

ASMFC River Herring Sustainable Fishing Plan for South Carolina

Introduction:

The purpose of this sustainable fisheries management plan is to allow existing river herring fisheries that are productive and cause no threat to future stock production and recruitment to remain in place and close all others. Some excerpts from the stock status review for SC's river herring were used in this document (ASMFC 2008). The review, 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 river herring.

Historically, river herring (blueback herring *Alosa aestivalis*) occurred in most of South Carolina's major rivers (Figure 1). Commercial fisheries for blueback herring in South Carolina occur to a limited extent in open rivers such as Winyah Bay tributaries, but the majority of river fishing activity occurs in hydro-electric tailraces of the Santee-Cooper River system (Figure 2). It remains the most important and the most closely monitored fishery in the state. A brief history of the Santee-Cooper Complex is detailed in Appendix 1. Recreational fisheries for blueback herring exist, but only as a bycatch to the American shad fishery.

Management of blueback herring in South Carolina is shared between the Marine Resources and Freshwater Divisions of the Department of Natural Resources (SCDNR). Management units are defined by stock and the complex of river(s) utilized. Management units include all rivers and tributaries within each area complex: Winyah Bay (Sampit, Lynches, Pee Dee, Bull Creek, Black, and Waccamaw Rivers) and the Santee-Cooper Rivers complex.

Current regulations:

The SCDNR manages commercial herring fisheries using a combination of seasons, gear restrictions, and catch limits. In 1964, commercial blueback herring fishing in Cooper River was restricted to daylight hours with a dip net not more than three feet in diameter and a limit of 100 lb (45.4 kg) per man per day. By 1969, regulations had been liberalized to allow nets with six foot diameters, fishing until ten o'clock p.m., and no limit on the harvest. Between 1966 and 1969, herring were abundant and the fishery expanded. Fishing success declined in the early 1970s and a limit of 45.4 kg of herring per man day was re-imposed in 1975. Today, the commercial fishery for blueback herring has a 10 bushel daily limit (227 kg) per boat in the Cooper and Santee Rivers and the Santee-Cooper Rediversion Canal. Seasons generally span the spawning season. All licensed fishermen have been required to report their daily catch and effort to the SCDNR since 1998. Current regulations are summarized in Appendix 2.

The recreational fishery has a 1 bushel (22.7 kg) fish aggregate daily creel for blueback herring in all rivers; however very few recreational anglers target blueback herring.

Brief description - Current status of the stocks:

a. Landings:

Reported commercial landings data of river herring in South Carolina are available from the National Marine Fisheries Service and the state. Landings reported to the NMFS prior to 1979 were collected from major wholesale outlets located near the coast and probably did not account for inland landings which were generally not sold at these outlets. NMFS data collected since 1979 usually include inland landings. In 1998, the state of South Carolina instituted mandatory reporting of commercial catch and effort. The wholesale dealer reporting system utilized by the NMFS may not include herring landings because herring sold as bait to licensed bait dealers may not be reported.

In 1969, the South Carolina Department of Natural Resources instituted a commercial creel survey to estimate catch and effort in the fisheries in the Santee Cooper system. Surveys occur at landings used to off-load and transport catch. The majority of herring harvested from the Cooper River (1969-1989) were landed at two locations between the hours of six p.m. and ten p.m. daily. Creel clerks stationed at these locations interviewed individual fishermen as the catch was unloaded. The time, date, type of gear used, catch, and number of fishermen aboard were recorded as each boat landed. The survey was expanded to the major landing below the St. Stephens Dam on the Rediversion Canal starting in 1990 as water flow and fish abundance declined in the Cooper River and increased in the Santee River and the Rediversion Canal. During low flow years when flow is reduced in the Rediversion Canal, herring and the fishery move to the Santee River below the Wilson Dam. or to the Cooper River downstream of Pinopolis Dam. Surveys have been infrequent at that location. Weight of harvest was estimated from the number of bushels of herring landed and a mean bushel weight of 25.4 kg (Cooke 1998). Numbers of adult blueback herring landed were estimated by dividing kg landed by the mean weight of an adult herring (0.14 kg). Although some landings are occasionally missed during the creel survey, the survey produces the most reliable estimates of catch and effort available for South Carolina waters. Landings were not estimated for reservoir fisheries with landings of mixed species and size composition.

SCDNR has conducted an annual recreational creel survey since 2001 to estimate exploitation and catch-per-unit-effort in the recreational fishery of the Santee Cooper system. These data consist of access point creel surveys (at end of a party's fishing day) for at least 2 h/d, 4 d/week along with effort estimates made by counting boats below the Pinopolis Dam, the Wilson Dam, or the Rediversion Canal at approximately 1400h each day of survey. Previous data demonstrated that a 1400h boat count measures maximum daily fishing pressure.

SCDNR also conducted sportfishing creel surveys on the Cooper and Santee Rivers in 1981 - 1982 and 1991 - 1993 to evaluate the impact of the Rediversion Canal on these recreational fisheries (Cook and Chapplear 1994). These surveys examined the total recreational fisheries on

each river, but did not provide data on catch of blueback herring. Thus, the surveys could only be used to indicate change in the size of the fishery.

Recreational creel surveys were conducted on the Savannah River in the late 1990s by the Georgia Department of Natural Resources in 1997 and SCDNR in 1998 and 1999. Estimates of catch from these surveys varied from year to year largely due to dramatically different flow conditions. Catch estimates from each of these creel surveys were provided by Boltin (1999).

b. Fishery Independent Indices:

A variety of sample efforts have been conducted to assess the condition of blueback herring stocks in South Carolina. Annual passage counts at the St. Stephen Dam on the Santee-Cooper Rediversion Canal provide the longest times series of data (Table 1). Periodic electro-fishing and gill net sampling occurred in the Santee River below the Wilson Dam and population estimates were obtained for several years at that location. Population estimates (1980-1990) were orders of magnitude larger than passage for the same time frame (Table 2). In addition, annual electro-fishing sampling has been conducted in Winyah Bay and the Santee, Cooper, Edisto, and Combahee Rivers. Ichthyoplankton surveys were made for several years on the Santee and Cooper Rivers. More recently, annual gillnetting has occurred to assess CPUE for adult herring returning to the Santee River. As part of another program, electrofishing sampling now occurs in Lakes Marion and Moultrie (Santee-Cooper Lakes) to assess juvenile recruitment in rivers upstream of impoundments.

c. Fishery Dependent Indices:

Over 1,000,000 kg of river herring were reported from South Carolina commercial fisheries in 1969. Landings declined precipitously soon after. They rebounded to a high of approximately 260,000 kg in the early 1980s and again in the 1990s. They have fluctuated at less than 70,000 kg since 2001. The bulk of the reported landings since 1989 have come from the Santee-Cooper system. Reported landings for the Pee Dee River of the Winyah Bay system have remained at less than 500 kg per year since mandatory reporting was initiated in 1989.

Annual variation in reported landings since the early 1970s may have been influenced by changes in allowable catch over the years. Landings in the Santee Cooper system were also affected by changes in discharge from the three dams and concurrent changes in fish migration and gear effectiveness.

Annual estimates of catch in kg, effort in man days, and kg catch/man day (CPUE) are available since 1969 from surveys of the Santee-Cooper fishery (Figure 3). Estimates of all three parameters have fluctuated widely over the time series. Highest estimates of landings and CPUE occurred early in the time series in the Cooper River prior to the diversion of water from the Cooper to the Santee system.

Many factors likely affected effort and landings. To evaluate potential causes of change, we separated data from the Cooper River into two time series (1969 - 1974 and 1975 – 2008) and subset data for the Santee River to those from 1975 – 2008. We then normalized the estimates by dividing annual values by the series mean. Sub setting the Cooper River data reduced the influence of the relatively large estimates obtained early in the time series on the rest of the data. Normalizing the time series placed all of the parameters on a comparable scale. Effort and landings were highly correlated in both the Cooper River fisheries (1969-1974, $r^2=0.90$; 1975-2008, $r^2=0.85$) and the Santee River fisheries (1990-2008, $r^2=0.94$) (Figure 4). Effort played an important role in dictating landings. However, CPUE was also related to effort. If we assume that CPUE was a measure of relative stock abundance, then we can speculate that changes in stock abundance and related fishing success led to changes in effort and then in landings.

CPUE in the Santee River fishery increased rapidly following increased flows from rediversion. CPUE leveled off in the mid to late 1990s and then declined abruptly following a severe drought that lasted from 1999 through mid 2002. Santee River CPUE has fluctuated without trend since that time. The initial CPUE increase in the Santee River fishery likely resulted from a combination of herring from the Cooper River stock that began to migrate into the Santee River as flow increased and improved production from improved spawning and nursery habitat. We do not know if reduced CPUE since the drought resulted from declining stock levels or from low fishing success caused by low water levels. Fishing did not occur, or was severely limited in 2002, and harvest estimates were not made.

4. Fisheries to be Closed:

- a. Commercial: Winyah Bay (Sampit, Lynches, Pee Dee, Bull Creek, Black, and Waccamaw Rivers). **Note: SC believes these fisheries are sustainable based on past and present anecdotal data, but since these data are not statistical in nature and under stipulations of Amendment 2, we must close these fisheries.**
- b. Recreational: Winyah Bay (Sampit, Lynches, Pee Dee, Bull Creek, Black, and Waccamaw Rivers)
Ashepoo River
Combahee River
Edisto River
Savannah River

5. Fisheries Requested to be Open:

- a. Commercial: The Santee-Cooper Rivers complex
- b. Recreational: The Santee-Cooper Rivers complex

6. Sustainability

Systems with a sustainable fishery are defined as those that demonstrate their river herring stocks could support a commercial and / or recreational fishery that will not diminish potential future stock reproduction and recruitment.

Potential rates of exploitation (u) were evaluated for the Santee-Cooper System as part of the herring stock status document prepared by the Stock Assessment Sub Committee (SASC). Rates were determined for the Santee River stock below the St. Stephens Dam after rediversion by dividing annual harvest by annual minimum population size calculated as passage at the dam plus harvest. Resulting estimates of u were considered to be maximum possible estimates because the denominator was the smallest possible estimate of abundance for this stock. Exploitation rates were very low ($u \leq 0.18$) and no trend was apparent among years. By comparison, u_{msy} (target exploitation rates) for blueback herring of the Chowan River, North Carolina was $u_{msy} = 0.67$, while that for herring of the Connecticut River, Connecticut and St. John River, New Brunswick were $u_{msy} = 0.75$ (Crecco and Gibson 1990). A recent estimate of u_{30} (benchmark u) for NY herring stocks was $u_{30} = 0.42$. Estimates of u imposed by the commercial fishery in the Rediversion Canal are well under all of these benchmarks. Continued harvest at these low rates should be sustainable and should allow for recruitment and future stock reproduction. In addition, numbers of blueback herring passed (438,746), at St. Stephen Dam in 2009, exceeded the past 5 years combined. During the years 1986-1990 concurrent population estimates of the Santee stock below the Rediversion Canal were orders of magnitude greater than fish passed at the dam. Recent declines in commercial landings correlate directly to a notable reduction in trips (Figure 5).

7. SCDNR will make changes in regulations indentified in this document and present them to the SC General Assembly to meet the 2012 deadline.

8. Adaptive Management

SCDNR will continue to monitor both fish passage and the commercial fishery landings in this system. In addition, fishery independent sampling for spawning adults in the lower river and juvenile sampling in the lake and rivers above the dams 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 this fishery.

Several recommendations were included for SC as part of the stock status review for river herring. They are highlighted in the following:

“We recommend that age data be obtained from blueback herring of the Santee River, the Santee-Cooper Rediversion Canal, and the Cooper River and that the commercial creel survey of tailrace fisheries in the system be continued.” Age and harvest data are important to understanding current stock dynamics and factors affecting recent river herring abundance. “We also recommend that a sample program be developed or existing programs be improved to track annual production of young.”

SC has since implemented all suggested recommendations as part of ASMFC/ACFCMA funded work or by utilizing other SCDNR funding sources. With the dissolution of Anadromous Fish Conservation Act funds, SCDNR was forced to be creative in order to meet requirements of Amendment 2. 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 the work. Furthermore, to date SCDNR has had ~48% cut from the operating budget and is expecting more cuts. If a reduction in force (RIF) is implemented and project personnel are affected, SCDNR will not be able to meet the requirements.

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Figure 1. South Carolina Rivers.

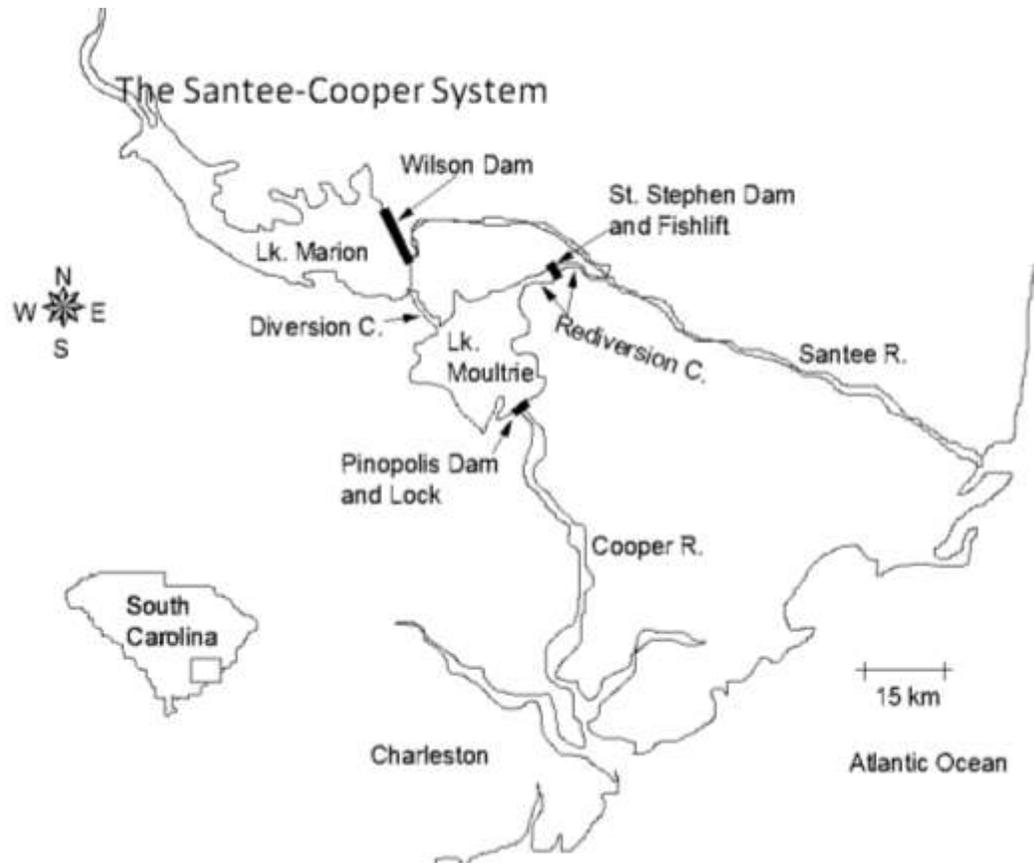


Figure 2. Santee-Cooper Rivers complex in South Carolina.

Table 1. Annual number of blueback herring passed at St. Stephen Dam

Year	Blueback herring passage
1986	187,000
1987	74,000
1988	232,000
1989	147,000
1990	71,000
1991	400,000
1992	589,000
1993	345,000
1994	298,000
1995	561,000
1996	1,452,285
1997	176,814
1998	112,466
1999	182,798
2000	695,586
2001	1,862,015
2002	421,459
2003	86,909
2004	35,545
2005	175,184
2006	105,129
2007	49,343
2008	8,503
2009	438,746

Table 2. Mark recapture population estimates of blueback herring in the Santee River, South Carolina.

Year	N	CV	Confidence Interval	
			Lower	Upper
1980	5,895,796	0.25	3,012,000	8,780,000
1981	4,054,521	0.23	2,236,000	5,873,000
1982	664,151	0.17	400,000	888,000
1983	2,352,005	0.45	297,000	4,407,000
1984	2,625,000	0.24	1,417,000	3,833,000
1985	6,205,353	0.71	0	14,822,650
1986	9,061,064	0.41	1,817,496	16,304,632
1987	3,805,457	0.29	1,657,618	5,953,296
1988	5,507,918	0.50	116,348	10,899,488
1989	5,501,964	0.22	3,153,678	7,850,250
1990	9,353,003	0.22	5,358,472	13,347,534

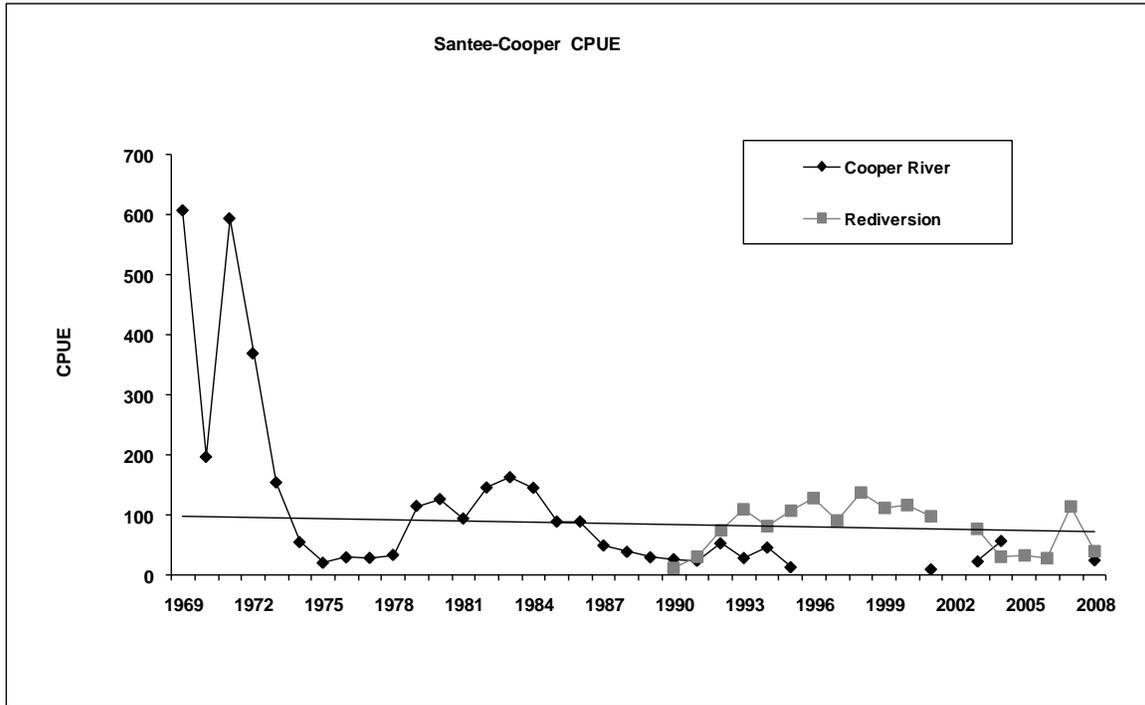


Figure 3. Estimated effort (CPUE) in the commercial fishery for blueback herring in the Cooper River and the Santee-Cooper Rediversion Canal, South Carolina.

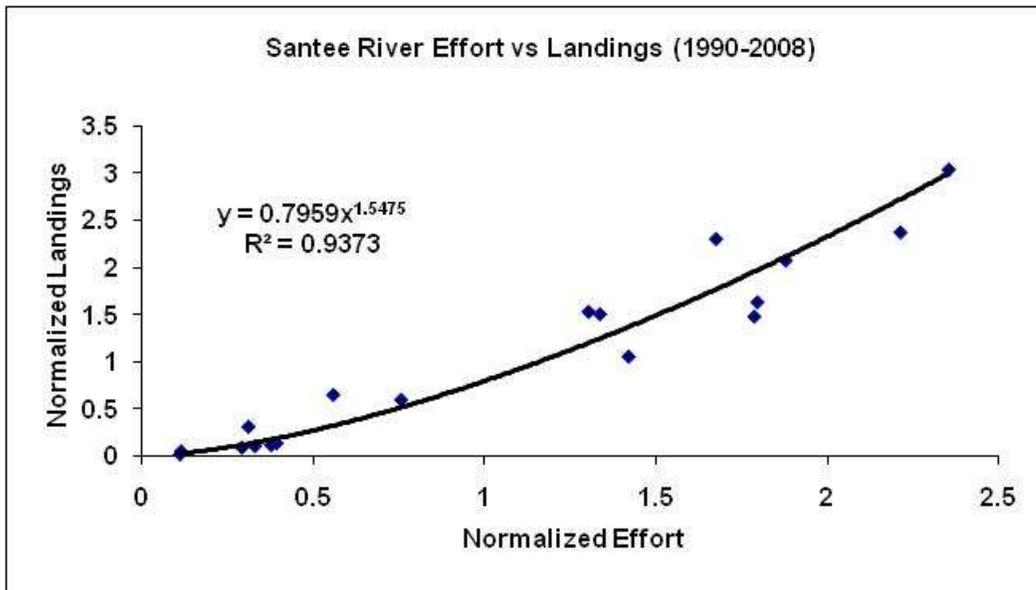
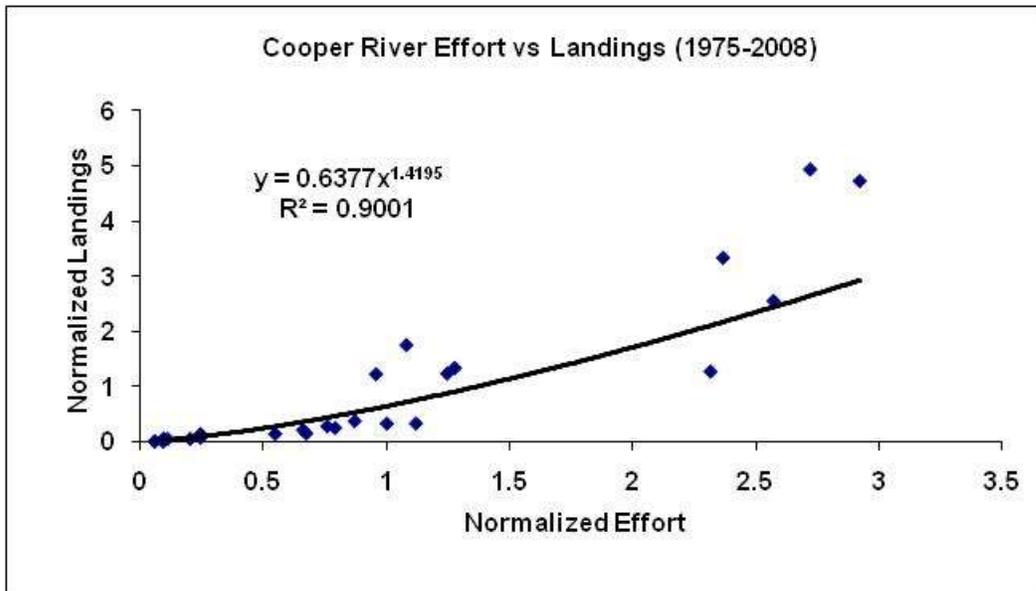


Figure 4. Normalized effort vs. normalized landings in the commercial fisheries of the Cooper and Santee Rivers, South Carolina.

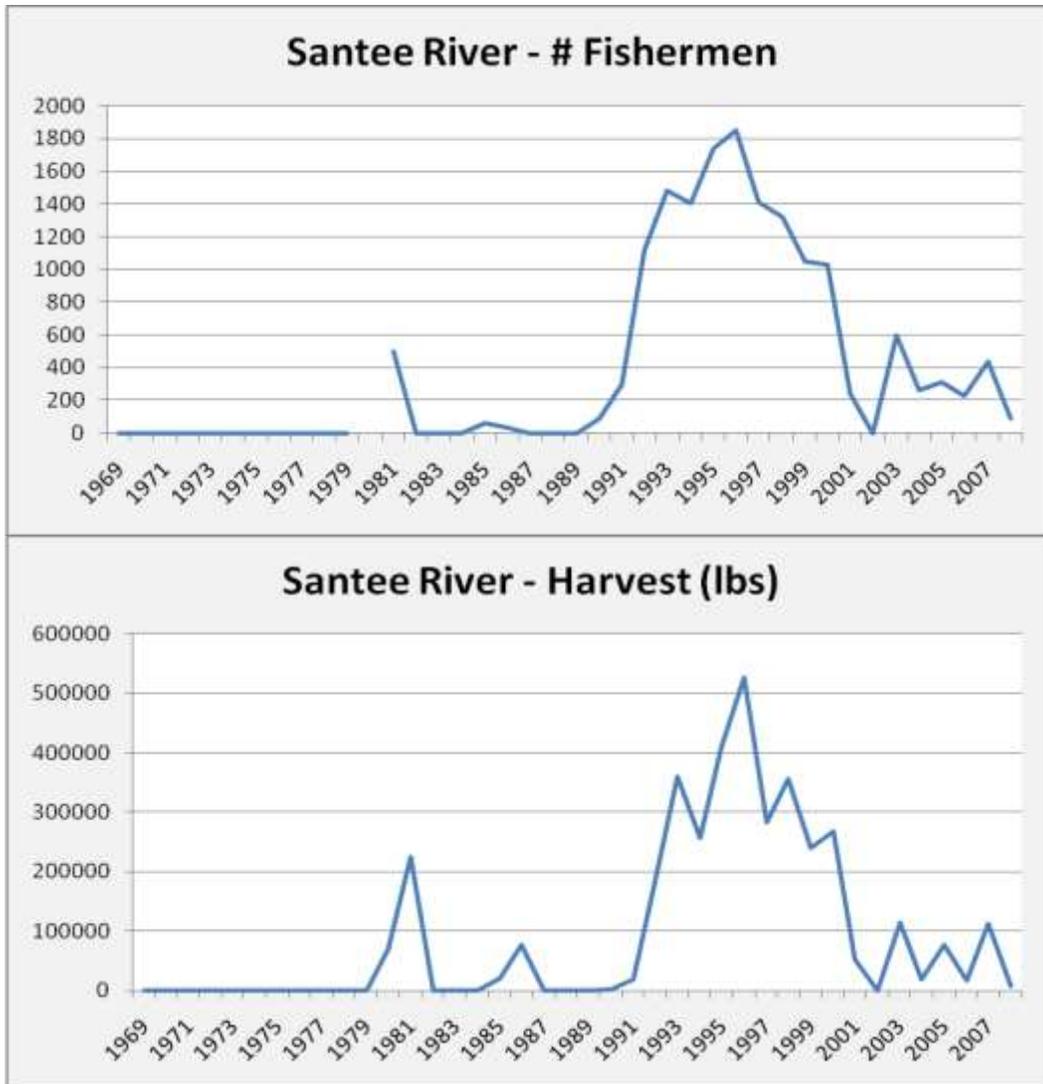


Figure 5. Number of fishermen versus pounds of herring harvested 1969-2007

Appendix 1. Brief description of the Santee-Cooper Complex

In 1938, the South Carolina Public Service Authority (SCPSA) initiated the Santee-Cooper Diversion Project. The project dammed Santee River at river km 143.201 and the headwaters of Cooper River creating two reservoirs joined by a canal (Figure 2). The canal allowed Santee River water to be diverted into Lake Moultrie and the Cooper River. Benefits provided were flood control, improved navigation, and hydroelectric power production. Wilson Dam, a flood control structure constructed on Santee River (river km 143) created Lake Marion. Pinopolis Dam (river km 77), a hydroelectric facility and navigation lock, impounded diverted water from Lake Marion along with the headwaters of Cooper River to form Lake Moultrie. In 1957, it was documented that blueback herring, passed into the lakes during boat lockings, provided as much as 25% of the diet of adult Santee-Cooper striped bass (Stevens 1957). Since then, the SCPSA has operated the lock three to six times daily during the spring spawning run, to allow blueback herring to enter the lake system. This action not only supplemented the system's forage base but also provided anadromous fish access to additional spawning areas. From 1975 to 1984, a hydroacoustic survey estimated 2.2 - 10.8 million blueback herring (mean = 5.7 million) were admitted into Lake Moultrie annually (Christie and Barwick 1984).

As a result of the Santee-Cooper Diversion Project, increased flows down the Cooper River from diverted Santee River water accelerated shoaling in Charleston Harbor (USACE 1975). The Cooper River Rediversion Project was proposed to reduce shoaling by reducing the flow to Charleston Harbor. In 1985, the U.S. Army Corps of Engineers (USACE) finished construction of a 9.5-mile canal to re-divert approximately 75% of the Cooper River flow back into Santee River. The project set a maximum weekly average discharge of 127 cms for Cooper River with the remainder being diverted to Santee River via the new Rediversion Canal. During periods of low water inflow (i.e. below 127 cms), virtually all water released from Lake Moultrie flows down Cooper River. This is because power generation at Pinopolis Dam is more efficient than at the new hydro-facility. Discharge is not regulated at the St. Stephen Dam on the Rediversion Canal. Wilson Dam still releases a continuous 14.6 cms from Lake Marion into Santee River. Concern that reduced discharge to Cooper River would attract fewer blueback herring, decreasing the number that annually migrated through Pinopolis Lock into the Santee-Cooper lakes arose. The USACE predicted that while fisheries resources may decline on Cooper River they would increase on Santee River (USACE 1975). To maintain the number of anadromous fish entering the lakes, the USACE constructed a fish lock on the Rediversion Canal to allow Santee River fish access to Lake Moultrie.

In 1985, water flowing from the Cooper River was re-diverted to the Santee River. A fish lock, constructed at the St. Stephen Dam on the Rediversion Canal, was designed to mitigate the decline of fish passage on the Cooper River. Despite this effort, total fish passage rapidly declined after Rediversion. High or intermittent discharges from the St. Stephen Dam hindered fish from entering the lock. In 1990, a flow agreement with the SCPSA was initiated allowing the lock to function more effectively and the numbers of fish passed to increase. Blueback herring passage through the two facilities has never equaled the pre-Rediversion levels that occurred at the navigation lock though. Modifications to the fish lock entrance channel to increase passage efficiency have been ongoing since construction. Phase I of the modifications was completed for the 1995 season. The modification provided a corridor for fish passage that was protected from

the turbulence of hydro-production, and is essentially a collection gallery that moved the entrances to the lock farther downstream. Phase IIA provided adjustable weir gates installed in the gallery prior to the 1997 season. Phase IIB became operational about halfway through the 2000 season and included a bypass siphon system that can deliver an additional attraction flow of 14 cms around the facility rather than through the fish lock grating. A juvenile separating device was also constructed to safely pass out-migrants downstream from this attraction flow.

Appendix 2. Summary of current regulations on take of blueback herring in South Carolina.

General

There is no commercial fishing activity for herring in the Ashley, Edisto, Combahee, Coosawhatchie, and Savannah Rivers or in State territorial Atlantic Ocean waters.

Season

The open season is 15 February - 15 April in the rivers draining into Winyah Bay, the Ashley River, and Charleston Harbor. The open season in the Santee River is 15 February - 1 May. The open commercial season for the Rediversion Canal of Santee River and the Tailrace Canal of Cooper River is 1 March - 1 May of each year. There is no closed season for the commercial take of herring in the Santee-Cooper Lakes with legal gears in open areas.

Harvest Limits

The allowable daily take of herring (including the allowable by-catch) for net fisheries is 10 US bushels per boat in the Tailrace Canal of the Cooper River, 250 lbs per boat in the Santee-Cooper Lakes, and 10 US bushels per boat in the Rediversion Canal. There are no other caps or quotas in effect for commercial herring fisheries in South Carolina.

Gears

Approved commercial gears are anchored (set or stationary) and drift gill-nets in all open riverine waters seaward of dams, with the exceptions of open portions of the Santee and Cooper River where other gears are allowed. Circular drop-nets up to six feet in diameter, lift-nets and cast-nets are the only gears allowed in the upper Tailrace Canal of the Cooper River and in the open portions of the Rediversion Canal of the Santee River. Lift-nets, cast-nets, and hook & line may be used within the Santee-Cooper Lakes and cast-nets and/or hook & line are legal gear in other inland reservoirs. Legal minimum mesh size for gill-nets is 2 1/2" stretched mesh in all State waters open to such gear. The length of any gill-net may not exceed one half of the width of the waterway where it is fished. Gill-nets may not be fished within 200 yards of any previously deployed net. Regulatory changes implemented in 2001 restricted net lengths to a maximum of 200 yards in freshwaters and 300 yards in inland marine waters.

Lift Periods

There is a weekly 84-hour lift period in effect for all waters of the Winyah Bay system during the open gill-netting season. The Ashley River and Charleston Harbor have no weekly lift period during open gill-netting season. The use of nets in the Cooper River Tailrace Canal is allowed only from sunrise until 10:00. Fishing with nets in the Rediversion Canal is allowed from 7:00 PM - 12:00 midnight EST or 8:00 PM – 12:00 PM EDT, with no lift period. Portions of several rivers are closed to commercial gear.

Actual regulations can be found at: <http://www.scstatehouse.gov/code/t50c005.htm>, under Article15.