MAINE YANKEE ATOMIC POWER COMPANY

EDISON DRIVE
AUGUSTA, MAINE 04336
(207) 623-3521

WMY 80-118
B.3.2.1
JHG-80-56

August 4, 1980

U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. Robert A. Clark, Chief
Operating Reactors Branch #3
Division of Licensing

Reference (1): License No. DPR-36 (Docket No. 50-309)

Subject: Shortnose Sturgeon

Dear Sir:

Pursuant to your information request of June 26, 1980, please find enclosed our responses to your questions on the taking of two shortnose sturgeon, Acipenser brevirostrum, an endangered species, at the Maine Yankee intake structure in June 1980.

We trust the enclosed material is responsive to your request. Should you need additional information or have any questions, please do not hesitate to contact us.

Sincerely,

MAINE YANKEE ATOMIC POWER COMPANY

John H Garrity

John H. Garrity, Director
Nuclear Engineering & Licensing

JHG:at

Enclosures

REPORT ON THE SHORTNOSE STURGEON FOUND AT THE MAINE YANKEE ATOMIC POWER STATION

INTRODUCTION

This information on the finding of two shortnose sturgeon, Acipenser brevirostrum, at the Maine Yankee Atomic Power Station in Wiscasset, Maine, was requested by the U. S. Nuclear Regulatory Commission (NRC), Licensing Division by their letter of June 26, 1980.

The following information was presented orally and discussed at a June 15, 1980 meeting held at Maine Yankee at the request of the USNRC. Meeting participants included representatives from the National Marine Fisheries Service (NMFS), Maine Department of Marine Resources (DMR), University of Maine, the NRC and Maine Yankee.

COLLECTION AND DESCRIPTION OF SHORTNOSE STURGEON

Two shortnose sturgeon, Acipenser brevirostrum, were taken from the Maine Yankee trash racks (5.4cm openings) in June, 1980 during routine cleaning of the trash racks. The location of the trash racks, vertical traveling screens and pumps associated with the intake structure are shown in Figure 1.

The following information briefly summarizes the details of collection and condition of the sturgeons. Mr. Glenn Nutting, Central Maine Power Company Environmental Studies Department Biologist, provided the identification of both specimens.

STURGEON 1

A male shortnose sturgeon, 87cm total length and weighing 1.8kg, was collected from the trash racks at

2300 EDT on June 2, 1980. The sturgeon was dead and in extremely poor condition when removed from the trash racks. The sturgeon was exposed to the atmosphere for nine (9) hours before the Environmental Studies Department was notified of its collection. Following identification on June 3, the sturgeon was kept frozen until it was delivered to DMR on June 6, 1980 for a pathological examination (Attachment 1).

STURGEON 2

On June 13, 1980 at 0730 EDT a second shortnose sturgeon, 69.5cm total length and weighing 1.25kg, was removed from the trash racks during cleaning. This sturgeon was also dead when collected. The sturgeon's weight was approximately one-half the normal weight for this size sturgeon.

The sturgeon was refrigerated for one-half hour while arrangements were made with DMR personnel to receive the specimen for postmortem examination. It was delivered to DMR at 1030 EDT, three hours after collection. (See Attachment 2 for the pathology report.)

PLANT OPERATING CONDITIONS

The times of trash rack cleaning, corresponding tidal stage, and average intake temperature from mid May through mid June 1980 are shown in Table 1. Between two and four circulating water pumps were operating during this period.

POSTMORTEM EXAMINATION

Mr. Stuart Sherburne, Marine Resources Scientist, Maine Department of Marine Resources, telephone 207/633-5572, provided the pathology reports on the sturgeon (Attachments 1 and 2).

The exact cause of death could not be determined for either sturgeon although Mr. Sherburne concluded

from a gross examination of the second sturgeon that a contributing factor in the "death of the fish was trauma as a result of direct physical force."

SHORTNOSE STURGEON POPULATION IN THE VICINITY OF MAINE YANKEE

Shortnose sturgeon, although classified an endangered species (32 FR 4001) under the Endangered Species Act (16 USC 1531-1543, 87 Stat 884), is fairly common in Montsweag Bay; they were first reported from the bay in 1971 (Fried and McCleave, 1973).

McCleave et al. (1977) studied the movements of shortnose sturgeon in Montsweag Bay by ultrasonic telemetry during the summer months of 1971-1974. They found that four sturgeon moved in the vicinity of the plant intake or outfall, when Maine Yankee was not operating or prior to its completion. The random wandering movements of shortnose sturgeon throughout Montsweag Bay are interpreted as foraging movements (McCleave et al., 1977).

Squiers and Smith (1979, Attachment 3) studied the sturgeon population in the Kennebec River and found shortnose sturgeon to be distributed throughout. They move into Montsweag Bay via the Sasanoa River. The shortnose sturgeon population in the Kennebec River is estimated to be 5000 adults (> 50cm). The 95% confidence limits of the estimate are from 3000 to 20,000. A summary of the shortnose sturgeon caught in Montsweag Bay by the Maine DMR appears in Table 2.

No shortnose sturgeon have been found in over 300, 24-hour impingement samples taken weekly since November 1972. Nor have they been taken in 10 years of monitoring the fish populations in the Montsweag Bay-Sheepscot River estuary. This program consists of monthly trawls (9m otter trawl, 25.4mm square mesh in the wings and body, 13.1mm square mesh in codend) and three-panel monofilament gillnets (45.6m long x 2.4m deep, mesh sizes of 12.7mm, 25.4mm, 50.8mm square measure) fished monthly near the surface.

IMPACT ASSESSMENT

The collection of two moribund shortnose sturgeon from the Maine Yankee trash racks in eight years of operation will have no impact on the sturgeon population in the Kennebec River. Shortnose sturgeon exhibit swim speeds in excess of average intake velocities at the trash racks (37cm/sec), thus avoidance is possible. Adult shortnose that randomly move throughout Montsweag Bay on foraging expeditions are normally not expected to be impinged on the trash racks although the possibility of an occasional sturgeon in poor condition cannot be ruled out, as has been reported herein.

No juvenile shortnose have been impinged on the traveling screens in eight (8) years of monitoring. Larvae of shortnose sturgeon are not found in the brackish water (13-27 ppt) of Montsweag Bay.

CONCLUSION

The operation of Maine Yankee has no effect on the shortnose sturgeon population of the Kennebec River.

LITERATURE CITED

Fried, S. M. and J. D. McCleave. 1973. Occurrence of the shortnose sturgeon (Acipenser brevirostrum), an endangered species, in Montsweag Bay, Maine. J. Fish, Res. Board Can. 30:563-564.

McCleave, J. D., S. M. Fried, and A. K. Towt. 1977. Daily movements of shortnose sturgeon, Acipenser brevirostrum, in a Maine estuary. Copeia(1):149-157.

Squiers, T. S. and M. Smith. 1979. Distribution and abundance of shortnose and Atlantic Sturgeon in the Kennebec River estuary. Completion Report. Project No. AFC-19. Maine Department of Marine Resources, Augusta, Maine.

TABLE 1

FREQUENCY OF TRASH RACK CLEANING,
TIDAL STAGE AND AVERAGE INTAKE TEMPERATURE
AT MAINE YANKEE DURING MID MAY - MID JUNE 1980

DATE	AVE. INTAKE TEMP. °C	START OF TRASH RACK CLEANING, EDT[1]	TIDAL STAGE
May 15	12.7	2200	Late Flood
16	12.8	1300	High
		2030	Low
17	13.1	1330	Late Flood
		2200	Early Flood
18	13.2	2300	Early Flood
19	13.0	0800	Late Ebb
26	15.0	1300	Mid Ebb
30	15.1	1400	Early Ebb
June 2	14.2	2200	Low
4	13.1	0300	High
		0600	Mid Ebb
5	13.0	0100	Mid Flood
6	13.8	1300	Early Flood
7	14.4	0200	Early Flood
9	13.4	0800	Late Flood
		1000	Early Ebb
10	13.6	1000	High
11	13.5	2100	Late Flood
13	14.3	0400	Late Ebb
		1100	Late Flood
		2200	Mid Flood
14	15.7	0300	Early Ebb
		0400	Mid Ebb
		0500	Late Ebb
		0800	Early Ebb

[1] based on strip chart recorders

TABLE 2

Location, Date, Fork Length (FL), Total Length (TL), Weight (Wt), and Tag Number of shortnose sturgeon captured in Montsweag Bay by Maine Department of Marine Resources personnel. All sturgeon captured in bottom nets 100 yds long, 6' or 8' deep, and comprised of three panels of 6", 7", 8" stretch mesh.

MONTSWEAG BAY LOCATION	DATE	F.L.(cm)	T.L.(cm)	Wt(lbs)	TAG NO.
Halfway Rock	6/14/77	86.1	97.0	10 ¼	0075
	8/11/77	None			
	11/12/77	None			
	7/14/78	None			
	7/25/78	None			
	8/29/79	None			
	6/18/80	61.5	70.5	4	0699
		96.0[1]	107.6	12	0698
	6/25/80	86.1[1]	96.0	8 ¼	0624
		84.1	95.0	8 ¼	0625
Pine Island	6/08/78	64.3	73.5	5 ¼	0278
	6/25/80	None			
Youngs Point	6/25/80	99.0	110.5	23 3/4	0623

[1]Sunken Eyes

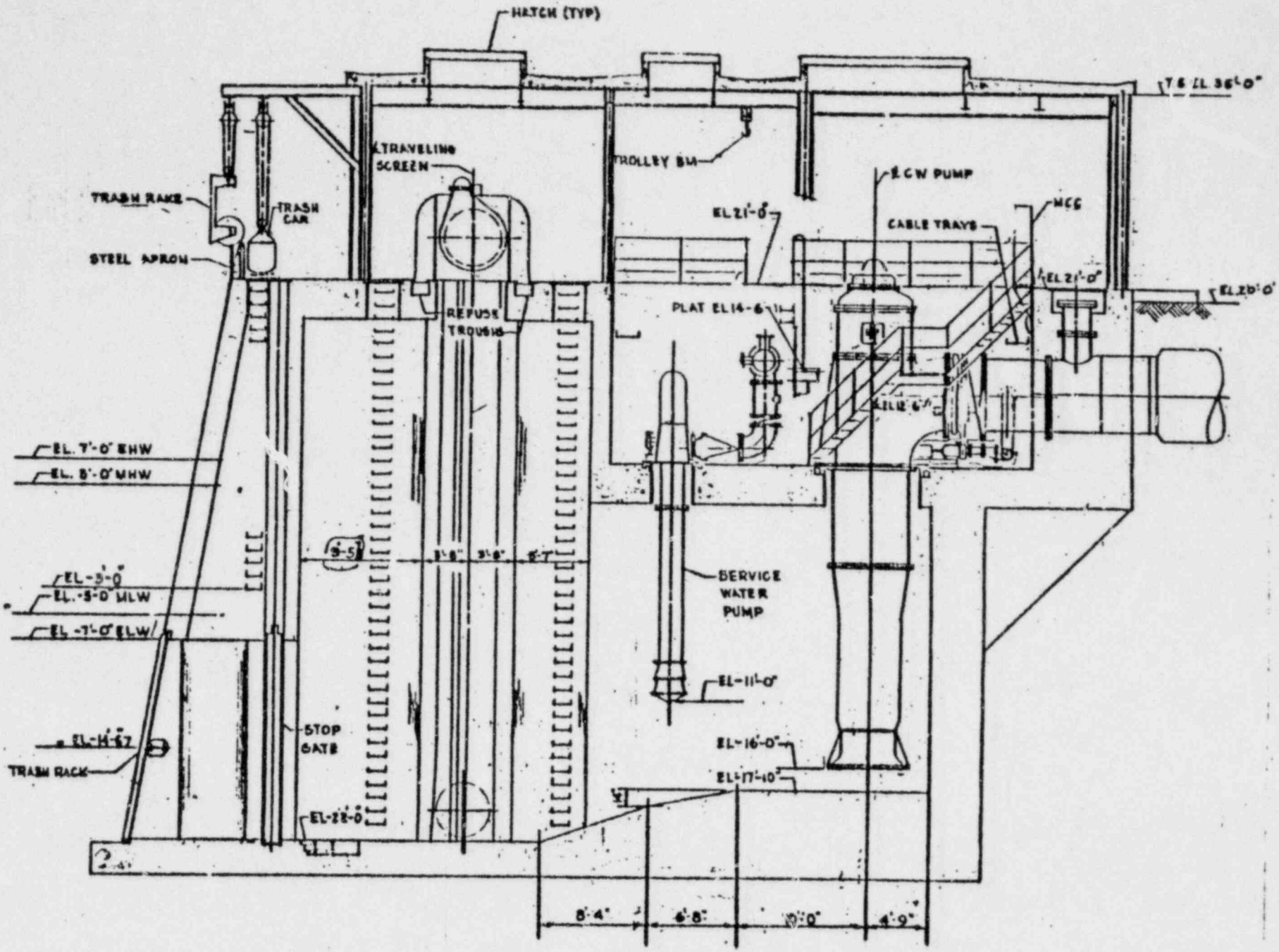


Figure 1. Maine Yankee Circulating Water Pump House

Attachment 1

SPENCER / POLLONIO, COMMISSIONER

AREA CODE (207)
289-2291

STATE OF MAINE
DEPARTMENT OF MARINE RESOURCES
STATE HOUSE — STATION 21
AUGUSTA, MAINE 04333

June 26, 1980

Steve Evans
Central Maine Power Company
Edison Drive
Augusta, Maine 04336

Dear Steve:

Enclosed is the report on the ~~first~~ shortnose sturgeon which was taken from the trash racks at Maine Yankee on June 5, I believe. taken 6/2/80 sde The cause of death could not be determined from our pathological examination. Stuart is in the process of examining the second shortnose sturgeon taken from Maine Yankee, but I doubt if any conclusive cause of death will be found.

We set three experimental gill nets on June 24th. We captured one large shortnose (110.5 cm TL) off Youngs Pt. This fish appeared to be in good condition with the exception of having white opaque eyes. McCleave also noted that some shortnose sturgeon that were examined by him also had white and opaque eyes. It is also not an uncommon occurrence in the Kennebec River. Two shortnose were captured just above Half-Tide rock (96.0 cm and 95 cmTL). Both these fish weighed 8¼ pounds (3.75 kg.). The average weight for shortnose sturgeon of this size in the Kennebec River is 11 pounds (5.5 kg.) although 8¼ pounds is within the range. One of these fish had sunken eyes and appeared to be in poor condition.

It is my opinion that the two shortnose sturgeon taken on the trash racks at Maine Yankee were probably in poor condition before being impinged on the racks.

Sincerely,

Thomas S. Squiers
Marine Resources Scientist

TSS/lb

State of Maine
DEPARTMENT OF MARINE RESOURCES

MEMORANDUM

Date June 13, 1980

To Tom Squiers

From Stuart Sherburne Stuart S Sherburne

Subject Shortnose sturgeon received partially frozen from Lee Alexander on June 6, 1980.

Here is the information I have. You can write the final report and include what you want, as the specimen was submitted to you. I would recommend that subsequent specimens to be submitted be refrigerated and not frozen and that we receive specimens as soon as possible so we will have comparatively fresh material to work with. Frozen tissues are worthless for histological work-up, although we gave it a try in this case.

Lengths: 74.5 cm (29.3 in.) fork length, 85.8 cm (33.8 in.) total length

Sex: male

Weight: 1.8 kg (4 lb.)

Scutes: 10 dorsal, 28 left lateral, 26 right lateral, 9 right ventral, 9 left ventral, 1 pre-anal, no superanals

Mouth width: 4.76 cm (1.9 in.)

Interorbital width: 5.44 cm (2.1 in.)

Snout length: 6.04 cm (2.4 in.)

Head length: 17.0 cm (6.7 in.)

Gill covers: One-fourth of gill cover was missing on the left side, about 20% of gill cover missing on right side. Opercular points were sharp, no apparent erosion; apparently due to genetic abnormality.

The sturgeon was very thin (emaciated in appearance), razor-backed with evidence of muscular atrophy. The ventral surface of the anal fin and caudal peduncle had evidence of hemorrhaging beneath the skin. This red area extended forward to 4 scutes from the tail.

There was a small quantity of ooze (mud consistency) in the duodenum extending from the pyloric apparatus to the spiral valve; the hindgut was empty. No obstructions were found that would prevent feeding or passage of food. There was no evidence of external or internal parasites.

Histological sections were prepared from muscle, intestine, pyloric apparatus, stomach (gizzard), heart, gill, gonad and liver. The liver showed areas of necrosis, but since the fish had been frozen and we don't know how long the fish had been dead before being frozen or how fast the fish was frozen and because of the consequent thawing, we cannot tell whether the necrosis was pre- or post-mortem.

The cause of death is unknown. The hemorrhagic areas near the tail appeared due to abrasion or contusion.

Attachment 2

PATHOLOGY REPORT

Shortnose sturgeon received at 10:30 A.M. on Friday, June 13, 1980 from William B. Campbell, Maine Yankee Environmental Studies. The fish was dead when found (7:30 A.M.) as far as Mr. Campbell knows. Taken off trash rack, before screens.

Gross Examination

Weight	2.75 lbs. (Normal wgt. 5.28 lbs.)
Mouth Width	4.7 cm
Interorbital width	5.05 cm
Snout length	5.5 cm
Total length	71.2 cm
Fork length	65.5 cm
Head length	15.2 cm
Dorsal scutes	9
Ventral scutes	8 left
	9 right
Lateral scutes	26 right
	27 left
Pre-anal scutes	3

Right Lateral Side

2nd and 3rd scutes torn. Lower ½ of 2nd scute torn.

3rd--95% attachment lost, skin not broken

4th--scute missing

8th--bruise, 10th--bruise above lateral line

11th--bruise 8:00 on ventral side

15th--bruise at 5:00 vent. side

18th--bruises 1-7:00

Left Lateral Side

No evidence of hemorrhaging.

#4 scute --1/3 missing.

#5 scute--upper scute present, but torn from skin

6 and # 7--torn, #8 worse than 7, top and bottom torn

Dorsal

Area of bruise on 1st dorsal scute on both sides.

Skin torn post. to 1st dorsal scute.

Left--2,3,4,5,6th scutes torn. 7th O.K.

Right--2 - 5 torn, worse at beginning.

Right Ventral

2nd scute torn off--break in skin

4th - 9th--hemorrhaged

Left Ventral

2,3,4,5,6th scutes torn away--worse at beginning

Rear of left gill area broken - 1.3 cm. Left gill very eroded--common. Bruise left side of ocular area. Tail--anal fin area hemorrhaged from base to top of fin ray, base of caudal fin hemorrhaged. Slight prolapse of the intestine through the anal opening. Exposed intestine had an area of inflammation. No food in stomach or intestinal tract; no obstructions were found that would prevent feeding or the passage of food. No external parasites observed.

Histology

Selected organs were dissected out and preserved in 10% seawater formalin. The sturgeon was frozen for future reference. Histological sections were prepared from the gill, heart, liver, intestine, stomach (gizzard), right anterior kidney, right and left posterior kidneys, gonad and anus. These sections were stained with hematoxylin and eosin stain. Price's giemsa method was employed on sections from the heart, right anterior kidney, right and left posterior kidney, gonad and liver. Price's stain was used to further differentiate the hematologic elements.

It should be noted that we are at a disadvantage in interpreting these sections for lack of reference slides of the normal histological appearance of the organs or knowledge of the rate and pattern of postmortem decomposition in the sturgeon. Therefore, only general comments can be made.

Examination for the presence of parasites and pathogenic microbes revealed necrotic areas in most sections. No parasites were observed. Degenerative cellular fragmentation was worst in the heart and liver. Rod-shaped and cocci types of bacteria were prominent in the heart section, less so in the liver. The kidney tissue appeared quite well preserved but again, there was evidence of bacteria associated with some tissue breakdown. There was some necrosis in the gonad and intestine but not associated with bacteria. This could be due to autolytic enzymes which are abundant in necrotic tissues. The anus showed a hyperemic area which is apparently the area of inflammation seen on gross examination.

If the microscopic pathology observed had been present at the time of death this fish would have had septecemia. Since the fish had been dead for an unknown length of time the pathology observed could have been due to postmortem autolysis.

It can be concluded that, from the gross examination, with the broken rear left orbital area, torn scutes on the left ventral, left lateral, dorsal, and right lateral surfaces and hemorrhagic areas on the dorsal, right lateral and right ventral surfaces a contributing factor in the death of this fish was trauma

as a result of a direct physical force.

Blood Examination

Packed cell volume (percentage of red blood cells in the blood) was 39.5% (probably within normal range); the plasma showed hemolysis (expected). The morphology slide prepared from a caudal cut showed a normal complement of red blood cells with normal maturation sequence. Approximately 4% immature red cells were present. There were only a few intact white cells present but neutrophils, lymphocytes and eosinophils were identified. Many basket cells (degenerated blood cells) were present in the smear. This would be expected postmortem. Rod-shaped bacteria were present throughout the blood smear. This could be due to postmortem autolysis and to contamination from the knife passing through the tissues while making the caudal cut. A blood sample was drawn from the heart with a sterile hypodermic syringe and needle. The heart was nearly empty of blood, so only several drops were obtained. The red blood cells that were intact appeared normal. Some bacteria were present extracellularly. The presence of bacteria could be expected in decomposing heart tissue.

In summary, the percentage of red blood cells in the blood appeared to be normal, the intact red cells that were present were of normal size, shape, color, nucleo-cytoplasmic ratio and maturation sequence for the circulating blood. We do not know how long this fish had been dead before being submitted but from a consultation with a fish pathologist (Martin Newman) at the Oxford, Maryland N.M.F.S. pathobiology lab, we surmise that this sturgeon had been dead for no longer than 15 hours. We have no objective proof of this, neither have we knowledge of the normal breakdown sequence of blood cells in other fish. We hope to pursue this matter further on experiments with cod and dogfish.

L Ventricle.

R. Ventricle

H - Hem.
P - Pressure
T - tone

Attachment 3

S D EVANS

COMPLETION REPORT
PROJECT #AFC-19

DISTRIBUTION AND ABUNDANCE OF SHORTNOSE AND ATLANTIC STURGEON IN THE KENNEBEC RIVER ESTUARY

PERIOD COVERED: June 1, 1976 to April 30, 1979

PREPARED BY: Thomas S. Squiers
Malcolm Smith

DEPARTMENT OF MARINE RESOURCES
STATE HOUSE
AUGUSTA, MAINE 04333

JOB TITLE:

Stock Assessment of Sturgeon in the Lower Kennebec River.

OBJECTIVES:

To determine the distribution and abundance of shortnose sturgeon and Atlantic sturgeon in the Kennebec River Estuary.

ACCOMPLISHMENTS:

Introduction:

Two species of sturgeon are present in the estuarial complex of the Kennebec, Androscoggin, and Sheepscot Rivers. The presence of Atlantic Sturgeon, Acipenser oxyrhynchus, in these systems is documented in the early historical records. Shortnose sturgeon, Acipenser brevirostrum, were not known to be present in Maine waters until they were first identified in 1971 by Fried and McCleave (1973) in Montsweag Bay, part of the Sheepscot River. They were subsequently found in the Kennebec River in 1972 by the Maine Department of Marine Resources (Flagg, personal communication).

The shortnose sturgeon was placed on the Endangered Species List in 1967 and by virtue of the passage of the Endangered Species Act of 1973, it is unlawful to take or possess a shortnose sturgeon. DMR applied for and received an Endangered Species Permit in September 1976 to conduct research on shortnose sturgeon.

Significant commercial fisheries for anadromous species are anticipated to develop in the Kennebec and Androscoggin Rivers as a result of intensive pollution abatement on the two systems (Flagg, personal communication). DMR initiated the sturgeon project to collect basic data such as distribution and movements to assure protection of shortnose sturgeon while allowing other commercial fisheries to develop.

HISTORICAL NOTES

The first known fishery for sturgeon was at Pejepscot Falls in 1628. Thomas Purchase supposedly fished for salmon and sturgeon from time to time on quite a large scale until the commencement of King Philips War in 1675. The only indication of the extent of the fishery was that Thomas Purchase caught about 90 kegs and 90 barrels of sturgeon in a three-week period (Wheeler and Wheeler, 1878).

The fishery for sturgeon in the eighteenth and nineteenth centuries is described by Goode (1887) as follows:

"In the early part of the eighteenth century there existed a flourishing sturgeon fishery in the Province of Maine, which employed some years over twenty vessels, and was esteemed an important branch of industry. It does not appear, however, to have been prosecuted continuously. Very early in the present century a company

of men came to the Kennebec, and, locating themselves on a small island near the outlet of Merrymeeting Bay, since known as 'Sturgeon Island', engaged in the catching of sturgeon, which they soused, packed in kegs, and shipped to the West Indies, where they sold at $1 a keg. This business was, however, suspended, for what reason is unknown, and though sturgeon were very abundant in the Kennebec during the early part of the present century, at least until about 1840, no attempt was made to utilize them except occassionally for home use, until 1849.

In 1849 a Mr. N. K. Lombard, representing a Boston form, came down to the Kennebec, established himself at "Burnt Jacket", in the town of Woolwich, between Bath and Merrymeeting Bay, and undertook to put up the roe of sturgeon for caviar, and at the same time boil down the bodies for oil. A large number of fishermen engaged in the capture of sturgeon to sell to Lombard. The price paid was 25 to 50 cents apiece. The first year there were obtained 160 tons of sturgeon. They yielded oil of fine quality, superior to sperm oil for illuminating purposes, in the opinion of the inhabitants of that vicinity, who have been accustomed to use it when attainable. The attempt to utilize the roe was at first unsuccessful. It was put inot hogsheads. Very lightly salted, and all spoiled. The next two years the roe was cured by salting heavier, drying, and laying it down with a little sturgeon oil, and was pronounced satisfactory. However, the business was discontinued after 1851. That year the sturgeon were quite scarce.

From this time there was a suspension of the sturgeon fishery until 1872, when some of the local fishermen of the Kennebec took it up again. In 1874 a crew of fishermen, headed by one John Mier, of New York, went into the business, catching and buying all they could, and shipping them to New York, where they proposed to smoke the flesh and utilize the roe for caviar and the sounds for glue. They aimed to catch the sturgeon early in the season, while the roe was yet black and hard, and to keep the fish alive until the proper time arrived for opening them. For the latter purpose they constructed a great pen, in which they at one time had seven hundred live sturgeon. After five years the sturgeon again became scarce, and the business was relinquished to local fishermen, who still continue to ship the flesh to New York, but throw away all other parts. In 1880, the least successful season in recent times, 12 fishermen were engaged in the business on the Kennebec, and the total catch was about 250 sturgeon, producing about 12,500 pounds of flesh which sold in New York at 7 cents per pound."

Since the 1880's the sturgeon fishery has been almost non-existent. Most of the recorded landings have been incidental catches (Table 1). The most common gear in which they are caught incidentally are anchored gill nets and otter trawls.

DESCRIPTION OF STUDY AREA:

The Kennebec and Androscoggin Rivers combined, drain approximately 9320 square miles of which 8600 square miles is located in Maine. The Kennebec River, draining 5870 square miles, arises in Moosehead Lake in Piscataquis and Somerset Counties and travels southerly for 118 miles before reaching tidal water. The tidal portion continues for

TABLE 1

MAINE COMMERCIAL FISHERY LANDINGS FOR STURGEON

DATE	POUNDS LANDED	VALUE
1849[1]	320,000	
1880	12,500	625
1909	6,000	1000
1910	9,000	1125
1911	19,900	2059
1912	20,000	2299
1913	8,100	1402
1914[2]	2,000	285
1924	3,528	1091
1928	652	87
1929	310	31
1931	1,061	176
1932	2,122	267
1935	900	90
1937	1,200	92
1938	500	28
1943	300	39
1945	400	48
1946[3]	400	43
1947	313	50
1948	228	39
1949	409	69
1950	393	32
1951	528	60
1952	637	118
1953	1,165	186
1954	1,440	275
1955	570	129
1956	690	138
1957	819	182
1958	730	130
1959	800	115
1960	974	162
1961	1,213	176
1962	611	80
1963	766	90
1964	72	7
1965	598	82
1966	444	55
1967	1,583	135
1968	568	40
1969	2,783	175
1970	6,201	349
1971	856	88
1972	1,055	165
1973	318	40
1974	368	75
1975	1,424	333
1976	1,339	289
1977	4,598	685

1. Maine Biennial Reports 1849 through 1914.
2. U.S. Bureau of Fisheries 1924 through 1946.
3. Maine Landings 1947 to Present.

another 20 miles to Abagedasset Point in Merrymeeting Bay (Fig. 1). This tidal section is essentially freshwater year round. The Androscoggin River joins the Kennebec River in Merrymeeting Bay. The Androscoggin River begins at the outlet of Umbagog Lake in New Hampshire and flows 161 miles to Merrymeeting Bay. The last 8 miles are tidal freshwater.

Merrymeeting Bay is the largest freshwater tidal bay in the eastern United States north of Chesapeake Bay. The bay is approximately fifteen miles in length and varies from one-half to three miles in width. It is 8400 to 9600 acres in size (Reed, 75). The main channel of the Kennebec River which flows through the bay varies in depth from 20 to 50 feet except at the outlet of the bay at Chops Point where the depth increases to 100 feet. The main body of the bay is relatively shallow being less than 20 feet. 4300 acres are in the intertidal zone and approximately 80% of this area is covered with aquatic vegetation. The dominant vegetation is wild rice and bullrushes (Spencer, 1966).

Four smaller drainages, draining less than 200 square miles combined, also enter Merrymeeting Bay. These are the Eastern, Cathance, Abagedasset, and Muddy Rivers.

The combined flows of the river systems entering Merrymeeting Bay continue for another twenty miles after leaving the bay. This section of river, referred to as the Kennebec River, is very narrow and turbulent in places. Depth varies from 20 feet to over 100 feet (Fig. 2). Salinities range from over 30 o/oo at the mouth to 0 o/oo at Chops Point. During extremely low flows saline water does extend beyond Chops Point into Merrymeeting Bay but bottom salinities rarely exceed 2 o/oo in the bay during these periods. The mean range in tide is 8 feet at the mouth of the river, 5 feet at Chops Point, and 4 feet at head of tide in Augusta.

The Sheepscot River which drains approximately 228 square miles, is adjacent to Kennebec River watershed. The tidal portion of the Sheepscot River forms an estuarine complex with the Kennebec River (Fig. 1). Low saline water (10 o/oo) enters Hockomock and Montsweag Bays from the Kennebec River by way of the Sasanoa River, a tidal channel between the two rivers, where it mixes with highly saline water from the main Sheepscot River (20 o/oo). The main channel of the Sheepscot River in the tidal portion is relatively wide in comparison to its drainage area and is highly saline (20 o/oo).

METHODS:

Sturgeon were captured by means of experimental multifilament gill nets. In 1977 the nets used were 90m long by 6 feet deep of #277 thread size. A net consisted of 3 panels of 3", 3½", and 4" bar mesh. In addition a multifilament gill net 90m long by 8 feet deep with 6" bar mesh was used for the capture of adult Atlantic sturgeon. Due to the damage these nets suffered form strong currents and debris they were replaced in 1978 by experimental gill nets of a larger thread size (#9). They were 90m long by 8 feet deep with 3", 3½" and 4" bar mesh. All nets were hung on the half. These nets were set one day and retrieved the next. Usually after each set the nets had to be cleaned of debris and mended which, in addition to bad weather, severely limited fishing effort.

Fish were measured for fork length (FL) and total length (TL) to the nearest millimeter. All lengths used in this report are fork lengths unless otherwise specified. Fork lengths can be converted to total lengths by multiplying by 1.10 (N=336). All fish were weighed to the nearest one-quarter pound with a spring scale.

Morphometric measurements and meristic counts were taken for 178 shortnose sturgeon and 15 Atlantic sturgeon. Mouth width was measured as the distance between the inside corners of the mouth. Snout length was measured as the distance from the tip of the snout to anterior fleshy portion of the orbit. Interorbital width was measured as the bony width between the eyes. Head length was measured from the tip of the snout to the posterior border of the opercular bone except in cases where the operculun was partially absent in which case the measurement was made to the cleithrum. Dorsal scutes were counted from the dorsal fin to head not including the scute interdigitated with the cranium. Lateral scutes were counted from the cleithrum to the base of the cardal fin. Ventral scutes were counted between the pectoral and pelvic fins. The above definitions are from Gorham and McAllister (1974).

Sturgeon were aged by counting growth rings in a basal section of the first pectoral ray by the method described by Cuerrier (1951). After drying the spines for a period of two months or more, a thin basal section was cut with a jewelers saw and sanded with fine emery cloth to a thickness of approximately .5mm. They were mounted in black plastic trays with a fast setting medium. They were read with a binocular microscope using transmitted light. The outside edge of spine sections was treated as an annulus for all fish sampled from April through November.

Seasonal movements and population estimates were determined by tagging and recapture methods. Sturgeon were tagged through the fleshy base of the dorsal fin using a modified Carlin tag with stainless steel wire bridle. The nets were set systematically instead of at random to maximize our knowledge of seasonal movements.

To estimate adult population size both the Petersen and Schnabel methods were employed. Any estimates made by these methods would be biased for two reasons. Gillnets which are selective for size were used both in capturing and recapturing fish. In addition, neither the tagging nor the subsequent sampling was done on a random basis which could result in a non-random distribution of tagged fish.

Water quality was monitored at all sampling stations. Three parameters were measured; dissolved oxygen, temperature, and salinity. Dissolved oxygen was measured with a yellow springs Dissolved Oxygen Meter #54 and salinity and temperature were measured with a Yellow Springs #33 Field salinometer.

RESULTS:

Due to the time involved in obtaining an Endangered Species Permit and gillnets, no sturgeon were captured during 1976.

RESULTS (Cont.):

~~264~~ 246 shortnose sturgeon and 8 Atlantic sturgeon were tagged with orange Carlin tags and released from late April, 1977 through November 1977. Two shortnose sturgeon were tagged with Petersen disc tags. Thus the total number of shortnose sturgeon tagged was 248 in 1977. In addition, two small shortnose sturgeon were released untagged after taking length-weight measurements, morphometric measurements, meristic counts and pectoral spines for aging purposes. Fourteen shortnose sturgeon suffered mortality during capture in 1977. The total number captured was 264.

During 1978, 72 shortnose sturgeon were captured. 69 were tagged and released; a shortnose sturgeon tagged in 1977 was recaptured and released; and 2 suffered mortality. Eight Atlantic sturgeon were captured in 1978. One suffered mortality and 7 were tagged and released.

Also a shortnose sturgeon which was caught in the leads of an experimental floating fish trap operated by DMR personnel is in our possession. This sturgeon was caught in outer Penobscot Bay and is the first record of shortnose sturgeon from this area.

TAXONOMIC DESCRIPTION:

A taxonomic description of shortnose and Atlantic sturgeon from the Kennebec River has been prepared. The most reliable external characteristics to distinguish shortnose sturgeon from Atlantic sturgeon are the ratios of mouth width (MW) to snout length (SL) and of mouth width (MW) to interorbital width (IOW). Expressed as a percentage, $\frac{MW}{SL} \times 100$ ranged from 44 to 95 for shortnose sturgeon compared to a range of 24 to 47 for Atlantic sturgeon from the Kennebec River (Table 2). The overlap was fairly small and as a general rule, if the mouth width is 40% of the snout length or greater, it is a shortnose sturgeon. Mouth width as a percentage of snout length for shortnose sturgeon from the St. John River, New Brunswick ranged from 44 to 79 compared to a range of 24 to 35 for Atlantic sturgeon (Gorham and McAllister, 1974).

The ratio of mouth width to interorbital width (IOW) was used to distinguish shortnose sturgeon from Atlantic sturgeon in the St. John River (Gorham and McAllister, 1974). $\frac{MW}{IOW} \times 100$ for shortnose sturgeon from the St. John River ranged from 63 to 90 compared to a range of 47 to 58 for Atlantic sturgeon. There was a small overlap in the ranges for the two species from the Kennebec River. $\frac{MW}{IOW} \times 100$ for shortnose sturgeon from the Kennebec River ranged from 63 to 102 compared to 43 to 66 for Atlantic sturgeon (Table 2). As a general rule the mouth width of shortnose sturgeon is greater than 60% of the interorbital width.

One character which has been used to identify shortnose sturgeon is the absence of supra-anal scutes. All shortnose examined did not have any supra-anal plates but supra-anal plates were also not evident on three adult Atlantic sturgeon. They were present on all juvenile Atlantic sturgeon examined. More Atlantic sturgeon need to be examined to determine the reliability of this character.

TABLE 2. Comparison of Body Proportions and Counts for Kennebec River Sturgeon with Data from the St. John River, New Brunswick (Gorham and McAllister, 1974) and the Sheepscot River, Maine (Fried and McCleave, 1973), (TL. = total length; FL = fork length; MW = mouth width; SL = snout length; HL = head length; IOW = interorbital width).

MW/SL x 100 (%)	24-27	28-31	32-35	35-6?	40-43	44-47	48-51	52-55	56-59	60-63	64-67	68-71	72-75	76-79	80-83	84-87	88-91	92+
Acipenser brevirostrum Kennebec River						1	1	5	9	25	21	26	40	13	22	8	4	3
St. John River						1	1	7	8	6	2	3	3	1				
Acipenser oxyrhynchus St. John River	8	5	1															
Kennebec River	1	2	4	5	1	2												

MW/IOW x 100 (%)	43-46	47-50	51-54	55-58	59-62	63-66	67-70	71-74	75-78	79-82	83-86	87-90	91-94	95-98	99-102
Acipenser brevirostrum Kennebec River						1	6	15	41	48	41	15	7	2	2
Sheepscot River						3	4	2							
St John River						1	4	6	12	4	1	4			
Acipenser oxyrhynchus St. John River		6	2	6											
Kennebec River	1	5	6	0	2	1									

SL/TL x 100 (%)	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	43-44	45-46	47-48	49-50	51-52	53-54
Acipenser brevirostrum Kennebec River	1	1		25	34	44	27	26	11	6				
St. John River						2	4	6	7	6	5	3		

TABLE 2. (Continued) - Page 2

SL x 100 (%) / HL	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	43-44	45-46	47-48	49-50	51-52	53-54	55-56
Acipenser oxyrhynchus									1	0	0	1	3	5	6
St. John River															
Kennebec River		1				1		1	4	6	3				

SL x 100 (%) / HL	5.5-5.9	6.0-6.4	6.5-6.9	7.0-7.4	7.5-7.9	8.0-8.4	8.5-8.9	9.0-9.4	9.5-9.9	10.0-10.4	10.5-10.9	11.0-11.4	11.5-11.9	12.0-12.4	12.5-12.9
Acipenser brevirostrum															
Kennebec River	1		7	27	26	40	38	14	12	3	3	4	1		
Acipenser oxyrhynchus															
Kennebec River						1			2	1	3	4	1	2	

IOW x 100 (%) / HL	24-25	26-27	28-29	30-31	32-33	34-35	36-37	38-39	40-41	42-43
Acipenser brevirostrum										
Kennebec River	1	4	12	33	45	43	18	12	5	2
Sheepscot River				1	1	2	3	3	1	
Acipenser oxyrhynchus										
Kennebec River		2	3	7	1	1	1			

Dorsal Scutes - # of	6	7	8	9	10	11	12	13	14
Acipenser brevirostrum									
Kennebec River	1	7	20	53	52	24	17	2	
Sheepscot River				4	3	2			
St. John River		1	2	5	10	10	3	1	

TABLE 2. (Continued) - Page 3

Dorsal Scutes - # of	6	7	8	9	10	11	12	13	14													
Acipenser oxyrhynchus St. John River			1	9	4																	
Kennebec River			2	4	8	1																
Lateral Scutes - # of	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35						
Acipenser brevirostrum Kennebec River	1	3	6	10	19	19	32	27	24	15	6	9	2	1	1	1						
Sheepscot River	0	0	0	0	3	0	0	1	2	3	0	0	0	0	0							
St. John River	0	0	0	2	2	4	9	4	3	3	0	3	1	0	1							
Acipenser oxyrhynchus St. John River	0	0	0	0	0	4	2	3	3	0	1	1	0	0	0							
Kennebec River			0	1	2	0	2	6	2	1	0	1	0	0	0							
Ventral Scutes - # of	6	7	8	9	10	11																
Acipenser brevirostrum Kennebec River	6	44	78	34	13	1																
Sheepscot River	0	1	3	5	0	0																
St. John River	1	2	12	14	3	0																
Acipenser oxyrhynchus St. John River	0	0	5	3	4	2																
Kennebec River			4	8	3																	

TAXONOMIC DESCRIPTION (Cont):

Another character which has been used to identify shortnose sturgeon is the presence of a single preanal scute compared to paired preanal scutes for Atlantic sturgeon (Gorham and McAllister, 1974). Shortnose sturgeon from the Kennebec River had both single and paired preanal scutes with a highly variable number of scutes posterior to the aforementioned scutes.

Shortnose sturgeon have a dark colored intestine compared to pale colored for Atlantic sturgeon. The 16 mortalities all had the characteristic black intestine. Three Atlantic sturgeon that were examined had pale colored intestines.

Additional morphometric measurements and meristic counts have been included in Table 2 for comparison to other shortnose sturgeon stocks.

LENGTH AND WEIGHT:

Three hundred thirty-five shortnose sturgeon have been examined for weight and length. The smallest shortnose sturgeon captured was 43.6 cm and the largest was 107 cm (App. 1). Very few fish less than 50 cm were caught as a result of using large mesh gill nets. Weight ranged from .45 kg to 9.19 kg. A length frequency histogram for shortnose sturgeon captured in 1977 (N-263) is presented in Figure 3. The average length for all fish combined was 72.8 cm. Length frequencies were also plotted by mesh size (Figure 4). Effort was constant for all three mesh sizes. There was considerable overlap in the length of sturgeon captured by the three mesh sizes. This is a result of sturgeon being caught both by gilling and entanglement. The average length of shortnose sturgeon captured in the six-inch mesh was 69.6 cm compared to 70.9 cm in the St. John River (Dadswell, 1976): The average length for shortnose sturgeon from the Kennebec River captured in eight-inch mesh was 78.7 cm compared to 92.7 cm in the St. John River (Dadswell, 1976).

Length frequencies for shortnose sturgeon captured in 1978 (N=69) are presented in Figures 5 and 6. The average length caught in six-inch mesh was 69.3 and 84.9 for eight inch mesh.

Seventeen Atlantic sturgeon were caught during the project period ranging in length from 59.0 cm to 150.5 cm (App. 2). Weight ranged from 1.48 kg to 29.55 kg.

The length-weight relationship for shortnose sturgeon (N-263) was:

$$\text{Log } W = 2.68 \text{ (Log } L) - 4.48$$

Where W is the weight in kilograms and L is fork length in centimeters (Figure 7). Relationships were also determined for three different periods during 1977 sampling season (Table 3). The slopes for period 1 (April - June), period 2 (July - August) and period 3 (September - November) were respectively 2.8168, 2.4911, and 2.9737. The difference in slopes could be the result of the fish being in different stages of their reproductive phases.

Weight at a given length was quite variable with some fish weighing twice as much as another fish of the same length (App. 3). Dadswell (1976) also found this to be true for shortnose sturgeon from the St.

TABLE 3.

LENGTH-WEIGHT RELATIONSHIPS OF SHORTNOSE STURGEON COLLECTED IN 1977 FROM THE KENNEBEC RIVER. THE INTERCEPT AND SLOPE ARE FROM THE RELATIONSHIP $Y = BX + A$ WHERE Y EQUALS Log_{10} WEIGHT (Kg) AND X EQUALS Log_{10} FORK LENGTH (CM).

PERIOD	NO.	INTERCEPT	SLOPE (b)	r
1. April - June	126	-4.7522	2.8168	.95
2. July - August	99	-4.1163	2.4911	.92
3. September - November	83	-5.0055	2.9737	.96
Combined	263	-4.4762	2.6783	.93

John River and attributed the difference to sturgeon being in different stages of the reproductive phase and variability in body proportions.

AGE AND GROWTH:

Age determinations were made for 129 shortnose sturgeon and 13 Atlantic sturgeon. The age frequency distributions are shown in Figure 8. Because of the use of large mesh gillnets (6', 7', 8' stretch), the distribution is skewed to the right. The distribution for sturgeon eight years and older is probably normal.

A dip in the age frequency is present in distribution for 1977 and, although not so evident, for 1978 between the ages of 8 to 14 (Fig. 8). It is unlikely that this dip in frequency is a result of gill net selectivity as it is not evident in the length frequency curve. The small number of fish captured between the ages of 8 to 14 may indicate that the majority of fish leave the river at this time to mature. The paucity of shortnose sturgeon at these ages may also be the result of weak age classes.

There is considerable overlap in the range of lengths among age groups. In certain instances the mean length for an older age group is less than that for a younger age group (Table 4). This could be the result of a small sample size, combined data for both sexes, sampling of more than one discrete population, highly variable growth rate between individuals due to genetic differences or improper aging techniques. Growth of shortnose sturgeon less than 25 years from the Kennebec River appears to be faster than found for shortnose sturgeon in the St. John River (Fig. 9). The average size of an 8 year old fish from the Kennebec River was 68.2 (Table 4) compared to 43.8 cm for the St. John River (Dadswell, 1976). The faster growth rate may be an artifact of selecting the faster growing fish in younger age classes by the use of large mesh gill nets. Beyond age 30 the growth rate for shortnose sturgeon from the Kennebec River is slower than found for shortnose sturgeon from the St. John River.

The mortality rate for shortnose sturgeon from the Kennebec River is greater than found in the St. John River. Only 23% of the age compared to 41% for the St. John River (Dadswell, 1976). By size, 36% of the shortnose sturgeon captured in the St. John River were over 80 cm compared to 20% for the Kennebec River (App. 3).

Based on the small sample of Atlantic sturgeon captured and aged, it appears that the growth rate for Atlantic sturgeon is greater than that of shortnose sturgeon even during the juvenile phase (App. 2). The average length for a six year old Atlantic sturgeon was 91.5 cm. The largest Atlantic sturgeon (150.5 cm) captured, was 17 years old and the oldest sturgeon (142.5 cm) captured, was 22 years old.

TABLE 4.

AGE, MEAN FORK LENGTH (FL), AND NUMBER (N) IN EACH AGE GROUP OF SHORTNOSE STURGEON CAUGHT IN THE KENNEBEC RIVER DURING 1977 AND 1978.

AGE	RANGE FL	MEAN FL (CM)	NUMBER
3		32.9	1
4		43.6	1
5		48.2	1
6	53.0-64.3	57.9	7
7	61.2-66.2	64.1	3
8	57.2-75.0	68.2	9
9	62.5-73.0	68.4	14
10	68.0-79.8	73.8	6
11	69.5-88.4	75.8	6
12	67.9-72.2	70.3	3
13	68.7-80.8	71.9	4
14	65.8-79.5	72.3	12
15	66.7-84.9	78.1	8
16	64.0-90.0	77.9	11
17	67.6-86.9	76.2	5
18	68.5-88.7	79.1	4
19	70.4-85.8	80.6	3
20	79.6-87.0	84.40	5
21	84.5-91.8	88.2	2
22	74.0-89.1	80.8	3
23	73.6-98.5	87.1	3
24	64.0-88.0	78.3	3
25	74.9-89.4	82.2	2
27	75.5-91.2	83.4	2
28		95.0	1
29		88.0	1
32		96.7	1
34		78.9	1
37	89.3-107.0	98.15	2

DISTRIBUTION AND SEASONAL MOVEMENTS OF SHORTNOSE STURGEON:

Shortnose sturgeon were found to be distributed throughout the Kennebec River system from Long Island near the mouth, to Gardiner near head of tide (Figure 10). They were found in the Androscoggin to head of tide and in the tidal portions of the tributary streams of Merrymeeting Bay. They were also found in the Sasanoa River, a tidal channel between the Kennebec River and the Sheepscot River estuary, and Montsweag Bay. Montsweag Bay, part of the Sheepscot River estuary, is the site at which shortnose sturgeon were just identified in the State of Maine (Fried and McCleave, 1973).

Gillnets were set at 19 sampling sites (Figure 11). Sampling sites were limited to eddies and backwater areas where nets could effectively be fished. Sites 13 & 14 were eliminated as sampling sites due to strong currents. Shortnose sturgeon were captured at all sampling sites except sites 3, 13, 14, 16, 18, and 19. Sites 2 (Bluff Head), 3 (Hockomock Bay), 6 and 15(Montsweag Bay), and 7 Sasanoa River) were influenced by variable salinites. The salt wedge rarely moves above Days Ferry (North Bath) in the Kennebec River.

Seasonal abundance data (Figures 12, 13, & 14), tag returns (Table 5), and observations indicate a general upriver movement in the spring and a general downriver movement in late summer and early fall. The upriver movement was evident in 1977 but was not so evident in 1978. A large concentration of shortnose sturgeon (26/90m net/ 24 Hr.) was present in the Sasanoa River (Site 7) at time of first sampling in mid-June, 1977 (Table 6 and Figure 12). Catch effort decreased to 8 in July, 1 in August, and 0 in September, 1977. The Sasanoa River site is affected by variable salinities. At the time of sampling in June the bottom salinity was 1.5 o/oo, and during July, August, and September the bottom salinity was generally greater than 15 o/oo.

All sampling sites upriver of the Sasanoa River were not affected by salinity. Due to limited manpower each upriver site was not sampled every month. During 1977, a large concentration was present at Abadasset Point (Site 4) in Merrymeeting Bay during May (Figure 13). This site was not sampled again until August at which time catch/effort was one-half that of May. At the next site upriver, Courthouse Point (Site 5), the concentration was highest in May and decreased to 0 in August. At Campmeeting Point (Site 10), shortnose sturgeon were present at time of first sampling in July (Figure 14). Sturgeon were abundant at Sands Island (Site 9) in June and July and at Gardiner (Site 12) in July (Figure 14). During August and September, no large concentrations were found at any of the sites. During late September and early October large numbers of sturgeon were seen jumping near Chops Point and Days Ferry, areas of deep turbulent water which could not be sampled. A large concentration (35/90m net/24 hr.) was found in the Sasanoa River in October but none were caught in early November (Table 6 and Figure 12). The bottom salinity was 8 o/oo at the time of sampling in October and 0 o/oo in early November.

Although it is difficult to discern any seasonal movement patterns based upon seasonal abundance at the different sampling sites, there appears to be a general upriver movement during the summer months in 1977 based on movement of tagged shortnose sturgeon. Four shortnose sturgeon were recaptured during the sampling season. Three of these

TABLE 5.

DATES AND LOCATIONS OF TAG RETURNS AND RECAPTURES OF SHORTNOSE STURGEON DURING 1977.

	TAG #	DATE TAGGED	SITE	DATE RECAPTURED	SITE	DAYS AT LARGE
1.	0010	5/17/77	4	5/26/77	4	9
2.	0040	5/19/77	2	6/3/77 (Return)	Long Is.	15
3.	0101	6/17/77	7	7/7/77	10	20
4.	0121	6/27/77	9	7/20/77	11	23
5.	0088	6/17/77	7	7/20/77	12	33
6.	0161	7/13/77	2	6/01/78	7	323

TABLE 6 : Catch by site, date gear, and species. The experimental gill net consisted of panel of 6", 7", 8" stretch mesh.

1977

SITE	MESH SIZE	DATE	CATCH/90m/24 hr. SHORTNOSE	ATLANTIC
1 Chops Point	Experimental	4/27/77	1	
	"	4/28/77	0	
	12 "	5/19/77	0	
	Experimental	9/29/77	0	
2 Bluff Head	Experimental	4/28/77	5	
	"	5/5/77	2	
	12 "	5/5/77	0	1 (adult)
	Experimental	5/19/77	6	
	"	6/17/77	0	1 (juvenile
	"	7/13/77	5	
	"	8/3/77	1	3 (juvenile
	"	9/8/77	1	3 (juvenile
	"	10/13/77	0	
3 Hockomock Bay	Experimental	5/17/77	0	
4 Abagadasset Pt.	Experimental	5/17/77	26	
	"	5/26/77	28	
	12 "	6/22/77	0	
	Experimental	8/17/77	12	
5 Court Hs. Pt.	Experimental	5/26/77	10	
	12 "	6/14/77	0	
	Experimental	6/27/77	2	
	Experimental	8/25/77	0	
6 Montsweag Bay	Experimental	6/14/77	1	
	"	8/11/77	0	
	"	11/2/77	0	
7 Sasanoa R.	Experimental	6/17/77	26	
	"	7/13/77	7	
	"	8/11/77	1	
	"	9/8/77	0	
	"	10/13/77	35	
	"	11/2/77	0	
8 Brick Isl.	Experimental	6/22/77	0	
9 Sands Isl.	Experimental	6/27/77	20	
	"	7/7/77	16	
	"	9/15/77	1	
10 Campmeeting Pt.	Experimental	7/7/77	13	
	"	9/22/77	1	
11 Morton Brook	Experimental	7/20/77	11	
	"	9/22/77	0	

SITE	MESH SIZE	DATE	CATCH/90m/24 hr. SHORTNOSE	ATLANTIC
12	Experimental	7/20/77	33	1 (adult)
Togus Stream	"	8/25/77	3	
	12 "	9/15/77	0	
	12 "	9/29/77	0	
13	Experimental	8/3/77	0	
Winnegance Creek				
14	12 "	8/17/77	0	
Eastern River				
		1978		
2	Experimental	6/01/78	3	
Bluff Head	Experimental	7/14/78	1	1 (adult)
	Experimental	8/24/78	0	
3	Experimental	8/17/78	0	
Hockomock Bay				
4	Experimental	5/12/78	6	2 (juvenile)
Abagadasset Pt.	"	6/07/78	7	
	Experimental	6/23/78	3	
	Experimental	7/06/78	1	
	Experimental	7/19/78	1	
	Experimental	8/02/78	4	
	Experimental	9/27/78	1	
	Experimental	10/26/78	0	
5	Experimental	5/24/78	0	
Court Hs. Pt.	Experimental	8/10/78	0	
6	Experimental	7/14/78	0	
Montsweag Bay	"	7/25/78	0	
7	Experimental	5/12/78	2	
Sasanoa R.	Experimental	6/01/78	3	
	Experimental	6/23/78	2	
	Experimental	7/06/78	2	
	Experimental	7/25/78	0	
	Experimental	8/17/78	13	
	Experimental	8/24/78	3	
	Experimental	10/12/78	7	
	8'Water "	10/20/78	0	
	18'Water "	10/20/78	2	
8	Experimental	7/19/78	2	1 (adult)
Brick Isl.	Experimental	8/02/78	2	
	Experimental	9/27/78	0	2 (1 adult, 1 juveni
	Experimental	10/26/78	0	
9	Experimental	5/24/78	0	
Sands Isl.	Experimental	6/15/78	1	
	Experimental	6/29/78	1	
	Experimental	7/12/78	1	
	Experimental	8/09/78	0	
	Experimental	8/10/78	0	
	Experimental	9/26/78	0	

TABLE 6 Cont. Page 3

SITE	MESH SIZE	DATE	CATCH/90m/24 hr. SHORTNOSE	ATLANTIC
10	Experimental	6/07/78	1	
Campmeeting Pt.	"	6/29/78	0	
	Experimental	7/12/78	0	
	Experimental	7/21/78	0	
	Experimental	8/09/78	0	
	Experimental	9/26/78	0	
11	Experimental	7/21/78	0	2 (adult)
Morton Brook				
15	Experimental	6/08/78	1	
Pine Isl.				
Montsweag Bay				
16	Experimental	6/15/78	0	
Browns Isl.				
17	100'-3" "	6/23/78	2	
South Side				
Abagadasset Pt.				
18	100'-3" "	7/12/78	0	
Eastern River				
Above James Eddy				
19	100'-3" "	7/21/78	0	
Eastern River				
Cooksey Channel				

fish were recaptured upriver of the site of tagging. The other sturgeon was recaptured at the site of tagging (Table 5).

Two shortnose sturgeon which were tagged at the Sasanoa River (Site 7) on June 17, 1977 were recaptured upriver. One was recaptured at Campmeeting Point (Site 10) traveling at least 23 miles in twenty days (Figure 15). The other sturgeon was recaptured 26 miles upriver of the Sasanoa River at Gardiner (Site 12) thirty-three days later (Figure 16).

A shortnose sturgeon which was tagged on June 27, 1977 at Sands Island (Site 9) was recaptured three miles upriver of Sands Island at Morton Brook (Site 11) twenty-three days later (Figure 17).

The fourth fish was tagged at Abagadasset Point (Site 4) on May 17, 1977 and recaptured at the same site nine days later.

There was also a tag return from a fisherman. This shortnose sturgeon was tagged at Bluff Head (Site 2) on May 19, 1977 and caught at Long Island, downriver from the tagging site on June 3, 1977 (Figure 18).

During 1978 no large concentrations of sturgeon were found at any of the sampling sites with the exception of a single catch of 13 shortnose sturgeon/90m net/24 hr at the Sasanoa River (Site 7) on August 17th (Table 6). During 1977, 267 shortnose sturgeon were caught in 38 net days (90m net/24 hr.) for catch/effort of 7.03 sturgeon/90m net/24 hr. In 1978, 72 shortnose sturgeon were caught in 47 net days for a catch/effort of 1.53 sturgeon/90m net/24 hr. This low catch/effort could be the result of utilizing experimental nets of larger thread size in 1978 but no large numbers of sturgeon were seen jumping in 1978 as had previously been seen in 1977. There was only one 1977 tagged fish recaptured at the Sasanoa River (Site 7) on June 1, 1978 (Figure 19).

Due to the low catch/effort and lack of recaptures in 1978 it is difficult to discern any seasonal movement patterns. It is possible that the majority of the adult shortnose sturgeon remained in the lower estuary in 1978 where good sampling sites are limited.

DISTRIBUTION OF ATLANTIC STURGEON:

Seven juvenile and two adult Atlantic sturgeon were captured in 1977. All juvenile Atlantic sturgeon and one adult were all caught at Bluff Head (Site 2), which is the lowermost sampling site. The juvenile sturgeon were caught from mid-June through early September when salinities were greater than 10 o/oo. The other adult Atlantic sturgeon was caught at Gardiner (Site 12) on July 20, 1977.

During 1978, three juvenile and five adult Atlantic sturgeon were captured. The three juvenile were all caught in Merrymeeting Bay which was essentially freshwater. Two of the juveniles were caught at Abagadasset Point (Site 4) May 12, 1978 and the other at Brick Island (Site 8) on September 27, 1978. Three of the fish referred to as adults (Tag #291, 294, and 322) were aged as being only ten and eleven years old and it is not known whether these fish were sexually mature (App.2). With the exception of one adult (tag #291) all Atlantic sturgeon were caught in upriver freshwater section

in 1978. One adult (Tag #298) which was captured at Morton Brook (Site 11) on July 21, 1978 was extruding milt indicating some Atlantic sturgeon spawn in late July.

The number of Atlantic sturgeon captured in 1977 and 1978 is most likely not representative of their true abundance in the Kennebec River. Due to strong currents in the Kennebec River, sampling was limited to eddies and backwater areas characterized by large flats built up by sedimentation, and abundant marcrophytes. These areas appear to be prime feeding grounds for shortnose sturgeon during the summer months but this may not be true for juvenile Atlantic sturgeon. Dovell (1977) found that in the Hudson River, juvenile Atlantic sturgeon are only found in water less than 25 feet deep for a short period in the spring and the fall. Dovell (1977) stated that after the water temperature rises above a certain level immature Atlantic sturgeon apparently seek deeper cooler waters. Dadswell (1976) found immature Atlantic sturgeon to be more abundant by a factor of 10:1 in salinities greater than 3 o/oo in the St. John River, New Brunswick.

All juvenile Atlantic sturgeon were either caught at downriver sites in the Kennebec River where salinities were greater than 10 o/oo or at upriver freshwater sites during the spring or fall supporting the findings of Dadswell (1976) and Dovell (1977).

OCCURRENCE OF SHORTNOSE STURGEON IN PENOBSCOT RIVER:

The first known occurence of shortnose sturgeon in the Penobscot River was documented in 1978. A shortnose sturgeon was caught June 30, 1978 in the leader of an experimental floating fish trap operated by the Extension Service of the Department of Marine Resources at Northport in Penobscot Bay. The salinity is over 30 o/oo at this site. The sturgeon was caught next to shore in shallow water in 5½" stretch mesh. The shortnose sturgeon was 64.9cm in fork length and weighed 2.4kg.

POPULATION ESTIMATE:

Population estimates based on 1977 and 1978 data would be biased for two reasons. Gillnets which are selective for size were used in both capturing and recapturing fish and neither the tagging nor the subsequent sampling was done on a random basis. In addition, it is uncertain whether all the shortnose sturgeon tagged in 1977 were available to be caught in 1978. It is possible that the majority of sturgeon tagged in 1977 may have remained in the lower estuary and adjacent coastal where they would not have been vulnerable to our gill nets.

Only one 1977 tagged shortnose sturgeon was recaptured in 1978. A Petersen estimate based on one recapture could be very unreliable especially considering the aforementioned possible biases and violated assumptions.

A modified Schnabel estimate (Chapman, 1952, 1954) was made to get a rough estimate of the population size. The Schnabel estimate was made using the 1977 data (Table 7). The estimate was 6032 adult shortnose sturgeon computed from the following formula (Chapman, 1952,

1954):

$$R = \frac{(CtMt)}{R+1}$$

Where C is the Catch at time t, M is the number of marked fish at large at time t, and R is the total number of recaptures.

The approximate 95% confidence interval using R (#recaptures) as a Poisson variable was from 2957 to 30,159. One should be very cautious in treating the above estimate as a true estimate of abundance because of the possible biases and violated assumptions.

TABLE 7.

COMPUTATIONS FOR MODIFIED SCHNABEL ESTIMATE FOR SHORTNOSE STURGEON TAGGED AND RECAPTURED IN THE KENNEBEC RIVER ESTUARY IN 1977.

TOTAL CATCH (c)	NUMBER MARKED (LESS REMOVALS)	MARKED FISH AT LARGE (M)	RECAPTURES (R)	CXM
1	1	0	0	0
1	1	1	0	1
5	5	2	0	10
2	2	7	0	14
26	26	9	0	234
6	6	35	0	210
38	33	41	1	1,558
1	1	74	0	74
26	26	75	0	1,950
22	22	101	0	2,222
29	25	123	1	3,567
12	12	148	0	1,776
44	38	160	2	7,040
1	0	198	0	198
1	1	198	0	198
12	11	199	0	2,388
3	1	210	0	630
1	0	211	0	211
1	1	211	0	211
1	1	212	0	212
35	---	213	0	7,455
268			4	30,159

Figure 1.

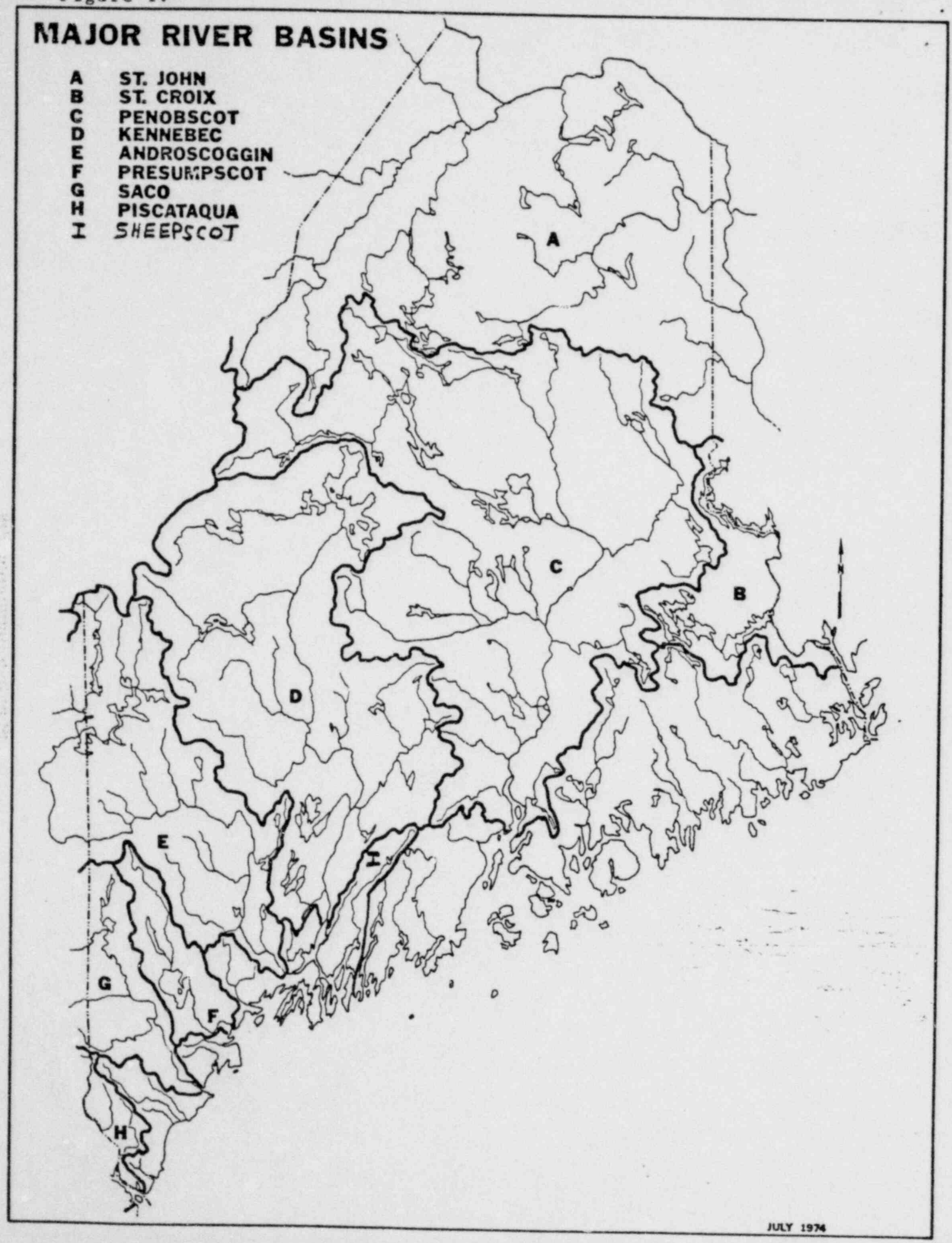

MAJOR RIVER BASINS
A ST. JOHN
B ST. CROIX
C PENOBSCOT
D KENNEBEC
E ANDROSCOGGIN
F PRESUMPSCOT
G SACO
H PISCATAQUA
I SHEEPSCOT
A
B
C
D
E
F
G
H
I
N
JULY 1974

Figure 2: Bottom contour of the Kennebec River from the mouth to head of tide at Augusta.

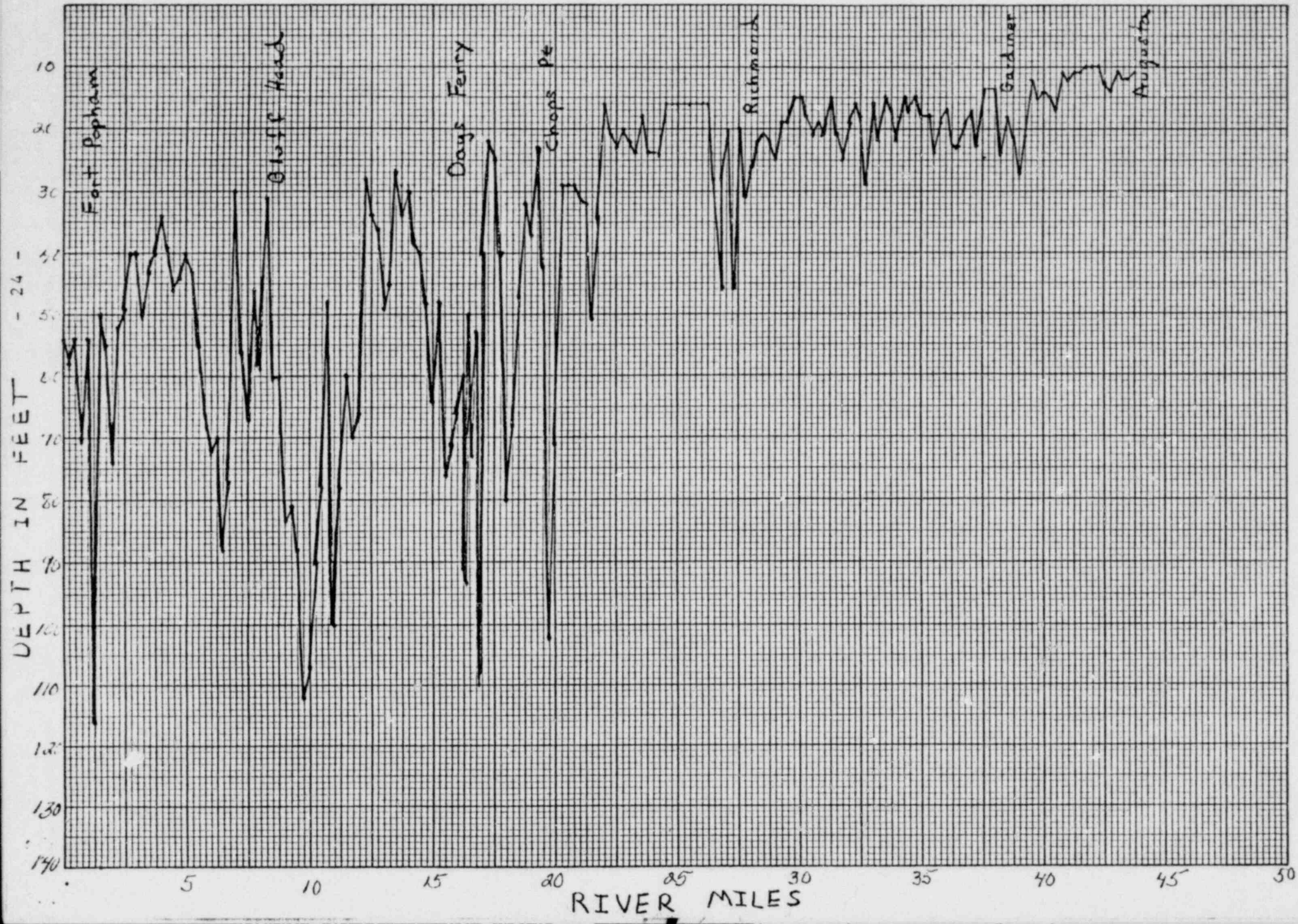


Figure 3: Length frequency distribution of shortnose sturgeon captured during 1977.

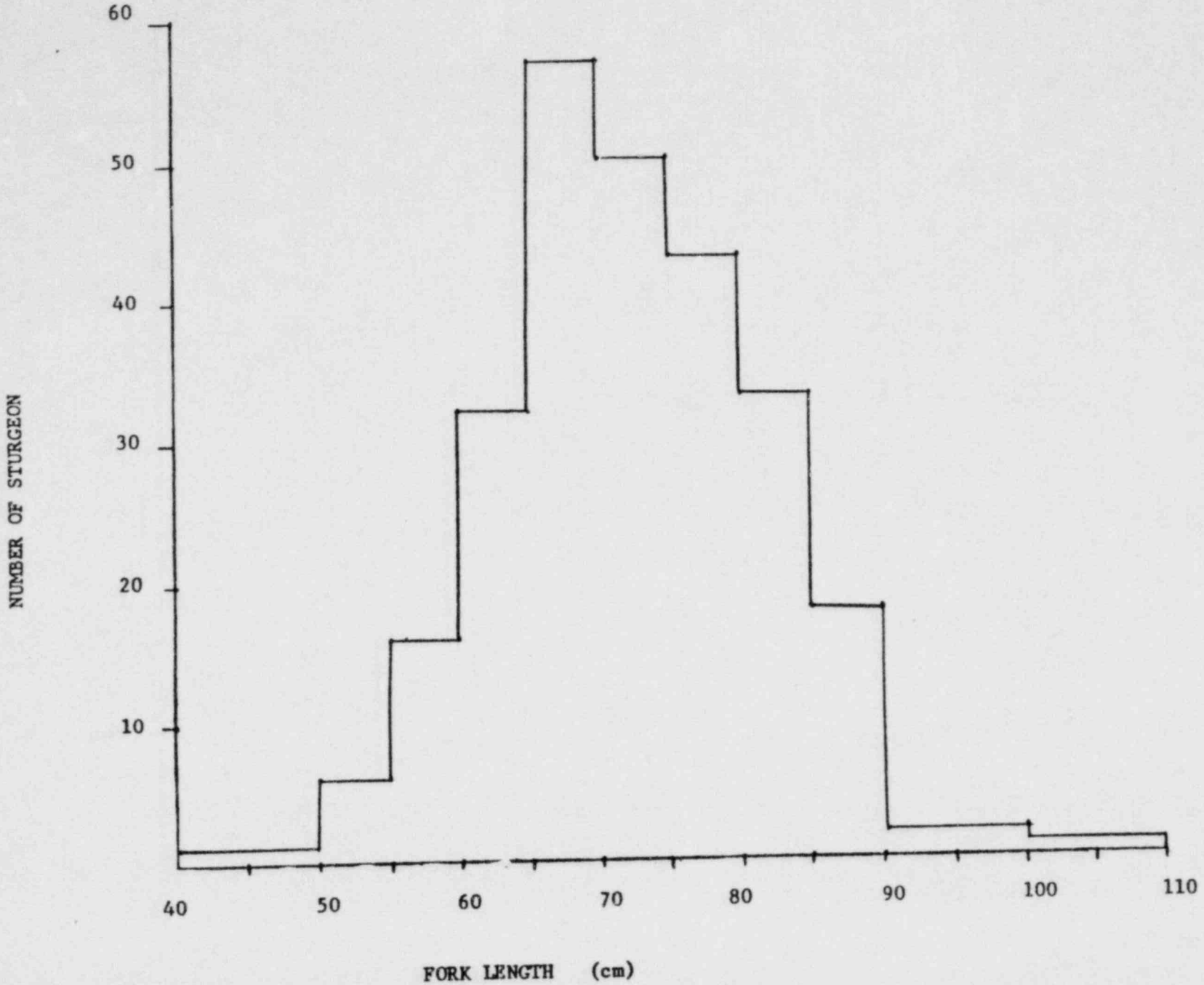
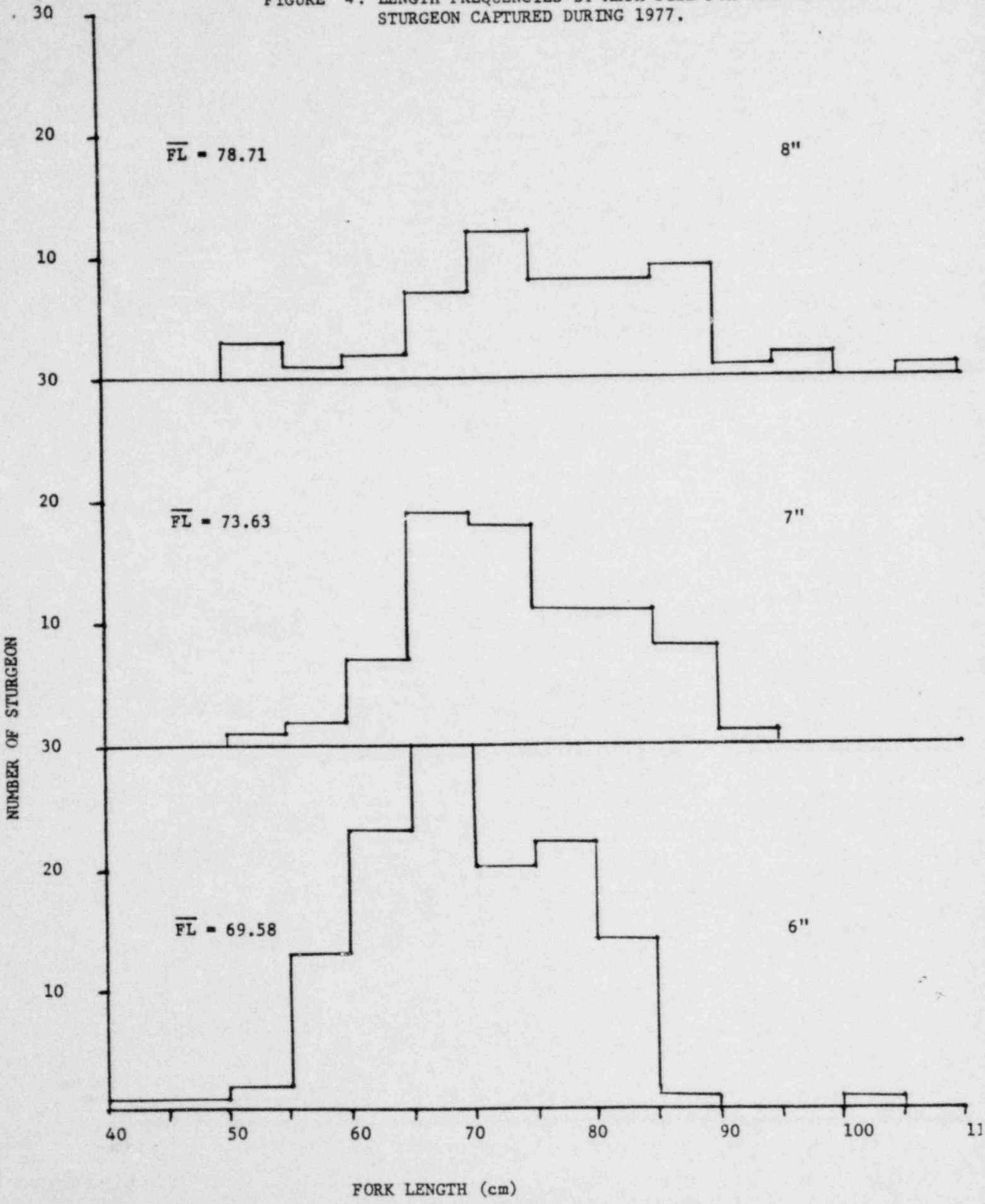


FIGURE 4. LENGTH FREQUENCIES BY MESH SIZE FOR SHORTNOSE STURGEON CAPTURED DURING 1977.



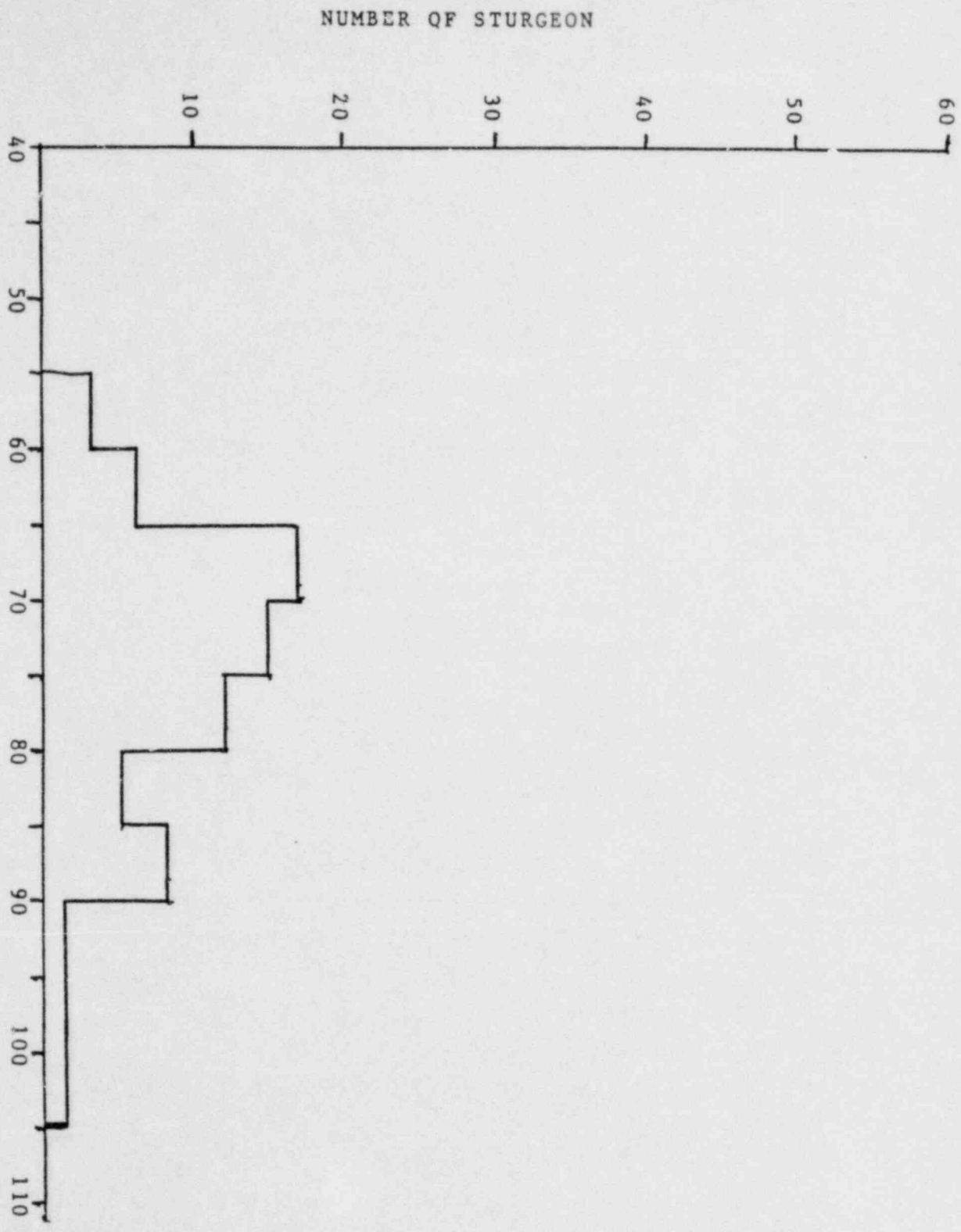


Figure 5: Length frequency distribution of shortnose sturgeon captured during 1978.

Figure 6: Length Frequencies by mesh size for shortnose sturgeon captured during 1978. Mesh size referred to is stretch measure.

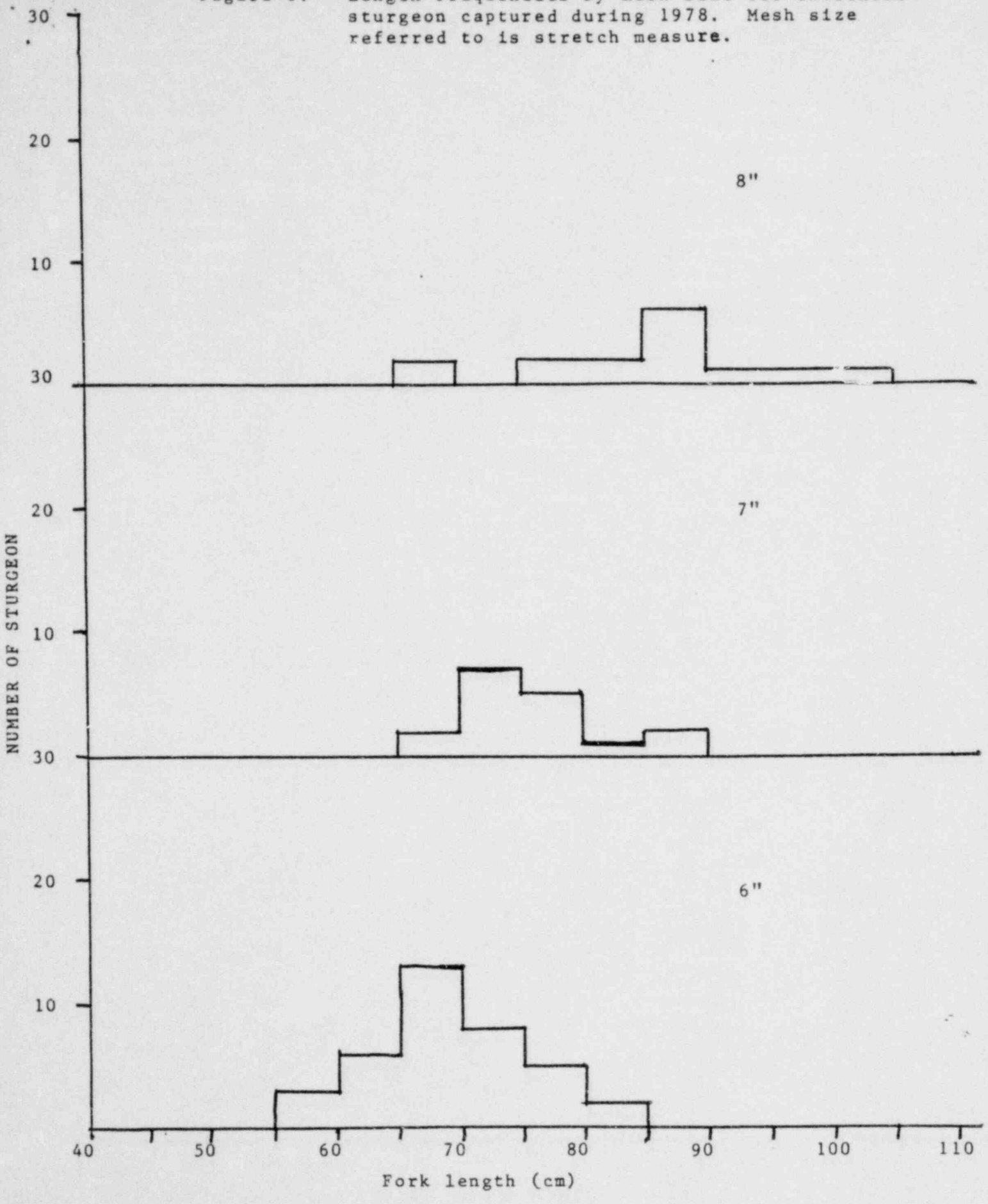


FIGURE 7. LENGTH-WEIGHT RELATIONSHIP OF SHORTNOSE STURGEON FROM THE KENNEBEC RIVER (N = 263).

LOG W = 2.68 (LOG L) - 4.48

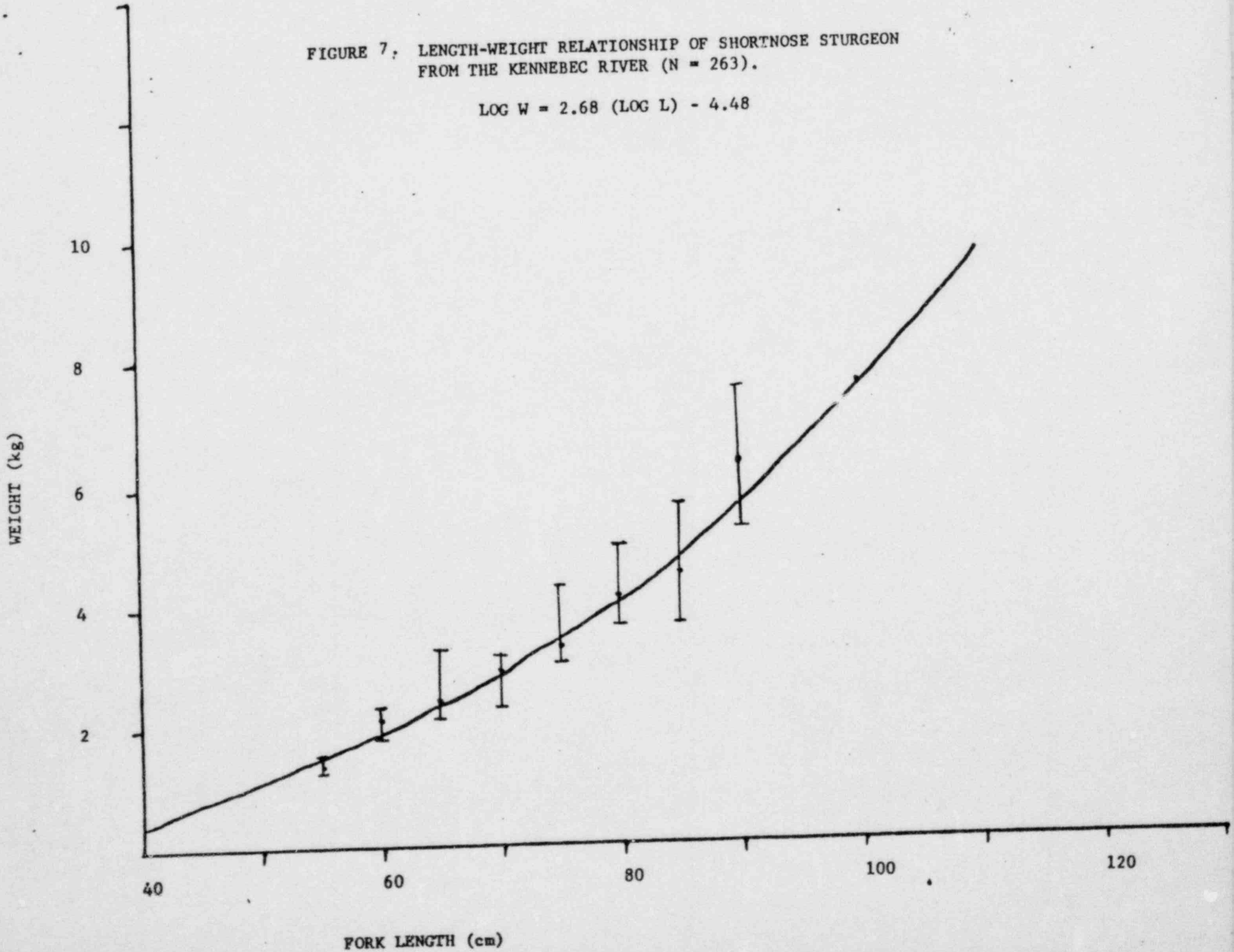


Figure 8: Per cent age composition of shortnose sturgeon captured in the Kennebec River during 1977 and 1978.

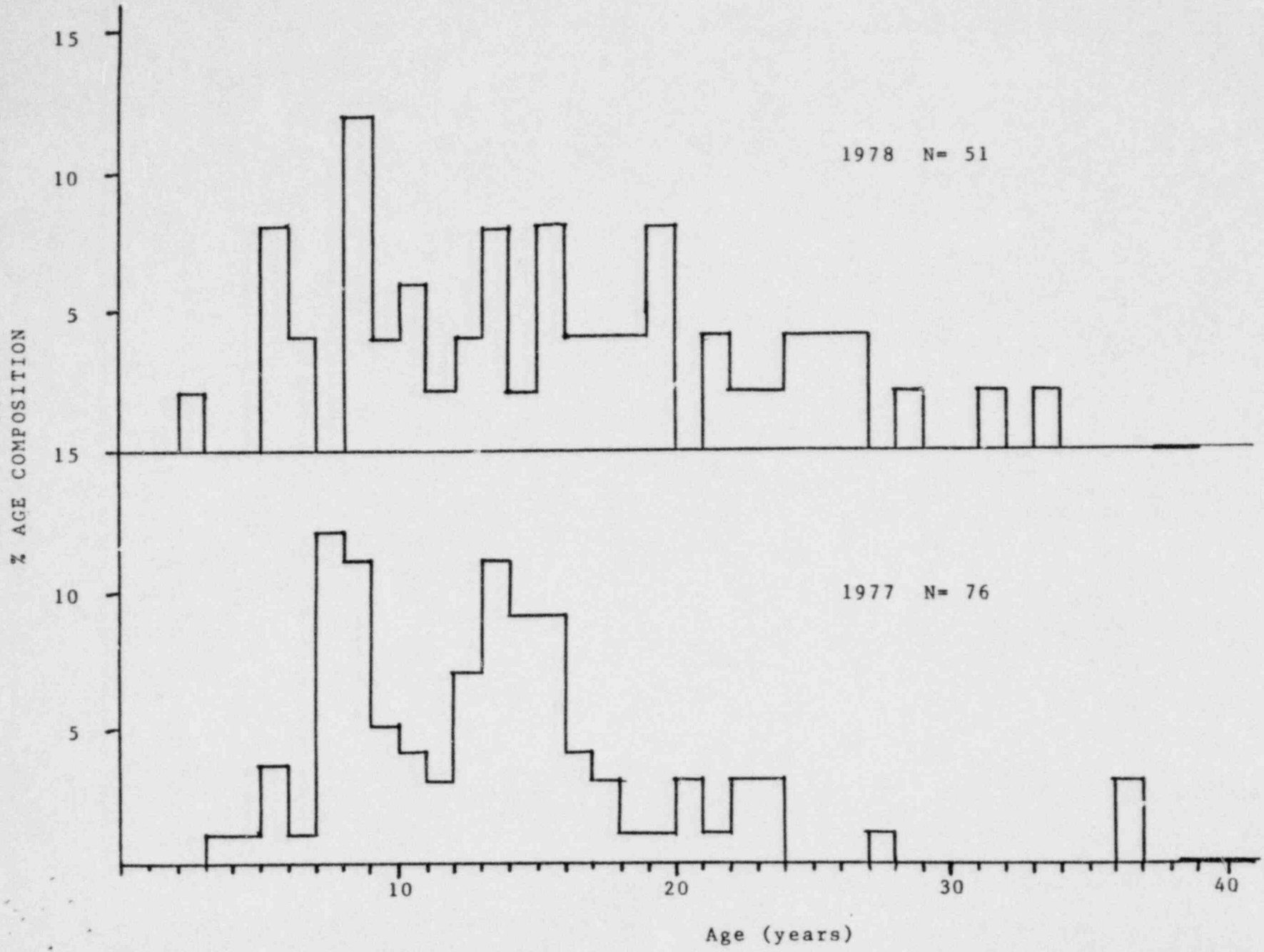


Figure 9: Comparison of growth curves for shortnose sturgeon from the Kennebec River and the St. John River.

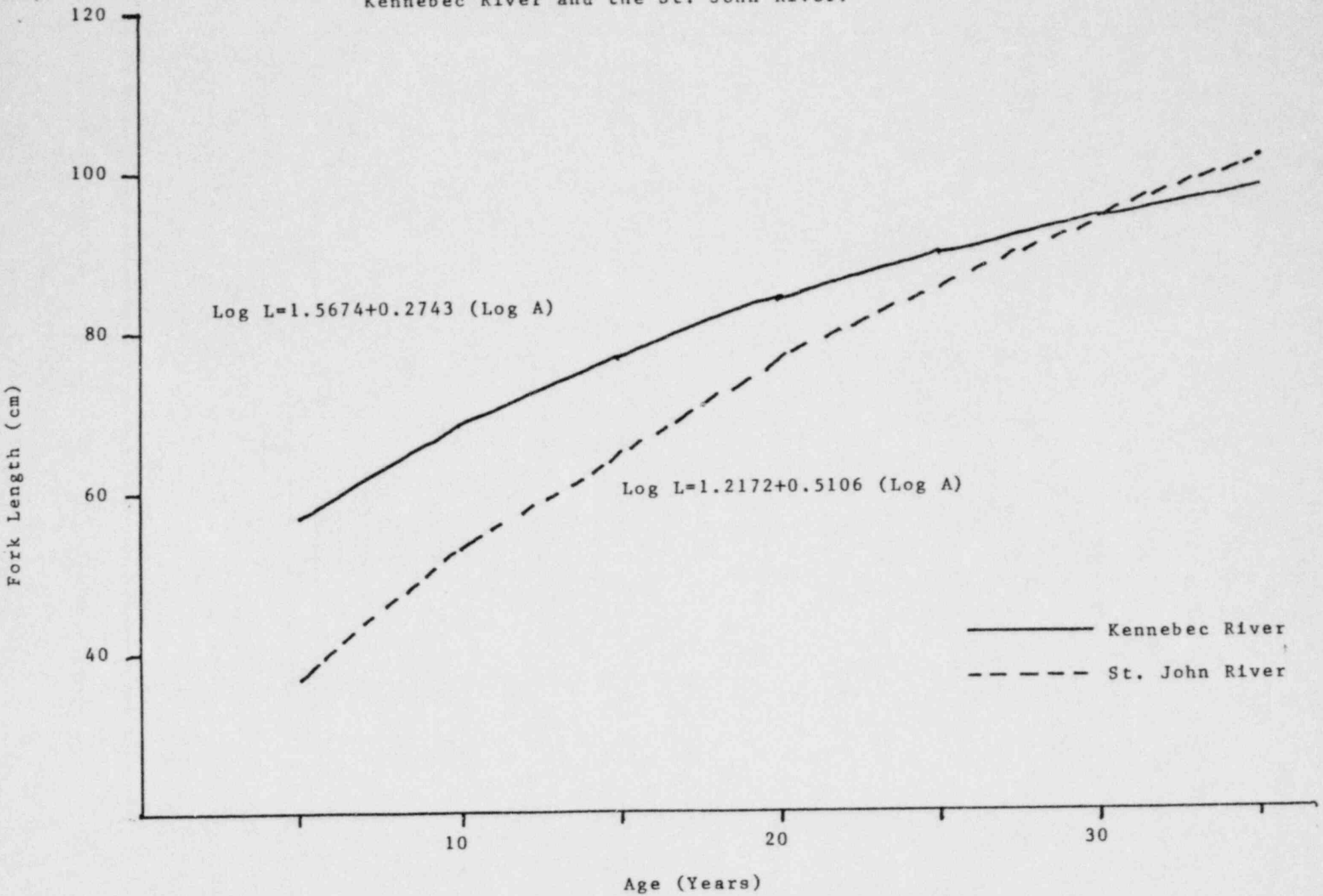


Fig. 11. Location of Sampling Sites

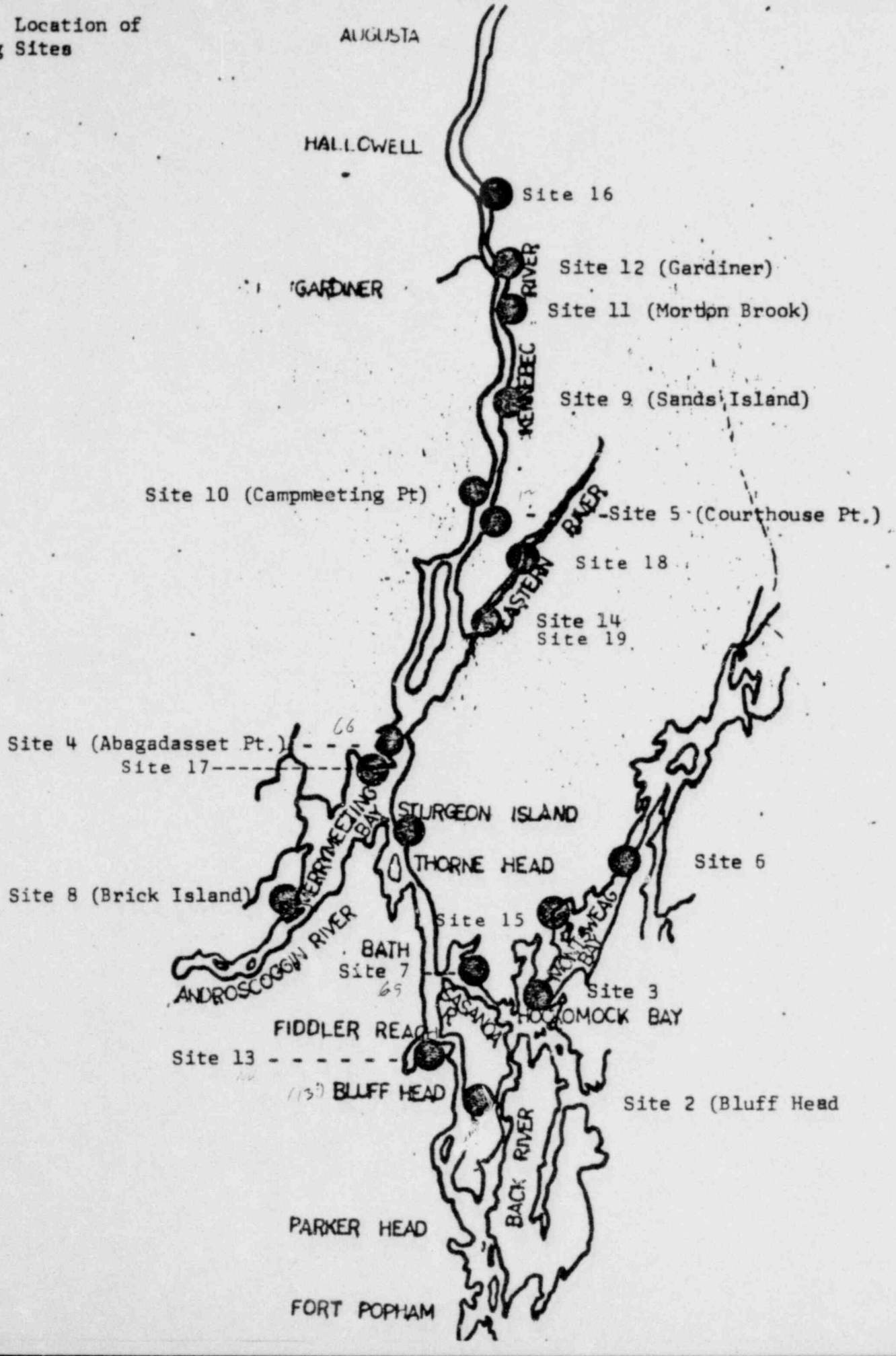


Fig. 10 Location of Areas where shortnose Sturgeon have been captured by fishermen and research personnel.

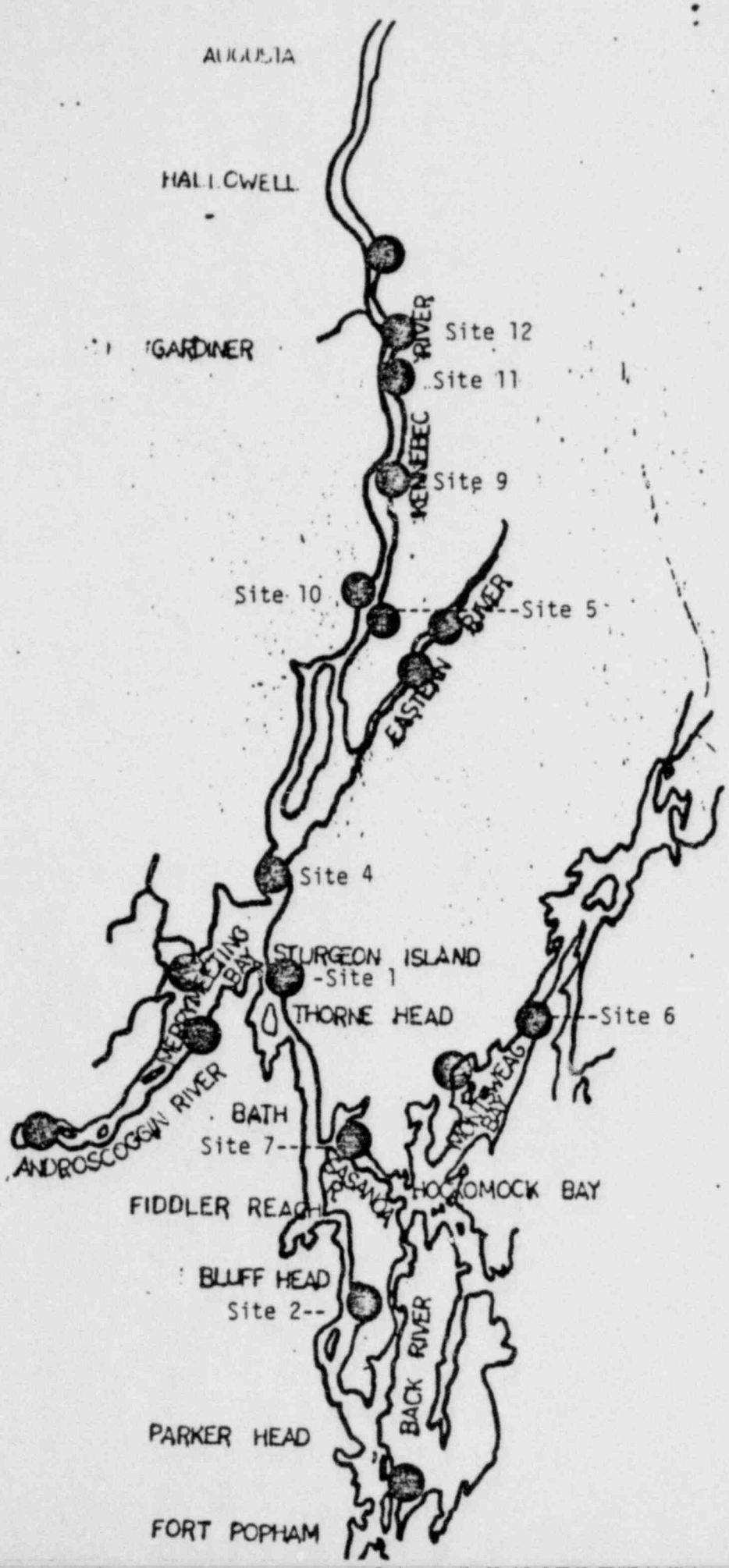


Fig12: Number of shortnose sturgeon caught in the Sasanoa River (Site 7) per 24 hr. set and bottom and surgace salinities.

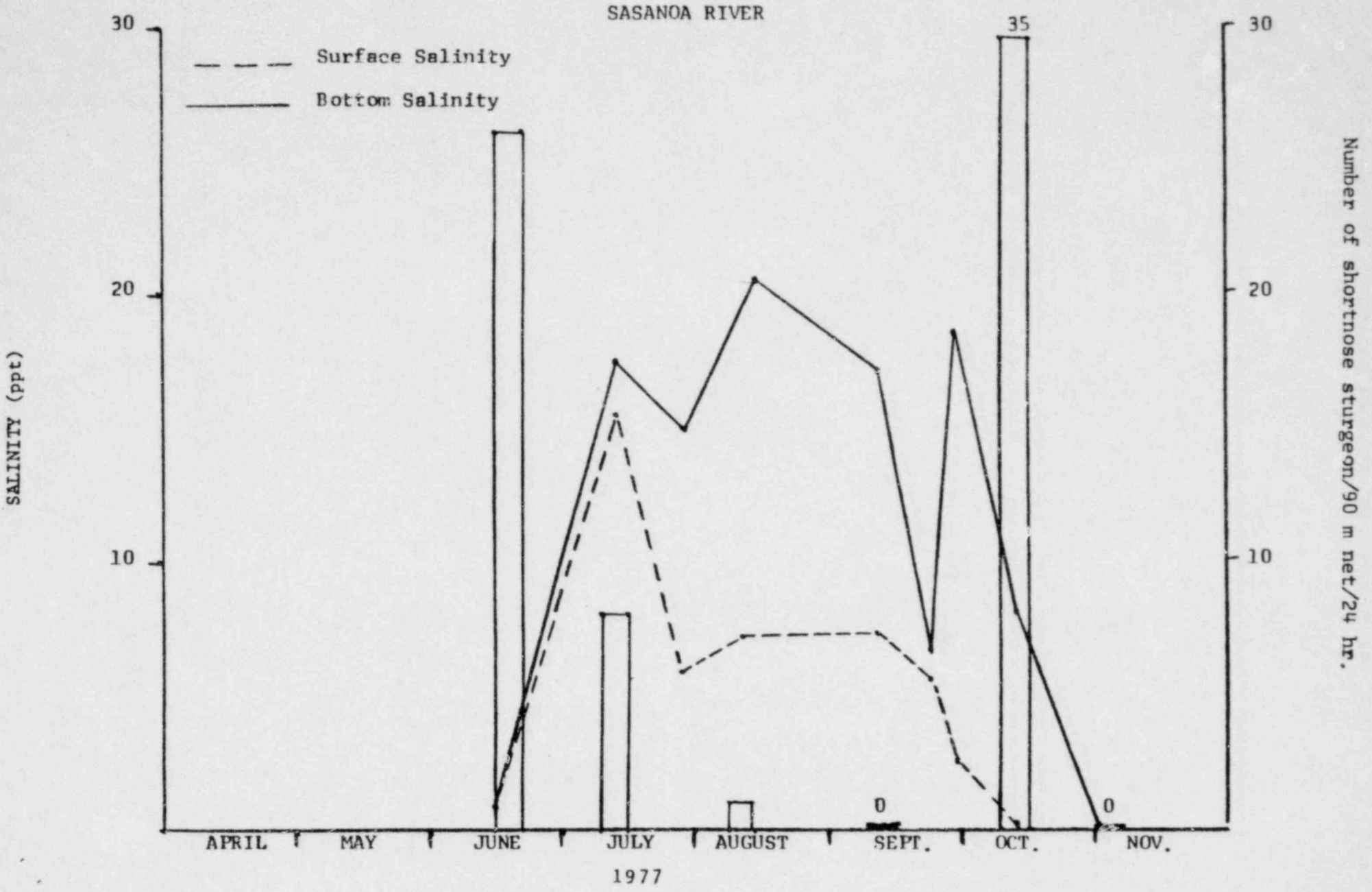


Figure 13: Number of shortnose sturgeon caught at Abagedasset Point (Site 4) Per 24 hr. set.

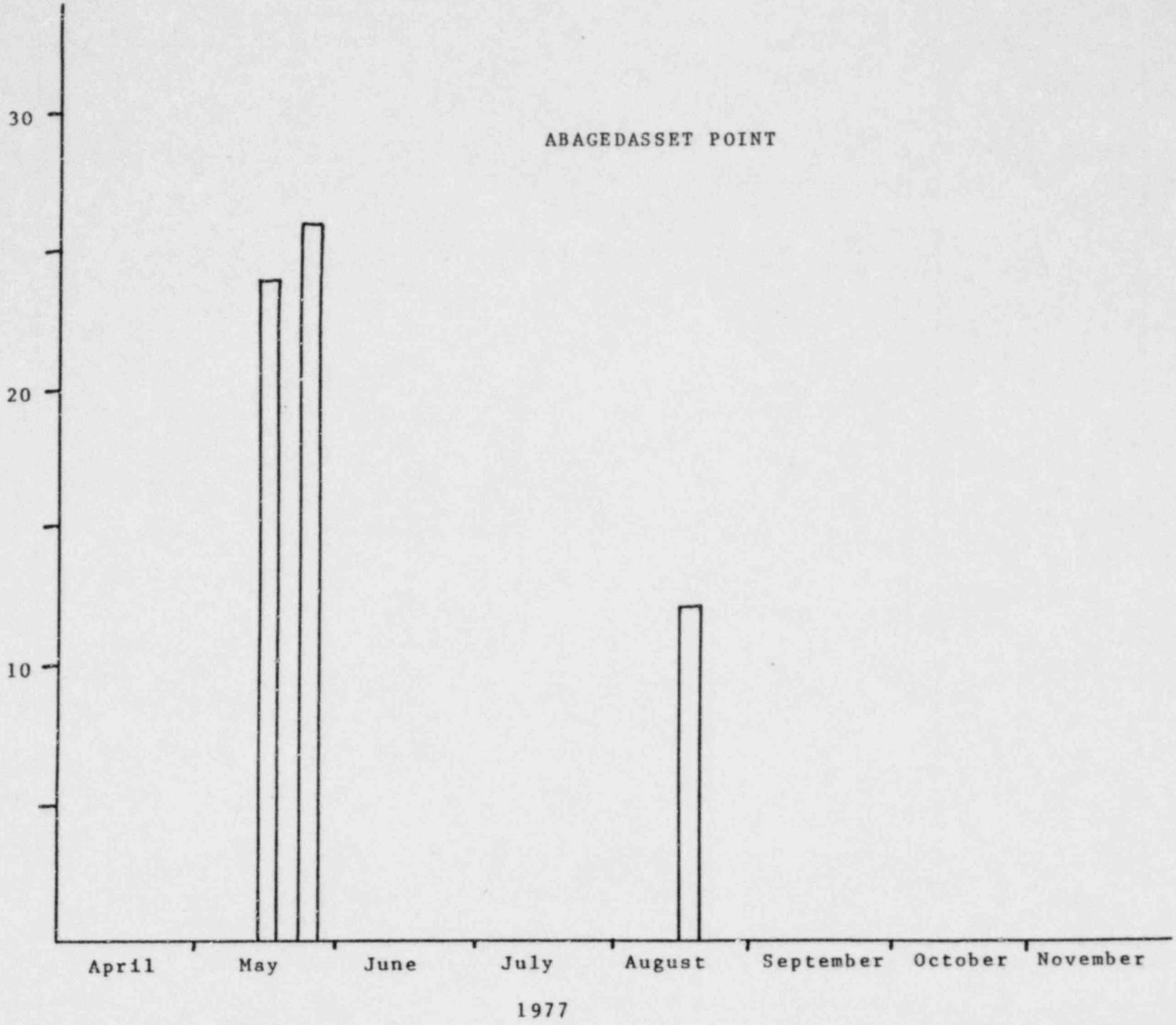


Figure 14: Number of shortnose sturgeon per 24 hr. gill net set at four upriver sites during 1977.

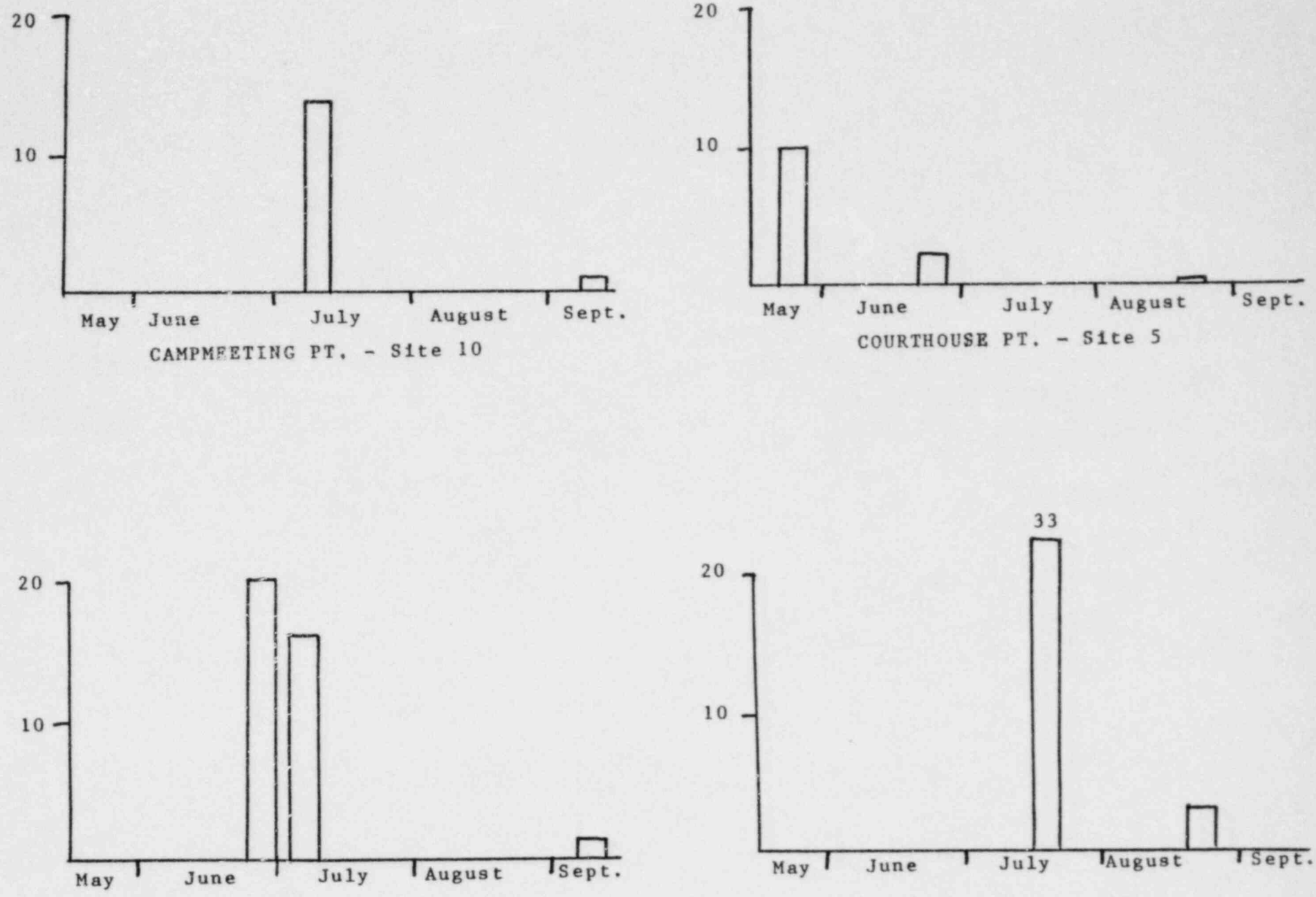


Fig. 15. Movement of tagged sturgeon #0101.

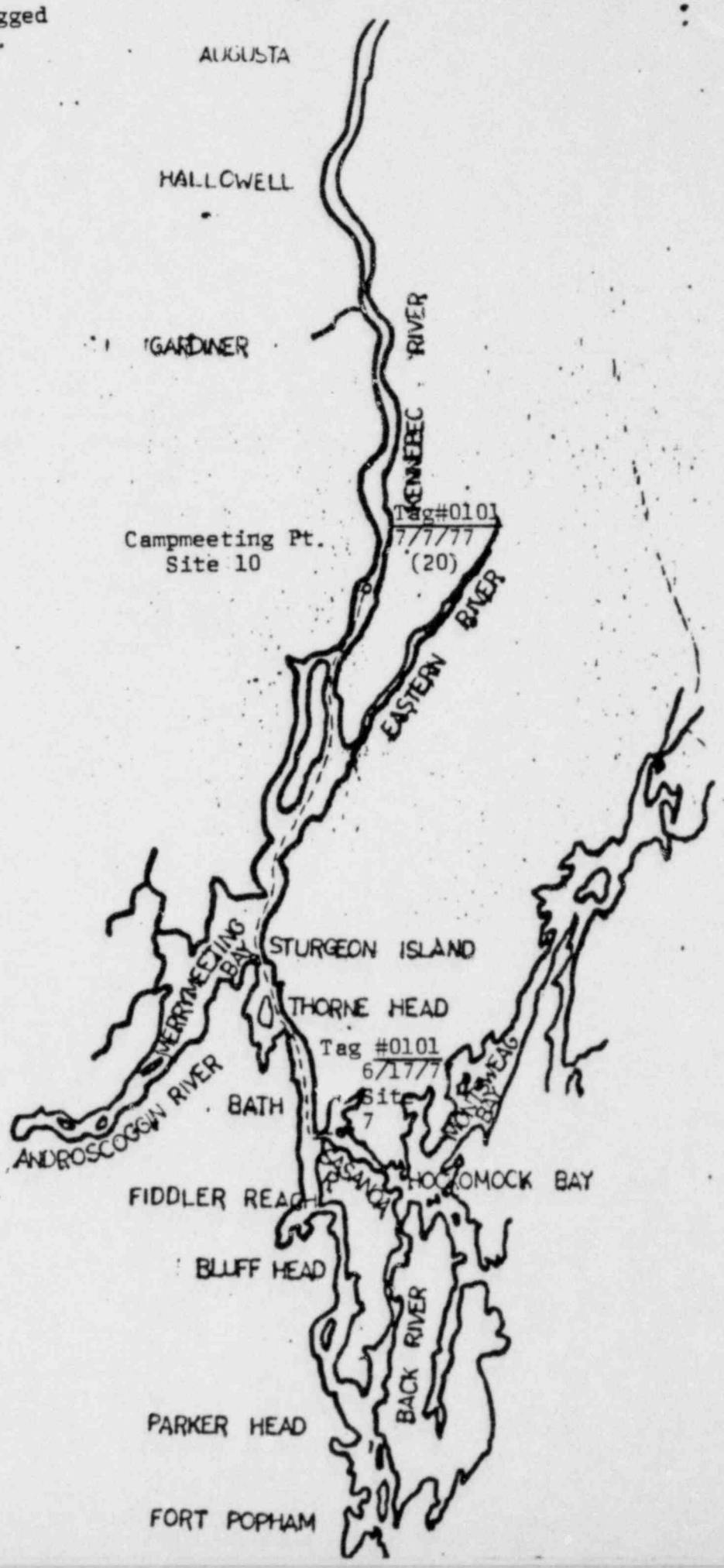


Fig. 16. Movement of tagged sturgeon #0088.

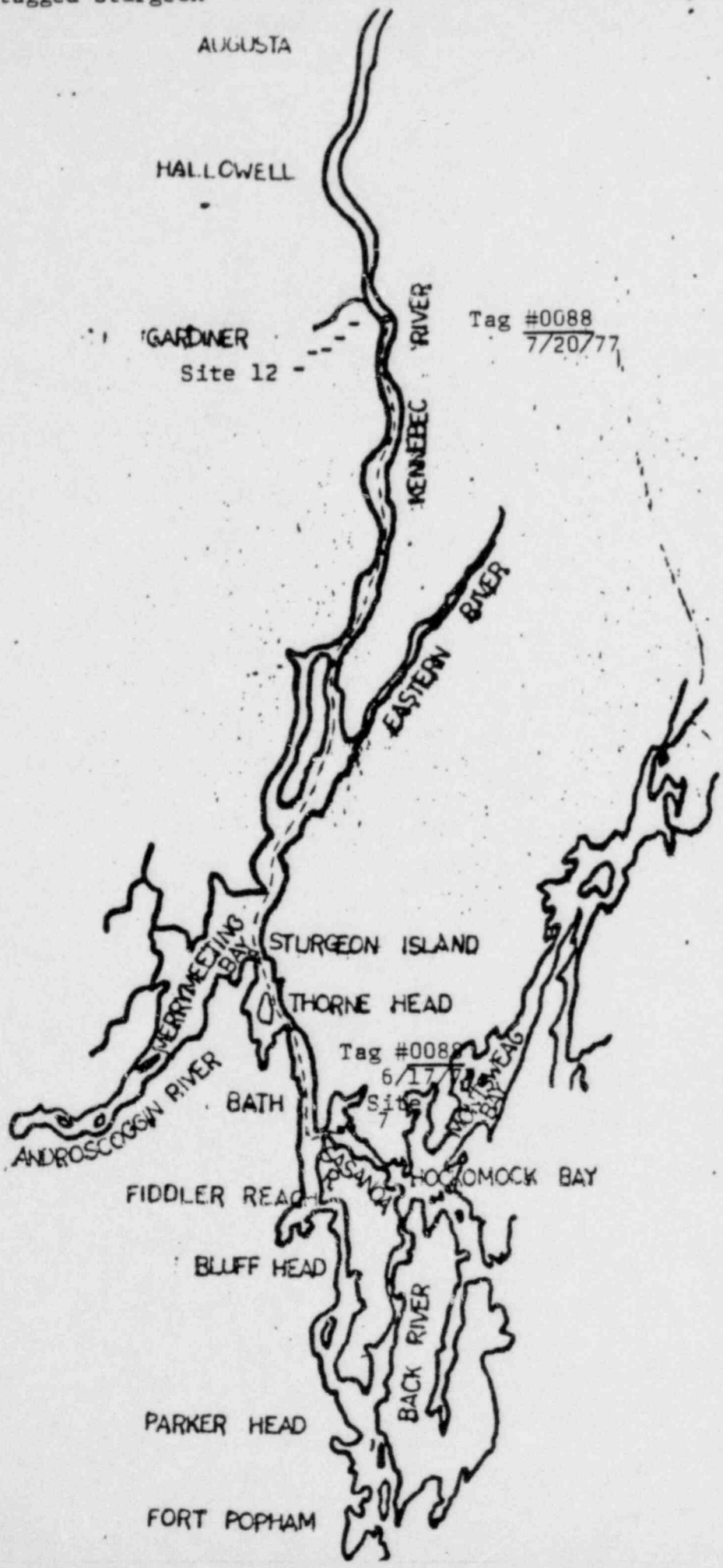


Fig. 17. Movement of tagged sturgeon # 0121.

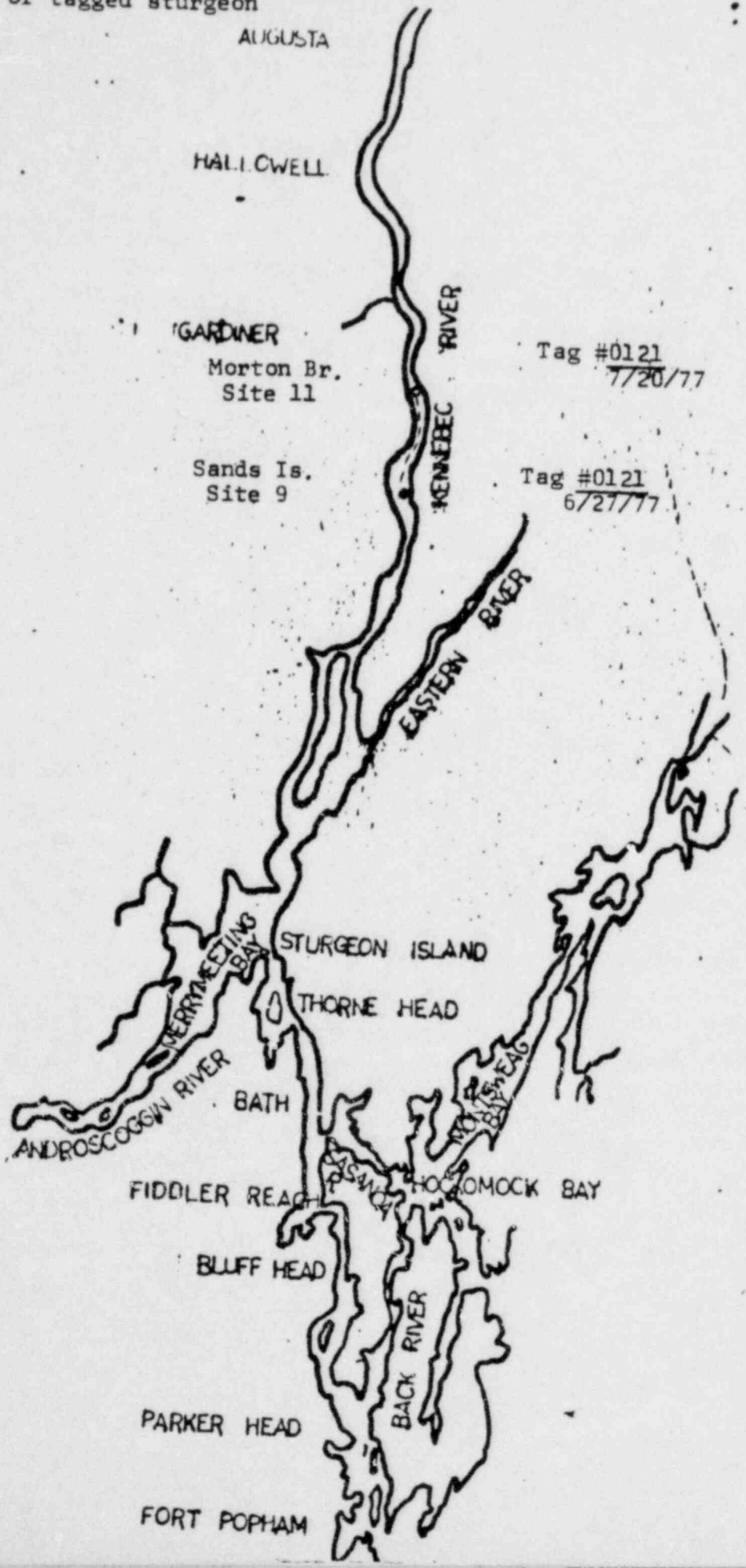
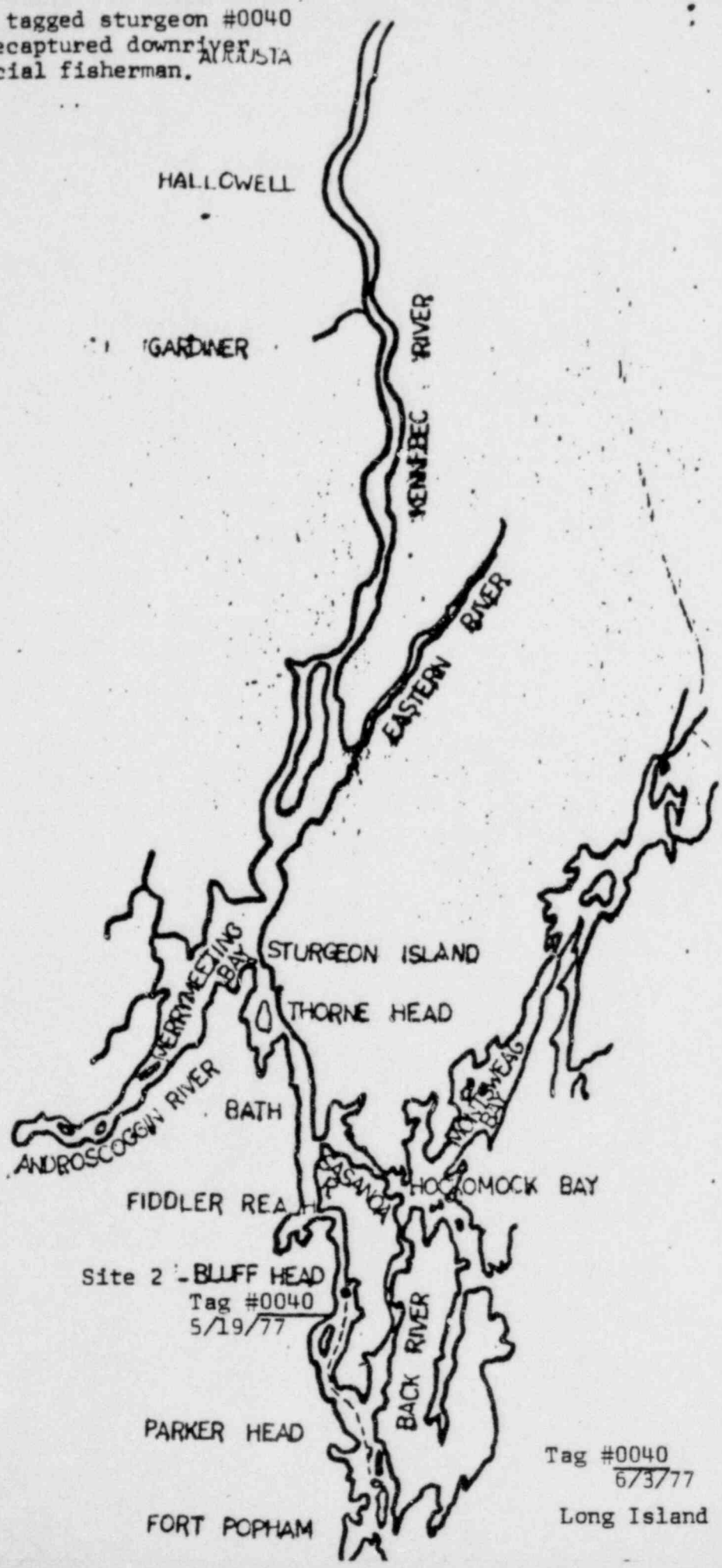


Fig 18. Movement of tagged sturgeon #0040 which was recaptured downriver by a commercial fisherman.



Appendix 1. Total length, fork length, weight, size of mesh captured in, and capture site for shortnose sturgeon taken from April, 1977 to November, 1978.

TAG NUMBER	FL (cm)	TL (cm)	WT. (Kg)	MESH SIZE	CAPTURE LOCATION
Petersen Disc #401	51.9	61.0		Handline	Eastern River
0000	68.9	78.4	2.72	3"	Site 1
0001	77.8	90.0	3.74	3"	Site 2
0002	107.0	121.4	9.19	4"	"
0003	83.6	93.0	4.65	4"	"
0004	88.0	98.5	7.37	4"	"
0005	79.6	88.2	3.69	4"	"
0006	69.3	79.5	2.83	3½"	"
0007	68.0	78.1	2.38	3"	"
0008					
0009	82.1	92.1	4.54	3"	Site 4
0010	74.5	82.0	3.29	3"	"
0011	64.4	74.9	2.27	3"	"
0012	71.6	82.3	3.29	3"	"
0013	67.9	76.8	2.83	3"	"
0014	70.5	80.0	2.95	3"	"
0015	70.8	78.8	2.61	3"	"
0016	79.8	91.6	4.31	3"	"
0017	80.8	89.6	4.08	3"	"
0018	76.4	89.3	4.20	3"	"
0019	86.9	95.6	5.78	3½"	"
0020	71.9	83.1	3.29	3½"	"
0021	69.6	78.2	2.83	3½"	"
0022	70.2	79.4	2.49	3½"	"
0023	85.8	97.6	4.76	3½"	"
0024	73.0	83.6	3.40	3½"	"
0025	71.9	82.9	2.95	3½"	"
0026	69.1	80.5	2.61	3½"	"
0027	89.3	102.0	5.22	3½"	"
0028	67.6	76.7	2.49	3½"	"
0029	73.2	87.7	3.40	4"	"
0030	79.6	89.3	4.31	4"	"
0031	79.6	91.7	4.99	4"	"
0032	79.4	92.4	4.76	4"	"
0033	95.0	105.0	6.12	4"	"
0034	91.8	103.0	6.01	4"	"
0035	57.2	65.6	1.47	3"	Site 2
0036	79.0	89.8	4.31	3"	"
0037	89.3	100.5	6.24	3½"	"
0038	85.4	96.6	3.63	3½"	"
0039	71.9	81.2	2.83	4"	"
0040	65.6	75.5	2.49	4"	"
0041	70.0	80.2	2.72	3"	Site 4
0042	71.4	81.7	2.95	3"	"
0043	67.5	77.2	2.49	3"	"
0044	59.4	66.7	1.36	3"	"
0045	65.3	75.5	2.27	3"	"
0046	72.4	84.0	3.29	3"	"
0047	75.6	84.2	2.49	3"	"
0048	71.9	82.3	2.83	3"	"

Appendix 1 (continued)

TAG NUMBER	FL (cm)	TL (cm)	WT. (Kg)	MESH SIZE	CAPTURE LOCATION
0049	61.2	81.1	2.04	3"	Site 4
0050	65.8	74.2	2.27	3½"	"
0051	63.4	73.0	2.49	3½"	"
0052	71.5	80.5	2.95	3½"	"
0053	79.5	88.7	3.63	3½"	"
0054	71.9	81.9	3.06	3½"	"
0055	77.7	86.6	3.52	3½"	"
0056	83.0	93.7	4.54	3½"	"
0057	81.2	91.2	3.74	3½"	"
0058	83.0	95.4	4.31	3½"	"
0059	72.6	85.8	2.95	4"	"
0060	66.8	74.0	2.49	4"	"
0061					
0062	69.8	79.5	2.95	4"	"
0063	88.1	99.1	4.88	4"	"
0064	85.0	94.2	4.42	4"	"
0065	100.0	110.2	7.26	4"	"
Mortality	87.0	96.6	4.20		"
Mortality	79.6	90.0	3.97		"
Mortality	78.5	90.4	4.65		"
<50cm	43.6	49.4	.45	3"	Site 5
0066	62.0	71.2	1.59	3"	"
0067	65.6	72.2	2.04	3"	"
0068	61.3	71.2	1.93	3"	"
0069	55.6	62.6	1.25	3½"	"
0070	69.4	78.8	2.72	3½"	"
0071	65.0	74.4	2.15	3½"	"
0072	78.9	89.6	4.31	4"	"
0073	74.8	86.2	3.06	4"	"
0074	84.6	93.5	4.76	4"	"
0075	86.1	97.0	4.65	3½"	Site 6 Montreux Bay
0076	76.1	84.3	3.63	4"	Site 7
0077	73.6	85.0	4.08	4"	"
0078	75.8	83.6	3.40	4"	"
0079	85.1	94.4	4.76	4"	"
0080	63.2	70.4	2.72	4"	"
0081	54.5	63.1	1.36	4"	"
0082 (73.4)	53.4	81.5	3.29	4"	"
0083	73.8	84.2	3.63	3½"	"
0084	75.1	87.4	3.29	3½"	"
0085	63.3	72.8	2.38	3½"	"
0086	77.5	90.4	3.74	3½"	"
0087	63.9	74.6	1.93	3"	"
0088	71.2	83.4	3.63	3"	"
0089	67.4	79.3	2.49	3"	"
0090	70.3	81.8	2.95	3"	"
0091	64.0	74.3	2.27	3"	"
0092	64.3	72.1	1.93	3"	"
0093	67.6	77.0	2.61	3"	"
0094	69.9	78.5	2.27	3"	"
0095	64.0	71.3	2.04	3"	"
0096	54.9	64.1	1.25	3"	"
0097	76.4	88.1	3.74	3"	"
0098	63.7	73.6	2.38	3"	"

Appendix 1 (continued)

TAG NUMBER	FL (cm)	TL (cm)	WT. (Kg)	MESH SIZE	CAPTURE LOCATION
0099	84.0	95.5	5.44	3"	"
0100	74.0	84.9	2.49	3"	Site 7
0101	69.1	75.2	2.95	3"	"
0103	78.4	86.5	3.18	3"	Site 5
0104	74.8	85.5	3.40	3½"	"
0105	70.5	79.6	2.83	3"	Site 9
0106	66.5	78.5	2.72	3"	"
0107	83.5	95.6	5.67	3"	"
0108	63.1	71.8	1.59	3"	"
0109	80.5	92.2	4.54	3"	"
0110	68.5	78.2	3.40	3"	"
0111	69.9	78.6	2.72	3"	"
0112	72.8	79.8	2.72	3"	"
0113	84.4	95.5	4.76	3"	"
0114	64.6	84.8	2.27	3"	"
0115	57.7	63.3	1.13	3"	"
0116	68.0	78.0	2.49	3"	"
0117	73.8	81.4	3.18	3½"	"
0118	70.5	78.5	2.72	3½"	"
0119	85.0	96.6	4.08	3½"	"
0120	79.1	88.4	3.40	3½"	"
0121	76.3	85.0	2.95	3½"	"
0122	76.3	88.9	4.08	4"	"
0123	86.3	95.6	4.76	4"	"
0124	74.8	85.8	3.63	4"	"
0125	82.5	92.3	4.88	4"	Site 9
0126	85.9	93.5	5.90	4"	Site 9
0127	69.0	78.1	2.95	4"	"
0128	72.1	82.2	3.74	3½"	"
0129	76.1	85.7	3.06	3½"	"
0130	64.1	70.5	2.49	3½"	"
Mortality	89.6	99.8	5.22	3½"	"
0131	78.4	83.6	3.97	3½"	"
0132	72.7	84.6	3.63	3½"	"
0133	69.8	79.5	3.18	3½"	"
0134	69.5	78.1	3.06	3½"	"
0135	80.0	93.3	4.42	3½"	"
0136	66.6	77.4	3.06	3"	"
0137	60.4	70.5	1.81	3"	"
0138	66.5	75.7	2.72	3"	"
50 cm FL	48.2	56.7	1.02	3"	"
0139	98.5	109.2	7.26	4"	Site 10
0140	66.0	75.3	2,83	4"	"
0141	73.4	84.5	3.40	4"	"
0142	81.5	92.1	3.97	3½"	"
0143	78.0	87.3	5.22	3½"	"
0144	82.6	94.7	4.76	3½"	"
0145	66.7	78.3	2.61	3"	"
0146	76.9	85.2	3.63	3"	"
0147	58.2	69.4	1.81	3"	"
0148	64.6	74.4	2.27	3"	"
0149	75.9	84.6	3.40	3"	"
Mortality	81.5	91.4	3.63	3"	"
0150	58.5	68.2	1.81	3"	Site 7

Appendix 1 (continued)

TAG NUMBER	FL (cm)	TL (cm)	WT. (Kg)	MESH SIZE	CAPTURE LOCATION
0151	78.0	88.4	3.86	3"	Site 7
0152	66.6	74.6	2.49	3"	"
0153	69.8	80.4	3.18	3"	"
0154	81.5	93.2	4.31	3½"	"
0155	67.0	75.4	2.49	3½"	"
0156	61.5	79.2	3.40	3½"	"
0157	66.4	74.8	2.95	3"	Site 2
0158	69.4	77.0	2.72	3"	"
0159	69.5	80.5	3.18	3"	"
0160	88.9	102.0	5.44	4"	"
0161	69.5	76.8	2.49	4"	"
0162	63.0	73.5	2.27	4"	Site 11
Mortality	70.8	77.5	2.72	4"	"
0163	71.0	80.9	3.18	4"	"
0164	53.5	64.0	1.59	3½"	"
0165	68.5	76.3	2.27	3½"	"
0166	68.8	79.0	2.83	3½"	"
0167	71.4	80.0	4.08	3½"	"
0168	63.2	73.9	2.49	3"	"
Mortality	65.5	73.3	2.15	3"	"
0169	59.6	67.5	2.15	3"	"
0170	69.1	78.2	3.06	4"	Site 12
0171	73.1	82.3	3.40	4"	"
0172	80.6	90.4	4.76	4"	"
0174	70.5	76.9	3.18	4"	"
0175	67.9	78.4	3.29	3½"	"
0176	67.1	78.0	2.95	3½"	"
0177	67.0	76.5	3.06	3½"	"
0178	79.0	90.0	3.86	3½"	"
0179	64.7	75.6	3.29	3½"	"
0180	74.6	85.0	4.31	3½"	"
0181	62.4	71.2	2.27	3½"	"
0182	56.6	64.6	1.47	3"	"
0183	71.4	82.7	2.61	3"	"
0184	66.4	77.4	2.61	3"	"
0185	61.4	73.2	1.70	3"	"
0186	66.7	76.5	2.49	3"	"
0187	57.9	69.2	1.93	3"	"
0188	57.6	67.0	1.93	3"	"
Mortality	59.6	68.6	2.27	3"	"
0189	78.1	88.9	4.54	3"	"
0190	63.0	71.0	2.38	3"	"
0191	63.5	73.4	2.49	3"	"
0192	56.3	63.0	1.93	3"	"
0193	77.1	85.3	1.93	3"	"
0194	65.3	70.9	2.15	3"	"
0195	70.2	80.8	2.72	3"	"
0196	68.5	80.3	2.95	3"	"
0197	63.3	72.2	2.95	3"	"
0198	72.2	87.8	3.63	3"	"
Mortality	83.8	94.8	4.76	3"	"
0199	66.5	76.6	2.95	3"	"
Petersen D. Backer	83.0	94.3	4.76	3"	"

Appendix 1 (continued)

TAG NUMBER	FL (cm)	TL (cm)	WT. (Kg)	MESH SIZE	CAPTURE LOCATION
Mortality	86.4	97.4	5.22	3"	Site 2
0203	55.3	64.8	1.47	3"	Site 7
0204	79.9	87.7	4.08	3"	Site 4
Mortality	83.3	93.5	3.97	3"	"
0205	59.4	69.5	2.15	3"	"
0206	60.6	66.9	2.27	3"	"
0207	83.4	95.1	4.99	3"	"
0208	61.0	68.2	2.15	3"	
0209	66.0	76.2	2.49	3½"	"
0210	81.5	92.2	3.86	3½"	"
0211	55.6	6 .3	1.59	3½"	"
0212	68.0	76.3	2.61	3½"	"
0213	80.5	90.6	3.86	3½"	"
0214	82.1	90.2	4.88	3½"	"
0215	72.4	81.5	3.18	3½"	Site 12
Mortality	84.9	98.3	5.56	3"	"
Mortality	75.3	84.2	3.63	3"	"
Mortality	80.6	90.3	4.31	4"	Site 2
0218	71.9	80.5	3.40	3½"	Site 9
0219	80.3	92.3	4.31	3½"	Site 10
0220	51.5	58.0	1.13	3"	Site 7
0221	69.9	79.0	2.83	3"	"
0223	70.9	82.5	3.40	3"	"
0224	75.9	86.6	4.31	3"	"
0225	61.6	72.1	1.59	3"	"
0226	76.4	86.3	3.74	3"	"
0227	69.4	78.1	3.06	3"	"
0228	77.0	87.9	4.31	3"	"
0229	62.6	69.5	2.27	3"	"
0230	74.1	87.0	3.97	3"	"
0231	67.1	77.5	2.83	3"	"
0232	81.7	90.3	4.54	3"	"
0233	75.0	84.7	3.52	3"	"
0234	79.5	90.7	3.74	3"	"
0235	64.0	73.6	2.27	3"	"
0236	70.0	80.4	3.06	3"	"
0237	83.0	95.4	5.56	3"	"
0238	77.6	86.3	3.63	3"	"
0239	75.3	83.0	3.63	3"	"
0240	79.0	89.9	3.97	3"	"
0241	90.0	104.0	7.48	3½"	"
0242	75.5	86.6	4.08	3½"	"
0243	66.7	76.0	2.95	3½"	"
0244	69.5	78.5	2.95	3½"	"
0245	73.5	83.8	3.40	3½"	Site 7
0246	74.0	83.0	4.08	3½"	"
0247	64.3	75.0	2.38	3½"	"
0248	84.5	95.0	5.67	4"	"
0249	73.6	85.5	3.97	4"	"
0250	86.1	98.5	6.35	4"	"
0251	85.5	97.0	4.42	4"	"
0252	83.0	95.5	4.08	4"	"
0253	53.0	61.8	1.47	4"	"
0254	80.2	90.5	4.76	4"	"
0255	59.2	68.0	1.81	4"	"

Appendix 1 (continued)

TAG NUMBER	FL (cm)	TL (cm)	WT. (Kg)	MESH SIZE	CAPTURE LOCATION
0257	64,9	72.0	2.05	3"	Site 4
0258	80.2	88.4	3.64	3"	"
0259	71.3	80.5	3.30	3½"	"
0260	75.5	85.5	3.18	3½"	"
0261	100.0	110.6	8.30	4"	"
0262	87.0	98.6	5.80	4"	"
0264	72.8	84.9	3.07	3"	Site 7
0265	88.7	98.0	6.02	4"	"
0266	79.1	87.0	3.86	3½"	"
0267	68.8	78.0	2.84	3½"	"
0268	66.8	75.5	3.30	3"	Site 2
0269	72.2	81.1	2.95	3"	"
0270	71.8	81.7	3.52	3"	"
0271	78.9	88.1	3.18	3"	Site 4
0272	69.5	77.7	2.61	3"	"
0273	67.6	74.7	2.50	3"	"
0274	79.1	93.6	4.32	3"	"
0275	85.5	98.2	6.25	3½"	"
0276	96.7	110.8	8.30	4"	"
Mortality	77.7	90.2	3.41	3½"	"
0277	74.9	83.9	2.73	3½"	Site 10
0278	64.3	73.5	2.39	3"	Site 15 — pools
0279	57.5	67.5	1.59	3"	Site 9
0280	58.7	68.7	1.59	3"	Site 17
0281	70.4	79.0	2.33	3"	"
Mortality	76.8	85.9	3.07	3½"	Site 4
0282	83.7	94.0	3.64	4"	"
0283	89.1	101.0	5.00	4"	"
0284	68.5	78.4	2.61	3"	Site 7
0285	69.4	79.8	3.64	4"	"
0286	69.3	79.5	3.18	4"	Site 9
0287	74.5	84.7	3.64	3"	Site 4
0288	74.0	82.5	3.41	3½"	Site 7
0289	64.0	72.4	2.27	3"	"
0290	88.0	98.5	2.39	4"	Site 9
0292	84.0	94.2	6.48	4"	Site 2
0293	91.2	104.3	7.05	4"	Site 4
0295	87.0	97.0	3.98	4"	Site 8
0296	85.0	93.5	5.00	3½"	"
0299	75.0	86.7	3.74	4"	"
0300	65.0	74.0	1.93	3"	"
0301	80.3	91.2	5.33	3½"	Site 4
0302	73.6	83.3	2.83	3½"	"
0303	72.8	84.6	2.61	3"	"
0304	63.4	71.1	1.81	3"	"
0305	69.5	80.1	2.95	3"	Site 7
0306	62.5	74.0	2.27	3"	"
0307	81.5	93.5	5.44	3"	"
0308	75.6	84.5	3.86	3"	"
0309	66.2	77.9	2.38	3"	"
0310	62.1	70.5	2.32	3"	"
0311	55.7	72.8	2.38	3"	"
0312	75.8	85.5	3.40	3"	"
0313	69.6	79.4	3.[illegible]8	3"	"

Appendix 1 (continued)

TAG NUMBER	FL (cm)	TL (cm)	WT. (Kg)	MESH SIZE	CAPTURE LOCATION
0314	72.5	82.0	2.72	3"	Site 7
0315	71.0	79.0	3.06	3½"	"
0316	72.5	83.0	3.18	3½"	"
0317	75.5	84.5	3.86	4"	"
0318	65.0	72.0	2.04	3"	"
0319	79.6	88.9	2.15	3"	"
0320	89.4	99.6	6.58	4"	"
0321	72.3	82.5	3.52	3½"	Site 4
0323	77.9	89.2	3.86	3½"	Site 7
0324	68.5	76.4	2.38	3"	"
0325	72.0	83.1	3.18	3"	"
0326	73.9	83.7	3.86	3"	"
0327	68.7	78.5	2.27	3"	"
0328	65.0	75.2	2.49	3"	"
0329	68.8	79.0	3.18	3"	"
0330	65.9	75.8	2.83	3½"	"
0331	57.2	66.5	1.59	3"	"

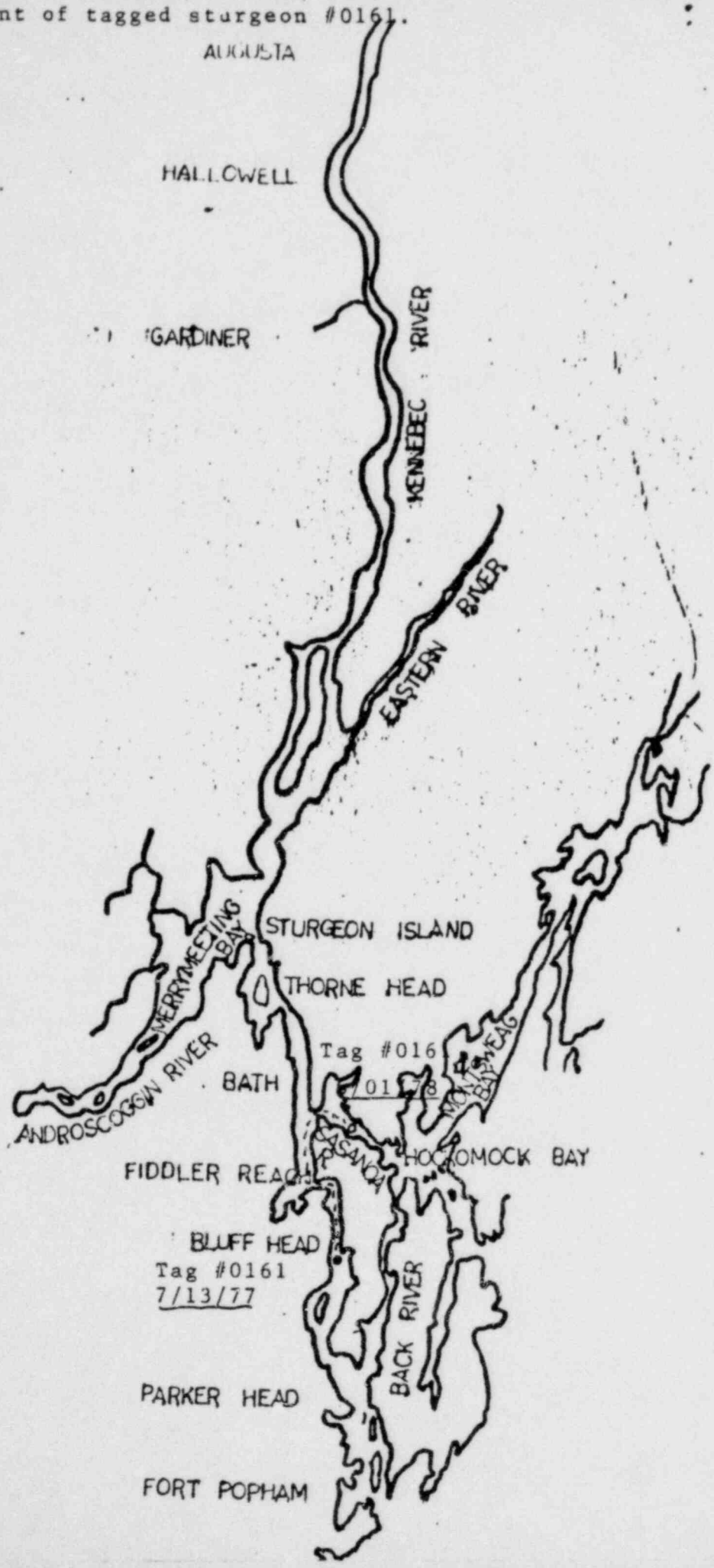
Appendix 2. Total length, fork length, weight, size of mesh captured in, capture site and age for Atlantic sturgeon taken from April, 1977 to November, 1978.

TAG NUMBER	FL (cm)	TL (cm)	WT. (Kg)	MESH SIZE	CAPTURE LOCATION	AGE
0008	150.5	167.5	27.67	6"	Site 2	17
0102	70.5	82.7	2.83	3"	"	4
0173	135.2	152.6	22.70	4"	Site 12	
0200	92.8	109.0	6.80	3½"	Site 2	5
0201	85.5	99.1	4.76	4"	"	6
0202	98.7	114.5	8.16	4"	"	6
0216	70.1	82.6	2.04	3½"	"	
0217	93.6	111.8	6.58	3½"	"	8
Mortality	97.9	114.5		3"	"	6
0256	59.0	68.3	1.48	3"	Site 4	
0263	84.0	97.4	4.66	4"	"	6
0291	124.2	138.0	19.55	3"	Site 2	11
0294	117.5	134.5	15.91	4"	Site 8	10
0297	145.7	159.2	29.55	4"	Site 11	20
0298	142.5	162.5	27.27	4"	"	22
0322	134.5	154.2	21.77	4"	Site 8	10
Mortality	90.5	106.8	6.12	3"	"	

Appendix 3: Mean weight, ranges, and fork lengths of shortnose sturgeon captured in the Kennebec River from April, 1977 to November, 1978.

FL (cm)	MEAN WEIGHT (Kg)	RANGE (Kg)	NUMBER
44	.45	-	1
48	1.02	-	1
52	1.13	-	1
53	1.47	-	1
54	1.48	1.36-1.59	2
55	1.70	1.25-2.38	3
56	1.59	1.25-1.93	3
57	1.53	1.47-1.59	4
58	1.70	1.13-1.93	6
59	1.77	1.36-2.15	3
60	2.08	1.81-2.27	3
61	2.02	1.70-2.27	5
62	2.24	1.59-3.40	6
63	2.34	1.59-2.95	10
64	2.24	1.93-2.49	13
65	2.37	1.93-3.29	10
66	2.60	2.04-3.30	12
67	2.70	2.49-3.06	13
68	2.69	2.27-3.40	16
69	2.93	2.61-3.74	15
70	2.84	2.27-3.18	21
71	3.19	2.61-4.08	11
72	3.14	2.61-3.63	19
73	3.36	2.72-4.08	11
74	3.44	2.49-4.08	11
75	3.58	3.06-4.31	13
76	3.55	2.49-4.31	13
77	3.43	1.93-4.31	5
78	3.93	3.18-5.22	11
79	3.88	2.15-4.76	9
80	4.24	3.63-5.33	15
81	4.47	3.74-5.44	5
82	4.33	3.63-4.88	8
83	4.51	3.64-5.56	9
84	5.35	4.65-6.48	7
85	4.81	3.63-6.25	8
86	5.15	4.42-6.35	7
87	4.94	3.98-5.80	4
88	5.77	2.39-7.37	4
89	5.70	5.00-6.58	5
90	6.35	5.22-7.48	2
91	7.05	-	1
92	6.01	-	1
95	6.12	-	1
96	8.30	-	1
98	7.26	-	1
100	7.78	7.26-8.30	2
107	9.19	-	1

Figure 19: Movement of tagged sturgeon #0161.



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