

A Comparison of Sportfishing in the Santee and Cooper Rivers, South Carolina, Before Rediversion

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Abstract: A 1-year sport fishing creel census, designed by North Carolina State University statisticians, was conducted on the Santee and Cooper rivers, South Carolina, from 26 February 1981 through 25 February 1982. Estimates of fishing effort, harvest, and success were obtained. The Santee River received more effort per unit area (81.0 hours/ha) but less total hours (96,215) than the Cooper River (50.9 hours/ha, 173,005 hours). Santee River fishermen expended most fishing effort (37.1%) seeking black crappie, while largemouth bass was the species most sought (29.4%) by Cooper River fishermen. Fishermen creeled 65.6 fish/ha weighing 33.7 kg/ha from Cooper River and 103.1 fish/ha weighing 29.3 kg/ha from the Santee. Fishing success was nearly equal for the 2 rivers. Cooper and Santee River fishermen caught 1.29 and 1.26 fish/hour, respectively. Most fishermen were local residents, and still fishing (which included cane pole fishing) was the preferred fishing method on both rivers. Bait casting and the use of artificial baits were more popular on the Cooper River than the Santee.

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The Cooper and Santee rivers provide habitat for a variety of sport fish which are economically valuable in South Carolina. The major freshwater species sought in both rivers are largemouth bass (*Micropterus salmoides*), striped bass (*Morone saxatilis*), black crappie (*Pomoxis nigromaculatus*), catfish (*Ictalurus* spp.), bluegill (*Lepomis macrochirus*), redbreast sunfish (*L. auritus*), and redear sunfish (*L. microlophus*). Blueback herring (*Alosa aestivalis*) and American shad (*A. sapidissima*) were sought seasonally by sport fishermen.

Cooper River has received supplemental stockings of striped bass and redear sunfish. Curtis (1979) reported collecting 46 fish species from a rotenone survey of Cooper River. Cooper River supports heavy sport fishing pres-

sure over most of its length, the most heavily utilized sections being the East Branch and the Tailrace Canal (U.S. Army Corps of Engineers 1975).

Santee River has received an average of 161,000 striped bass fingerlings annually since 1977 (R. Harrell, pers. comm.). Forty-eight fish species were captured in a rotenone survey of the Santee (Curtis 1979). Sport fishing pressure is considered light to moderate (U. S. Army Corps of Engineers 1975). Results of previous sport fish creel surveys conducted on the Cooper or Santee rivers could not be found in the literature. The objective of this study was to obtain creel census estimates from sport fishermen on the Cooper and Santee rivers prior to completion of the Cooper River rediversion project so changes in sportfishing effort, success, and harvest can be detected after rediversion.

In 1976, approval was given to the U.S. Army Corps of Engineers to construct a long canal (15.4 km) which would redivert much (80%) of the flow of the Cooper River into the Santee River system. The main purpose of this canal will be to reduce the silt load which is carried into Charleston harbor by the Cooper River. Many ecological changes will occur because the mean discharge of the Santee River will increase 356,832 liters/sec, while the mean discharge in Cooper River will decrease 356,832 liters/second (U.S. Army Corps of Engineers 1975). In terms of the fishery resources of the Santee and Cooper rivers, the Corps of Engineers stated that the "resources are directly related to the discharge and overflow characteristics and will therefore be decreased in the Cooper River and increased in the Santee River" (U.S. Army Engineers 1975). While this may be the general quantitative result of rediversion, studies were initiated to determine the qualitative effects of rediversion on the fisheries of both rivers. Also, objective documentation of rediversion will help insure that proper consideration is given to the natural resources in future construction projects of this magnitude.

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Methods

This study was confined to the freshwater portions of the Cooper and Santee rivers. The Cooper River study area flows 45 km from Pinopolis Dam to the confluence of Goose Creek and includes the 2 main branches, East and West, which converge approximately 23 km downstream from the dam. Cooper River is a large river with a mean monthly discharge of 441,000 liters/second. The study area covers a surface area of about 3,400 ha which includes 2,430 ha of abandoned ricefields. These ricefields provide diverse habitat for a variety of sport fish (Christie 1978, Curtis and Christie 1982),

and are intermittently connected to the main channel of the river. Access to Cooper River is easy using any of 8 public or private landings, and numerous permanent residences maintain access to the river.

The Santee River study area covers a 140 km stretch of river located between Wilson Dam and Highway 17. Santee River has an average flow of 14,160 liters/second but flows of up to 438,960 liters/second have been recorded during flood control operations (U.S. Army Corps of Engineers 1975). The freshwater portion of the Santee River is normally shallow and slow moving, meandering through hardwood swamp, and covers about 1,118 ha. Boat navigation is difficult because of submerged stumps and rock outcroppings. Access is limited to 5 public ramps or unpaved private landings. Permanent dwellings are few.

Creel surveys designed by statisticians from North Carolina State University were implemented on 26 February 1981 and continued through 25 February 1982. Three randomly selected weekdays and 1 randomly selected weekend day were worked each week. Holidays were included as weekend days. The sample day was divided into morning and afternoon periods. The morning period began at sunrise and continued until midday. The afternoon period began at midday and extended until sunset. One of the 2 periods, determined randomly, was worked each day. On Cooper River, a roving clerk survey was implemented. The river was divided into 4 sections of near equal length, and the creek clerk would survey 1 river section each work day. The section of the river surveyed was pre-determined randomly. Instantaneous counts of fishermen were made by counting all fishermen as the clerk traveled from 1 end of the designated river section to the other. Catch and harvest data were obtained from fishermen interviews conducted on the return trip. An attempt was made to interview all fishing parties encountered.

On the Santee River, a roving clerk creel survey and an access point survey were utilized. The roving clerk survey was conducted on the Santee from just below Wilson Dam to the Highway 17 bridge. The Santee River was sectioned into 4 survey areas. In Sections 1 and 2, the creel clerk conducted instantaneous fisherman counts and interviews during a 1-way downstream boat trip of the survey sections. In Sections 3 and 4, sampling was conducted as previously described on Cooper River throughout the duration of the study. An access point survey was conducted at the public boat landing at Wilson Dam, where the creel clerk obtained fishermen counts and harvest information from fishermen completing their trip.

Information requested from fishermen included the number of fishermen in the party, length of time spent fishing on that trip, species sought, number and estimated weight of catch by species, fishing method, bait used, and origin of the fishing trip (distance traveled to fish). From those data, total effort, effort by species fished for, success by species, success by species fished for, and harvest by species were estimated for each season. Seasons were defined as spring (26 February–25 May), summer (26 May–25 August), fall (26 Au-

gust–1 December), and winter (2 December–25 February). Total effort equalled the total number of hours expended by fishermen during 1 season. Effort by species equaled the number of hours expended for 1 particular species. Success by species was calculated by dividing the harvest (numbers and weight) of each species by total effort. Success by species fished for was computed by dividing the harvest of the species sought by the number of hours expended by fishermen seeking that species. Success and success fished for were computed by numbers and weight/hour. Harvest was estimated for each species by number and weight. Additionally, distance traveled by the fishermen was categorically analyzed. Fishermen were classified as local or non-local (those who traveled more than 80.2 km).

Results

A total of 3,720 fishermen were interviewed on Cooper River during the study period. Fishermen expended an estimated 173,005 hours (50.9 hours/ha, 3145 hours/km) during that time (Table 1). Largemouth bass fishermen expended 29.4% of the total fishing effort exerted on Cooper River. Catfish fishermen and redear sunfish fishermen applied 27.0% and 22.1% of the total fishing effort, respectively. Data were collected from 1,600 Santee River fishermen. An estimate of 96,215 hours (81.0 hours/ha, 687 hours/km) was expended by fishermen on the Santee. Most (37.1%) of the fishing effort on the Santee was exerted by crappie fishermen, while catfish and bluegill sunfish fishermen expended 30.4% and 22.3% of the total effort, respectively.

Seasonal fishing trends were observed on both rivers. Cooper River fishermen were most active during the spring and fall, when 41% and 28% of the total effort was expended, respectively (Table 2). Most (18%) fishing effort expended during the spring was exerted by redear sunfish fishermen.

Table 1. Estimates of sportfishing effort by species, effort expended per hectare by species, and the standard error of those estimates for the Santee and Cooper rivers, South Carolina, from 26 February 1981 through 25 February 1982.

Species sought	Cooper River			Santee River		
	Hours	Hours/ha	SE	Hours	Hours/ha	SE
Blueback herring	1,226	0.36	503	606	0.51	523
Catfish (sp.)	46,667	13.72	10,383	19,189	24.57	11,744
Striped bass	1,729	0.51	591	8	1.01	7
Redbreast sunfish	1,240	0.36	994	1,066	0.90	535
Bluegill sunfish	18,055	5.31	5,020	21,488	18.09	9,102
Redear sunfish	38,295	11.26	13,601	628	0.53	600
Largemouth bass	50,824	14.95	11,897	3,578	3.01	1,440
Black crappie	7,735	2.28	3,033	35,675	30.03	26,513
Other	7,234	2.13	2,957	3,977	3.35	2,735

Table 2. Seasonal estimates of percent of total effort, by species, from Cooper and Santee rivers from 26 February 1981 through 25 February 1982.

Species sought	Percent of total hours by season							
	Spring		Summer		Fall		Winter	
	Cooper	Santee	Cooper	Santee	Cooper	Santee	Cooper	Santee
Blueback herring	1	1	0	0	0	0	0	0
Catfish (sp.)	8	16	10	6	8	8	1	0
Striped bass	0	0	0	0	0	0	1	0
Redbreast sunfish	1	1	0	0	0	0	0	0
Bluegill sunfish	4	14	3	6	4	2	0	0
Redear sunfish	18	0	2	0	1	0	0	0
Largemouth bass	7	1	3	2	12	1	7	0
Black crappie	1	8	0	0	0	0	3	29
Other	1	0	1	2	3	2	0	0
Total	41	41	19	16	28	14	12	29

Fishermen seeking redbreast sunfish or blueback herring were only encountered during the spring season. Catfish fishermen exerted the most effort (10%) during the summer, and largemouth bass fishermen expended the most fishing effort during the fall and winter (12% and 7%, respectively). Santee River fishermen were most active during the spring and winter, exerting 41% and 29% of the total fishing effort during those seasons, respectively. Fishing for blueback herring and striped bass occurred only during the spring season. During the spring, summer, and fall, fishermen expended more hours (30%) seeking catfish than for any other species. Fishermen expended 37% of the total fishing effort seeking black crappie, predominantly during the winter season.

The number and weight of fish harvested/ha varied considerably between Santee and Cooper rivers (Table 3). Cooper River fishermen caught 223,048 (SE = 43.4%) fish weighing 114,490 kg (SE = 25.3%), or 65.6 fish/ha weighing 33.7 kg/ha. Catfish species dominated the harvest by number and weight, followed by redear sunfish, bluegill, and largemouth bass. On the Santee, fishermen caught 122,489 (SE = 41.7%) fish weighing 34,802 kg (SE = 39.9%) or 103.1 fish/ha weighing 29.3 kg/ha. Although greater numbers of fish were creel/ha from Santee River than Cooper River, weight harvested/ha was much less, particularly for bluegill, redbreast sunfish, and catfish species. Black crappie, catfish, bluegill, and redbreast sunfish were the most abundant species creel/ha by number and weight on the Santee. The average weight for all species creel/ha was higher from the Cooper River (0.51 kg/fish) than from Santee (0.28 kg/fish). Average weights ranged from 0.22 kg for blueback herring to 1.20 kg for striped bass from the Cooper River, compared to 0.10 kg for redbreast sunfish to 0.66 kg for "other"

Table 3. Estimates of sport fish number and weight (kg), per hectare estimates of number and weight, and average weight by species from the Cooper and Santee rivers, South Carolina, from 26 February 1981 through 25 February 1982.

Species	Cooper River					Santee River				
	N	Kg	N/ha	Kg/ha	Average wt. (kg.)	N	Kg	N/ha	Kg/ha	Average wt. (kg.)
Blueback herring	7,691	1,699	2.26	0.50	0.22	3,519	767	2.96	0.64	0.22
Catfish (sp.)	68,892	52,294	20.26	15.38	0.76	26,730	11,505	22.50	9.68	0.43
Striped bass	1,301	1,565	0.38	0.46	1.20	354	200	0.29	0.16	0.56
Redbreast sunfish	2,717	845	0.79	0.25	0.31	10,867	1,116	9.15	0.94	0.10
Bluegill sunfish	38,659	10,527	11.37	3.10	0.27	34,228	4,463	28.81	3.75	0.13
Redear sunfish	50,479	16,064	14.85	4.72	0.32	1,291	216	1.08	0.18	0.16
Largemouth bass	21,567	17,603	6.34	5.18	0.82	1,475	891	1.24	0.75	0.60
Black crappie	10,264	3,244	3.01	0.95	0.32	36,705	10,788	30.89	9.08	0.29
Other	21,478	10,649	6.31	3.13	0.50	7,320	4,856	6.16	4.08	0.66

Table 4. Estimates of success in number and weight (kg) of fish caught/hour by species from the Cooper and Santee rivers, South Carolina, from 26 February 1981 through 25 February 1982.

Species	Cooper River		Santee River	
	N/hour	Kg	N/hour	Kg
Blueback herring	.044	.010	.036	.008
Catfish (sp.)	.398	.302	.275	.120
Striped bass	.007	.009	.003	.002
Redbreast sunfish	.016	.005	.111	.012
Bluegill sunfish	.223	.060	.352	.046
Redear sunfish	.292	.093	.013	.002
Largemouth bass	.125	.102	.015	.009
Black crappie	.059	.019	.378	.112
Other	.124	.062	.075	.050

species, which included carp (*Cyprinus carpio*) and bowfin (*Amia calva*) from the Santee.

The number of fish harvested/hour was nearly equal for the 2 rivers. On Cooper River, 1.29 fish/hour were caught compared to 1.26 fish/hour creeled on the Santee. Cooper River fishermen caught fish weighing an average of 0.66 kg, and were most successful catching catfish, averaging 0.40 fish/hour weighing 0.30 kg (Table 4). Fishermen also had success catching reardear sunfish, bluegill, and largemouth bass. Santee fishermen caught fish weighing an average of 0.36 kg. Fishermen had the best luck catching crappie on the Santee, creeling 0.38 crappie/hour weighing 0.11 kg. Fishermen were also successful catching bluegill sunfish and catfish.

Most of the fishermen interviewed on both rivers were local (traveled less than 80.2 km) (Table 5). Still fishing, which included cane pole fishing,

Table 5. Origin of fishermen, method of fishing, and type of bait used, by percent, from Cooper and Santee rivers during 26 February 1981 through 25 February 1982.

Category	Cooper River	Santee River
Origin		
Local	77	80
> 50 miles	23	20
Method of fishing		
Still	58	86
Cast	32	13
Other	10	1
Bait used		
Natural	75	94
Artificial	25	6

was the preferred fishing method and natural bait was preferred over artificial bait on both rivers. Baitcasting was more popular on Cooper River than on the Santee, as was the use of artificial baits.

Discussion

Results from this study indicate that the Santee and Cooper rivers sustain productive sport fisheries all year. Annual estimates of fishing effort and harvest revealed that Cooper River fishermen caught 223,048 fish in 173,005 hours, while Santee River fishermen creeled 122,489 fish in 96,215 hours. Santee River received more fishing pressure (81.0 hours/ha) than Cooper River (50.9 h/ha), but less fishing pressure/km. The low estimate of fishing pressure/ha from Cooper River was due to the inclusion of abandoned ricefields in the study area. Abandoned ricefields comprised 71.4% (2,430 of 3,400 ha) of the creel survey study area. An attempt was made to count all fishermen utilizing ricefield areas. However, access to those areas was difficult for fishermen and creel clerks and some fishermen were probably overlooked. Also, observation indicated that on a per-unit area comparison, the river received much more fishing pressure than the ricefields. The higher estimate of fishing pressure/kilometer (3,145 h/km) is a better indicator of fishing pressure on Cooper River than the lower per-hectare figure.

The low pressure estimate obtained from Santee River reflects the limited access to the fishery. Fishing pressure was unusually high during the winter due to increased fishing activity at Wilson Dam. Fishing activity peaked at the Dam following a release of flood water from Lake Marion into the river which caused a concentration of fish below the dam after the flood waters receded. This locally well-known event occurs about once every 3 years and attracts large numbers of fishermen. Fishing pressure on the Santee remained high through the spring and then declined through the summer and fall as water levels declined. Although estimates of effort were not obtained for each section of the Santee River, observation indicated that most (90%) of the fishing pressure for the entire river occurred at Wilson Dam. It was not unusual for the creel clerk to work 8 or 10 days without encountering a fisherman, except at Wilson Dam.

Harvest, by number and weight, from the Santee and Cooper rivers compared favorably with those estimates reported from similar Georgia coastal streams, while estimates for average weight and success were higher than those estimates obtained from similar coastal streams (Holder and Germann 1979). Estimates of harvest appeared to be of reasonable magnitude and should provide an accurate pre-rediversion assessment of the Santee and Cooper river fisheries.

The 4 most abundant species harvested from the Santee and Cooper rivers differed from those species harvested from other coastal streams. Red-

ear sunfish, largemouth bass, bluegill, and catfish dominated the Cooper River creel, numerically, while black crappie, bluegill, catfish, and redbreast sunfish were the most numerous species harvested from the Santee. The most abundant species reported from creel surveys conducted on other rivers included largemouth bass, bluegill, black crappie and redbreast sunfish (Coomer and Holder 1980, Germann 1981, Hornsby and Hall 1981). The inconsistency in species composition reported from the various creel surveys was probably due to the different habitats associated with the various study areas. The redear sunfish fishery, which contributed 22.6% and 14.0% by number and weight to the Cooper River creel, was practically non-existent in the Santee or other coastal rivers. This important fishery was established in 1967, when redear sunfish were introduced in the Cooper River watershed by the South Carolina Wildlife and Marine Resources Department. Catfishes, including channel catfish, white catfish, and several species of bullheads, dominated the Cooper River creel numerically. The acceptance of catfish as a food fish, and their eagerness to bite as demonstrated by the success rates of anglers, provided incentive for their pursuit. Black crappie contributed substantially to the Santee River fishery. Their presence in the Santee was due to flood releases from Wilson Dam deporting large numbers of black crappie in the river. This finding was not a normal fishing trend, and their numbers were much less significant in the preliminary creel census conducted on the Santee during the winter of 1980. In normal (non-flood) years, bluegill and catfish would probably dominate the Santee creel.

Weithman and Anderson (1978) considered size of fish, catch rates, species, and diversity of catch as determinants of angling quality. The average weight and catch rates of fish from both the Santee and Cooper rivers were above average compared to other coastal streams, and fishermen creeled a variety of sport fish. By their (Weithman and Anderson) criteria, the Santee and Cooper rivers would be considered above average fisheries.

Most of the fishermen interviewed during both surveys were of local origin (having traveled less than 80.2 km). The origin of the trip, or distance fishermen travel to fish, may prove valuable in discerning if changes occur in the quality of fishing in the Santee or Cooper rivers after rediversion. As suggested by Nielson et al. (1980), the proportion of local and non-local fishermen may be related to the angling quality of the fishery. As the angling quality of a fishery increases, a greater number of non-local fishermen should be attracted to the fishery, and vice versa.

The precision of estimates varied for the different parameters examined. Estimates for effort generally had proportional standard errors less than 30.0%. Harvest estimates had higher proportional standard error. For comparison purposes, the standard error should be low, preferably less than 15.0%.

In summary, a 1-year creel census was conducted on the Santee and Cooper rivers, South Carolina, from 26 February 1981 through 25 February 1982. Fishing pressure per unit area was greatest on the Santee, with fishermen applying 81.0 hours/ha of effort compared to 50.9 hours/ha on Cooper River. Cooper River received 3,145 hours/km and supported heavy fishing pressure while the Santee received light to moderate fishing pressure (687 hours/km). From observation, more fishermen were encountered on the East and West branches of Cooper River and concentrated at Wilson Dam on the Santee. Fishing effort and species sought varied seasonally. In general, most effort was expended on the Santee for catfish and black crappie, while on Cooper River fishermen sought largemouth bass, catfish and redear sunfish.

While the statement made by the U.S. Army Corps of Engineers that "the resources are directly related to the discharge and overflow characteristics and will therefore be decreased in the Cooper River and increased in the Santee River" may prove correct, that statement addressed quantity and not quality. It is unlikely that the quality of the existing fisheries in the Santee and Cooper rivers will remain unchanged. Unless considerable changes take place within population structures and fish communities present in each river, it is probable that the decrease of the largemouth bass and redear sunfish fisheries in Cooper River will be replaced by an increase in the Santee River catfish fishery. A similar creel census conducted after rediversion should indicate qualitative and quantitative changes in the Santee and Cooper River sport fisheries.

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