrograph, reducing the magnitude and frequency of higher flows while increasing the magnitude and frequency of lower flows. This flattening effect is most pronounced from Buford Dam to West Point. However, in the rest of the river, the ratio of upstream storage capacity to average annual discharge is relatively low. As a result, the ability to increase low flow levels with releases from storage is generally limited.²¹¹

In the Apalachicola River, the impact of the reservoir system on the natural flow regime is generally less significant than natural fluctuations, except during periods of low discharge. During these low discharge periods, the reservoir system does have some capacity to supplement downstream flows. However, this potential is constrained by limited storage capacity in the lower reservoirs and competing demands for water. Historically, up until the 1990s and during years with normal rainfall, factors like hydropower generation, navigation, and recreation were the primary influences on water release schedules.²¹² However, since the 1990s, navigation has become less influential in determining water releases. In drought conditions, municipal, industrial, recreational, and agricultural demands become the dominant factors affecting water releases. The limited storage capacity in downstream reservoirs and increased agricultural withdrawals during periods of low rainfall can lead to reduced discharge in the lower stretches of the Apalachicola-Chattahoochee-Flint (ACF) system.²¹³

²¹⁰Hrabik, pers. comm. December 5, 2023.

²¹¹Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 30.

²¹²Leitman *et al.* 1991. 223-246.

²¹³Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 30.

The spawning phase of Alabama shad may be influenced heavily by disrupted flow regime factors such as temperature, flow volume, and the timing of releases from hydropower projects. Water quality concerns, specifically below reservoirs, might be of greater significance during the egg, larval, and outmigration stages of the Alabama shad's life cycle. These early life stages could be more sensitive to deteriorating water quality conditions.

Across the species' range, the presence of diverse habitat types is likely essential for the recruitment of juveniles and the sustainability of a viable population. Many documented extirpations of the species have occurred in dammed systems, where critical habitat types may have been lost downstream of dams. In these altered environments, the natural hydrological patterns and sediment transport mechanisms no longer function as historically, leading to inevitable changes in water depths and flows that many species rely on to complete their life cycles.²¹⁴

Research on other river-dwelling species supports the idea of changing Essential Fish Habitat (EFH) through successive ontogenetic stages. For instance, Pacific salmon, brown trout, and alewife all require a range of habitats to support the developmental changes that occur during their first year of life. Several factors influence these shifts, including dietary needs, water quality requirements, and predation pressure. As these ontogenetic changes occur during recruitment, a mix of different habitat types and variations in physicochemical conditions may be critical for these species within their native environments. Disrupted flow regimes significantly alter the physical and physicochemical conditions required by the Alabama shad for survival.

Future river modification projects and the inadequacy of dam removal

While NOAA's 2017 negative finding stated that "few new dams are being built today,"²¹⁵ and that the "threat of dams to Alabama shad is more likely to decrease in the future, as dams are either removed or additional fish passages are added,"²¹⁶ several river modification projects are presently proposed within the Alabama shad's native range. Dam removal would require congressional authorization and is unlikely to occur within the timeframe required to recover Alabama shad populations.

The U.S. Army Corps of Engineers has proposed a flood control project, known as the "One Lake Project, on the Pearl River. The modification will create a 1500-acre lake and could hamper potential migrations of the Alabama shad within one of its historic native river habitats. The One Lake project could also affect future Alabama shad reintroduction efforts on the Pearl River. The U.S. Army Corps of Engineers, Mobile District (USACE Mobile District) is also reviewing a permit application to construct two water supply lakes for maintaining Pascagoula River flow

²¹⁴Mickle 2010. 13-14.

²¹⁵NOAA 2017. 4036.

²¹⁶NOAA 2017. 4036.

during drought periods. Known as the “Lake George” project, multiple species, including the Alabama shad and gulf sturgeon, would be heavily impacted.

Pollution

NOAA’s 2017 negative finding conducted a review of water quality assessment reports for ten river systems: (1) ACF; (2) the Missouri/Gasconade/Osage; (3) Meramec; (4) White; (5) Ouachita/Little Missouri; (6) Pascagoula/Leaf/Chickasawhay; (7) Mobile/Alabama; (8) Escambia/Conecuh; (9) Choctawhatchee/Pea; and (10) the Suwanee. Water quality was suitable for 2,150 miles, accounting for 48 percent of the assessed mileage. About 2,100 miles (47 percent) were designated as impaired, indicating one or more issues that prevented the river systems from meeting water quality standards. Mercury levels impaired all rivers other than the Meramec and White Rivers. Low dissolved oxygen impaired all river systems other than the Meramec, Pascagoula, Leaf, and Chicksawhay. Alabama shad prefer cooler river waters with high dissolved oxygen (DO);²¹⁷ insufficient levels of DO can cause hypoxia with detrimental effects on fish larvae. In the American shad, closely related to the Alabama shad, low DO was found to impact shad larvae negatively, and levels below 80% (6.94 mg) reduced egg viability.²¹⁸

This same assessment designated segments of several river systems that are home to Alabama shad as impaired due to issues related to biota. In this context, "biota" refers to the community of aquatic animals, including fish, reptiles, amphibians, aquatic insects, and other aquatic life forms, that one would typically expect in a healthy waterway. When these aquatic communities are considered unhealthy, reduced, or absent, and the exact cause of this problem is unknown, the water quality is categorized as impaired. The Chattahoochee River was designated as impaired based on issues related to fish biota, which means that the presence and health of the fish populations in that segment of the river were not as they should be in a healthy waterway. The underlying cause of this problem still needs to be definitively identified. The Flint and Osage Rivers are impaired due to benthic and aquatic macroinvertebrates, and the Leaf River was designated impaired due to biological impairment.

The White, Leaf, and Conecuh Rivers were classified as impaired due to issues related to sedimentation. Other factors contributing to impairments in various river systems were also identified. These include the presence of PCBs (Polychlorinated Biphenyls) in the Chattahoochee River, organic material in the Conecuh River, algal growth and chlorophyll-a levels in the Suwannee River, and salinity, solids, chlorides, and sulfites in the Suwannee River.

The Alabama shad also encounters significant pollution in its coastal habitat. Human activities heavily influence waters in the Gulf of Mexico, primarily through the input of excess nutrients. Eutrophication has led to low dissolved oxygen and increased chlorophyll *a* concentrations,

²¹⁷NOAA 2017. 4025.

²¹⁸Fuda 2006. viii.

reduced water clarity, the outgrowth of toxic algal blooms, and the loss of submerged aquatic vegetation.²¹⁹ The National Coastal Condition Report (NCCR) 2015 found that 18% of the Gulf of Mexico estuarine areas were in good condition, 55% were in fair condition, and 28% were in poor condition based on the eutrophication index. Ecological fish tissue contamination was degraded in Gulf of Mexico estuaries, with 74% of waters in poor condition and 15% in fair condition, higher than the national estimate of 55%.

Human activity has heavily influenced coastal waters where the Alabama shad conducts portions of its lifecycle; these anthropogenic pressures will only build with time as the population grows in coastal counties along the Gulf of Mexico. The population of the 48 coastal counties along the Gulf of Mexico increased by more than 133% from 4.9 million people in 1960 to 11.3 million people in 2000.²²⁰

Land use practices play a significant role in shaping water quality within the ACF (Apalachicola-Chattahoochee-Flint) system. Substantial influences on water quality are exerted by agriculture and urban development — particularly in the upper Flint and Chattahoochee River basins. In these areas, urbanization has the most significant impact on water quality due to both point sources like wastewater discharge and nonpoint sources such as urban runoff.²²¹

In the lower Flint, Chattahoochee, and Apalachicola River basins, nonpoint pollution stemming from agriculture and silviculture practices has the most significant impact on water quality. Agricultural and forestry activities significantly affect the water quality in these regions; land use within the Apalachicola basin is mostly forestry.²²²

Throughout 73 percent of the ACF basin, several pesticides are heavily utilized — bentazon, paraquat, 2,4-DB, methanearsonate (MSMA/DSMA), alachlor, and pendimethalin, with applications covering extensive acreage. The most substantial quantities of pesticides were associated with alachlor, MSMA/DSMA, fluometuron, atrazine, metolachlor, and bentazon.²²³

Pesticides are employed in forested areas managed for silviculture, constituting about 64 percent of the ACF River basin. The period between clear-cutting and the establishment of stable forest growth is also a critical time for potential runoff and erosion, coinciding with heavy pesticide use and the heightened vulnerability of water resources to contamination.²²⁴

²¹⁹Kennicutt 2017. 75.

²²⁰Kennicutt 2017. 58.

²²¹Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 29.

²²²Mickle 2010. 39.

²²³The Apalachicola-Chattahoochee-Flint (ACF) River National Water Quality Assessment (NAWQA) Program study.

²²⁴The Apalachicola-Chattahoochee-Flint (ACF) River National Water Quality Assessment (NAWQA) Program study.

In urban and suburban areas, constituting approximately four percent of the ACF River basin, pesticides are applied to turf, lawns, and roadsides to control weeds, insects, and pests.²²⁵ Several pesticides are widely used across the ACF River basin, particularly for treating pests (other than weeds) in agricultural, silvicultural, urban, and suburban areas.²²⁶

Pesticides are known to have adverse effects on the hemato-biochemistry and tissue histology of freshwater fish. Due to the large surface area of gills and direct contact with the aquatic environment, fish are vulnerable to pollutants and fluctuations in water quality.²²⁷

Conductivity

In one study, conductivity, rather than temperature, was the most reliable predictor of the presence or absence of shad.²²⁸ In other ecosystems, conductivity influences the presence of species at different trophic levels, including plankton, aquatic insects, shads, and basses.²²⁹

Human disturbance tends to increase the amount of dissolved solids in river systems, which increases conductivity; by the conclusion of this century, the median electrical conductivity could rise from 0.319 mS cm⁻¹ to 0.524 mS cm⁻¹ in U.S. streams. More than 50% of streams may experience electrical conductivity increases exceeding 50%, and around 35% could see their electrical conductivity more than double.²³⁰

As river conductivity changes in response to land use and climate-related factors, the range of suitable habitat available for the Alabama shad will shrink further, pressuring the already range-restricted species.

Oil spills

On April 20, 2010, an explosion and fire occurred while drilling an exploratory well in the Gulf of Mexico. This incident took place approximately 50 miles southeast of the Mississippi River Delta, Louisiana, and 87 miles south of Dauphin Island, Alabama. As a result of the explosion, the semi-submersible Deepwater Horizon (DWH) drilling rig sank, leading to the release of oil and natural gas into the Gulf of Mexico. The well was temporarily capped on July 15, 2010, which helped reduce the amount of oil leaking, but it wasn't officially sealed until September 19, 2010.²³¹

²²⁵The Apalachicola-Chattahoochee-Flint (ACF) River National Water Quality Assessment (NAWQA) Program study.

²²⁶The Apalachicola-Chattahoochee-Flint (ACF) River National Water Quality Assessment (NAWQA) Program study.

²²⁷Ghayyur 2021. 609.

²²⁸Mickle *et al.* 2010. 13.

²²⁹Mickle *et al.* 2010. 13.

²³⁰Olson 2019. 1.

²³¹NOAA 2017. 4051.

Estimates of the quantity of released oil varied over time, but the final official figures indicated that between 53,000 and 62,000 barrels were released daily during the event. In total, wells leaked 4.9 million barrels (approximately 780,000 cubic meters) of oil into the Gulf of Mexico.²³² Additionally, around 2.1 million gallons of chemical dispersant were applied, with 1.4 million gallons applied to surface waters and 0.77 million gallons applied directly at the wellhead between May 15 and July 12, 2010.²³³

There are no studies examining the direct effect of the DWH spill on the Alabama shad. It is, however, likely that the spill zone overlapped with the Alabama shad's range, and the species came in contact with oil or chemical dispersants resulting from the spill.²³⁴ As the DWH spill occurred in April when females were upriver, it is unlikely that spawning adults and early-life Alabama shad were exposed to toxins. Oil and dispersant chemicals could endanger juvenile and non-spawning individuals.

In November 2023, a pipeline leak occurred in the Gulf of Mexico. To date, the leak is estimated to have discharged over one million gallons of crude oil and prompted the closure of a 67-mile undersea pipeline by Main Pass Oil Gathering Co (MPOG). The Main Pass Oil Spill is the second largest in Gulf history behind Deepwater Horizon. The incident occurred around 19 miles offshore of the Mississippi River Delta, near Plaquemines Parish, situated southeast of New Orleans.²³⁵

Oil spills, oil drilling, and oil infrastructure will continue to pose a threat to the Alabama shad for the foreseeable future. In December 2023, the Biden administration offered oil leases on more than 300 parcels in the Gulf of Mexico encompassing 2,700 square miles (7,000 square kilometers) in Alabama shad habitat. Major oil companies including Chevron, Hess, and BP, bid \$382 million for offshore drilling rights in these parcels. The expansion of offshore oil and gas leases raises concerns about potential oil spills and their impact on anadromous fish species like the Alabama shad.²³⁶

The Main Pass Oil Spill presents a serious threat to the oceangoing Alabama shad, which have relied about the waters offshore of the Mississippi Delta to overwinter before making spawning runs upriver. While 2010's Deepwater Horizon Spill garnered widespread public attention, dozens of fires and explosions like the November 2023 disaster have occurred since and received comparatively little attention. Further, pinpointing and addressing a leak can be exceedingly

²³²NOAA 2017. 4051.

²³³NOAA 2017. 4051.

²³⁴NOAA 2017. 4051.

²³⁵Houston Chronicle, 2023. *A million gallons of oil spilled in the Gulf of Mexico. Who will clean it up?* November 29th: <https://www.houstonchronicle.com/opinion/editorials/article/gulf-oil-spill-louisiana-texas-18519266.php>

²³⁶Metro, 2023. *Oil companies offer \$382M for drilling rights in Gulf of Mexico in last offshore sale before 2025.* December 20th: <https://www.metro.us/oil-companies-offer-382m-for-offshore-drilling-rights-in-last-sale-before-2025/>

difficult, and measuring the impacts upon biodiversity can take years.²³⁷ The Gulf of Mexico is thus ever vulnerable to potential oil spills and leaks; Deepwater Horizon and the Main Pass oil spills are two of the worst and most recent oil spills among a long list of oceanic disasters with the potential to threaten the Alabama shad.

Thousands of oil spills occur each year in the Gulf of Mexico, according to NOAA, and at least 44 recent spills have leaked a half-million gallons or more.²³⁸

Oil exposure can have chronic adverse effects on fish and delayed indirect impacts that can cascade through the affected ecosystem. Fish can suffer from difficulties in growth, survival, or reproduction or modified migratory behaviors due to oil exposure.²³⁹ Polycyclic aromatic hydrocarbons, or PAHs, a compound present in oil, are known to disrupt cardiac function in fish by damaging ion channels within the animal's heart muscle cells.²⁴⁰ PAH exposure can also cause DNA damage, internal and external lesions, gill and organ dysfunction, and reduced survival to maturity.²⁴¹

Mining practices

Sand and gravel mining within the Alabama shad's native rivers threaten to modify or destroy critical spawning habitat. Mining activities conducted on the Pearl and Bogue Chitto rivers in Louisiana have historically disrupted the breeding cycle of the Alabama Shad. These practices involved the removal of sand and gravel from riverbeds, significantly reducing the available substrate required for the fish's reproduction.²⁴² Today, sand and gravel mining is permitted in the Chattahoochee River Basin, and illegal mining continues to affect waterways.²⁴³ The suburban areas surrounding the Chattahoochee River National Recreation Area are undergoing significant and fast-paced development and expansion. According to population projections, the total population in the metro Atlanta region will grow by 51% between 2015 and 2050. Development of the surrounding land, resource management issues, and improper utilization of resources — such as illegal gold mining — will continue to affect the region as populations grow. Sand, gravel, and illicit gold mining threaten to modify or destroy habitat within one of the Alabama shad's most critical population strongholds.

²³⁷Houston Chronicle, 2023. *A million gallons of oil spilled in the Gulf of Mexico. Who will clean it up?* November 29th: <https://www.houstonchronicle.com/opinion/editorials/article/gulf-oil-spill-louisiana-texas-18519266.php>

²³⁸NOAA Office of Response and Restoration. "Oil and Chemical Spills." November 21, 2023. "Five Things to Know about the Gulf of Mexico Oil Spill." The Hill. November 21, 2023.

²³⁹Fodrie and Heck 2011. 4.

²⁴⁰NOAA 2014. *Heart Failure in Fish Exposed to Oil Spills*. February 13th: <https://www.fisheries.noaa.gov/feature-story/heart-failure-fish-exposed-oil-spills#:~:text=Even%20low%20levels%20of%20oil,s oaked%20seabirds%20come%20to%20mind.>

²⁴¹Snyder *et al.* 2015. 8786.

²⁴²Holcomb *et al.* 2015. 370.

²⁴³Chattahoochee River National Recreation Area Geologic Resources Inventory Report 2022.

Further, proposed graphite mining projects along Alabama's Coosa River threaten to modify habitat within one of the Alabama shad's native rivers. Westwater Resources secured mineral rights for 42,000 acres with substantial graphite deposits in 2018 and anticipates commencing mining activities by 2028. Alabama Graphite's processing facility will initially yield around 7,500 tons of battery-grade graphite annually, with plans for future expansion to reach 15,000 tons.²⁴⁴

Electric generating plants and other facilities

Electric generating plants and other facilities withdrawing water from the Alabama shad's native rivers may kill high numbers of young diadromous fishes through entrainment and by impinging larger specimens against intake screens.²⁴⁵ Power plants also affect local temperature regimes through discharges of warm water, endangering the temperature-sensitive Alabama shad. Low dissolved oxygen resulting from industrial discharges is known to affect other *Alosa* species on the Atlantic coast.²⁴⁶ Research indicates that the elevated temperatures caused by human activities and reduced oxygen levels have adversely impacted the migration success of various diadromous species at different points in their life cycle. These human-induced alterations introduce additional pressures that ultimately lead to reduced reproductive success within populations.²⁴⁷

Thermoelectric power plants, generally concentrated in regions with more water availability like the Southeast, appear in crucial areas and mouths of rivers where Alabama shad congregate.²⁴⁸ For example, in the ACF river basin, the second largest use of surface water is thermoelectric power generation.²⁴⁹ The Mobile River basin, historically one of the Alabama shad's most critical habitats, has been plagued by the polluting effects of power plants. The Mobile River has been deemed one of America's most endangered rivers where Alabama Power's Plant Barry contains more than 21 million tons of toxic coal ash, and radium, mercury, arsenic, and other cancer-causing chemicals pollute its waters.²⁵⁰

Prolonged drought

The Southeast region is generally considered rainfall-rich; however, the area has experienced increasingly severe droughts worsened by heightening water demands.²⁵¹ Drought conditions

²⁴⁴Underwood, Jerry. 2021. *Westwater resources plans first U.S. graphite processing plant in Alabama*. June 22: <https://www.madeinalabama.com/2021/06/westwater-resources-plans-first-u-s-graphite-processing-plant-in-alabama/>

²⁴⁵Limburg and Waldman 2009. 962.

²⁴⁶NOAA 2017. 4047.

²⁴⁷Bannon and Ling 2003.

²⁴⁸Power Plants in the United States. <https://synapse.maps.arcgis.com/apps/dashboards/201fc98c0d74482d8b3acb0c4cc47f16>

²⁴⁹USGS.

²⁵⁰Sierra Club 2022. *Mobile River named among America's Most Endangered Rivers of 2022*. April 20th:

<https://www.sierraclub.org/alabama/blog/2022/04/mobile-river-named-among-america-s-most-endangered-rivers-2022>

²⁵¹National Integrated Drought Information System.

present a growing threat to the Alabama shad, a species sensitive to water temperatures, depth, and salinity — factors slated to change significantly in light of both the immediate and long-term effects of drought. Temperature changes and hypoxia can have significant adverse impacts on the migration success of several diadromous species throughout their lifecycle, stressors that ultimately lessen reproductive success within populations.²⁵²

Water shortages have historically plagued the ACF river system, a threat that ENSO or other climate dynamics could exacerbate in the future. Today, the southeastern U.S. is prone to droughts as severe or more severe than those over the instrumental record; beyond the immediate effects of scant rainfall, such diffuse effects can accumulate slowly over time and lead to “pervasive hydrological drought.”²⁵³ Drought conditions have been rendered more severe by dense and growing populations in the ACF river basin and significant water consumption; the Metropolitan North Georgia Water Planning District forecasts a 60% growth in demand for water by 2035.

Low flow rates

Record-setting low-flow rates have plagued the Alabama shad’s native rivers, impacting natural river flows, estuary health, and water conditions. Lower surface water inputs and subsequent decreased discharge levels increase river temperatures and can drive Alabama shad to seek cooler water microhabitats; while little is known of the species’ temperature tolerance, other members of the genus to which the Alabama shad belongs can experience die offs due to elevated temperatures.²⁵⁴ Alabama shad are sensitive to changes in water temperature, as they enter rivers when water temperatures reach a certain threshold, and gonads ripen with increasing water temperature.²⁵⁵

The Apalachicola River, once the Alabama shad’s most vital population stronghold, has less groundwater input and runoff late in summer. It is also a wide river with low flow velocity, and is fed by a shallow lake, lake Seminole. The river’s flow is also held artificially at drought levels for long periods during dry conditions to keep reservoir Lake Lanier full.²⁵⁶ As population growth throughout the ACF Basin continues to strain water resources, the frequency of anthropogenically induced low-flow periods will likely increase. The river is thus sensitive to increased temperatures, which could drastically imperil the sensitive Alabama shad.²⁵⁷ When extreme low water events take place, the Alabama shad’s refugia may vanish, and recruitment could be disrupted — highlighting the necessity for a minimum flow requirement.²⁵⁸

²⁵²Bannon and Ling 2003. 207.

²⁵³Pederson *et al.* 2012. 7.

²⁵⁴Mickle 2010. 12.

²⁵⁵NOAA 2017. 4024.

²⁵⁶America’s Most Endangered Rivers for 2016.

²⁵⁷Mickle 2010. 12.

²⁵⁸Mickle 2010. 13.

An analysis of the Alabama shad's Pascagoula River habitat indicated that lower temperatures emerged as the primary factor associated with the presence of Alabama shad. Additionally, a comprehensive habitat utilization study conducted within the Pascagoula highlighted the significance of temperature as a crucial predictor for the existence of shad. The study also suggested that thermal refuges within the river system might play a critical role in the success of shad recruitment.²⁵⁹ Low flow rates and subsequent warmer water temperatures could extirpate the Alabama shad from some of its most vital habitats.

Changes in marine habitat

Several factors are potentially affecting Alabama Shad in marine waters. These factors include issues such as the Gulf hypoxic zone, oil spills, an increased frequency of hurricanes leading to fish kills, alterations in salinity, and changes in habitat.²⁶⁰ The Alabama shad's marine life stage is virtually unstudied; thus, it is unknown how changes in the marine environment could affect the species. Several fisheries biologists underscored the dual concern that the Alabama shad faces significant potential threats within its marine habitat while concerningly little is known about the species' range, habitat requirements, and behavior within the Gulf of Mexico. In light of the species' population crash after 2012, how the species is affected in its marine habitat — described as a “black box”²⁶¹ — should remain a concern.²⁶²

Each summer, a zone with low oxygen levels, often termed a dead zone, emerges along the Texas-Louisiana shelf. The dead zone occurs when nutrient-rich freshwater from the Mississippi and Atchafalaya Rivers enters the Gulf of Mexico. Interestingly, organisms may become trapped and perish, creating desolate zones that are typically vibrant with life.

Fisheries biologist Jeffrey Quinn noted that this hypoxic zone could significantly threaten the Alabama shad. This hypoxic zone typically forms in the summer, but Quinn and various studies have indicated that Alabama shad seem to be moving unpredictably and at all times of the year. Quinn noted that the Alabama shad's emergence at the incorrect time of year could cause individuals to come into contact with this potentially detrimental zone lacking high dissolved oxygen concentrations required by the Alabama shad.²⁶³

The Gulf of Mexico has also experienced long-term warming trends. Sea surface temperature (SST) increased approximately 1.0°C (1.8°F) between 1970 and 2020, equivalent to a warming rate of roughly 0.19°C (0.34°F) per decade at twice the rate of warming in the global ocean near the sea surface. Warming occurred at all depths from the sea surface to bottom, with greatest

²⁵⁹Mickle 2010. 12-13.

²⁶⁰Quinn *et al.* 2023. 14.

²⁶¹Travis Ingram, pers. comm., December 2023.

²⁶²Steve Sammons, pers. comm. December 13, 2023.

²⁶³Jeffrey Quinn, pers. comm. October 17, 2023.

rates in the upper 50 meters (164 feet).²⁶⁴ These warming trends can intensify existing threats to the Gulf of Mexico, such as sea level rise and the formation of hypoxic areas. Additionally, oceanic warming contributes to the increased intensity of hurricanes.²⁶⁵ Hurricanes can cause sudden changes in salinity, low dissolved oxygen, and oceanic turnover — events deadly to marine life, mainly fish, crabs, sea turtles, and other species sensitive to rapid changes in water quality. Between 1979 and 2017, there has been a notable increase in the number of major hurricanes, while the number of minor hurricanes has declined. This trend is expected to continue, with projections indicating an increase in Category 4 and 5 hurricanes, as well as higher hurricane wind speeds.²⁶⁶ Hurricanes have caused mass die-offs in similarly imperiled species like the gulf sturgeon; thus, projected increases in major hurricanes threaten the anadromous Alabama shad. Further, the increasingly hurricane-prone Gulf of Mexico coast is lined with chemical plants — including about half of the nation’s oil and gas refineries²⁶⁷ — making future oil or chemical spills a looming threat for coastal species like the Alabama shad.

The conversion of wetlands to other uses, climate change, freshwater inflow, and saltwater intrusion significantly threaten Gulf coastal wetlands. Coastal fish species, and in particular, anadromous species, often use coastal marshes as “nursery” habitats.²⁶⁸ Alabama shad likely utilize habitats and food resources offered by coastal wetlands as a species preferring to remain close to shore; with changes to coastal wetland habitat, the species may lose habitat critical to part of its lifecycle.

Overutilization

Commercial fishing and bycatch

The Alabama shad once migrated up the Mississippi River and several significant tributaries, including the Red, Ouachita, Arkansas, Missouri, Ohio, and Tennessee rivers.²⁶⁹ In the late 1800s, it was common during the Alabama shad’s spring spawning runs to sustain a commercial fishery within the Mississippi River system,²⁷⁰ and the Alabama shad was reputed as a highly regarded food fish.²⁷¹ Reported commercial landings of Alabama shad were 3,165 kg in 1889 and 48 kg in 1902; no commercial landings have since been reported.²⁷² Perhaps pressured by fishing

²⁶⁴NOAA 2023.

²⁶⁵NOAA 2023.

²⁶⁶NOAA 2023.

²⁶⁷Haughey, Addie. 2022. Putting Justice First in Ocean Policy: September 22: <https://earthjustice.org/article/putting-justice-first-in-ocean-policy>

²⁶⁸Simenstad *et al.* 2002. 597.

²⁶⁹Buchanan *et al.* 1999. 21.

²⁷⁰Buchanan *et al.* 1999. 21.

²⁷¹Buchanan *et al.* 1999. 21.

²⁷²NOAA 2017. 4052.

activity, the population of *A. alabamae* saw a dramatic decline throughout its range during the 20th century, a trend accentuated by dam construction and pollution in recent decades.

The former U.S. Fish Commission noted commercial landings of 3,170 kg (6,955 lbs) from the Ohio River in Indiana and Kentucky in 1889 and 68 kg (150 lbs) from Alabama in 1902; Alabama shad may have represented an important food source in the early 1900s.²⁷³ The Alabama shad can be angled with a small lure and is considered as flavorful as the American shad, which represents the largest recreational fishery of all shads in North America.²⁷⁴ While no commercial catch exists for the Alabama shad today, historical fishing practices reduced population numbers significantly, and the species' palatability makes it a candidate for potential exploitation in the future. The Alabama shad is also sometimes used as bait for striped bass fishermen.

While commercial harvest does not directly target the Alabama shad, a robust commercial fishery in the Gulf of Mexico, overlapping with the range of the shad, makes the species vulnerable to bycatch — the capture of non-target species in the process of commercial fishing. Recent reports exist of Alabama Shad bycatch (15 Alabama Shad individuals; 61 unidentified *Alosa* sp.) in gill nets targeting Striped Mullet *Mugil cephalus* around the Louisiana-Mississippi state line.²⁷⁵ As a schooling fish, the Alabama shad is vulnerable to bycatch in the menhaden fishery, which explicitly targets schools of clupeid.²⁷⁶ The Gulf of Mexico's menhaden fishery is also the second-largest fishery by weight in the U.S.,²⁷⁷ the fishery's role in supplying fertilizer, animal feed, and bait for fisheries means harvest will likely continue in the Gulf and will continue to threaten the Alabama shad.

Further, the Gulf of Mexico shrimp trawl fishery is ranked 5th highest in the world for bycatch numbers²⁷⁸ and destructive trawling activities commonly impact small fish such as silver hake, red hake, and *Alosa* spp.²⁷⁹ Research has suggested that bycatch negatively impacts the recovery of river herring, closely related to the Alabama shad.²⁸⁰

The Alabama shad may also be bycatch in striped mullet fisheries.²⁸¹

Although there have been efforts to facilitate the spawning of anadromous species in freshwater habitats with dam removals, many river herring populations have not shown signs of recovery, and studies have indicated that the incidental catch of river herring could be hindering the

²⁷³Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 12.

²⁷⁴Alabama Shad Restoration and Management Plan for the Apalachicola-Chattahoochee-Flint River Basin 2008. 12.

²⁷⁵Mathers *et al.* 2016. 21.

²⁷⁶Mickle, pers. comm. October 20, 2023.

²⁷⁷NOAA.

²⁷⁸Parsons and Foster 2015. 210.

²⁷⁹He *et al.* 2015. 1514.

²⁸⁰Roberts *et al.* 2023. 1.

²⁸¹Quinn *et al.* 2023. 14.

species' recovery. Shrimp trawling in the Gulf of Mexico has one of the world's highest bycatch rates; given *Alosa* species' vulnerability to bycatch and the Alabama shad's anadromous life cycle in the heavily-fished Gulf of Mexico, it is reasonable to assume bycatch represents a significant threat to the species.

Disease and predation

Alabama shad collected below JWLD in 2013 exhibited signs of poor physical health, including visible wounds. Researchers exclusively observed wounds on adult Alabama shad that were not present on younger fish, which suggests that the source of these wounds may have originated in the Gulf of Mexico. Most of the Alabama shad collected had large, open sores or gash-like wounds. These wounds were severe, in some cases exposing internal organs and bone. These damages were not observed on other anadromous species, indicating that Alabama shad may either be more susceptible to the source of the wounds or occupy areas not frequented by other species.²⁸² While the exact cause of the wounds remains unknown, they appeared similar to symptoms of a disease seen in blueback herring on the Atlantic Coast, which was attributed to mycobacteria and could result in ulcers, emaciation, and sometimes death. Researchers reported similar wounds on fish that could relate to the Deepwater Horizon Oil Spill and resembled the wounds found on Alabama shad.²⁸³

Predation on juvenile Alabama shad could be significant — researchers have observed predatory fish feeding on groups of Alabama shad near the water's surface.²⁸⁴ Several shad species, including gizzard shad (*Dorosoma cepedianum*), threadfin shad (*Dorosoma petenense*), and blueback shad (*Alosa aestivalis*), serve as essential prey for a range of larger riverine predators.²⁸⁵

Inadequacy of existing regulatory mechanisms

The Alabama shad currently has no federal status or protection as a protected species. NOAA Fisheries considered the Alabama shad for listing in the late 1990s; in 2004, NOAA Fisheries reclassified the Alabama shad as a "Species of Concern," removing its Candidate Species status. The species is unlisted and likely extirpated in Illinois, Iowa, and Tennessee. It is considered Critically Imperiled in Kentucky, Arkansas, Louisiana, Mississippi, Georgia, and Florida, and it is Imperiled in Oklahoma, Missouri, and Alabama.²⁸⁶ The perilous status of the Alabama shad reflects the overall failure or inability of existing federal, state, and local ordinances and statutes to protect and provide for the conservation of the Alabama shad.

²⁸²NOAA 2017. 4052.

²⁸³NOAA 2017. 4052.

²⁸⁴Mickle 2010. 45.

²⁸⁵Mickle 2010. 45.

²⁸⁶NatureServe 2023.

State regulatory mechanisms

The Alabama shad's unique biology necessitates tailored conservation strategies for the species' genetically and ecologically distinct populations. Conserving the Alabama shad will require addressing the distinct limiting factors present within each confined habitat. State-level conservation plans specific for each Alabama shad population are critical to the species' conservation and longevity. State-level conservation plans are nonexistent or inadequate to protect the species.

Alabama's State Wildlife Action Plan mentions the need for migratory passage at the Tombigbee River dams and Miller's Ferry Dam on the Alabama River to conserve the Alabama shad. Locking on all of Alabama's dams has declined since the 1970s. No plans to conduct conservation locking exist in the state. Florida's Imperiled Species Management Plan for 2016-2026 does not include the Alabama shad. Georgia's State Wildlife Action Plan includes the "American Shad Management Plan for Altamaha River," a project concluded in 2012, and the "Alabama Shad Management Plan-ACF Basin," completed in 2013. No ongoing projects to protect the Alabama shad, however, exist in the state of Georgia. Arkansas plans to monitor the Alabama shad in the Little Missouri, Ouachita, Arkansas, and White Rivers. The plan includes provisions to ensure locking on the lower Ouachita River, however, no records indicate that locking is being exercised. Kentucky's 2023 State Wildlife Action Plan includes stipulations to conduct targeted surveys and research on the Alabama shad. Still, no conservation locking protocols exist to facilitate potential spawning migrations. There are no conservation plans for the Alabama shad in Mississippi, Louisiana, Oklahoma, Tennessee, Indiana, Illinois, Iowa, or Missouri.

Federal regulatory mechanisms

Regulations on the harvest of the Alabama shad

Federal law does not regulate the harvest or collection of Alabama shad in Federal waters, and there are no restrictions on the harvest of Alabama shad in marine waters.

In the state of Florida, hook-and-line has been the only allowable fishing gear for all shad species (Alabama, American, and hickory shad); recreational and commercial fishermen have a limit of 10 shad as an aggregate. Recreational regulations in Louisiana limit the taking of shad species to 50 pounds (22.7 kilograms) per day, with no size limit. Mississippi does not list the Alabama shad as a game fish in the Department of Wildlife fishing regulations. It may be taken as bait with certain equipment by resident anglers holding the appropriate fishing license for personal

use during sport fishing. Missouri and Arkansas classify the Alabama shad as a non-game fish with no specific catch or possession limits.

Alabama shad is a protected species in both Alabama and Georgia. One can only collect the species with a state-issued scientific collector's permit that specifically mentions Alabama shad. These states do not permit recreational or commercial harvest.

There are no restrictions on Alabama shad harvest in the species' marine habitat, and Mississippi, Arkansas, and Missouri have no state regulations regarding Alabama shad harvest. Other states across the shad's range have harvest limits on Alabama shad but do not outright ban take of the species.²⁸⁷

Federal and state law still permit the take of Alabama shad in some cases — harvest regulations are not adequate to preserve a species teetering on the edge of extinction. Where bans on the take of the species exist, the Alabama shad is still vulnerable to the negative effects of bycatch.

The Federal Power Act (FPA)

The Federal Power Act (FPA) is a federal law addressing the protection, mitigation, and enhancement of fish and wildlife resources, including anadromous fish, that may be impacted by hydroelectric facilities regulated by the Federal Energy Regulatory Commission (FERC). The FPA mandates several important processes and requirements to safeguard these resources. FERC is required to consult with both state and federal resource agencies when considering proposed hydroelectric projects. This consultation includes seeking and implementing recommendations from these agencies to address various aspects of fish and wildlife, such as their habitats, instream flows (including timing, quality, and quantity), reservoir management, project construction and operation, fish entrainment and mortality, and recreational access. FERC must engage in a similar consultation process with federal and state resource agencies when renewing operating licenses for existing dams. This ensures that the impacts on natural resources are considered and addressed. Both NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS), along with certain U.S. federal land management agencies, can establish mandatory conditions related to fish passage that must be included in hydropower licenses. One must design fish passage conditions to facilitate the movement of fish, including anadromous species, past hydroelectric facilities. These conditions are essential for preserving fish populations. Section 10(j) of the FPA specifies that FERC licenses should include requirements to protect, mitigate damages to, and enhance fish and wildlife resources based on recommendations provided by state and federal agencies during the licensing or license renewal process. Section 18 of the FPA stipulates that FERC license holders must construct, maintain, and operate fishways as prescribed by the Secretary of the Interior or the Secretary of Commerce. These fishways are

²⁸⁷NOAA 2017. 4053.

critical for supporting fish migration. The law also allows for the reservation of fishway prescriptions to address future impacts that may emerge.

While the FERC includes explicit provisions for the protection of anadromous fish, the inadequacy of conservation locking on major barriers like the JWLD showcase the inadequacy of this federal law to preserve the Alabama shad.

The Outer Continental Shelf Lands Act (OCSLA)

The Outer Continental Shelf Lands Act (OCSLA) defines the Outer Continental Shelf (OCS) as the submerged lands located beyond a state's coastal waters, typically extending three miles offshore, and falling under the jurisdiction of the United States. Within the framework of the OCSLA, the Secretary of the Interior holds the responsibility for overseeing the exploration and development of mineral resources of the OCS. The Act grants the Secretary the authority to issue leases to the most qualified and responsible bidders through a sealed competitive bidding process. Furthermore, the Secretary is empowered to create regulations as needed to ensure the effective execution of the Act's provisions. As amended, the Act establishes the guidelines for implementing a program focused on oil and gas exploration and development on the OCS.

The OCSLA requires that exploration and development is carried out in a manner providing for the “protection of the environment” and the “conservation of the natural resources of the outer Continental Shelf.” Despite these stipulations, oil and gas production continues to harm ecosystems along the Gulf of Mexico coastline. Over 14,000 unplugged oil and gas wells exist in the Gulf of Mexico, structures that can leak oil into the marine environment and often remain undetected.²⁸⁸ Despite legal obligations that mandate the decommissioning of offshore platforms and equipment on the seafloor, the actual implementation and enforcement of these requirements have been inconsistent. The OCSLA and its associated regulations govern oil and gas leasing in federal waters, and they specify that decommissioning should involve tasks such as permanently sealing wells, removing platforms, decommissioning pipelines, and clearing obstructions from the seafloor. These regulations also stipulate that within a year of lease termination, one must permanently seal wells and remove all platforms and facilities. However, the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE) have not consistently upheld adherence to these decommissioning requirements.²⁸⁹ There are

²⁸⁸Loomis, Rebecca and Ramirez, Rebecca. 2023. *Study Shows 14,000 Unplugged Oil and Gas Wells in Gulf of Mexico*. Natural Resources Defense Council: May 23:

<https://www.nrdc.org/bio/rebecca-loomis/study-shows-14000-unplugged-oil-and-gas-wells-gulf-mexico>

²⁸⁹Loomis, Rebecca and Ramirez, Rebecca. 2023. *Study Shows 14,000 Unplugged Oil and Gas Wells in the Gulf of Mexico*. Natural Resources Defense Council: May 23:

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more inactive and unplugged oil and gas wells than currently operational ones in the Gulf of Mexico.²⁹⁰

Furthermore, the regulations sometimes permit oil and gas operators to leave pipelines on the seafloor, a practice known as "decommissioning in place." This is allowed only in specific situations where structures will not obstruct navigation, fishing, or harm the environment. Nevertheless, in practice, BSEE often will enable operators to leave pipelines on the seafloor rather than removing them. The Government Accountability Office revealed that since the 1960s, BSEE has granted permission for the oil and gas industry to leave over 97 percent of pipeline mileage, almost 18,000 miles, on the seafloor in the Gulf of Mexico. Recent data also demonstrates that decommissioning-in-place has become the norm rather than the exception, with BSEE approving almost 96 percent of applications for this practice from 2015 to May 2020, resulting in hundreds of pipeline segments remaining on the ocean floor.²⁹¹

Despite the potential adverse environmental impact of leaving oil and gas pipelines in the ocean, BSEE and BOEM officials have acknowledged that the ecological consequences of decommissioning-in-place practices have not been sufficiently studied.²⁹²

BOEM has also failed to require oil and gas operators to provide adequate upfront funding for decommissioning. These companies are supposed to offer financial assurances, such as bonds, to ensure that there are sufficient funds for decommissioning, even if a company goes bankrupt. However, a Government Accountability Office study found that less than eight percent of decommissioning costs in the Gulf were covered by financial assurances, potentially leaving the public responsible for billions of dollars in cleanup costs.²⁹³

The Outer Continental Shelf Lands Act not only fails to consider the conservation of imperiled species like the Alabama shad, but actively threatens the long-term viability of the Gulf of Mexico's biodiversity. By authorizing oil and gas exploration and failing to enforce cleanup properly, the act furthers habitat degradation and modification in the heavily impacted Gulf of Mexico.

²⁹⁰Loomis, Rebecca and Ramirez, Rebecca. 2023. *Study Shows 14,000 Unplugged Oil and Gas Wells in Gulf of Mexico*. Natural Resources Defense Council: May 23:

<https://www.nrdc.org/bio/rebecca-loomis/study-shows-14000-unplugged-oil-and-gas-wells-gulf-mexico>

²⁹¹Loomis, Rebecca and Ramirez, Rebecca. 2023. *Study Shows 14,000 Unplugged Oil and Gas Wells in Gulf of Mexico*. Natural Resources Defense Council: May 23:

<https://www.nrdc.org/bio/rebecca-loomis/study-shows-14000-unplugged-oil-and-gas-wells-gulf-mexico>

²⁹²Loomis, Rebecca and Ramirez, Rebecca. 2023. *Study Shows 14,000 Unplugged Oil and Gas Wells in Gulf of Mexico*. Natural Resources Defense Council: May 23:

<https://www.nrdc.org/bio/rebecca-loomis/study-shows-14000-unplugged-oil-and-gas-wells-gulf-mexico>

²⁹³Loomis, Rebecca and Ramirez, Rebecca. 2023. *Study Shows 14,000 Unplugged Oil and Gas Wells in Gulf of Mexico*. Natural Resources Defense Council: May 23:

<https://www.nrdc.org/bio/rebecca-loomis/study-shows-14000-unplugged-oil-and-gas-wells-gulf-mexico>

The Clean Water Act (CWA)

As a fish species dependent on the health of its native rivers, the Clean Water Act (CWA) — aimed at restoring and maintaining the chemical, physical, and biological integrity of the nation's waters (33 U.S.C. 1251) — should protect the Alabama shad and its habitat. Unfortunately, the CWA is insufficient to protect the Alabama shad without the additional protections of the Endangered Species Act and a Critical Habitat designation. The provisions of the CWA fail to safeguard the petitioned species as insufficient regulations allow pollution from point sources and provide no regulation of nonpoint sources, leading to the ongoing degradation of water quality and loss of stream and wetland habitat.

Existing regulations are inadequate to protect riverine habitats, vital to the Alabama shad's survival, from nonpoint sources of pollution such as agricultural, residential, and urban runoff, which are typically approached in a non-regulated manner. Agricultural runoff comprises over 70 percent of impaired U.S. river kilometers yet is commonly unregulated by permit requirements.²⁹⁴ Some Concentrated Animal Feeding Operations (CAFOs) are designated as non-point sources of discharge, which allows for significant pollution to enter waterways under certain state regulations.²⁹⁵ Under regulated non-point source pollution represents a serious threat to the habitats upon which the Alabama shad depends — fertilizers and pesticides used on corn, soybeans, cotton, and peanuts, runoff from hog operations, as well as sediment flowing from agricultural and timber land pollute and diminish the water quality of critical habitat areas.

Further, existing regulations are inadequate to protect the Alabama shad from accidental spills from agricultural, coal-fired power plant, and coal mining wastes.²⁹⁶

Water quality has been consistently identified as a threat to Alabama shad; unfortunately, as outlined previously, current regulations are insufficient to protect the health of the species' habitat. NOAA's 2017 negative finding addressed the current state of water quality in the rivers where one can find Alabama shad; state reports indicated that approximately half of the river miles within the current range of Alabama shad are considered good water quality. However, in the remaining areas, water quality is impaired for various reasons, such as the presence of heavy metals, low dissolved oxygen (DO) levels, impaired aquatic life (biota), sedimentation, and the presence of other organic and inorganic contaminants.

²⁹⁴Neves *et al.* 1997. 43-86.

²⁹⁵Mallin, M.A. and L.B. Cahoon 2003. 369-385.

²⁹⁶Herrig, J. and P. Shute. 2002. Chapter 23: aquatic animals and their habitats. Southern Region, USDA Forest Service and Tennessee Valley Authority. 45 pp. In: Wear, David N.; Greis, John G., eds. 2002. Southern forest resource assessment. Gen. Tech. Rep. SRS-53.

Water quality conditions in the Gulf of Mexico are highly variable; however, overall ecological conditions have been judged as “fair to poor.”²⁹⁷ Many Gulf of Mexico coastal sites exhibit high levels of eutrophication and low dissolved oxygen concentrations. High levels of eutrophication have resulted in increased turbidity associated with high chlorophyll *a* levels, low levels of dissolved oxygen, and moderate to high levels of toxic algal blooms and epiphyte abundances. The northwestern Gulf of Mexico experiences some of the highest petroleum input levels of any North American marine waters as a result of tanker traffic, oil and gas platforms, contaminated inflows from the Mississippi, and natural seeps. Fish in the Gulf of Mexico have elevated levels of PCBs, DDT, dieldrin, mercury, cadmium, and toxaphene in their tissues.²⁹⁸

One study predicted that 13 of 38 Gulf of Mexico estuaries would develop worse conditions. No estuaries were expected to improve in condition. Human population pressures, development pressures, and human-associated activities were expected to worsen conditions in the Gulf of Mexico.²⁹⁹

Coastal Zones Management Act (CZMA)

The initial objectives of the Coastal Zones Management Act (CZMA) are to safeguard natural resources, oversee coastal development, enhance the quality of coastal water, regulate nonpoint source (NPS) pollution, and facilitate public recreational access to coastal areas.

The CZMA has faced limitations in its ability to address non-point source (NPS) pollution effectively. NPS pollution, which includes runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification, cannot be attributed to a specific polluter. Runoff of nitrogen and phosphorus into waterways has led to significant issues like large algal blooms and the formation of hypoxic zones. Downstream states suffer the most as they lack control over pollution originating upstream, which hampers effective coastal zone management. The difficulty of regulating pollution from the nation’s largest rivers is evidenced by the fact that the Gulf of Mexico’s hypoxic zone has not reduced in size; only 18% of its estuarine areas are considered in good condition. Ecological fish tissue contamination was degraded in Gulf of Mexico estuaries, with 74% of the waters in poor condition.

The Magnuson Stevens Fishery Conservation and Management Act (MSFCMA)

The Magnuson Stevens Fishery Conservation and Management Act (MSFCMA, 16 U.S.C. §§1801 et seq.) governs the conservation and management of commercial and recreational fisheries in U.S. federal waters (3-200 nautical miles from shore). The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires NOAA Fisheries to identify and describe Essential Fish Habitat (EFH) for all federally managed fisheries in order to mitigate the negative effects upon habitat caused by fishing, and to identify other actions to

²⁹⁷Kennicutt 2017. 75.

²⁹⁸Kennicutt 2017. 146.

²⁹⁹Kennicutt 2017.

encourage the conservation and enhancement of EFH, or habitats necessary for spawning, breeding, feeding, or growth to maturity. No EFH has been established for the Alabama shad and the species is not considered a federally managed fishery.

While the Magnuson-Stevens Act incorporates provisions to protect fish species from bycatch by promoting sustainable fisheries management and implementing measures to reduce incidental catch of non-target species, the Alabama shad is still vulnerable to bycatch. The MSFCA has failed to protect the Alabama shad from the ongoing threats of fishing and habitat modification or destruction.

The National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) requires federal agencies to consider the effects of management actions on the environment, but fails to place substantive requirements on agencies to choose environmentally benign alternatives. NEPA also requires federal agencies to fully and publicly disclose the potential environmental impacts of all proposed projects. Actions taken by federal agencies (such as the Army Corps of Engineers, Department of the Interior, Federal Energy Regulatory Commission, Bureau of Reclamation, and Environmental Protection Agency) with the potential to impact Alabama shad or Alabama shad habitat are subject to the NEPA process. The NEPA process requires these agencies to describe a proposed action, consider alternatives, identify and disclose the potential environmental impacts of each alternative, and involve the public in the decision-making process. The public can provide input on what issues should be addressed in an Environmental Impact Statement and can comment on the findings in an agency's NEPA documents. Lead agencies must consider all public comments received regarding NEPA documents during the comment period. However, NEPA does not explicitly prohibit federal agencies from choosing alternatives that negatively affect imperiled species or the ecosystems they depend on. Even if Alabama shad or their habitat are present in a federal agency's project area, NEPA does not prohibit these agencies from choosing project alternatives that could negatively affect individual Alabama shad, Alabama shad populations, or potential Alabama shad habitat.

Co-Occurrence with ESA Species

The Alabama shad may benefit somewhat from the overlapping range with federally listed species such as the Gulf sturgeon. These protections, however, are not adequate to protect the Alabama shad from extinction.

Both the gulf sturgeon and the Alabama shad rely on connectivity within the ACF river system to carry out their life cycles; despite this recognition, conservation locking remains inadequate to provide passage for these species. Although the ACF River basin is recognized as a critical habitat for the federally threatened Gulf sturgeon, mismanagement of upstream tributaries has nevertheless led to increasingly severe Apalachicola low-flow periods. Floodplain and wetland

habitats continue to shrink, and nonpoint source pollution from herbicides, pesticides, nitrates, petroleum products, and heavy metals, difficult to regulate under the Clean Water Act, continue to affect the basin. Massive population growth in the ACF Basin continues to strain water resources and accelerate pollution.³⁰⁰

Despite overlapping range with a federally threatened species, the Alabama shad remains threatened by pollution, dwindling water resources, and inadequate conservation locking regimes. Further, the Alabama shad occupies a wide range beyond that of the gulf sturgeon and purple bankclimber. Variations in habitat and local adaptations can lead to significantly different ecological interactions across the species' distribution, and the species' biology likely necessitates unique conservation strategies tailored to genetically and ecologically distinct populations. Specific populations might require tailored recovery strategies to address the distinct limiting factors present within their confined habitats.³⁰¹ Given the Alabama shad's wide geographic reach and specific habitat requirements, protections offered by other protected species alone do not suffice to protect the species.

Climate change regulatory mechanisms

Existing global, national, and state climate change legislation and agreements are wholly insufficient in addressing the problem of ocean acidification, changing ocean conditions, and changing water temperatures and availability exacerbated by climate change. These conditions represent a substantial threat to the long-term survival of the Alabama shad in its marine and freshwater environments.

Greenhouse gas emissions from climate change are among the least regulated threats to the Alabama shad. The main international mechanisms addressing greenhouse gas emissions and global warming include the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Copenhagen Accord. While these agreements are significant steps towards reducing the threat of climate change, they do not adequately address the challenges posed by global warming to the Alabama shad. Despite the existence of international climate mechanisms, the Southeast continues to face heightened risks of heat-related issues, flooding, and more frequent occurrences of extreme heat episodes. Coastal areas, in particular, are experiencing a rise in flood frequencies resulting from the combined impacts of intense rainfall events and sea level increases brought about by climate change. The Southeast's ecosystems are undergoing significant alterations in response to shifting air and ocean temperatures, as well as rising sea levels. As a consequence of extreme weather events, many species will experience redistribution, and there will be substantial modifications to ecosystems, making the region's natural environment particularly vulnerable to climate-driven transformations.³⁰²

³⁰⁰Apalachicola Riverkeeper 2023.

³⁰¹Mickle 2010. 279.

³⁰²U.S. Climate Resilience Toolkit.

At the national level in the United States, there are currently no legal mechanisms in place to regulate greenhouse gasses. Urgent action to reduce greenhouse gas pollution is essential to slow down global warming and, ultimately, stabilize the climate system to protect and restore Alabama shad habitat.

Other natural or manmade factors affecting the continued existence of the species

Population fluctuations and reproductive biology

NOAA's 2017 negative finding cited the Alabama shad's drastic population fluctuations as a likely cause for apparent low population numbers and the species' rapid growth rate as advantageous for the shad to recover from environmental disturbance. While populations may fluctuate with periodic population reductions, long-term, consistent declines, and extirpations observed for decades do not constitute mere population fluctuations but rather plummeting populations or, in many cases, total extirpations.

Ichthyologist Dr. Jake Schaefer noted that historically, populations were “enormous”³⁰³ enough to support commercial fisheries, where for decades, researchers have failed to observe these massive populations, “orders of magnitude greater”³⁰⁴; rather, it has been difficult or impossible for researchers to locate the species. Steve Rider of the Alabama Division of Wildlife and Freshwater Fisheries similarly noted that Alabama shad populations are not experiencing fluctuations but rather “low levels of fish.” According to Rider, after 20 years of targeting sampling efforts in the Mobile River basin, researchers have failed to observe population rebounds indicative of a boom cycle. Rider described the species' apparent precipitous decline as “alarming.”³⁰⁵ Long-term trends in Alabama shad populations would be highly unlikely to constitute undulations.

Alabama shad populations are not bouncing back, especially in key population strongholds. In the Apalachicola River basin, Alabama shad populations were as high as 123,000 in 2012 during spawning runs. However, r-population fluctuations have not been observed since then, and no bounce back has occurred. Instead, populations have crashed and remained consistently low since 2012.³⁰⁶

³⁰³Schaefer, pers. comm. October 13, 2023.

³⁰⁴Schaefer, pers. comm. October 13, 2023.

³⁰⁵Rider, pers. comm. November 3, 2023.

³⁰⁶Georgia Department of Natural Resources. Alabama shad data 2007-2023.

NOAA also did not consider records of Alabama shad captures in the Chipola River. These documents describe several hundred Alabama shad in gill nets in the Chipola River; based on observations, Alabama Shad is nowhere near as abundant in the Chipola River today.³⁰⁷

Further, as a r-selected species, the Alabama shad is more predisposed to collapse or depletion due to climate variability or environmental disturbance. The Alabama shad is extremely vulnerable simply due to its reproductive biology — an anadromous fish; the species requires a clear passageway upstream to spawning grounds, and females may spawn just once in their lifetime.³⁰⁸

Fish species with fast-growing populations like the Alabama shad may be more vulnerable to disturbances like overfishing or climate-related extreme events.³⁰⁹ While Alabama shad populations may recover faster than fishes with slower-growing populations, collapses can be significant and long-lasting³¹⁰ to the extent that recovery would be difficult. Given the species may experience substantial fluctuations in population size from year to year, this makes the Alabama shad vulnerable to collapse during low population years. The boom-and-bust cycle described in NOAA's 2017 finding is not supported by enough data to be conclusive.³¹¹ Further, if the species has a small source population, the boom-and-bust cycle is rendered meaningless.³¹² Salmon, for example, often fluctuate in abundance based on ocean conditions, but have been listed as population fluctuations involve orders of magnitude fewer fish compared to historical levels³¹³ due to habitat modification and loss. While conservation biology and evidence from terrestrial species typically suggest that slow-growing populations are most at risk, environmental disturbances may alter or possibly reverse this pattern.³¹⁴ Fast-growing populations within variable environments are susceptible to overfishing or climate variability; the risk of collapse is more than tripled for species with fast-growing compared to slow-growing populations. With the increasing variability of flow dynamics, water temperatures, and water quality in the Alabama shad's freshwater and marine habitats, the species' reproductive dynamics would likely make it more vulnerable to population collapse. The Blue Pike, a species like the Alabama shad, would have occasional years of successful recruitment. The species never recovered from a low year and is now extinct.

Shad populations worldwide have experienced declines and extirpations.³¹⁵ American Shad populations on the East Coast have also experienced significant declines, with many populations

³⁰⁷Williams, pers. comm. October 22, 2023.

³⁰⁸NOAA 2017. 4024.

³⁰⁹Pinsky and Byler 2015. 1.

³¹⁰Pinsky and Byler 2015. 7.

³¹¹Quinn, pers. comm. October 17, 2023.

³¹²Quinn, pers. comm. October 17, 2023.

³¹³Wainwright and Kope 1999. 445.

³¹⁴Pinsky and Byler 2015. 1.

³¹⁵Mcbride and Holder 2008. 1668.

now dominated by stocked fish.³¹⁶ The largest remaining population of American Shad, numbering between 1.2 to 6 million fish, is a non-native, introduced population found in the impounded Columbia River basin. The allis shad (*Alosa alosa*) in Europe only has 5 out of 29 functional stocks remaining.³¹⁷ While NOAA has suggested that low abundance represents only a moderate risk to Alabama Shad, research on other *Alosa* species has shown that extirpations are common, causing some species to go extinct.

Many North Atlantic obligate marine fishes have declined; anadromous species like the Alabama shad — with river-specific populations — are more vulnerable to population-level extirpation or extinction if those extirpations occur serially, as has been observed with populations of Alabama shad.³¹⁸

Climate change

Climate change is altering species distributions significantly. Particular to anadromous species like the Alabama shad, warming is shifting the phenologies of spawning runs, potentially disrupting the species' historical ecological relationships throughout its lifecycle. Climate change will affect the severity of floods and droughts, decreasing the likelihood of successful annual reproduction for this anadromous species.³¹⁹ The Alabama shad's preference for cool waters will limit the species' ability to adapt during drought or heat spells, which are increasing in intensity and frequency in the southeastern United States.

Climate change will cause complex and unpredictable changes in the interaction between saltwater and freshwater habitats. As ocean temperatures and currents shift, the productivity of marine waters will change, with indelible impacts upon the food resources required by the Alabama shad. Too, warming may cause the productivity of inshore habitats to increase,³²⁰ with potentially detrimental effects on the Alabama shad, which prefers minimal benthic algal growth and high dissolved oxygen.

Forecasts predict climate change will heighten annual variation in precipitation rates, accelerating population fluctuations in the r-selected Alabama shad. Projections of future conditions in the Southeast suggest that the region will experience more severe droughts, and extreme rainfall events are generally likely to become more frequent and intense.³²¹ Such climatic variability will increase the danger of the Alabama shad having a poor year and a total population collapse.³²²

³¹⁶Hendricks 2003. 303.

³¹⁷Bagliniere *et al.* 2003. 85.

³¹⁸Limburg and Waldman 2009. 955.

³¹⁹Limburg and Waldman 2009. 962.

³²⁰Limburg and Waldman 2009. 962.

³²¹U.S. Climate Resilience Toolkit.

³²²Schaefer, pers. comm., October 13, 2023.

Climatic variability will affect the shad during both drought and flood years. The temperature-sensitive Alabama shad will be affected by more intense and frequent drought and warmer average water temperatures. Further, more frequent and severe flooding events will lessen the likelihood of successful spawning runs. The Alabama shad appears sensitive to flooding — during heavy rainfall years, shad runs are weak or nonexistent. The species is likely confused by heavy currents³²³ and numerous studies have suggested that exceptionally high-flow years may be linked to reduced spawning success and diminished numbers of migrating individuals.³²⁴ Dam fishways are often not successful at passing shad.³²⁵

Robert Hrabik, ichthyologist with the Missouri Department of Conservation and author of the *Fishes of Missouri*, expressed concern over the impact of climate change and urbanization and sprawl on the Alabama shad's riverine habitats. Hrabik said that recent flooding events, which have been “some of the most intense” in recorded history, have caused turbidity to increase, the buildup of fine sediments, and significant deposition of debris. Such drastic changes to the Alabama shad's habitat will have significant negative effects on the species.

Hrabik also noted that climate change could reduce the Alabama shad populations further and confine the species to specific, limited habitats. He described that one should be “concerned” about the potential impacts of more frequent and intense drought and flood events upon the Alabama shad.³²⁶

Climate change has also affected the temperature of the Gulf of Mexico, where the Alabama shad overwinters, and the Southeastern rivers where the fish spawns. Such temperature shifts could cause an earlier spawn run in the temperature-sensitive Alabama shad. Warmer water temperatures could also drive the Alabama shad's energy demands outside their budget during migration, leading to mortality.³²⁷ Temperature can exert a robust control on growth potential by increasing metabolic rates and can set a maximum consumption rate.³²⁸

As juveniles feed on small invertebrates, there is a risk of a mismatch between the photoperiod and temperature regime. If Alabama shad, cued by abnormal oceanic or riverine temperatures, spawned earlier than in a typical year, there is a danger the species would miss a corresponding invertebrate hatch.³²⁹ Further, if riparian zones morph as a result of climate change, insect communities may shift in response, jeopardizing the Alabama shad's food resources.³³⁰

³²³Quinn, pers. comm., October 17, 2023.

³²⁴Kerns *et al.* 2017. 327.

³²⁵Aunins *et al.* 2013. 572-574.

³²⁶Hrabik, pers. comm., December 1, 2023.

³²⁷Mickle, pers. comm., October 20, 2023.

³²⁸Kaylor *et al.* 2021. 1728.

³²⁹Schaefer, pers. comm., October 13, 2023.

³³⁰Mickle, pers. comm., October 20, 2023.

Genetic factors

Genetic variation is critical in maintaining the adaptive potential of a species or population and the fitness of individuals to ensure their survival.³³¹ Observed genetic variation, both in number of alleles and heterozygosity, was lower than expected among Alabama shad based on other studies.³³² These findings suggest that the Alabama shad has been subject to a historical bottleneck event. The authors warned that Apalachicola River Alabama shad should be “monitored for and protected against any depression of demographic rate that could cause the population to decline.”³³³ While the authors concluded that genetic factors such as genetic drift and inbreeding do not immediately endanger the Alabama shad, that conclusion hinged on the stability of biotic and abiotic factors. The slew of changing conditions this species faces — from shifting water temperatures to reduced access to spawning habitat due to inadequate conservation locking regimes — means the species is subject to volatile biotic and abiotic factors. If the species’ range is restricted further, future concern for genetic bottleneck events will increase.³³⁴ The genetic similarity of the species is a concern in the event of an environmental disturbance, such as a devastating hurricane.³³⁵ The Alabama shad’s reduced genetic diversity impedes its ability to adapt to such changing environmental conditions and heightens its extinction risk.

Invasive species

Invasive species have posed significant challenges to the health of southeastern aquatic systems. Several invasive species directly threaten the existence of the Alabama shad.

The invasive Asian carp, introduced to the southeast in the 1970s to control weeds and parasites, have spread throughout the Mississippi River system and pose a profound threat to shad species. The Asian carp’s rapid growth rate and high trophic overlap with facultative planktivores like the Alabama shad places competitive pressure on native fish populations.

One study found the Asian carp’s effects on gizzard shad to be subtle and detrimental over long periods. The study found reduced body condition among gizzard shad after establishing Asian carp. Further, Asian carp could affect the fecundity of shad, as a decline in body condition can reduce fecundity. Reduced body condition can also make shad more vulnerable to poor health and diseases.³³⁶

³³¹Moyer 2011. 2.

³³²Moyer 2011. 1.

³³³Moyer 2011. 12.

³³⁴Mickle, pers. comm. October 20, 2023.

³³⁵Rider pers. comm. November 3, 2023.

³³⁶Irons, Sass, McClelland & Stafford 2007. 271.

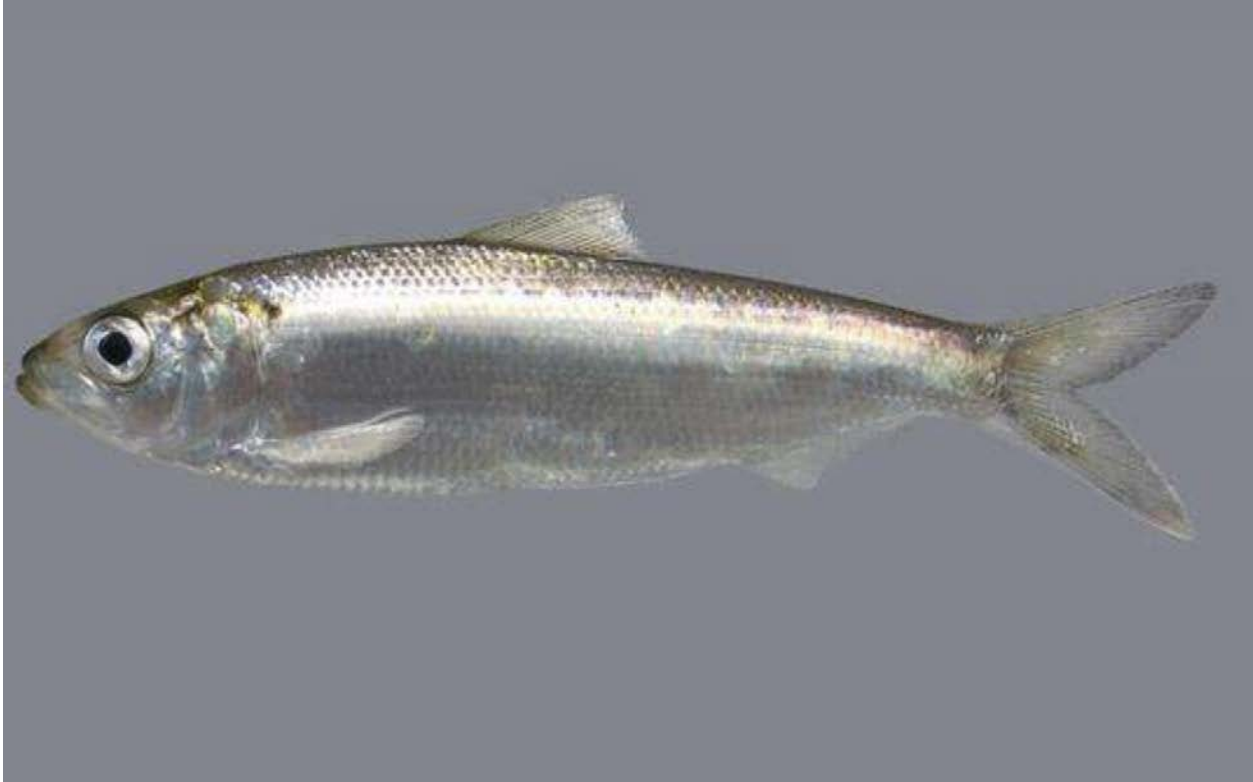
Insect decline

The diet of young Alabama shad consists primarily of Hymenoptera and Lepidoptera, along with a diverse array of other insect orders, while Ephemeroptera emerged as an indicator for the diets of larger Alabama shad. The decline of insect biomass in rivers affected by changing flow regimes and habitat composition will inevitably affect availability for the Alabama shad.

A study in the southeastern U.S. conducted a comparative study examining changes in the density, biomass, and community structure of freshwater invertebrate assemblages over more than 30 years. The study's findings revealed a significant decline in biomass. Biomass in the 2010s was approximately 60% of the total biomass observed in the 1980s; the decline in freshwater invertebrate biomass was attributed to climate-related changes in flood dynamics. Specifically, the reduced occurrence of seasonal flooding, traditionally transporting floodplain carbon to filter-feeding consumers, has diminished over several decades. Additionally, rises in water temperatures are likely to have exerted effects on invertebrate assemblages.³³⁷

³³⁷Stoker *et al.* 2023. 632.

NEW INFORMATION SINCE 2017 NEGATIVE FINDING



In 1997, NOAA Fisheries (previously NMFS) recognized the Alabama shad in Florida and Alabama as a potential candidate for listing under the Endangered Species Act. In 2013, NOAA Fisheries determined that this species may warrant listing and initiated a comprehensive status review. In 2017, NOAA Fisheries concluded that the species did not meet the criteria for listing under the ESA.³³⁸

Substantial new information is included in this petition that was not considered in the 2017 negative finding. Here are summaries of the new information.

New data from federal and state fisheries biologists is presented that was not previously considered.

Data was gathered from state biologists, experts, and agencies across the Alabama shad's historic range. These data show Alabama shad survey results, abundance, and location across decades in

³³⁸NatureServe 2023.

rivers and coastal areas. These data indicate that the Alabama shad has disappeared from 90% of its historic freshwater range. The Alabama shad exists in only small populations in 15 of the 75 rivers it historically occupied.

Conservation locking has failed and stopped occurring at Jim Woodruff Dam on the Apalachicola River.

Data emerging since 2017 indicates that Jim Woodruff Dam has not conducted any conservation locking since 2016, and today, the dam barely operates its locks, which have fallen into disrepair.

Historically, Jim Woodruff Lock and Dam operated 24 hours a day primarily for commercial barge traffic. However, since the discontinuation of commercial traffic in the late 1960s, lock operation was scaled back to just eight hours per day, mainly to accommodate recreational boats on demand. This reduction in operating hours resulted in a significant decline in the number of lockages, decreasing to less than 100 per year from a peak of 1,200 during the height of commercial usage. Additionally, the decline in barge traffic and the cessation of navigational dredging in 2001 further diminished the frequency of lock operation.

Between 2017 and 2020, the Jim Woodruff Dam experienced a total of 167 lock openings, none of which were explicitly designated for fish passage. Subsequently, from 2021 to 2022, records indicate 14 lock openings, with none identified as conservation locking. The ACF River system's lockage information sheet specified that locks would operate only by appointment, likely resulting from a nationwide effort to reduce operational costs and indicating a diminishing emphasis on locking, whether for conservation purposes or otherwise.

The aging Jim Woodruff dam is barely operational, and all but one of its locks are in disrepair. As a result, operators are limiting operations of its locks. Conservation locking has effectively ended at Jim Woodruff Dam for the foreseeable future.

Further, during periods of low flow or drought conditions, which are increasingly prevalent throughout the Alabama shad's range, fish passage may be entirely obstructed under certain flow levels. If drought conditions occur within the Alabama shad's native river basins during the spring, there might be no conservation lockage activity to enable the passage of the Alabama shad.

The significant decrease in conservation locking frequency and, in some cases, the outright cessation of locking within the Alabama shad's habitat raises serious concerns for this anadromous species, which relies on daily lockings aligned with their upstream and downstream migration windows. It is evident that the current conservation locking practices and their implementation fall far short of adequately supporting the Alabama shad's migration. NOAA's

2017 negative finding, heavily relying on the presumed efficacy of conservation locking for the species' conservation, is undermined by the stark reality of infrequent or non-existent conservation locking.

The best route for alosine fish restoration is by providing access to historical spawning grounds as opposed to other conservation strategies such as stocking.³³⁹ Unfortunately, conservation locking is not occurring today, and with increasing water scarcity in the southeast, there is little prospect of increased locking activity in the future. During prolonged drought, conservation locking is less likely to take place; the passage of anadromous species would represent a lower priority action after hydropower and water concerns.³⁴⁰

Conservation locking has failed or not occurred on other dams in the Alabama shad's remaining range.

NOAA's 2017 Negative Finding claimed that conservation locking would soon occur on other dams across the region. To date, no other dams conduct any conservation locking across the Alabama shad's range.³⁴¹

Conservation locking is not adequately effective for the passage of migratory fish, even when exercised with recommended frequency.

Even when practiced with sufficient regularity, conservation locking protocols are only moderately effective. A study revealed that the passage efficiency of Alabama shad through the Jim Woodruff Dam was 59% when locks operated seven days a week from 0800 to 1600 hours. Passage efficiency for American shad in the Cape Fear River was 33% in 1996-1997, improving to 61% in 1998, while the efficiency in the Savannah River was 53% in 2001, dropping to 9% in 2002. In another study, Alabama shad fitted with acoustic tags passed through locks with 45 percent efficiency. A study on the Alabama River examining conservation locking regimes on the Claiborne and Millers Ferry Dams found that fish scarcely utilized the locks. The spillways on the Claiborne Dam, accessible to fish only during flooding events and typically only accessible to strong-swimming species like the paddlefish for passage, led the authors to conclude that conservation lockages were not a broadly successful conservation strategy. Multiple studies across different river systems have shown conservation locking to be only moderately effective.

³³⁹Hasselmann and Limburg 2012. 174.

³⁴⁰Williams, pers. comm., December 7, 2023.

³⁴¹Williams, pers. comm., December 7, 2023; Rider, pers. comm. December 7, 2023

NOAA's 2017 finding claimed that fishways are considered to be "well developed and well understood for the main anadromous species, including *Alosa* species."³⁴² Fishways have not proved to be a successful conservation strategy for the Alabama shad, a species sensitive to strong currents and not considered a strong swimmer. During heavy rainfall years, shad runs are weak or nonexistent. High flows confuse the Alabama shad, and flood-heavy years have led to reduced spawning success and low numbers of migrating individuals.³⁴³ Other shad species are also sensitive to turbulent water conditions and were shown to be deterred by turbine activity at the base of dams. Fishways are not a successful strategy for passing Alabama shad.³⁴⁴

Alabama shad have been extirpated from key rivers in its namesake state.

Despite extensive surveys and sampling efforts by state biologists, no Alabama shad were collected from three former population strongholds. No Alabama shad were observed in the entire Mobile River basin, and only three were collected from the Choctawhatchee, indicating a precipitous decline of 98% from 2011 to 2018. The authors concluded:

"Although A. alabamiae was recently denied listing under the Endangered Species Act by the National Marine Fisheries Service due to lack of apparent range-wide extinction, our results indicate what was once considered the second largest population of A. alabamiae from the Choctawhatchee River is on the verge of extirpation. Alosa alabamiae could become extirpated from Alabama in the near future, which is a significant portion of its range."

Data and new information in other range states also show extirpations and significant declines in Alabama shad.

Communications with biologists working on the ground to study the Alabama shad throughout its range indicate that the species has become more difficult to locate despite targeted, intensive survey efforts. Where fragmented and small Alabama shad populations remain, numerous novel threats pressure the species and make populations vulnerable to total extirpation.

Missouri

According to Robert Hrabik, an ichthyologist at the Missouri Department of Conservation, state biologists have collected the Alabama shad in low numbers over the past few decades. Since 1995, survey efforts have only produced 207 Alabama shad specimens in Missouri. Further,

³⁴²NOAA 2017. 4057.

³⁴³Quinn, pers. comm., October 17, 2023.

³⁴⁴Aunins *et al.* 2013. 572-574.

numerous factors — including the escalating threats of climate change and urbanization — have significantly morphed the Alabama shad’s habitat quality.

To showcase the species' shrinking range in Missouri, Hrabik said that the Alabama shad has not been identified in the Big River, Bourbeuse River, or Osage River in the past 25 years. Alabama shad strongholds in the Missouri River basin appear to exist in the Gasconade and Meramec Rivers, where populations are stable or relatively declining. Despite decades of intensive surveying, the species has not been detected in the Middle Mississippi River.

Urbanization, sprawl, and historic deforestation practices near the city of St. Louis are likely reducing the range and populations of Alabama shad in the Meramec River, which Hrabik noted has changed significantly in habitat quality and composition since the 1850s. Further, the increased severity of extreme weather due to climate change will likely have profound negative impacts on Alabama shad habitat and populations. Hrabik noted that extreme flooding events, some of which have been the “most intense” observed in the last decade, have “seriously affected the abundance” of native fish species in rivers like the Osage. Hrabik expressed his concern at a predicted increase in extreme drought and flood events, which he noted could have “negative impacts” on species like the Alabama shad.

Alabama

Steve Rider, author of a groundbreaking 2021 study revealing that the Alabama shad is now likely extirpated from one of its most critical habitat strongholds, expressed extreme concern with the Alabama shad’s status. Rider conclusively said that the Alabama shad is not widespread, and where it is found, there are few. Within one of the species greatest historical strongholds, he said, “there is no doubt numbers have declined.” Rider noted that the species is on a “precipice” and that to prevent the species’ extinction, we “have to do something now.”

Rider also noted low numbers of Alabama shad in the Choctawhatchee River, where the species was caught at a low rate of .26/individuals per hour during an intense survey effort. Furthermore, sampling was conducted during migratory windows, when the species would most likely be detected. Despite intensive efforts to locate the species, Alabama — historically home to the second largest population of the Alabama shad — has seen continual declines. Utilizing consistent survey methods since 1999, researchers have noted a consistent and “precipitous decline” among Alabama shad, which Rider described as “alarming.”

In addition to the direct threat posed by river modification and impoundment, Rider said that other pressures like climate change could push the Alabama shad to the brink. He noted the growing danger of warming Gulf of Mexico waters for the temperature-sensitive Alabama shad. Rider also described the species' genetic similarity as a “definite concern” — a lack of genetic

diversity, in combination with low population numbers and a contracting range, makes the loss of an entire year class more likely.

Georgia

Data from Georgia reveals that Alabama shad populations could be as low as 324, even in the species' most important habitat in the Apalachicola River.³⁴⁵ Large Alabama shad runs have not been observed in a decade, where sampling efforts in the early 2010s produced population estimates in the hundreds of thousands of individuals.³⁴⁶

2012 was the last large run of Alabama shad observed in the state of Georgia, when researchers estimated populations to be 123,000 individuals. This spawning class was not observed to return in subsequent years. No “boom” years have been observed in a decade despite survey efforts. Alabama shad populations do not appear to be fluctuating but rather consistently low or declining for a decade or longer.³⁴⁷

Travis Ingram, a fisheries biologist for the State of Georgia, described Alabama shad populations in the state as “somewhat stable,” while emphasizing the necessity of conservation locking to ensure the survival of the species. The successful spawning of the Alabama shad is contingent upon access to suitable habitat in the Flint River. Ingram said no suitable spawning habitat exists below the JWLD, therefore, the Alabama shad requires consistent passage beyond this impoundment to survive and reproduce. Unfortunately, records indicate that no conservation locking is taking place to facilitate the passage of Alabama shad to critical breeding habitat in the Flint River. Without passage beyond the JWLD, spawning would be difficult or impossible; the majority of returning Alabama shad captured in survey efforts were observed to have spawned in the Flint River system.³⁴⁸

Steve Sammons, a fisheries management scientist at Auburn University, also described the total disappearance of a year class of 120,000-130,000 Alabama shad after 2012 as the “most catastrophic loss”³⁴⁹ of the Alabama shad recorded. Sammons noted that the fish may have encountered a threat in their marine habitat — such as dangerous oil pollutants — and failed to return for spawning in subsequent years. He also described his concern over the decline or cessation of conservation locking on the JWLD due to general disrepair, lock dysfunction, and the decline of boat traffic.

³⁴⁵Travis Ingram, Fisheries Biologist, Georgia Department of Natural Resources, September 2022.

³⁴⁶Travis Ingram, Fisheries Biologist, Georgia Department of Natural Resources, December 2023.

³⁴⁷Travis Ingram, Fisheries Biologist, Georgia Department of Natural Resources, December 2023.

³⁴⁸Travis Ingram, Fisheries Biologist, Georgia Department of Natural Resources, December 2023.

³⁴⁹Sammons, pers. comm., December 12, 2023.

Ingram said it is unknown what threats the Alabama shad faces in its marine habitat. The species could be threatened by the fishing industry or pollutants such as waterborne oil. Ingram added that researchers observed lesions on the Alabama shad after the Deepwater Horizon oil spill. The causes of disease among Alabama shad are still unknown and could pose an ongoing threat to the species.³⁵⁰ Sammons also noted the presence of lesions on Alabama shad in 2011 and 2012, which could indicate that the species is affected by dangerous pollutants in its marine habitat.

Arkansas

NOAA's 2017 negative finding concluded it not possible to determine if the Gulf of Mexico's dead zone would pose a significant threat to the Alabama shad, a threat not investigated with sufficient depth by the agency to warrant scientific veracity. Jeffrey Quinn of the Arkansas Game and Fish Commission noted the significant threat posed to the Alabama shad by the Gulf of Mexico's hypoxic zone. With climate change affecting phenological cues, the Alabama shad is migrating unpredictably and at different times of the year. Quinn said that while historically, the Alabama shad would not have been likely to encounter the Gulf dead zone, the species' morphing migration times could increase the likelihood that Alabama shad encounter such potentially lethal marine conditions. A 2023 report authored by Quinn noted numerous other threats to the Alabama shad in its marine habitat, including "oil spills, a record number of hurricanes and their associated fish kills, salinity changes, and habitat alteration."³⁵¹

Novel insights also shed light on the inefficacy of fishways in the passage of shad. Alabama shad are particularly sensitive to flows and are likely confused by heavy currents; other shad species have been observed to be repelled by the presence of turbines at the Holyoke Dam and Connecticut River. Large floods in the Ouachita, Red, or Atchafalaya rivers could be responsible for low migration rates of Alabama Shad to Arkansas. High flow years could be related to low spawning success and low numbers of migrating Alabama shad. Both American Shad and Alabama Shad migrations are impacted by turbulent conditions, and unfortunately, fishways at dams are often ineffective for the passage of shad. Both flows and temperatures vary significantly in the system, which comprises Remmel Dam, DeGray Dam, and Narrows Dam; how such fluctuations could disrupt normal migratory cues and lead to recruitment variability is still unstudied.³⁵²

Florida

There are critical references to Alabama shad abundance in the state of Florida that NOAA 2017 negative finding did not evaluate. There are historic records of Alabama shad captures in the Apalachicola River and its major tributary, the Chipola River, that dwarf today's population numbers. These observations note several hundred Alabama shad in gill nets in the Chipola

³⁵⁰Travis Ingram, Fisheries Biologist, Georgia Department of Natural Resources, December 2023.

³⁵¹Quinn *et al.* 2023. 14.

³⁵²Quinn *et al.* 2023. 14.

River. A record from Dead Lakes in 1978 noted the presence of 419 Alabama shad individuals. Another record from the Chipola River at the junction of the Apalachicola River Cutoff in 1954 noted the capture of 157 individuals.³⁵³ These numbers — from the Chipola watershed alone — showcase the former abundance of the Alabama shad compared to recent records. The Alabama shad is nowhere near as abundant in the Chipola River today.

Mississippi

Paul Mickle of the University of Southern Mississippi, who has studied the Alabama shad intensively for over a decade, noted several important threats to the species not considered in NOAA's 2017 negative finding. Mickle underscored the threat of climate change to the Alabama shad in its riverine and marine habitats. A changing climate could affect the Alabama shad's food resources and the timing of its migration or could cause direct mortality if warmer temperatures drive migrating individuals beyond their energy budget. Mickle also noted that the less direct effects of climate change, such as changing riparian zones, could make habitat less suitable for the temperature, salinity, and turbidity-sensitive Alabama shad.

Mickle also highlighted the significant threat that the Gulf of Mexico fishing industry poses to the Alabama shad, a factor entirely overlooked in NOAA's 2017 finding. Mickle, who has studied *A. alabamae* behavior in depth, noted that as a schooling fish, it is highly vulnerable to fishing operations targeting menhaden — a species that also displays schooling behavior.

Further, while NOAA cited genetic factors as having a low probability of posing extinction risk to the species, Mickle indicated that the Alabama shad's range contraction and decline in Missouri indicate otherwise. Given the converging pressures placed upon the Alabama shad by climate change, the fishing industry, range contraction, and a long list of other factors, Mickle said the possibility of genetic bottleneck could pose a serious threat to the species.

Alabama shad's range has contracted even further since 2017.

Surveys and sampling efforts from state biologists have concluded that Alabama shad's range has been reduced even further since 2017. It occurs in only two rivers in its namesake state, and it has been reduced to only 10% of its historic range. Records also indicate the Alabama shad has been extirpated from 60 rivers of the 75 rivers it historically occupied.

New data and information shows that coastal occurrences are also declining across the Alabama shad's range.

Coastal distribution of Alabama shad has also decreased substantially across its entire marine range in the Gulf of Mexico. Previous observations in coastal waters were significantly more numerous, frequent, and abundant. U.S. Fish and Wildlife and NMFS records not previously

³⁵³Williams, pers comm. December 7, 2023.

considered in the 2017 Negative Finding show significantly more observations of Alabama shad in coastal waters in the 1970-1990 than in the past two decades. Trawl surveys also indicate larger numbers of Alabama shad in greater densities from 1970-1990 than in the past two decades.³⁵⁴

New data indicates that r-selected Alabama shad are not simply experiencing fluctuations but rather long-term population declines and reductions in range.

NOAA's 2017 negative finding consistently claimed that the Alabama shad is a highly fecund, r-selected species and can recover from very small populations. Historically, this argument may have held true when the Alabama shad ranged across 75 rivers and occupied wide-ranging, diverse habitats. Now reduced to only a fraction of its range and concentrated in a select few habitats — increasingly pressured by various anthropogenic factors — small populations are at risk of complete extirpation in the event of environmental disturbance. While the negative finding argued that the Alabama shad occupies a wide range of habitats and is thus resilient to environmental disturbances, this is to ignore that the species occurs in just 10% of its previous range. Only small, poorly studied, and difficult-to-locate populations occur in its remaining habitats. Extirpated from most of its historic range, the Alabama shad has a reduced ability to recover from disturbance; the fact that the species has only small populations within a shrinking range makes the species highly vulnerable to extinction.

In addition, NOAA's claim that low Alabama shad numbers represent mere population fluctuations fails to explain the long-term, consistent declines observed for decades among the species populations. Historic populations described as “enormous”³⁵⁵ and “orders of magnitude greater” than current populations³⁵⁶ haven't been observed in recent years; instead, it has been difficult or impossible for researchers to locate the species even through targeting survey efforts. These long-term downward trends or outright extirpations would be highly unlikely to constitute undulations. Sammons confirmed these observations, expressing his concern that the species occurs in “low abundances” throughout its range — where even using targeted survey methods, researchers collect only a few individuals “here and there.”³⁵⁷ Sammons also noted that as streamlined survey efforts have still failed to locate Alabama shad individuals in large numbers for the past decade, the timing and method of sampling cannot be the cause for low abundance among Alabama shad. Sammons said “the data is probably the strongest indication of a serious problem,” and that detection probability cannot account for the persistent difficulty in finding individuals since 2012. While Alabama shad still exist in low numbers in the Apalachicola

³⁵⁴ FWS data 1970-2020.

³⁵⁵ Schaefer, pers. comm., October 13, 2023.

³⁵⁶ Schaefer, pers. comm., October 13, 2023.

³⁵⁷ Sammons, pers. comm., December 13, 2023.

system — the most important stronghold for the species — populations are markedly reduced from historical numbers. In the remainder of the Alabama shad’s range, the Alabama shad has disappeared or exists in extremely low abundances.³⁵⁸

Distribution records housed on FishNet2 provide a vast database of Alabama shad occurrence data over time. This data provides a clear indication that the species has steadily declined throughout its range, and in some cases, has been extirpated from its native river systems over the past 20 years. While NOAA’s 2017 finding claimed that the observed scarcity of Alabama shad could be a result of the difficulty or frequency of sampling efforts, this robust dataset showcasing dwindling Alabama shad numbers across broad geographic areas provides a direct rebut to their claim.

While short-lived species like the Alabama shad can recover faster than slower-growing fishes, collapses can be significant and long-lasting³⁵⁹ to the extent that recovery would be difficult or impossible. While conservation biology typically holds that slow-growing populations are most at risk, environmental disturbances may alter or possibly reverse this pattern to make short-lived species more vulnerable.³⁶⁰ While the Alabama shad can rebound quickly, only a handful of viable populations remain, and in the species strongest population stronghold, the Apalachicola system, a rebound has not been observed for a decade after a catastrophic crash in 2012.³⁶¹ Further, while the fish can rapidly recover from a population crash, the converse also applies — the Alabama shad is also vulnerable to rapid decline or extirpation.³⁶²

Disrupted flow regimes due to river modification and impoundment, an increase in the severity and frequency of drought and flooding events in the Southeast, and numerous other anthropogenic environmental disturbances could cause small, fragmented populations of the Alabama shad to go extinct in the remaining habitats where they occur. Importantly, while NOAA’s finding claimed that the Alabama shad would have a “high productivity potential” when provided access to historic spawning habitat, such access does not exist due to damming and inadequate conservation locking regimes.

Recent and novel targeted survey efforts have failed to yield Alabama shad.

Similarly, NOAA’s negative finding claimed that short-term studies on Alabama shad populations have failed to demonstrate river populations, as the species is prone to high natural variability and may have evaded detection in some river systems. The finding claimed “even

³⁵⁸Sammons, pers. comm., December 13, 2023.

³⁵⁹Pinsky and Byler 2015. 7.

³⁶⁰Pinsky and Byler 2015. 1.

³⁶¹Sammons, pers. comm., December 13, 2023.

³⁶²Sammons, pers. comm., December 13, 2023.

studies designed to target Alabama shad have yielded difficulties in detecting the species,” and “it is unknown whether catch rates were influenced by environmental factors... or were strictly a reflection of very low population numbers.” The finding claimed that species detection probabilities were likely less than 100 percent. A 2021 study directly rebuts NOAA’s claim. This study used refined, targeted sampling methods during the fish’s spring spawning migration when one would most likely detect Alabama shad. Electrofishing, considered the most effective method to collect spring-spawning Alabama shad, was used. The study still failed to locate *A. alabamae* in the Alabama River or Tombigbee River.³⁶³ Just four Alabama shad were noted on the Conecuh River³⁶⁴ and seven on the Choctawhatchee River.³⁶⁵ Sampling efforts on the Choctawhatchee River in 2022 located three Alabama shad over 11.4 hours of sampling efforts, for a rate of .26 catches per hour.³⁶⁶ Critically, sampling was targeted for Alabama shad at the location and time period most likely to locate the species.³⁶⁷ Such numbers suggest that the historical distribution and relative abundance of the Alabama shad in Alabama have “decreased drastically”³⁶⁸ and that the fish has been extirpated from the Mobile River basin, a critical historic stronghold.

Other research efforts contradict NOAA’s claim that low catch rates could be a product of environmental factors rather than low population numbers. Ichthyologist Dr. Jake Schaefer described that targeted sampling efforts from 2006-2011, in addition to general sampling since that period, have failed to locate Alabama shad in large numbers. Schaefer noted that he and his research team “almost never see them” and that surveys over the past decade have located only two to three individuals.³⁶⁹ Consistent, decades-long failure to locate Alabama shad using targeted surveying — even within the species’ most important river systems — demonstrates the decline or extirpation, rather than the fluctuation, of Alabama shad populations.

Historical data from the Library of Congress substantiates the previous commercial fisheries and large populations of Alabama shad.

New information and data from the Library of Congress reveal the extent of Alabama shad decline from historically large populations. Historical records reveal that this species was clearly once abundant enough to support commercial fisheries. Comparing past accounts of robust Alabama shad abundance to today’s comparatively scarce records, one can make the reasonable assumption that Alabama shad populations have experienced long-term declines.

³⁶³Rider *et al.* 2021. 142.

³⁶⁴Rider *et al.* 2021. 142.

³⁶⁵Rider *et al.* 2021. 143.

³⁶⁶Rider, pers. comm. November 3, 2023.

³⁶⁷Rider, pers. comm. November 3, 2023.

³⁶⁸Rider *et al.* 2021. 143.

³⁶⁹Schaefer, pers. comm. Oct. 13, 2023.

Ichthyologist Dr. Jake Schaefer confirmed these observations, stating that historical populations were “enormous” enough to support commercial fisheries. For decades, researchers have failed to observe massive populations described by the historical record. Even with the use of Alabama shad-specific targeted sampling methods, it has been difficult or impossible for researchers to locate the species. Steve Rider of the Alabama Division of Wildlife and Freshwater Fisheries further described that Alabama shad populations are not experiencing mere fluctuations but rather “low levels of fish” with no recent records resembling those of historical observations. Reported commercial landings of Alabama shad were 3,165 kg in 1889 and 48 kg in 1902; no commercial landings have since been reported.³⁷⁰

There are other critical references to the species abundance that NOAA did not consider in their 2017 negative finding. There are records of Alabama shad captures, particularly in the Apalachicola River and its major tributary, Chipola River. These documents describe several hundred Alabama shad in gill nets in the Chipola River; based on observations, the species is nowhere near as abundant in the Chipola River today.³⁷¹ A historic U.S. Fish and Wildlife Service report from Florida described Alabama shad as “the most abundant anadromous fish found on the Gulf coast”³⁷² and that the species “occurs in the greatest numbers in the Apalachicola River.”³⁷³ The same report describes spring migrations of Alabama shad as “numerous enough to be caught by anglers,”³⁷⁴ and that “a commercial fishery for Alabama shad does not exist in Florida, even though the population appears large enough to support one.”³⁷⁵ The report resoundingly reveals that the Alabama shad was once highly abundant in the ACF river basin and that populations were once large enough to support a commercial fishery.

Records from the Missouri Department of Conservation also indicate the presence of Alabama shad in great numbers no longer observable today. In the early 20th century, the Alabama shad was reported in the Mississippi River system from the Ohio River at Louisville, from the Mississippi River near Keokuk, and from Oklahoma. At that time, the species was common enough to support a limited commercial fishery.³⁷⁶

Newspaper articles from Georgia in the late 1800s to early 1900s suggest that eels,³⁷⁷³⁷⁸ shad, and sturgeon³⁷⁹ historically migrated up the Flint River in significant numbers before the Jim Woodruff Lock and Dam blocked these now rare anadromous species’ migrations. Such accounts

³⁷⁰NOAA 2017. 4052.

³⁷¹Jim Williams, pers. comm. October 22, 2023.

³⁷²U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

³⁷³U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

³⁷⁴U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

³⁷⁵U.S. FWS Coordination Report. 1978. Appendix III. Diadromous Fishery Resources. 22.

³⁷⁶Missouri Department of Conservation. 2022. "Alabama Shad: Habitat and Conservation.

<https://mdc.mo.gov/discover-nature/field-guide/alabama-shad>

³⁷⁷*The Leader Enterprise and Press*, Thursday, April 21, 1921.

³⁷⁸*The Marietta Journal*, Thursday, November 1st, 1883.

³⁷⁹*The Americus Times Recorder*, Wednesday, September 21st, 1921.

provide a valuable and jarring glimpse into these species' robust population numbers before river modification and impoundment. Newspapers describe shad migrations up the Flint River as "plentiful."³⁸⁰ The accounts also note "thousands of shad in the Flint River,"³⁸¹ and that shad were observed to "accumulate in large numbers."³⁸² Other accounts describe shad as "so abundant in the Flint River that a fishery, properly equipped, would reap a harvest at this season of the year"³⁸³ and that "quite a number of shad"³⁸⁴ were caught in the Flint River near Albany. The species described in such accounts are now rare or impossible to find, showcasing the drastic declines among Alabama shad and similarly sensitive species affected by habitat modification and fragmentation.

Historically, Alabama shad were previously abundant in Alabama's Mobile Basin as well. An article in the *Florence Gazette* from May 1878 stated that "great quantities of young shad have been caught this spring in the Coosa, Etowah, and Oostanaula rivers, in traps and nets."³⁸⁵ An 1878 article in the *Livingston Journal* reported that over a thousand pounds were caught in the Coosa in one week, and that "our market is so glutted with these delicious fish that they are selling for only 5 to 7 cents a pound."³⁸⁶ Catches of Alabama shad were also being reported in the Black Warrior River at Tuscaloosa, and in the Alabama River at both Selma, and Montgomery.³⁸⁷

One newspaper article from from the *Montgomery Advertiser* in 1897 stated, "About two years ago there was a remarkable catch of shad at Tuscaloosa. At the foot of the lock works going on in the Warrior River it was no trouble to catch large quantities of them."³⁸⁸ Another article from 1860 in the *Independent American* (Troy, Ala.) suggests that Alabama shad were once abundant, but had declined to the point that conservation was required: "The shad [sic. *Alosa alabamae*] [were] formerly caught in large numbers in the Chattahoochee River... We suggest to fishermen, that no more shad be taken from our waters, until they become more plentiful. When caught they should be returned alive to the water."³⁸⁹

³⁸⁰*The Americus Times Recorder*, 1901.

³⁸¹*The Dawson News*, March 25th, 1908.

³⁸²*The Dawson News*, March 25th, 1908.

³⁸³*The Dawson News*, March 25th, 1908.

³⁸⁴*The Marietta Journal*, April 3rd, 1879.

³⁸⁵ Hershey *et al.* 2024. 23-24.

³⁸⁶ *Ibid.*

³⁸⁷ *Ibid.*

³⁸⁸ *Ibid.*

³⁸⁹ Hershey *et al.* 2024. 23-24.

New data shows climate change is having an even greater impact on Alabama shad.

Climate change, particularly temperature changes, affect Alabama shad's species growth, development, reproduction ability, mortality rates, and range. Contrary to information contained in NOAA's 2017 negative finding, predictions indicate that climate change will amplify yearly variations in precipitation rates in the Southeast, making severe population fluctuations or extirpations among Alabama shad more likely. Forecasts for the Southeast predict more intense droughts and an increased likelihood of extreme rainfall events.³⁹⁰ These climatic extremes heighten the risk of Alabama shad experiencing poor years and facing a potential total population collapse.³⁹¹

The temperature sensitivity of the Alabama shad makes it susceptible to the effects of more frequent and intense droughts and subsequent warmer average water temperatures. The Alabama shad's preference for cool waters will limit the species' ability to adapt during heat waves and drought periods.

Meanwhile, the increased frequency and severity of flooding events diminish the likelihood of successful spawning runs. The Alabama shad appears particularly sensitive to flooding, as evidenced by weak or nonexistent shad runs during heavy rainfall years.³⁹² The species may be adversely affected by strong currents, and several studies suggest a correlation between exceptionally high-flow years and reduced spawning success and diminished numbers of migrating individuals.³⁹³ Unfortunately, fishways in dams often prove ineffective in facilitating the passage of shad.³⁹⁴

Warming ocean and riverine temperatures could shift the phenologies of spawning runs, potentially disrupting the species' historical ecological relationships throughout its lifecycle. Climate change heightens the possibility of mismatch between the photoperiod and temperature conditions. If, prompted by abnormal temperatures in the species' ocean or riverine habitat, Alabama shad spawn earlier than usual, there is a risk that the shad's migration does not correspond with the hatching of invertebrates. Additionally, alterations in riparian zones due to climate change could lead to shifts in insect communities, posing a threat to the Alabama shad's food sources. Climate change could also change the productivity of marine and river habitats with unknown impacts on the Alabama shad's food resources.

³⁹⁰U.S. Climate Resilience Toolkit.

³⁹¹Jake Schaefer, pers. comm., October 13, 2023.

³⁹²Jeffrey Quinn, pers. comm., October 17, 2023.

³⁹³Kerns *et al.* 2017. 327.

³⁹⁴Aunins *et al.* 2013. 572-574.

As an anadromous species, the Alabama shad relies on specific temperature and flow-dependent cues for successful migration and reproduction. Flows and water temperatures will become less consistent as climate change continues to afflict the southeast, with potentially devastating consequences for Alabama shad migrations.

Climate change has also affected the temperature of the Gulf of Mexico, where the Alabama shad overwinters. Warmer temperatures could increase the prevalence and negative effects of the Gulf hypoxic zone, which Jeffrey Quinn noted poses a significant threat to the Alabama shad. Normally formed in the summer, this zone is traditionally associated with specific seasonal patterns. Quinn explained that with the Alabama shad's increasingly unpredictable movements throughout the year due to climate change, the fish's emergence at irregular times might expose individuals to this potentially harmful zone. Alabama shad are particularly sensitive to low oxygen concentrations.³⁹⁵

The ACF river basin — the Alabama shad's most vital population stronghold — is experiencing increasingly complex water management challenges due to competing water needs between heavily populated states.³⁹⁶ Water strains will only increase as the region experiences population growth and the increased frequency and intensity of drought spells. A strain on water resources will entail less reliable flows for migrating Alabama shad and the potential for generally shallower, warmer, and more turbid waters.

The Alabama shad's most important spawning habitat in the Flint River is threatened by effects of climate change and concurrent intensification of agriculture. The Flint River is fed by groundwater and utilized heavily for agricultural purposes, making it particularly vulnerable to low flows and warmer water temperatures during drought years.³⁹⁷ Irrigation continues to strain groundwater resources in the Flint River Basin, considered the Alabama shad's most suitable spawning habitat and home to some of the largest remaining populations of the species. In June 2023, the state of Georgia considered easing a decade-old moratorium on new or expanded withdrawals in the Flint River Basin.³⁹⁸

Between 1954 and 2004, water levels decreased in the non-tidal section of the Apalachicola River due primarily to channel deepening and widening from dams and navigational modifications to the river. The reduction in water levels has significantly altered the long-term hydrological conditions in over 200 miles of off-channel floodplain sloughs, streams, and lakes.

³⁹⁵Jeffrey Quinn, pers. comm. October 17, 2023.

³⁹⁶NOAA: Drought.gov

³⁹⁷Steve Sammons, pers. comm., December 13th, 2023.

³⁹⁸Nolin, Jill. 2023. *State EPD could ease ban on tapping Flint River basin water for first time in a decade*. Georgia Recorder: June 21st:

<https://georgiarecorder.com/2023/06/21/state-epd-could-ease-ban-on-tapping-flint-river-basin-water-for-first-time-in-a-decade/>

These changes have affected the majority of the 82,200 acres of floodplain forests in the non-tidal section of the Apalachicola River.³⁹⁹

As a result, both the quantity and quality of floodplain habitats supporting fish, mussels, and other aquatic organisms have diminished. Concurrently, wetland forests in the floodplain are undergoing alterations in response to drier conditions. The decline in water levels is likely “the most significant anthropogenic impact” experienced thus far in the Apalachicola River and its associated floodplain. The decline has been intensified by persistent decreases in spring and summer flow — particularly during periods of drought — a trend driven by climate change and anthropogenic factors such as water consumption and reservoir evaporation.⁴⁰⁰

Low water levels in the ACF river basin are now occurring more frequently and lasting longer than before 1954. This has led to extended periods during which floodplain streams are without water, isolated, or not flowing. If the Apalachicola, and likely, other rivers within the Alabama shad’s range, are losing water over time from evapotranspiration, impoundments, and climate change, the Alabama shad could suffer severe negative impacts. More specifically, during periods of drought, the JWLD system may not have enough water to conduct conservation locking activities vital to the survival of the Alabama shad.

New data shows the increased likelihood and impact of oil spills in Alabama shad habitat.

Steep declines in Alabama shad populations across Gulf states impacted by oil spills have been noted by state biologists. Records from the state of Georgia show a steep decline in Alabama shad in the years immediately after the Deepwater Horizon oil spill of 2011. Nearly every state fisheries biologist suggested that the Deepwater Horizon oil spill likely had an impact on Alabama shad.

Oil spills continue to impact Alabama shad and their habitat. The second-largest oil spill in Gulf history occurred in November 2023 just 17 miles from the mouth of the Mississippi River where Alabama shad historically conducted massive migrations upriver.

After the Deepwater Horizon oil spill, fisheries biologists in Georgia observed lesions on the Alabama shad in the Apalachicola River basin. Since the oil spill, Alabama shad populations have crashed in the Apalachicola River basin and not recovered to pre-spill levels.⁴⁰¹

³⁹⁹Light *et al.* 2005. 1.

⁴⁰⁰Light *et al.* 2005. 2.

⁴⁰¹Travis Ingram. pers. comm., December 9, 2023.

Fisheries biologists across the region also unanimously agreed that additional research was needed to better understand Alabama shad's coastal habitat and life cycle, which have been increasingly affected by additional and expanding offshore oil leases and continued long-term oil and gas operations in the Gulf.

REQUEST FOR CRITICAL HABITAT

The Center for Biological Diversity, Miccosukee Tribe of Indians, and partners encourage the U.S. Fish and Wildlife Service to designate critical habitat for the Alabama shad concurrently with its listing. Critical habitat as defined by Section 3 of the ESA is: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) the specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species (16 U.S.C. § 1532(5)).

Congress recognized that the protection of habitat is essential to the recovery and/or survival of listed species, stating that: “classifying a species as endangered or threatened is only the first step in ensuring its survival. Of equal or more importance is the determination of the habitat necessary for that species’ continued existence... If the protection of endangered and threatened species depends in large measure on the preservation of the species’ habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat.”

The Alabama shad urgently needs critical habitat protection to be issued concurrently with its threatened or endangered species designation.

Alabama shad critical habitat consists of free-flowing rivers and tributaries, surrounding riparian habitat, estuaries, coastal waters in the Gulf of Mexico and migratory corridors between marine and riverine sites, which are essential to the Alabama shad’s long-term genetic health and survival. Rider *et al.* noted that the Alabama shad could “become extirpated from Alabama in the near future, which is a significant portion of its range.” Habitat protection, river restoration, and maintaining large tracts of free-flowing rivers are vital to the species’ survival. The Alabama shad depends on complex riverine habitat for spawning, contiguous free-flowing river, and healthy, protected coastal waters for its survival.

The Alabama shad will not survive without protection of its remaining native river systems, migration corridors, and coastal and marine habitats. The Alabama shad occurs within some of the most heavily impacted ecosystems in the southeastern United States. The ACF river basin, harboring the largest known populations of Alabama shad, is not only adjacent to large, growing population centers but severely fragmented by dams, dredging, and various water storage projects. Even within relatively unimpounded river systems, changing water quality conditions and flow regimes are permanently altering the habitat of the Alabama shad.

The Alabama shad’s marine life stage occurs in one of the nation’s most heavily impacted coastal regions — the Gulf of Mexico. Today, the Alabama shad is found only in a few river systems

where the species is highly sensitive to specific temperature, salinity, turbidity, and habitat structure. Ease of riverine passage, healthy riparian zones, and natural flow regimes are especially critical to Alabama shad. Protecting, connecting, and restoring southeastern rivers where the largest remaining Alabama shad populations exist is critical to the species' survival.

Specifically, currently occupied river habitat deserving of protection includes the following:

- Suwannee and Santa Fe River basin in Florida and Georgia
- St. Mark's River basin in Florida
- Apalachicola-Flint-Chattahoochee River basin and Chipola River in Florida and Georgia
- Choctawhatchee River basins in Florida and Alabama
- Escambia-Conecuh River basin in Florida and Alabama
- Pascagoula-Leaf-Chickasawhay River basin in Mississippi
- Pearl River basin in Mississippi
- Ouachita River basins in Arkansas
- Meramec and Gasconade River basins in Missouri

In addition, previously occupied portions of rivers should also be included as critical habitat to ensure the Alabama shad's recovery. The Alabama shad has disappeared from 78% of its historical range; recovery depends on restoring Alabama shad to some of the best remaining habitat, including portions of the following rivers:

- Ochlockonee River (FL)
- Perdido River (FL)
- Yellow River (FL)
- Mobile River (AL)
- Alabama River (AL)

Additionally, designating critical habitat in the Gulf of Mexico coastal areas where the species overwinters and matures is essential for the survival and recovery of the Alabama shad. The following specific areas provide core marine critical habitat for the Alabama shad:

- Mouth of the Suwannee River (FL)
- Apalachicola Bay (FL)
- Escambia Bay (FL)
- Choctawhatchee Bay (FL)
- Perdido Bay (FL)
- Pascagoula Bay and coastal areas behind its barrier islands (AL)
- Mouth of the Mississippi River (LA)

Critical habitat will protect the Alabama shad from further harm and population decline and ensure its full recovery.

In addition, other species of conservation concern also depend on the habitat where Alabama shad resides, including the Gulf sturgeon, tapered pigtoe, round ebonyshell, Southern sandshell, Chipola slabshell, narrow pigtoe, fat three-ridge, Suwannee moccasinshell, orange-nacre mucket, narrow pigtoe and Alabama sturgeon. Federally listing the Alabama shad and concurrently identifying critical habitat would provide protections for other rare and imperiled aquatic species similarly reliant upon specific threatened coastal and riverine ecosystems.

Climate change threatens the last pockets of Alabama shad habitat, both riverine and marine. The inadequate use of conservation banking and proposed river modification projects imperil what remains of Alabama shad habitat. Critical habitat is urgently needed to ensure the survival of the Alabama shad.

CONCLUSION

The Alabama shad urgently needs Endangered Species Act protections. This rare and imperiled anadromous fish, extirpated from 90% of its historic range and restricted to a few heavily-impacted ecosystems, is on the verge of extinction.

The species' complex life history, requiring both riverine and marine habitat and free passage between the two, makes the Alabama shad especially vulnerable to habitat fragmentation and modification and the effects of climate change. The rivers where Alabama shad occurs are some of the most heavily altered and polluted ecosystems, and they are increasingly affected by rapidly growing populations, water demands, pollution, and land use changes in the Southeast.⁴⁰² In addition, the Alabama shad's marine habitat in the Gulf of Mexico contains some of the most heavily industrialized and polluted waters in the country, and they face increasing impacts from population growth, development, nutrient runoff and hypoxic zones, climate change, and commercial fishing industries.

Alabama shad decline presents a complex and pressing conservation challenge, as the species is in decline both within impounded and free-flowing rivers. While river modification projects likely represent the greatest threat to the species, other anthropogenic factors such as warming water temperatures, changing salinity, and eutrophication drive the species closer to extinction. Many other threats, including agricultural pollution, oil spills, bycatch, disease, and invasive species, further imperil the Alabama shad.

Recent studies provide conclusive evidence that the Alabama shad is in severe decline and in danger of disappearing from its most critical remaining river systems, even in the Apalachicola River, home to the species' last known stronghold. However, this population is endangered by Jim Woodruff Dam blocking migration critical to the species' survival. The failure of conservation locking has led to continued declines in the Apalachicola population.

The distribution and abundance of the Alabama shad in Alabama, one of the species' most important range states, have decreased drastically.⁴⁰³ The Alabama shad populations have declined by 98% in the past decade in the Choctawhatchee River, and the species is likely extirpated from the Mobile River basin.⁴⁰⁴ Alabama fisheries biologist Steve Rider noted that the "Alabama shad has arrived at a precipice, and we have to do something now" to prevent the species' extinction.⁴⁰⁵

⁴⁰²Mickle 2010. 7.

⁴⁰³Rider *et al.* 2021. 143.

⁴⁰⁴Rider *et al.* 2021. 149.

⁴⁰⁵Rider, pers. comm., November 3, 2023.

Similar population declines have been observed in Georgia on the Apalachicola River, where populations have crashed from 123,000 in 2012 to as few as 324, a decline of 99.8%.⁴⁰⁶ Alabama shad populations have steeply declined across its entire range.

While the Alabama shad is state-listed in all of its range states, no conservation plans exist for the species' recovery. Present regulations are not only inadequate to protect the Alabama shad, but in some cases directly enable the decline of the species. The Outer Continental Shelf Lands Act, for example, not only fails to consider the conservation of the Alabama shad, but actively threatens the species by authorizing oil and gas exploration and failing to enforce cleanup properly.

Alabama shad habitat is disappearing and increasingly fragmented. Populations have plummeted throughout the species' once vast range, and the Alabama shad is on the brink of extinction. Alabama shad urgently require federal protection under the Endangered Species Act.

⁴⁰⁶ Georgia Department of Natural Resources. Alabama shad data 2007-2022.

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