COMMERCIAL AND SPORT SHAD FISHERIES OF THE EDISTO RIVER SOUTH CAROLINA, 1955

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ABSTRACT

The Edisto River, South Carolina, shad fishery was investigated to determine fishing effort, fishing rate, total catch, size of run, and spawning escapement for 1955. The commercial fishery catch-and-effort data were obtained from logbooks kept by each fisherman. The total catch made by sport fishing was determined by a post-card survey. The catch-and-effort data were combined with a tagging and recovery program, and it was estimated that the fishing rate was approximately 20 percent, the total catch was 11,000 shad, and the size of run was 56,000 shad (fiducial limits 28,000 to 100,000). Unfortunately, catch-and-effort records for previous years were not available for this stream; therefore, sizes of former runs and escapements could not be determined.

It is suggested that the State of South Carolina establish a system of collecting yearly catch-and-effort records on the Edisto River. If these records are obtained for a period of years, an intensive study, similar to that conducted in 1955, can be made to determine factors affecting shad abundance.

CONTENTS

	Page
Description of the river and shad fishery	1
Catch-and-effort statistics	3
Commercial fishery	3
Sport fishery	4
Population estimate	4
Miscellaneous studies	6
Discussion and recommendations	7
Summary	7
Literature cited	9

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In 1950, the United States Fish and Wildlife Service began a new study[1/] of the American shad (Alosa sapidissima) sponsored by the Atlantic States Marine Fisheries Commission. The purpose of the study is to determine causes for the decline in Atlantic coast shad production since 1890 and to recommend measures whereby the species may be restored to its former level of abundance.

Since the inauguration of this investigation a number of Atlantic coast shad producing waters have been studied. They are the Connecticut River, the Hudson River, the Delaware River, Chesapeake Bay and its major tributaries, the Neuse River, the Ogeechee River, and the St. Johns River. During the spring of 1955 efforts were concentrated on the Edisto River in South Carolina. The objective was to determine the present status of the fishery by obtaining statistics on fishing effort, fishing rate, total catch, size of run, and spawning escapement.

Catch statistics on the Edisto River are almost non-existent for previous years. McDonald (1887) gave the 1880 shad catch for this river as 90,000 pounds[2/]. Stevenson (1899) listed the amount of gear fished and the catch in 1896 as follows: 62 gill nets - 21,967 shad, 12 seines - 2,634 shad, and 83 bow nets - 3,672 shad, making a total of 28,273 fish caught by all gears.

The American shad is the largest member of the herring family (Clupeidae) in North American waters. It is an anadromous fish, which spends the major portion of its life in the ocean but which returns to fresh water to spawn. The sexually mature adults (3 to 5 years old) enter the rivers in the spring for spawning, and it is at this time that they are taken by fishermen. The progeny of the surviving fish remain in the rivers until fall and then migrate to the sea. More detailed information on the life history of this species can be found in a publication by Bigelow and Schroeder (1953).

Alonzo Seabrook, Director, Division of Commercial Fisheries, South Carolina Wildlife Resources Department, and G. Robert Lunz, Director, Bears Bluff Laboratories have provided valuable assistance in gathering material for this study. Acknowledgment is also given to the staff of the U. S. Fishery Laboratory, Beaufort, N. C., for aid in the field and for review of the manuscript.

Description of the river and shad fishery

The Edisto River basin is confined to the southern portion of South Carolina where the main Edisto River is formed by the junction of the North and South Edisto Rivers (fig. 1). The North Edisto has its origin near the town of Batesburg, S. C., and the South Edisto originates near Johnston, S.C. These branches flow parallel (not shown in fig. 1) in a southeasterly direction until they unite near the town of Branchville, S.C. From here, the river continues in a southerly direction until it reaches Givhans Ferry State Park where it abruptly turns southward and eventually enters the Atlantic Ocean at St. Helena Sound.

The river is approximately 90 miles long, and each branch is about 70 miles long. Most of the river is narrow with overhanging trees, numerous shoals, and loose shifting sand. Drainage from swamps, which generally border the river, gives the water a brownish or tea color. In addition, the Edisto is characterized by low turbidity and low alkalinity. There are no dams or falls, and the limit of tidal influence is in the vicinity of Fishburn Landing.

1/ Previous investigations of South Carolina shad by the Service are reported in Cable (1944).

2/ The average weight of shad caught in this river in 1955 was 3 pounds. Using this average, approximately 30,000 shad were caught in the Edisto River in 1880.

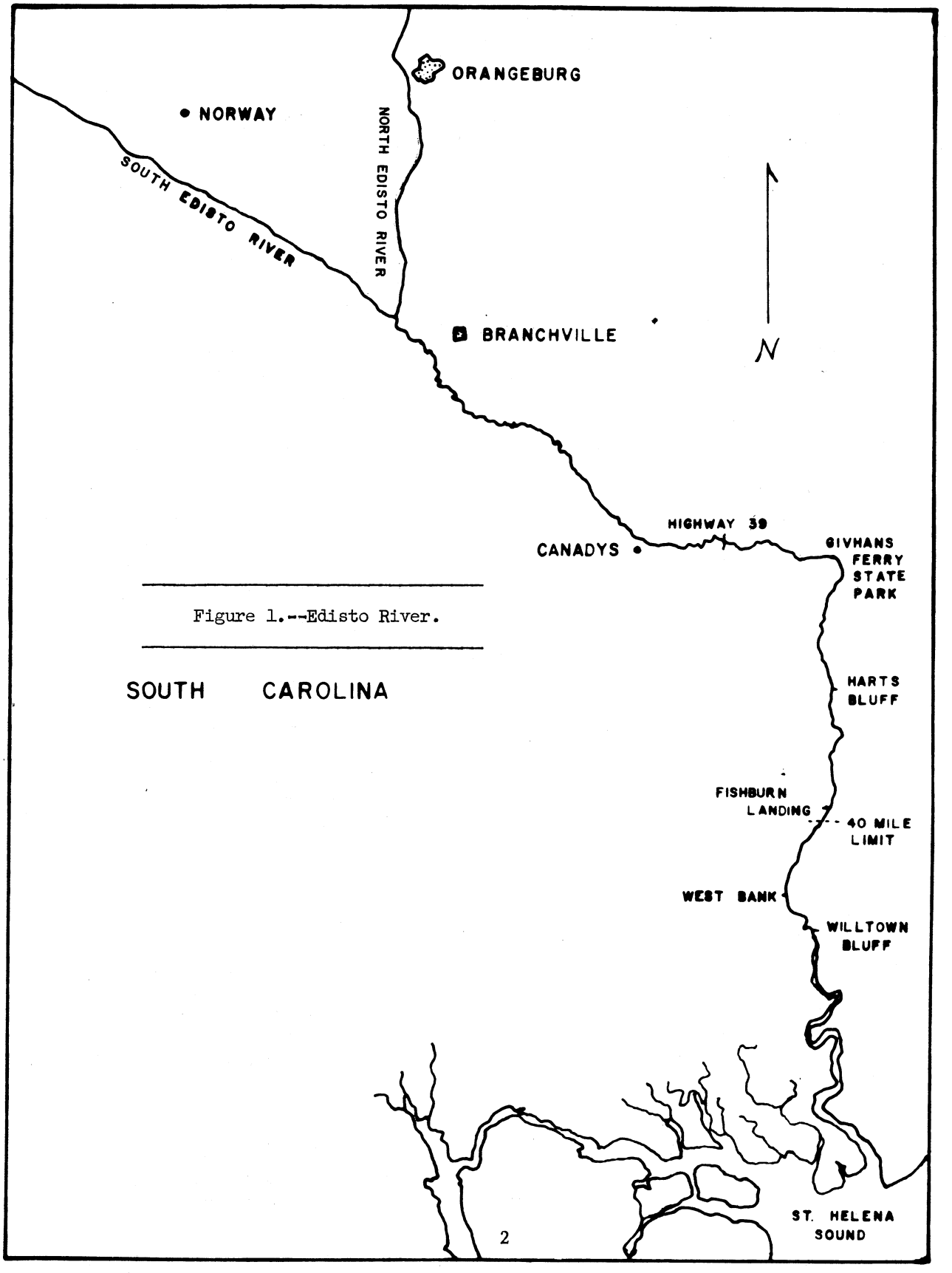

Figure 1.--Edisto River.

SOUTH CAROLINA

The area drained by the Edisto River is one of the most productive agricultural areas in the Southeastern States, and it supports a wide variety of crops, as well as beef and dairy cattle. There is relatively little industry adjacent to the river, most of it being confined to the area around Orangeburg. Aside from minor sources of sewage at the headwaters of both branches and at Orangeburg, the Edisto River is free from pollution (South Carolina, 1953).

Commercial fishing for shad is permitted during the hours from Tuesday noon until Friday noon, February 1 to March 24, in the lower 40 miles of the river (from the river mouth to Fishburn Landing), and is permitted, during the same hours, from February 1 to April 20 in the rest of the river. Fishing gear is limited to set gill nets, drift gill nets, haul seines, and bow nets. Nets are not permitted to extend more than halfway across a stream and are not permitted to be used within 200 yards of a net that has previously been set. Minimum mesh size for gill nets is limited to 5-1/2 inches stretch measure. Because all commercial fishing is done at night, activity is limited to three nights per week. For purposes of this report, the commercial fishing area in the lower 40 miles of stream is termed the lower fishery, and the rest of the river is termed the upper fishery.

In the lower fishery, set gill nets are fished from shore to midstream at right angles to the current. The net is fished by fastening the inshore end to a stake while the offshore end is held in position by a heavy anchor. This gear is set after dark at low tide and is lifted at the next low tide. The lengths of the lower fishery set gill nets range from 30 to 85 yards. Set gill nets are the only commercial gear fished in this area, except for three drift gill nets that are used immediately below Fishburn Landing. A drift gill net, as the name implies, is placed in the water and allowed to drift with the current. This gear can be drifted for a half-mile or more if the stream is free of obstructions. When the fishing season closes in the lower fishery, the operators of the three drift nets move upstream and fish above Fishburn Landing in the upriver area. In the analysis of data these three nets are included with the upriver drift net fishery.

In the upriver fishery from Fishburn Landing to the vicinity of Canadys, set gill nets, drift gill nets, and seines are fished. Set nets range in length from 5 to 25 yards, and they are fished in eddies and held in position with stakes. Because the river is narrow in this area, set nets are shorter and are fished differently than in the lower river. The drift nets and haul seines fished in the upriver area range in length from 20 to 50 and 50 to 100 yards respectively. Bow nets are fished from Highway 39 to Orangeburg on the North Edisto and to Norway on the South Edisto. This type of net is cone-shaped with a 6-foot oval opening and a bag length of approximately 7 feet. The wooden frame to which the net is attached is made from a long pole about 1 inch in diameter. The bow is formed by bringing the ends of the pole together so that they cross approximately 18 inches from each end. A short stick is lashed across these two extensions to form a handle. The net is fished from a stationary platform which is located adjacent to the river bank. The fisherman holds the net down into the water at right angles to the current and when a fish enters the opening, the net is raised and the fish is removed.

In addition to the commercial shad fishery on the Edisto River it provides important sport fishing. Sport fishing extends from West Bank to Canadys; however, most fish taken in this manner are caught between West Bank and Harts Bluff.

Catch-and-effort statistics

Commercial fishery

The South Carolina Division of Commercial Fisheries supplied a list of all licensed net fishermen (set gill net, drift gill net, and seine) who fished for shad in the Edisto River. Each man was contacted and given a logbook in which he was requested to enter his catch and the amount of gear fished each fishing day. These records were checked several times during the season to ensure that they were being kept as requested. After the close of the shad season, the catch made by each type of gear was tabula-

ted. Total effort expended by each type of gear was determined by multiplying the length of each net, in yards, by the number of days fished by that type of net. The sum of the individual efforts gave total effort in yard-days. This same procedure was used to obtain total effort for all commercial gear. Catch per-unit-effort was obtained by dividing the catch by the total effort (table 1). Effort by bow net and by hook-and-line fishermen was not determined.

Bow nets are large and cumbersome and as they are left at the fishing site when not in use, they can easily be counted from a boat in the river. At the height of bow net fishing a boat tour of the river revealed that 207 bow nets were in use. Bow nets do not require a license on the Edisto and apparently large numbers of them are fished. Logbooks kept by 47 operators of bow nets, revealed that the average seasonal catch of each net was 19.3 shad (range 2 to 63). Assuming that this sample was representative of the average catch, it is estimated that the bow nets caught a total of 4,000 fish.

Sport fishing

Several camps on the river rent boats, but many of the boats used for sport fishing are privately owned and are brought to the river and launched. A post-card survey was used to estimate the total number of shad taken by sport fishing. The 60-mile sport-fishing area was divided into two 30-mile sectors; sector 1 extended from West Bank to Harts Bluff, and sector 2 extended from Harts Bluff to Canadys. Each sector was cruised by boat every other day from March 5 through May 1 3/, and a post card was given to each fishing party. Each day that a sector was surveyed, it was cruised twice (upstream in mid-morning and downstream in the afternoon) to contact all fishermen. Each fishing party was requested to report the number of male and female shad caught, the number of fishermen in the party, and the length of time fished. The card number, sector fished, and date were entered by the census taker. Throughout the census period, 317 cards were given out in sector 1, and 70 were given out in sector 2. Fifty-six percent of the cards were returned from sector 1, and 51 percent were returned from sector 2.

Calhoun (1950) made a study of post-card response in California, where post-card surveys have been used extensively to estimate the sport-fishing catch. He found that the cards were returned at random, and he could detect no bias in the data. In other words, fishing success or failure did not influence the return of the card. Assuming that the post cards distributed in this survey were returned at random, as was found to be true in California, an estimate of the Edisto River shad catch made by hook-and-line can be made.

According to data obtained from the survey, a total of 376 boats fished in sector 1 and 83 boats fished in sector 2. These figures are higher than the total number of cards distributed, because at times all fishing parties could not be contacted. As expected, not all of the cards that were distributed were returned; however, according to data obtained from the returned cards, 179 boats caught 322 shad in sector 1, for an average catch per boat of 1.80 shad, and 36 boats caught 38 shad in sector 2, for an average catch per boat of 1.06 shad.

As stated above, the river was surveyed only on alternate days, therefore to obtain the total number of boats that fished during the season, the actual count of boats was doubled -- making a total of 752 boats for sector 1 and a total of 166 boats for sector 2. Multiplying these figures by the average catch per boat for each sector and adding the products (752 x 1.80 + 166 x 1.06) gives a total catch of 1,530 shad. For purposes of this study, the figure has been rounded off to 1,500 shad (table 2).

Population estimate

A tagging and recovery program was conducted to determine fishing rate, size of run, and spawning escapement. Shad were caught and tagged throughout the fishing season at West Bank by means of a set gill net. The catch was inspected regularly to ensure that only vigorous specimens were tagged. A

3/ Sport fishing began approximately March 5 and ended before May 1.

Table 1.--Shad catch, effort, and catch-per-unit of effort of various types of gear, Edisto River, 1955

Type of gear	Estimated catch	Number of nets	Effort (yard-days, in hundreds)	Catch per unit effort
Lower fishery set net --	924	42	430	2.15
Upper fishery set net--	354	40	45	7.87
Upper fishery drift net--	1,569	21	117	13.41
Upper fishery haul seine--	2,664	8	129	20.65
Upper fishery bow net--	4, 000	207	---	---
Hook-and-line (sport fishing)--	1,500	---	---	---
Total	11,011			

Table 2.--Post-card survey data used to estimate Edisto River sport-fishing catch

	Number cards distributed	Number cards returned	Average catch per card returned	Total boats fished	Number shad caught
Sector 1 --	317	179	1.80	752	1, 354
Sector 2--	70	36	1.06	166	176
Total catch					1, 530

Petersen-type tag was attached to the back of the fish immediately below the dorsal fin. When a shad was removed from the net, a scale sample was taken and the fish was weighed, measured, tagged, and released. A total of 112 shad were tagged during the fishing season. To ensure recovery of recaptured tags, all fishermen who had been given logbooks were contacted several times during the season and a reward of 50 cents was paid for each tag returned. However, relatively few tags were recovered, which tends to make our estimate of population size subject to error.

To estimate the size of run by means of tag and recovery technique, the number of shad tagged, the number of tags recovered, and the total number of shad caught must be known. Normally, data should be obtained from all types of gear to make this estimate; however, the lower fishery was closed to commercial fishing on March 24, which was before the entire run of shad had entered the river. Therefore, the data from this fishery could not be used. Also the scarcity of data response on the part of the bow-net fishery made it impractical for use in the estimate. The catch and tag recovery data from the remaining types of gear were used to estimate population size. To determine if there was a difference in the tag recovery-catch ratio of the various types of gear a chi-square test was made between the total catch of female shad by each type of gear and their respective tag recovery, as follows:

	Number of female shad caught	Number of tags recovered
Upper set nets -	289	2
Upper drift nets -	1,199	6
Seines - - - - - -	1,444	3
Sport fishery - - -	689	1
	3,621	12

$$X^2 = 3.6, \quad P \sim 0.30$$

This analysis indicates that there was no significant difference in the tag recovery-catch ratio of female fish regardless of the type gear used; therefore, the data were used to estimate the fish population. Only female shad were used in the analysis because the gear from which tag samples were obtained was selective to female shad on the basis of size of fish caught (the gear caught only the large fish, most of which were females). The total catch by these gears was 6,117 shad (n) from which 12 tags were recovered (s). A total of 108[4/] tags had been attached to fish in this area.[3/]

The total population (N) available to the upriver fishery was determined by the formula: - $N = \frac{nt}{s}$.

Solving this equation, it was found that the population of the upriver fishery was 55,053 shad. Ninety-five percent confidence limits were obtained for this estimate using a formula (55) from Chapman (1948). Upper and lower population estimates were calculated to be 100,000 and 28,000 shad, respectively.

To determine the total number of shad that entered the Edisto River, the catch made in the lower fishery was added to the upper-river population estimate. The number of shad caught before entering the upriver fishery was 924; therefore our best estimate of the number of shad entering the Edisto in 1955 was 56,000. The total catch was 11,011 shad, the overall fishing rate was calculated to be 20 percent, and the spawning escapement was estimated to be 45,000 shad. As previously stated, the above estimates are based on few tag recoveries and therefore may be subject to large error.

Miscellaneous studies

Scale samples from the commercial catch were studied to determine age distribution and the number of times each fish had spawned[5/]. No spawning marks were found on

4/ Four of the original 112 tags were recaptured by the lower river set nets.

5/ When a shad spawns and returns to the ocean it leaves a characteristic mark on its scales which is termed a spawning scar or mark

any of the scales examined, which indicates that Edisto River shad die after their first spawning. This same conclusion was reached by Cable (1944) from examination of Edisto River shad scales. Two hundred ninety-two Edisto River shad were sampled and aged us ing the method of Cating (1953), and it was found that the majority of males were 3 and 4 years old and most of the females were 5 years old (table 3).

When a female shad spawns, it casts its eggs loose in the water where they are fertilized by one or more males. The individual eggs are semi-buoyant and are carried with the current. Special-type nets are set in the current to intercept these eggs and limit the spawning area.

In 1938, Cable (unplublished data) made an intensive study of the shad spawning area in the Edisto River (table 4). She found that the major shad spawning area was between West Bank and Givhans Ferry State Park. Eggs were found, however, as far downstream as Willtown Bluff and as far upstream as Orangeburg.

During the present study a survey was made to determine the 1955 shad spawning area in the Edisto River. Nineteen egg sampling stations were established between Willtown Bluff on the lower river and Orangeburg and Norway on the North and South Edisto Rivers, respectively. Each station was visited four times between March 18 and May 8, and two nets were set on each occasion. These sampling nets were cone-shaped, with a diameter of 1 meter and a length of 3 meters, and were made of nylon marquisette with approximately 24 meshes to the inch. Relatively few eggs were obtained in this study, possibly because of high water and debris, which limited sampling time to 1/2 hour per set. However, results of this limited survey tend to corroborate Cable's 1938 findings.

Discussion and recommendations

Cable (1944) believed that the Edisto River shad population was overfished. In 1938, she stated that the lower river set gill net fishery caught 65 percent of its weekly catch on Monday night, 20 percent on Tuesday night, 10 percent on Wednesday night, and 5 percent on Thursday night. Because the fish that escaped were then subject to the upriver fishery, she concluded that, at most, only 10 percent of the run escaped to spawn. The above condition does not appear to be true in 1955. Catch records were obtained from all nets fished in the lower fishery, so the proportion of the weekly catch made each night can easily be determined. It was found that on the average 36 percent of the catch was made on Tuesday night and 32 percent was made on each of the remaining two nights.

The sport and bow net fisheries caught 50 percent of the total shad catch in 1955, and, although not subject to any regulations, it is estimated that over one-third of the total shad catch was made by this gear (table 1).

There are no catch-and-effort records available for previous years on the Edisto. However, commercial fishermen on the river state that catches have been declining for a number of years. Before the cause of this decline can be ascertained, catch-and-effort records must be obtained for a period of years. If these data are obtained, an intensive study, similar to that conducted in 1955, can be made to determine the factors that are affecting the population. On the Connecticut River and the Hudson River, where data of this type were available (Fredin, 1954; Talbot, 1954), the major cause of population fluctuations was determined, and, as a result, it is now possible to manage these fisheries to obtain maximum yields. If data were made available, this also could be accomplished for the Edisto River.

SUMMARY

1. Shad were taken in the Edisto by the following types of gear: set gill net, drift gill net, haul seine, bow net, and hook and line. Catch data were obtained from logbook records kept by the operators of all types of gear except hook and line. The total catch made by this fishery was determined by a post-card survey. Total 1955 Edisto River shad catch was estimated to be 11,000 shad.

Table 3.--Age distribution of male and female shad taken in the Edisto River

Age Years	Male		Female	
	Number	Percent	Number	Percent
3	14	35	--	--
4	17	43	31	12
5	9	22	155	62
6	--	--	66	26

Table 4.--Egg samples collected in the Edisto River in the spring of 1938 by L. E. Cable

Station	Number of sets	Number of eggs
Willtown Bluff (3 miles below)	2	0
Willtown Bluff	11	6
West Bank	114	472
Fishburn Landing	80	228
Harts Bluff	26	133
Givhans Ferry	25	128
Canadys	22	19
Branchville	16	6
Norway	22	0
Orangeburg	28	4

2. A tagging and recovery program was conducted during the fishing season, and it was estimated that the overall fishing rate was approximately 20 percent and that the size of run was 56,000 shad (fiducial limits 28,000 to 100,000).

3. Age readings of 292 scale samples taken from the Edisto River commercial shad catch revealed that the majority of males were 3 and 4 years old and most of the females were 5 years old.

No spawning scars were found on any of the scales examined, which indicates that Edisto River shad die after their first spawning.

4. Results of a spawning-ground survey by L. E. Cable indicate that the major shad spawning area in the Edisto River is between West Bank and Givhans Ferry State Park.

5. Because of the absence of previous years' catch-and-effort data, the factors affecting the abundance of Edisto River shad could not be ascertained. It is urged that the State of South Carolina establish a system of collecting shad catch-and-effort records for the Edisto River. When these data have been collected for a period of years, a study similar to that conducted in 1955 can be made to determine the factors that are affecting population. If these factors can be controlled, proper management procedures can be initiated.

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