

American Shad Sustainable Fishing Plan Update for South Carolina

Prepared by

Bill Post and Chad Holbrook

August 30, 2017



South Carolina Dept. of Natural Resources

Wildlife and Freshwater Fisheries and Office of Fisheries Management

Updated-ASMFC American Shad Sustainable Fishing Plan for South Carolina

Introduction:

The purpose of this sustainable fisheries management plan is to allow existing shad fisheries that are productive and cause no threat to future stock production and recruitment to remain in place and close all others. Excerpts from the ASMFC 2007 stock assessment for SC's American shad were used in this document (ASMFC 2007). The assessment, which was prepared and submitted to the ASMFC shad and river herring board by SCDNR and the Stock Assessment Subcommittee (SASC), summarizes SC's fisheries for American shad.

American shad (*Alosa sapidissima*) are found in at least 19 rivers of South Carolina (Waccamaw, Great Pee Dee, Little Pee Dee, Lynches, Black, Sampit, Bull Creek, Santee, Cooper, Wateree, Congaree, Broad, Wando, Ashley, Ashepoo, Combahee, Edisto, Coosawhatchie, and Savannah rivers). Many have historically supported a commercial fishery, a recreational fishery, or both, including the Winyah Bay system (primarily the Waccamaw and Pee Dee rivers), the Santee-Cooper system, Ashley, Edisto, Ashepoo, Combahee, Coosawhatchie, and Savannah Rivers (Figure 1).

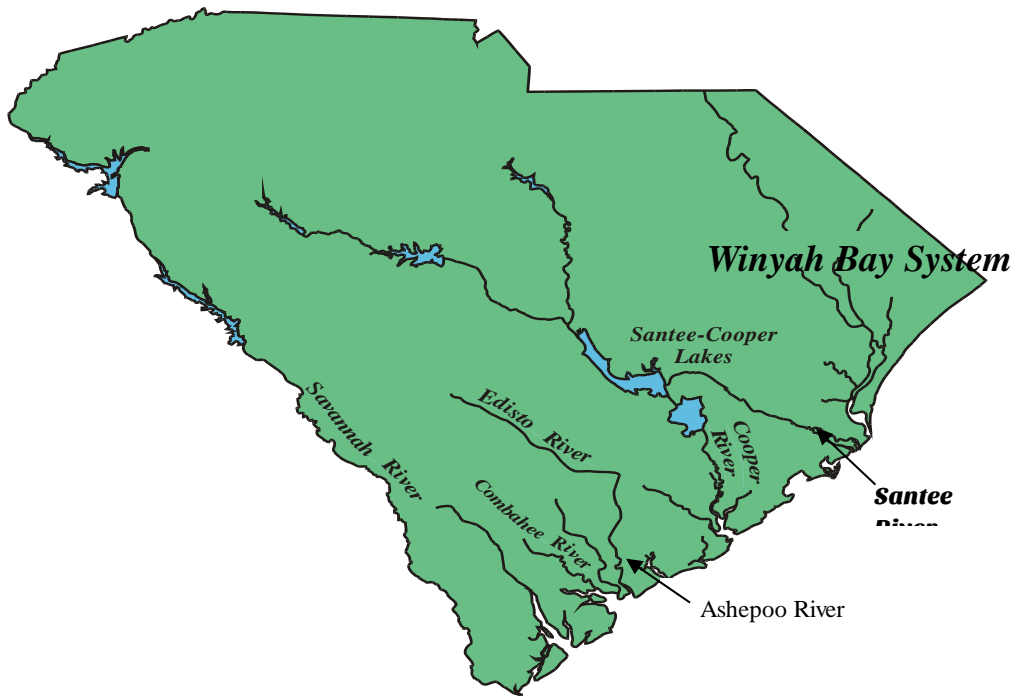


Figure 1. Map of major South Carolina drainage basins and river systems with American shad (*Alosa sapidissima*) fisheries or historical American shad runs.

Currently, commercial fisheries exist in Winyah Bay, Waccamaw River, Pee Dee, Black, Santee, Edisto, Combahee, and Savannah rivers, while the Sampit, Ashepoo, Ashley, and Cooper rivers no longer support commercial fisheries. With the closure of the ocean-intercept fishery beginning in 2005, the Santee River and Winyah Bay complex comprise the largest commercial shad fisheries in South Carolina. Recreational

fisheries exist in the Cooper, Savannah, Edisto, and Combahee rivers, as well as the Santee River Rediversion Canal.

Data for American shad are available to assess trends in fishery and stock status for the following river systems in South Carolina: the Pee Dee run (consisting of Winyah Bay, Waccamaw and Great Pee Dee rivers), Santee River, Cooper River, Edisto River, Combahee River, and Savannah River. Additional data for the Savannah River are provided by Georgia Department of Natural Resources (GADNR).

The South Carolina Department of Natural Resources (SCDNR) manages American shad populations and collects fishery-independent and fishery-dependent data for the major shad rivers in the state. SCDNR has collected voluntary landings data by river system since 1979 and instituted mandatory catch and effort reporting in 1998. There are still some gaps in these data, but they provide the broadest temporal and spatial view of American shad stocks in South Carolina. As part of fishery independent sampling, SCDNR also conducted tag-return studies in the gill-net fisheries for several rivers, but these were not used to determine stock status, because in recent years, fishers have grown skeptical that providing tag returns to SCDNR led to new more restrictive changes in the fishery and may lead to future closures. In the past, these studies rotated among rivers and ran 2 to 5 years per river before moving to a different river. However, due to growing concern for the species, SCDNR began conducting this monitoring in multiple “reference” rivers during the shad season. During these studies, SCDNR collected biological information to support other studies (e.g., age, repeat spawning, length and weight data). In some systems, SCDNR also conducted creel surveys (Cooper River and Savannah River), fish counts (Santee River), and young of the year (YOY) sampling (Santee-Cooper system, Pee Dee River, Edisto River, and Savannah River).

This plan primarily draws upon investigations conducted by the SCDNR’s Marine Resources Division and Division of Wildlife and Freshwater Fisheries to provide a river-specific assessment of relative stock status for American shad. The general approach to this document was to (1) characterize fisheries by the magnitude and trend of landings data (Catch Per Unit Effort=CPUE) and note if the system still supports a viable fishery and (2) review supporting fishery-dependent and fishery-independent data sets and conduct analyses for each river system when applicable.

Current Regulations:

South Carolina manages its shad fisheries using a combination of seasons, gear restrictions, and catch limits (Appendix 1.) implemented over several management units: Winyah Bay and Tributaries (Waccamaw, Great Pee Dee, Little Pee Dee, Lynches, Black and Sampit rivers); Santee River; Charleston Harbor (Wando, Cooper & Ashley rivers); Edisto River; Ashepoo River; Combahee River; Coosawhatchie River; Savannah River within South Carolina; Ocean Waters; and Lake Moultrie, Lake Marion, Diversion Canal, Intake Canal of Rediversion Canal and all tributaries and distributaries.

The first river-specific commercial regulations for American shad in South Carolina were enacted in 1993 for the Edisto River in response to SCDNR’s studies that identified overfishing as a major contributor to a perceived trend of population decline [Act # 343 of the 1992 South Carolina General Assembly].

Beginning with the 1998 commercial shad-netting season, all licensed fishermen are required to report their daily catch and effort to the SCDNR. In 2000, Act #245 of the 2000 South Carolina General Assembly was passed in response to the perceived population status of shad populations in each of the state's river systems supporting an American shad fishery. This Act led to the closure of the commercial gill-net fishery on the Coosawhatchie River and a substantial reduction in potential gill-net fishery effort for other systems supporting small American shad stocks in South Carolina, including the Combahee, Ashepoo, and Ashley rivers (www.dnr.sc.gov).

Significant changes in shad and herring regulations became effective in 2001 with the passage of the Marine Resources Act of 2000, which gave the SCDNR authority to implement a permit program for the State's shad and herring fisheries. All commercial shad and herring fishery license holders were issued permits that could be used to "restrict the number of nets for taking shad...in any body of water where the number of nets or fishermen must be limited...to prevent congestion of nets or watercraft, or for conservation purposes". The number and conditions of permits can be controlled "to designate areas, size and take limits, hours, type and amount of equipment, and catch reporting requirements," and enabled SCDNR to phase out the ocean-intercept fishery by 2005. In addition, a recreational aggregate creel limit of 10 American and hickory shad per person was implemented in all state waters, except for the Santee River in which a 20 fish creel limit was set.

Further proposed restrictions in the previous SFMP document, to address sustainability, were implemented in 2013 and were the first changes in SC's shad fishery since the closure of the ocean-intercept fishery in 2005. These changes (Appendix 3), in concert with changes required by the National Marine Fisheries Service (NMFS) to account for by-catch of sturgeon (Appendix 2), without a doubt, far exceeded by a wide margin, any restrictions imposed on SC's shad fishery to date.

Brief description – Current status of the stocks:

a) Landings:

South Carolina has monitored commercial fisheries for American shad within state waters since 1979. The NMFS landings data before 1979 were collected from major wholesale outlets located near the coast; therefore, it is likely that inland landings were not completely accounted for in these years, since many shad fishermen claim not to sell their catch and keep it for personal consumption. No landings were attributed to the South Carolina ocean-intercept fishery before 1979. SCDNR has landings by system since 1979 for the Atlantic Ocean (i.e., the ocean-intercept fishery), Winyah Bay, Waccamaw River, Pee Dee River, and Santee River. These data were used in the 2007 shad stock assessment by SC and ASMFC. Data collected since 1979 generally include inland landings and should be considered as a separate time series. Those time series begin in 1998 when the mandatory reporting requirement was instituted for the statewide fishery.

There are some discrepancies between SCDNR and NMFS American shad landings. One reason for this is that NMFS uses dealer landings reports for their records; however, many shad fishermen claim not to sell their catch and keep it for personal consumption.

The Cooper River supports an active recreational fishery below the Pinopolis Dam tailrace in the late winter to early spring. SCDNR has conducted a creel survey from 2001 to 2015 to estimate exploitation and catch-per-effort in this recreational fishery. SCDNR also conducted sportfishing creel surveys on the Cooper and Santee Rivers from 1981 to 1982 and 1991 to 1993 in order to evaluate the impact of the Rediversion Canal on these rivers' recreational fisheries (Cooke and Chappellear 1994). These surveys examine the total recreational fisheries on each river for each study period.

Recreational creel surveys were conducted on the Savannah River in the late 1990s by GADNR (1997) and SCDNR (1998 and 1999). Estimates of catch from these surveys varied from year to year largely due to dramatically different flow conditions, as 1998 was a "flood" year and 1999 a "drought" year. Catch estimates from each of these creel surveys are available in Boltin (1999); however, the year-to-year estimates were highly dependent on the impacts of the river flow on the recreational fishery. In 1997, no additional information on the flow was reported. Due to requirements of Amendment 3 to ASMFC's shad and river herring fishery management plan, SCDNR conducted creel surveys beginning in 2011, however, due to the deteriorating wing wall at the New Savannah Bluff Lock and Dam, recreational fishing is no longer permitted at this location.

b) Fishery Independent Indices:

Spawning stock:

Fishery-independent CPUE data were collected using 12.7 cm stretch mesh drift gill nets for the years 1994 - 2015. In the past, as approved by Amendment 1 of ASMFC's shad and river herring fishery management plan (FMP), these studies rotated among rivers and ran 2 to 5 years per river before changing river systems. However, due to growing concern for the species, SCDNR began conducting this monitoring on multiple "reference" rivers during the season. During these studies, SCDNR collected biological information to support other studies (e.g., age, repeat spawning, length and weight data).

Juvenile Surveys:

Trawl sampling studies were conducted for juvenile American shad in the fall of 1985 in the Edisto River and Winyah Bay using 4.9 and 7.6 m otter trawls. Sampling in the Edisto River occurred from September through November with 32 trawls that caught two American shad. Winyah Bay sampling took place October and November. Nineteen trawls over five stations yielded three American shad. Data were also collected from another SCDNR trawl project in the Santee River where 15 juvenile American shad and 30 juvenile blueback herring were collected. These programs were discontinued after a single sampling season. However, due to growing concerns to prove sustainability, SCDNR began yearly sampling for YOY in 2009 in some systems and 2010 in others. In addition, YOY sampling in the Santee Cooper Lake System occurred as part of yet another SCDNR study in 2008.

c) Fishery Dependent Indices:

Historical commercial shad landings from NMFS are available for South Carolina back to 1880 with the highest reported landings occurring in 1896 (304,819 kg). NMFS reporting agents compiled landings recorded before 1979. Landings data are available for 11 years between 1880 and 1926 with a range of 94,349 to 304,819 kg and a mean of 188,615 kg. Beginning in 1927, a continuous data stream of landings is available to the present, except for the 1940s (WWII). Landings generally declined from the late 1800s throughout the twentieth century reaching a low in the 1970s, with annual landings averaging 16,477 kg from 1973 to 1976.

With the onset of mandatory reporting in 1998, South Carolina shad fishermen were required to report effort and landings data. In 2000, 2,727 commercial shad fishing trips were reported to SCDNR. The number of reported trips generally decreased from 2000 to 2015 with 1,281 trips taken in 2015. Nearly all fishermen (>95%) have submitted at least one monthly report since 2000, while only 60 to 70 percent report some catch (SCDNR records). It is likely that the ocean-intercept fishery closure in 2005 contributed to the decrease in landings from the 2004 amount of 170,212 kg.

With the closing of the ocean-intercept fishery in 2005, the Santee River and Winyah Bay now constitute the largest remaining commercial shad fisheries in South Carolina with Santee River landings comprising 58 percent and Winyah Bay landings 38 percent of the 2005 statewide total. In 2015, shad trips in Winyah Bay complex and Santee River accounted for 35 percent and 46 percent of the total shad trips, respectively.

d) Other: none

e) Fisheries Closed in the previous plan

- a. Waccamaw River (Bull Creek to North Carolina border)
- b. Ashley River
- c. Charleston Harbor
- d. Wando River
- e. Ashepoo River

Fisheries requested to be Open (Commercial and Recreational):

- a. Pee Dee River run (Winyah Bay, Waccamaw, and Pee Dee River)
- b. Black River
- c. Santee Cooper System
- d. Edisto River
- e. Combahee River
- f. Savannah River

f) Sustainability

Systems with “sustainable fisheries” are defined as those that demonstrate shad stocks could support a commercial and / or recreational fishery that will not diminish potential future stock reproduction and recruitment. Data used, in most cases, are landings (CPUE) that occurred since the 2007 stock assessment (i.e. after 2004). Sustainability for SC rivers is determined by catch trends (both using fishery-independent and fishery-dependent data), and in some cases, juvenile abundance. In addition to these, as part of requirements of Amendment 3, SC already imposed several gear restrictions, cap limits, and changes to the legal fishing season. Furthermore, in response to the National Marine Fisheries Service (NMFS), SC further restricted the fishery to account for and limit the by-catch of sturgeon in the shad fishery. In 2013, statewide gear restrictions were implemented (Appendix 2). These restrictions, while resulting in an 88% reduction of by-catch of Atlantic and shortnose sturgeon, also no doubt led to more protection for adult shad during spawning runs. Sustainability targets have been developed by using fishery-dependent data (landings/CPUE) and/or fishery-independent data collected since the last year of data included in the stock assessment and using the 25th percentile of the annual mean (Table 1).

Pee-Dee River Run (Winyah Bay, Waccamaw to Bull Creek, and Pee Dee River)

In order for American shad to enter the Pee Dee River, they must first swim through the Winyah Bay and the lower most portion of the Waccamaw River. Therefore, SCDNR will refer to this as the Pee Dee River Run of shad. There is little doubt some shad continue up the Sampit and Waccamaw Rivers, but those rivers/river segments are not being considered in this sustainability option and were closed to fishing in 2013 (Figure 2).



Figure 2. Map of the Winyah Bay system highlighting the “Pee Dee run” of shad

SCDNR uses both fishery-independent and fishery-dependent data to justify the continued existence of this fishery. The 2007 stock assessment concluded “that, overall, these shad stocks have remained stable or increased slightly since the late 1970s.” More recent catch rates (kilogram of shad captured in a 92m. net fished for one hour) also indicate a stable trend (Figure 3). In fact, during the 2011 fishing season, fisheries were suspended twice for two weeks at a time, due to the excess of shad at the local fish markets. SCDNR also conducts fishery-independent sampling in the Waccamaw River using gear comparable gear (92m. floating/drift gill net with 12.7 cm. stretch mesh) and observed similar catch rates (CPUE=kg. of shad/92m. net/1 hr.). SCDNR will continue this sampling on an annual basis.

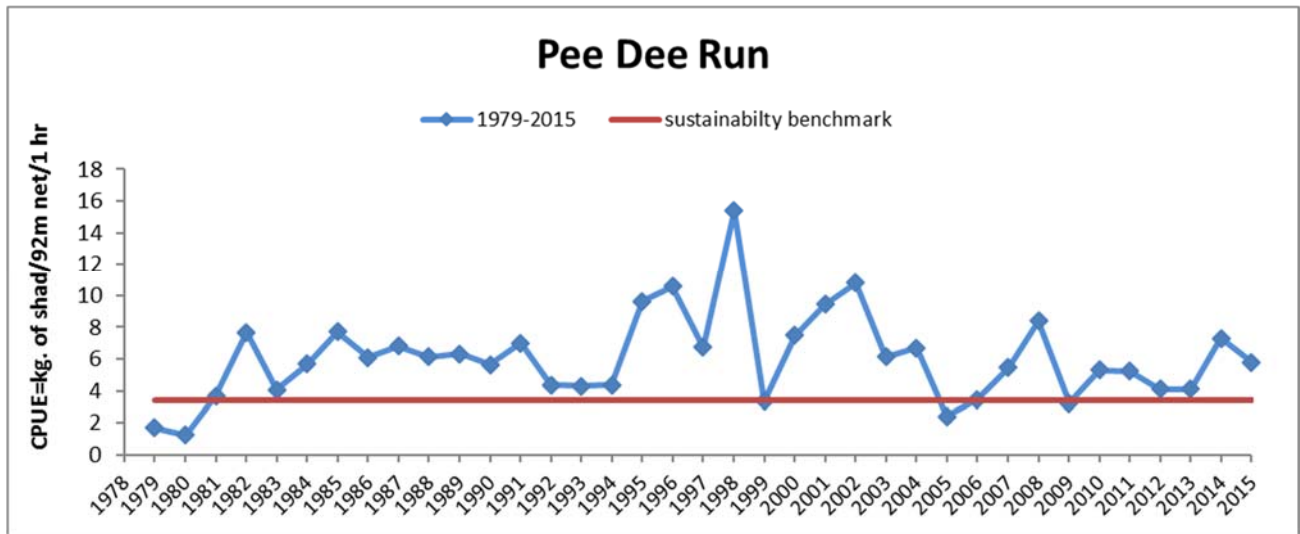


Figure 3. Commercial catch per unit effort (kg. fish per 92-m net hr) of American shad and sustainability target for the Pee Dee Run.

Beginning in 2010, SCDNR also collected YOY shad from this system during the summer outmigration. Shad with lengths ranging from 77-137mm were collected using electro-fishing gear. Catch rates (CPUE=number of shad caught per hour) were equal to 31.28. This was also somewhat comparable to efforts from another SCDNR survey conducted in 2008 which yielded a CPUE of 47 for American shad. However, during this study, more sites were used over a broader reach of river during this project and unfortunately, due to ongoing budget cuts, sampling for this project was discontinued. However, YOY sampling is consistent with results from 2010 and will continue on an annual basis.

SC requests to maintain this fishery at current levels with annual monitoring to occur as mentioned. The Pee Dee run is considered by SCDNR to be sustainable at current levels and with newly passed regulation changes, migrating shad should receive additional protection which will only help the sustainability of the species. The approved sustainability benchmark of 3.41 was developed by using the 25th percentile of the annual mean for CPUE’s for the last ten years. If the CPUE’s fall below the sustainability target for three consecutive years, management action will be taken. Potential management actions are gear restrictions, season changes, catch limits, or closure.

Black River

The 2007 stock assessment concluded “This relatively small river is perceived to have undergone significant American shad stock declines over the past 25 years.” More recent CPUE (kg. of shad captured in a 92m. net fished for one hour) data (2000-2015) suggest that while catches are low, they remain consistent and, given the low effort, appear to be stable in more recent years. Currently, the Black River commercial shad fishery consists of only 2 fishermen and neither fisherman depends on their catch for commercial purposes. Because the number of fishers decreased since 2011, landings data for this river are confidential are not provided in this plan. However, it should be noted, catch rates for this river did not fall below the approved sustainability benchmark. Additionally, the Black River remains an undammed river with low flow rates which pale in comparison with those from the dammed Santee River (5912 cfs) or Pee Dee River (11,267 cfs) for the same time series.

SC requests to maintain this fishery at reduced levels. The Black River run of shad is considered by SCDNR to be sustainable at lower levels and with newly passed regulations, migrating shad should also receive additional protection. If catch rates (CPUE= kg. of shad/ 92m net fished for 1 hr.) for the Black River run commercial fishery fall below 0.97 three consecutive years, changes by SCDNR to the commercial regulations will be implemented. This sustainability benchmark was developed by using the 25th percentile of the annual mean for CPUE’s for the last ten years. Potential management actions could be gear restrictions, season changes, catch limits, or closure.

Regulatory changes mentioned earlier, greatly affected fishing effort and gear used in the Winyah Bay System Rivers. These changes may be responsible for the perceived increase in catch rates in recent years. In any event, SC believes current restrictions (shortened season, allowable nets reduced by 90%, restrictions on recreational netters gear, 50% reduction for recreational anglers limit, and ultimately capping the fishery at current levels) in combination with those required statewide by NMFS for the incidental by-catch of sturgeon, will provide adequate protection for spawning shad for years to come.

Santee Cooper System

Santee River

SCDNR has both fishery-independent and fishery-dependent data to justify the continued existence of this fishery. The 2007 stock assessment concluded “that the Santee River American shad stock in the Santee River benefited greatly from the Rediversion project.” Catch rates (CPUE), used in the assessment, indicated a stable if not increasing trend. More recent CPUE (kg. of shad captured in a 92m. net fished for one hour) data suggest that those trends continue (Figure 4). As mentioned earlier, during the 2011 fishing season, fisheries were suspended twice for two weeks at a time, due to the excess of shad at the local fish markets.

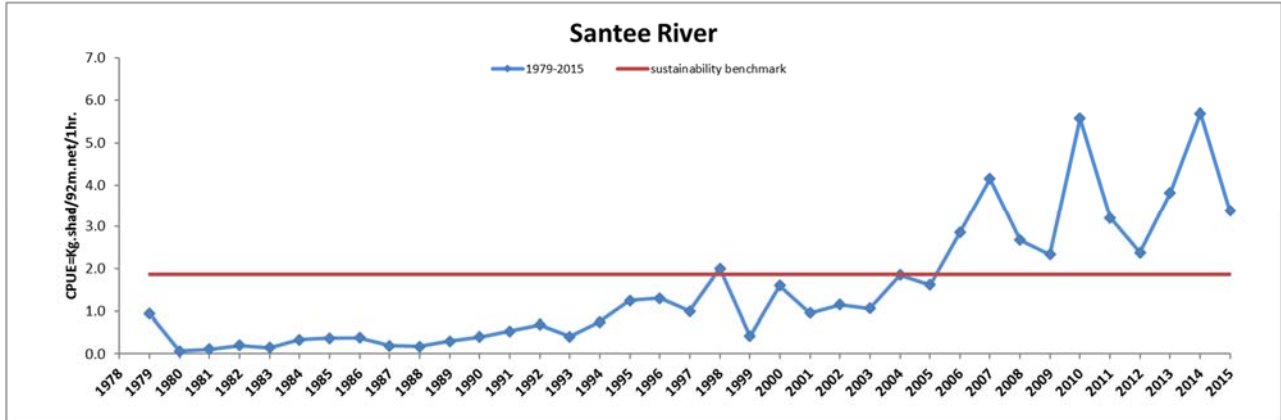


Figure 4. Commercial catch per unit effort (kg. fish per 92-m net hr) of American shad and sustainability target for the Santee River.

SCDNR also conducts fishery-independent sampling in the Santee River using comparable gear (92m. floating/drift gill net with 12.7 cm stretch mesh) to provide trends of abundance for the spawning stock. Catch rate (CPUE=# of shad/92m. net/1 hr.) data for this sampling (2008-2015) is included in Figure 5.

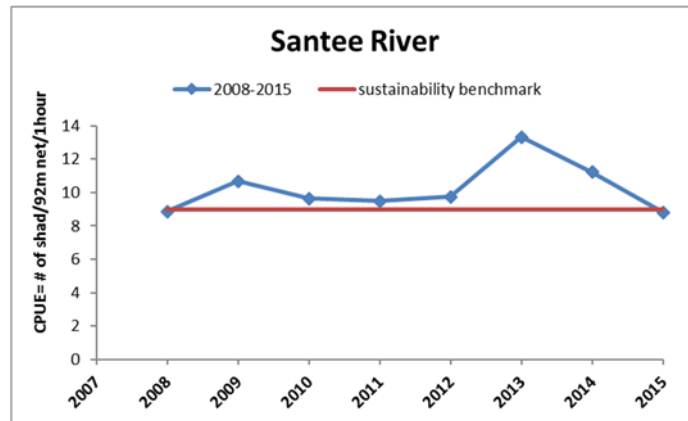


Figure 5. Fishery-independent catch per unit effort (kg. fish per 92-m net hr) of American shad and sustainability target for the Santee River.

SC requests to maintain the Santee River fishery at current levels with annual monitoring to occur as mentioned. This run is considered by SCDNR to be sustainable at current levels and with new regulations, migrating shad should receive additional protection. SC proposes that a catch rate sustainability benchmark of 1.8 (kg. of shad/92m net fished for 1 hr.) be used to manage the Santee River commercial shad fishery. In addition, fishery-independent sampling catch rates (CPUE) for the Santee River must not fall below 9. These sustainability benchmarks were developed by using the 25th percentile of the annual mean for CPUE's for the last ten years or in the case for the fishery independent data all available data. If catch rates or CPUE's fall below the sustainability targets for three consecutive years, management action will be taken. Potential management actions could be gear restrictions, season changes, catch limits, or closure.

Cooper River

No commercial fisheries exist on the Cooper River by SC regulation. However, there is a recreational fishery that exists below Pinopolis Dam. SCDNR conducts annual creel surveys to assess catch rates in this fishery. The Cooper River fishery is concentrated near Pinopolis Dam from the sanctuary line (0.2 km downstream of the dam) to about one km downstream of the dam. Since the fishery season is relatively short (about two months) effort and catch-per-unit-effort were estimated daily to increase precision. Data collection, consisting of either angler surveys, effort estimates, or both were conducted for virtually all days during each year's study period, which was defined subjectively by angler presence and manpower availability. During survey periods, a creel clerk interviews shad fishermen as they land their boats. An average of 6 hours of survey periods are conducted during daylight hours. Creels take place during these time periods because it was determined these were times when the most effort was being exhibited. Effort estimates consists of counting boats in the fishery, which is virtually entirely visible from the Pinopolis Dam, several times daily; this estimate assumes that the maximum daily count equals total daily effort. Catch rate (CPUE=#shad caught in 1 hour) data from these surveys has been collected, beginning in 2000, and is used to manage the fishery. CPUE for 2015 equaled 2.09, this is consistent with previous 4 years (Figure 6).

SC requests to maintain this fishery at current levels with annual monitoring to occur as mentioned. The Cooper River run is considered by SCDNR to be sustainable at current levels. SC proposes that an sustainability CPUE benchmark of .81 (25th percentile of the annual mean of CPUEs for the last 10 years) be used to manage the Cooper River recreational shad fishery. If CPUEs for Cooper River recreational fishery fall below .81, three consecutive years, changes by SCDNR to the recreational regulations will be considered. Potential management actions could be gear restrictions, season changes, catch limits, or closure.

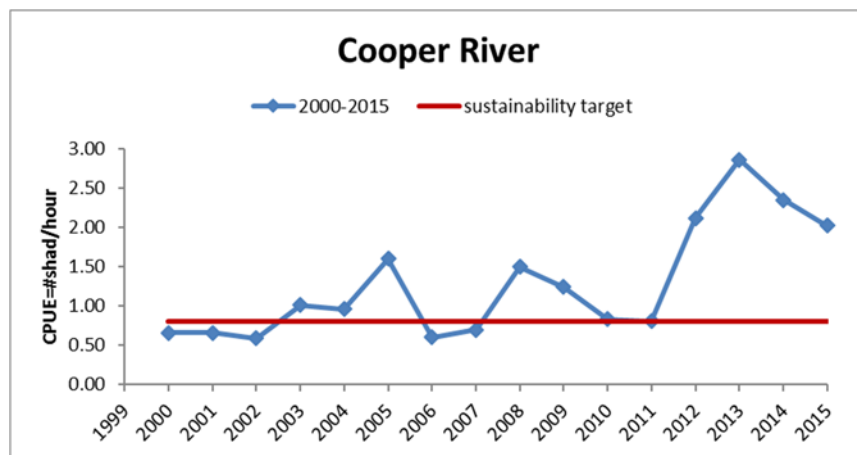


Figure 6. Annual catch per unit effort (# of shad per hr.) and sustainability target for the Cooper River recreational shad fishery.

Edisto River

The 2007 stock assessment concluded “that recent estimates of commercial CPUE have been very low for the Edisto River for time series (1979 to 2005) and average for 13 of the last 15 years, but have rebounded a bit since 1997.” More recent CPUE (kg. of shad captured in a 92m. net fished for one hour) data suggest that while catches are low, they remain consistent (Figure 7). In addition, the ACE Basin Rivers (Ashepoo, Combahee, and Edisto) have been under “drought” conditions for the majority of recent years. In fact, the average flow during those years was 1453 cfs. This is extremely low considering in “normal” years, flows are ~ 4,500 cfs. Also, the Edisto River is SC’s longest undammed river and flows are considerable lower from those of the Santee River (5912 cfs) or Pee Dee River (11,267 cfs) for the same time series.

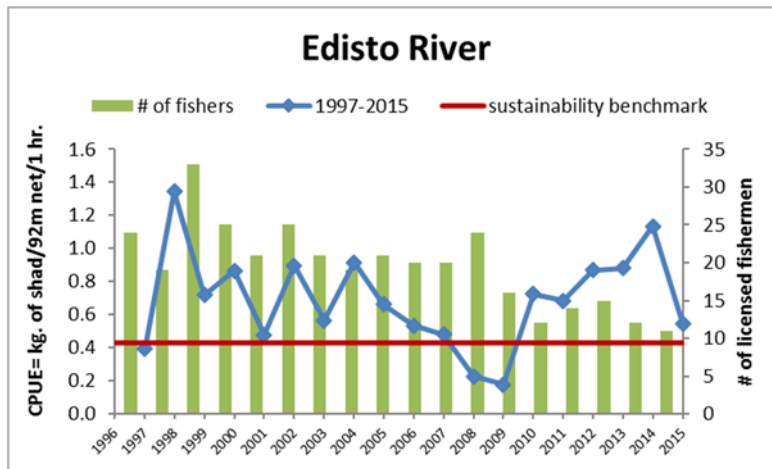


Figure 7. Commercial catch per unit effort (kg. fish per 92-m net hr) of American shad and sustainability target for the Edisto River.

SCDNR collected fishery-independent data only for the years for years 1994-1998. During these years, shad were captured using a 92m. floating/drift gill net with 12.7 stretch mesh. Catch rates (CPUE=kg. of shad/92m. net/1 hr.) remained relatively consistent for these years. SCDNR tried to duplicate this effort in 2006 and 2007. Unfortunately, due to copious incidental catches of Longnose gar (*Lepisosteus oseus*), sampling was discontinued. These fish were encountered during each sampling trip which made catching shad problematic. When numerous gar became entangled, the net became very inefficient at catching shad. The average catch rate for gar for the sampling periods was 4.86 fish per 92 m net per hour.

SC requests to maintain this fishery at reduced levels with annual monitoring to occur as mentioned. The Edisto River run of shad is considered by SCDNR to be sustainable at lower levels in combination with new regulation changes, migrating shad should receive additional protection. If catch rates (CPUE= kg. of shad/ 92m net fished for 1 hr.) for the Edisto River run commercial fishery fall below 0.43 three consecutive years, changes by SCDNR to the commercial regulations will be implemented. This sustainability benchmark was developed by using the 25th percentile of the annual mean for CPUE’s for the last ten years. Potential management actions could be gear restrictions, season changes, catch limits, or closure.

Regulatory changes in 1993 and 2000 mentioned earlier greatly affected fishing effort and gear used in the ACE Basin (Ashepoo, Combahee, and Edisto) rivers. These changes may be responsible for the perceived increase in catch rates in recent years. In any event, SC believes current restrictions coupled with 2013 regulatory changes (shortening the season, cutting allowable nets by 80%, restrictions on recreational netters gear, reducing the recreational anglers limit by 50%, and ultimately capping the fishery at current levels) and in combination with those required statewide by NMFS for the incidental by-catch of sturgeon, will provide adequate protection for spawning shad for years to come.

Combahee River

The 2007 stock assessment concluded “This relatively small river is perceived to have undergone significant American shad stock declines over the past 25 years.” More recent CPUE (kg. of shad captured in a 92m. net fished for one hour) data suggest that while catches are low, they remain consistent in the most recent years (Figure 10). Currently, the Combahee commercial shad fishery consists of only 1 fisherman and he doesn’t use the catch for commercial purposes. Because the number of fishers decreased since 2011, landings data for this river are confidential are not provided in this plan. However, it should be noted, catch rates for this river did not fall below the approved sustainability benchmark. In addition, the ACE Basin Rivers (Ashepoo, Combahee, and Edisto) have been under “drought” conditions for the majority of recent years. In fact, the average flow during those years was 182 cfs. This is extremely low considering in “normal” years, flows are ~ 600 cfs. Also, the Combahee River remains an undammed river and flows are extremely low compared with those from the Santee River (5912 cfs) or Pee Dee River (11,267 cfs) for the same time series.

SCDNR collected fishery-independent data for the years for years 1993 and 1999. During these years, shad were captured using a 92m. floating/drift gill net with 12.7 stretch mesh. Catch rates (CPUE=kg. of shad/92m. net/1 hr.) were .27 for 1993 and 0.21 in 1999. Like the Edisto River sampling, copious incidental catches of Longnose gar (*Lepisosteus oseus*), led to the termination of sampling efforts. These fish were encountered during each sampling trip which made catching shad extremely problematic. When numerous gar became entangled, the net became very inefficient for catching shad.

SC requests to maintain this fishery at reduced levels. The Combahee River run of shad is considered by SCDNR to be sustainable at lower levels and with new regulations, migrating shad should receive additional protection. If catch rates (CPUE= kg. of shad/ 92m net fished for 1 hr.) for the Combahee River run commercial fishery fall below 0.53 three consecutive years, changes by SCDNR to the commercial regulations will be implemented. This sustainability benchmark was developed by using the 25th percentile of the annual mean for CPUE’s for the last ten years. Potential management actions could be gear restrictions, season changes, catch limits, or closure.

Regulatory changes in 1993 and 2000, mentioned earlier, greatly affected fishing effort and gear used in the ACE Basin (Ashepoo, Combahee, and Edisto) rivers. These changes may be responsible for the perceived increase in catch rates in recent years. In any event, SC believes current restrictions coupled with 2013 changes (shortening the season, cutting allowable nets by 90%, restrictions on recreational netters gear, reducing the recreational anglers limit by 50%, and ultimately capping the fishery at current

levels) and in combination with those required statewide by NMFS for the incidental by-catch of sturgeon, will provide adequate protection for spawning shad for years to come.

Savannah River

Because the Savannah River occurs in both SC and GA and as part of new ASMFC mandates required in Amendment 3 to the shad and river herring fishery management plan, annual shad monitoring for this system is a cooperative effort between SCDNR and GADNR. Combined, fishery-independent and fishery-dependent data are available to justify the continued existence of this fishery. The 2007 stock assessment concluded “Over the past century, the magnitude of shad landings from the Savannah River has declined tenfold although the CPUE data available since 1979 indicates some stability in the current level of exploitation at a level much reduced compared to historical production.” Catch rates (CPUE), used in the assessment, indicated a stable trend. More recent CPUE (kg. of shad captured in a 92m. net fished for one hour) data from SC suggest that those trends continue (Figure 8). Catch rates for GA fishermen are available, but due to confidentiality agreements, are not supplied in this document. However, between the years 2001-2015, fishermen caught no fewer than 25kg of shad per trip.

During the 2010-2015 seasons, GADNR conducted fishery-independent sampling for adult American shad in the Savannah River at the New Savannah Bluff Lock and Dam (NSBL&D), near Augusta, GA (~RKM 302). Shad were collected during their spawning migration (March, April, and May) using electro-fishing gear. Catch rates (CPUE= # of shad/hour) for 2015 were 480.6. This is an increase from CPUE's of 269.5 that were observed in 2010. This sampling will continue on an annual basis to better assess the abundance of spawning stocks in the Savannah River.

SCDNR also conducted a creel survey of recreational fishermen, at NSBL&D in 2011, 2012, 2013. Sampling was structured similarly to the Pinopolis Dam creel on the Cooper River, SC. However, due to logistical problems, staff was unable to start the creel until well into the shad season. This, unfortunately, led to incomplete angler catch data for those seasons. Creel sampling continued on an annual basis, however, due to the deteriorating wing wall at the NSBL&D, recreational fishing is no longer permitted at this location.

SC and GA request to maintain this fishery at current levels with annual monitoring to occur as mentioned. The Savannah River run is considered by SCDNR and GADNR to be sustainable at current levels and with imposed regulation changes in 2013 taking hold, migrating shad should receive additional protection, which will only help the sustainability. Additionally, before the 2011 season, GA implemented new regulations to protect spawning shortnose sturgeon. This regulation moved the upper commercial boundary downstream approximately 103 rkm. In an effort to protect sturgeon and also remain consistent in a shared border river, SC passed similar regulations. These regulations provide ~136 more river kilometers of additional spawning habitat for shad unobstructed by commercial gear.

SC proposes that a sustainability benchmark for CPUE (kg. shad/92m. net/fished for 1 hr.) of 2.4 be used to manage the Savannah River shad fishery. GA proposes that a sustainability benchmark for CPUE (Kg. shad/trip) of 25.5 be used to manage the Savannah River shad fishery. If either SC or GA falls below the proposed benchmark three consecutive years, changes by SCDNR and GADNR commercial regulations

will be considered. These sustainability benchmarks were developed by using the 25th percentile of the annual mean for CPUE's for the last ten years, or in GA's case, all available data. Potential management actions could be gear restrictions, season changes, catch limits, or closure.

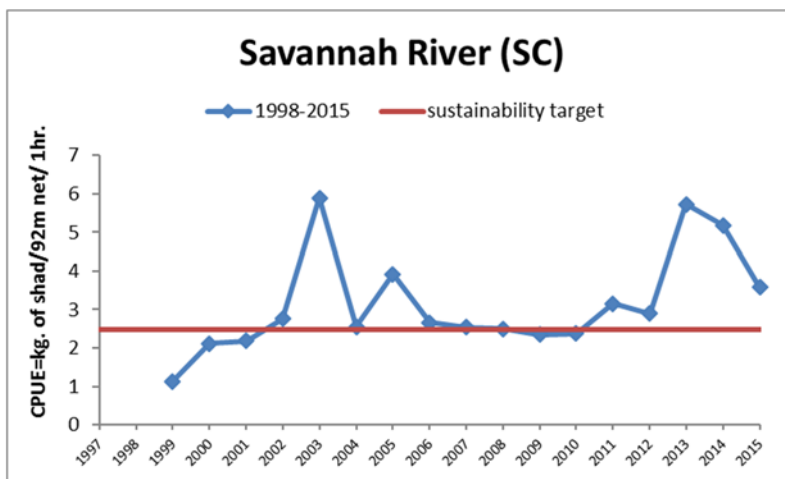


Figure 8. SC's annual commercial catch-per-unit-effort (CPUE) of American shad and sustainability target for the Savannah River.

Table 1. Sustainability values and triggers.

Index	Survey	Benchmark Value	Years included in index	Management trigger
Pee Dee River Run	Fishery dependent	3.41 kg/ 92 m net/hr.	1979-2015	3 consecutive years below benchmark
Black River	Fishery dependent	0.97 kg/ 92 m net/hr.	2000-2015	3 consecutive years below benchmark
Santee-Cooper Rivers Complex	Fishery dependent	1.8 kg/ 92 m net/hr.	1979-2015	3 consecutive years below benchmark
Santee-Cooper Rivers Complex	Fishery independent	9.0 shad/ 92 m net/hr.	2008-2015	3 consecutive years below benchmark
Santee-Cooper Rivers Complex	Fishery dependent	0.81 shad/hr.	2000-2015	3 consecutive years below benchmark
Edisto River	Fishery dependent	0.43 kg/ 92 m net/hr.	1997-2015	3 consecutive years below benchmark
Combahee River	Fishery dependent	0.53 kg/ 92 m net/hr.	1998-2015	3 consecutive years below benchmark
Savannah River	Fishery dependent	2.4 kg/ 92 m net/hr.	1998-2015	3 consecutive years below benchmark

g) Adaptive Management

SCDNR will continue to monitor fish passage, commercial fisheries, and recreational landings in SC rivers. In addition, fishery independent sampling to assess spawning adults and juvenile abundance will continue annually.

If collected data indicates changes in exploitation or decreasing abundance in juveniles, action will be taken by SCDNR. These actions may include increasing days for escapement, limiting seasons, etc. In the event these actions are not successful in reversing negative trends, SCDNR would then be forced to close those fisheries.

Several recommendations were included for SC as part of the stock assessment for American shad. They are highlighted in the following:

Commercial Landings and Effort

1. Increase compliance with mandatory catch and effort reporting from commercial fishery, particularly in the Santee River, Winyah Bay system, Savannah River, and Edisto River
2. Continue the “volunteer CPUE” series to compare with CPUE series developed from comprehensive mandatory reporting database
3. Input volunteer commercial catch and effort from field reports into digital format so raw data are available for future analysis
4. Collect age, length, weight, and spawning history information from shad caught in commercial fisheries in the Santee River, Winyah Bay system, Savannah River, and Edisto River
5. Age validation study of American shad from South Carolina rivers (especially, Santee River, Winyah Bay system, Savannah River, and Edisto River)

Tagging

1. Continue monitoring of river systems (Santee River, Waccamaw River and Edisto River) on rotating basis (yearly rather than a three year schedule)
2. Improve tagging study design (e.g., develop high-reward design, telemetry studies to get estimates of migration abortion, double tagging study to estimate tag loss, and tag-mortality study) to improve relative exploitation estimates
3. Conduct tagging studies for duration of shad migration and continue to collect effort information from sampling collections (e.g., soak time, net length, and mesh size) to permit development of CPUE calculations

Creel Surveys

1. Continue to conduct creel surveys in rivers with notable recreational fisheries (Savannah River and Cooper River); if necessary, conduct creel surveys on a rotating basis

Fish Passage

1. Develop species specific upstream and downstream passage efficiency at all rivers with priority given to Santee-Cooper system dams
2. Develop species specific counts at Pinopolis fish lock on the Cooper River

Juvenile Abundance Index

1. Investigate juvenile abundance on at least one river (e.g., Santee River, Waccamaw River, or Edisto River)

General

1. Collect environmental covariates (tidal stage, flood stage, flow rate, water temperature, cloud cover, water clarity, annual precipitation, etc.) to aid development of CPUE indices

SC has since implemented all suggested recommendations and in some cases exceeded them, with the exception of those at the Pinopolis fish lock. A fish counter system will be installed at that site by spring 2018. Nevertheless, SC continues sampling as part of ASMFCA/ACFCMA funded work or by utilizing other SCDNR funding sources. Furthermore, with the dissolution of Anadromous Fish Conservation Act funds, SCDNR was forced to be creative in order to meet requirements of Amendment 3. To complete all mandated goals annually, personnel from other areas and funding sources have been used. Once these funds expire it is anticipated SCDNR will simply not have adequate personnel to complete this work. Additionally, to date SCDNR has had ~60% cut from the operating budget and is expecting future cuts. If a reduction in force (RIF) is implemented and project personnel are affected, SCDNR will not be able to meet these requirements.

Additional recommendations

Several recommendations were suggested and added to this plan by the Shad and river herring Technical Committee, these include:

- Consider joint coordination with NC on the Great Pee Dee River similar to what is occurring on the Savannah River (GA).
- Consider ways to develop current juvenile indices to perhaps be used in future updates to the plan.
- Consider discussions with GA to develop consistent management measures for the Savannah River in the event that either state falls below the sustainability benchmark for 3 consecutive years.
- In the future, consider using biological metrics, where available, as an additional benchmark for all State indices.

References

ASMFC (Atlantic States Marine Fisheries Commission). 2007. American shad stock assessment peer review report. Washington, D.C.

Appendix 1.

Summary of South Carolina Shad Laws by Water or Fishery Area

SECTION 50-5-1506. Zones, seasons, times catch limits, size limits, methods, and equipment for taking shad.

In addition to other provisions of law, the following provisions govern seasons, times, methods, equipment, size limits, and take limits in commercial fishing for shad in the waters of this State specified below:

(a) Black River, Great Pee Dee River, Little Pee Dee River, Lynches River, Waccamaw River from Big Bull Creek to Winyah Bay, Winyah Bay, and all tributaries and distributaries thereto as follows:

(i) Pee Dee River and tributaries above U.S. Highway 701 and Black River:

(1) Season: January 15 through April 15;

(2) Times: noon Monday through noon Saturday;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(ii) Remainder of Winyah Bay system including all of Big Bull Creek and Waccamaw River with tributaries below the entrance of Big Bull Creek:

(1) Season: January 15 through April 1;

(2) Times: Monday noon to Saturday noon, local time;

(3) Methods and equipment: No restriction provided drift nets of not more than nine hundred feet in length are allowed in Waccamaw River between Butler Island and U.S. Highway 17 during lawful times;

(4) Size and take limits: No limits.

(b) Santee River below Wilson Dam including the Rediversion Canal below St. Stephen Dam, North Santee River and Bay, South Santee River, and all tributaries and distributaries thereto as follows:

(i) Rediversion Canal from St. Stephen Dam seaward to the seaward terminus of the northern dike of the Rediversion Canal:

Season: No open season;

(ii) Rediversion Canal from the seaward terminus of the northern dike of the Rediversion Canal seaward to Santee River:

(1) Season: January 15 through April 15;

(2) Times: 7:00 a.m. to 7:00 p.m. local time, Tuesday and Thursday;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(iii) Wilson Dam seaward to U.S. Highway 52 bridge:

Season: No open season.

(iv) U.S. Highway 52 bridge seaward to S.C. Highway 41 bridge:

(1) Season: January 15 through April 15;

(2) Times: 7:00 a.m. to 7:00 p.m. local time, Tuesday and Thursday;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(v) S.C. Highway 41 bridge seaward:

(1) Season: January 15 through March 15;

(2) Times: Monday noon to Saturday noon, local time;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(c) Wando River and Cooper River seaward to the U.S. Highway 17 bridges, Charleston Harbor, Ashley River, and all tributaries and distributaries thereto as follows:

(i) Tailrace Canal from Wadboo Creek to the Jefferies Power Plant:

Season: No open season.

(ii) Cooper River from Wadboo Creek to U.S. Highway 17:

Season: No open season.

(iii) Ashley River seaward to its confluence with Popper Dam Creek:

(1) Season: No open season;

(2) Reserved

(3) Reserved

(4) Reserved

(iv) Remainder of the Charleston Harbor system:

(1) Season: No open season;

(2) Reserved

(3) Reserved

(4) Reserved

(d) Edisto River Estuary, Edisto River, North and South Branches (Forks) of the Edisto River, and all tributaries and distributaries thereto as follows:

(i) Above U.S. Highway 15 bridge:

(1) Season: February 1 through March 30;

(2) Times: Tuesday noon to Saturday noon, local time;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(ii) Seaward of U.S. Highway 15 bridge and above U.S. Highway 17 bridge:

(1) Season: February 1 through March 30;

(2) Times: Tuesday noon to Saturday noon, local time;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(iii) Seaward of U.S. Highway 17 bridge:

(1) Season: February 1 through March 30;

(2) Times: Wednesday noon to Friday midnight, local time;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(e) Ashepoo River and all tributaries and distributaries thereto as follows:

(1) Season: No open season;

(2) Reserved

(3) Reserved

(4) Reserved

(f) Combahee River and all tributaries and distributaries thereto as follows:

(i) Tributaries and distributaries, except main stems of Salkehatchie Rivers:

Season: No open season.

(ii) Main river including main stems of Salkehatchie Rivers:

(1) Season: February 1 through March 15;

(2) Times: For anchored nets, Tuesday noon to Friday noon, local time; for driftnets, Monday noon to Saturday noon, local time;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(g) Coosawhatchie River and all tributaries and distributaries thereto as follows:

Season: No open season.

(h) South Carolina portions of Savannah River and all tributaries and distributaries thereto as follows:

(i) Main river below U. S. Highway 301 and above U. S. Interstate Highway 95:

(1) Season: January 1 through April 15;

(2) Times: 7:00 a.m. Wednesday to 7:00 p.m. Saturday, local time;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(ii) Tributaries and distributaries above U.S. Interstate Highway 95 bridge:

Season: No open season.

(iii) Seaward of U.S. Interstate Highway 95 bridge.

(1) Season: January 1 through March 31. Taking or attempting to take shad with anchored nets is prohibited at all times in the Savannah River's Little Back River, Back River and the north channel of the Savannah River downstream from the New Savannah Cut;

(2) Times: 7:00 a.m. Tuesday to 7:00 p.m. Friday, local time;

(3) Methods and equipment: Any lawful method and equipment;

(4) Size and take limits: No limits.

(i) Atlantic Ocean territorial sea as follows:

(1) Season: No open season;

(2) Reserved

(3) Reserved

(4) Reserved

Appendix 2. Proposed statewide changes to SC's shad fishery to account for by-catch of sturgeon

	Existing regulation	Proposed change	Benefit
Recreational			
<i>Gear restrictions</i>			
Gill nets	1 net w/ lengths up to 300yds	1 net w/ length not exceeding 100 ft.	Limits the length of net a recreational angler using commercial gear can use.
Commercial			
<i>Gear restrictions</i>			
All rivers	10 nets per licensee allowed	5 nets per licensee allowed	Cuts available nets by 50%
*Edisto River	10 nets per licensee allowed	2 nets per licensee allowed	Cuts available nets by 80%
*Combahee River	10 nets per licensee allowed	1 nets per licensee allowed	Cuts available nets by 90%
<i>Procedure change</i>			
All rivers	Must check each net once every 24 hrs.	Must check each net twice during 24hrs.	Reduces risk of potential mortality for captured sturgeon.
<i>Area restrictions</i>			
Savannah River	Fishing allowed I-95 to spirit creek	Fishing allowed I-95 to Hwy 301	Restricts fishing on ~110 rkm of potential sturgeon spawning habitat.
<i>Season changes</i>			
Winyah Bay and Tributaries (includes Waccamaw and Great Pee Dee Rivers)			Moves the legal season up two weeks, allowing for fewer nets during the sturgeon spawning migration.
Pee Dee River and tributaries above Hwy. 701, Waccamaw River and tributaries above entrance of Big Bull Creek	Feb. 1 - Apr. 30	Jan. 15 - Apr. 15	
Remainder of Winyah Bay system	Feb. 1 – Apr. 15	Jan. 15 - Apr. 1	
Santee River			Moves the legal season up two weeks, allowing for fewer nets during the sturgeon spawning migration.
Hwy. 52 bridge seaward to Hwy. 41 bridge	Feb. 1 - Apr. 30	Jan 15 - Apr 15	
Hwy. 41 bridge seaward	Feb. 1 - Mar. 31	Jan 15 - Mar 15	
Edisto River			Restrictions as a result of ASMFC's shad sustainability plan will shorten the season to 6 weeks.
Above U.S. Hwy. 17 bridge	Jan. 15 - Apr. 15	Feb. 1 - Mar. 15	
Seaward of U.S. Hwy. 17	Jan. 15 - Mar. 31	Feb. 1 - Mar. 15	
Combahee River			Restrictions as a result of ASMFC's shad sustainability plan will shorten the season to 6 weeks.
Main river, including main stems of Salkehatchie Rivers	Jan. 15 - Mar. 31	Feb. 1 - Mar. 15	

* Restrictions as a result of ASMFC's state sustainability plan.

Appendix 3. Proposed changes to shad fisheries in the Edisto and Combahee Rivers.

	Existing regulation	Proposed change	Benefit
Recreational			
<i>Gear restrictions</i>			
Edisto River			
Gill nets	1 net w/ lengths up to 300yds	1 net w/ length not exceeding 100 ft.	Limits the length of net a recreational angler using commercial gear can use.
Hook and line	10 shad per day creel	5 shad per day creel	Decreases the amount of shad legally kept by 50%.
Combahee River			
Gill nets	1 net w/ lengths up to 300yds	1 net w/ length not exceeding 100 ft.	Limits the length of net a recreational angler using commercial gear can use.
Hook and line	10 shad per day creel	5 shad per day creel	Decreases the amount of shad legally kept by 50%.
Commercial			
<i>Gear restrictions</i>			
Edisto River	10 nets per licensee allowed	2 nets per licensee allowed	Cuts available nets by 80%
Combahee River	10 nets per licensee allowed	1 nets per licensee allowed	Cuts available nets by 90%
<i>License cap</i>			
Edisto River	No limit	Only licensees that purchased a license during the last 5 years will be eligible to remain in the fishery with no new licenses issued	Allows current fishermen to fish, does not allow for additional exploitation, and caps the fishery.
Combahee River	No limit	Only licensees that purchased a license during the last 5 years will be eligible to remain in the fishery with no new licenses issued	Allows current fishermen to fish, does not allow for additional exploitation, and caps the fishery.
<i>Season changes</i>			
Edisto River			
Above U.S. Hwy. 17 bridge	Jan. 15 - Apr. 15	Feb. 1 - Mar. 15	Shortens the season to 6 weeks
Seaward of U.S. Hwy. 17	Jan. 15 - Mar. 31	Feb. 1 - Mar. 15	Shortens the season to 6 weeks
Combahee River			
Main river, including main stems of Salkehatchie Rivers	Jan. 15 - Mar. 31	Feb. 1 - Mar. 15	Shortens the season to 6 weeks

