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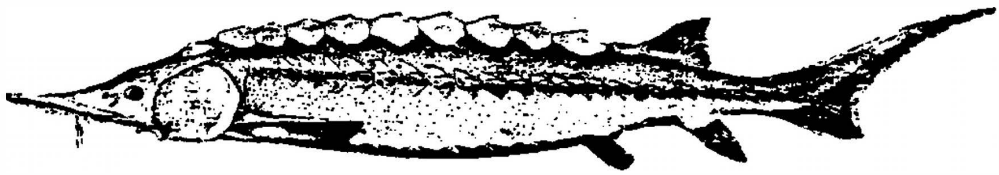

BIOLOGICAL & FISHERIES DATA
ON
ATLANTIC STURGEON, *Acipenser oxyrhynchus* (Mitchill)

AUGUST 1977

Biological and Fisheries Data

on

Atlantic sturgeon, *Acipenser oxyrhynchus* (Mitchill)

by

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INTRODUCTION

The Atlantic sturgeon has had a long history of utilization and exploitation in the United States. Earliest records of use by aboriginal Americans date to 2198 B. C. (Ritchie, 1969). Throughout its range, this species virtually disappeared at the turn of the 20th century. Overexploitation, deterioration of water quality, and damming of rivers were the major factors contributing to the decline of a once important industry.

The original draft was prepared as a report at the request of the Research Management Division of the National Marine Fisheries Service, Washington, D. C. The review of pertinent literature is intended to serve as a historical data base and information library on biology and status, and enable relevant management agencies to rationally assess the present condition of the stocks. Their judgments will determine what action, if any, is required to conserve this species under the Endangered Species Act of 1973. In addition, we have queried marine fisheries agencies of Atlantic and Gulf coastal states as well as private interests to determine the scope of present and proposed research.

Historical catch reports for many of the states probably reflect landings of both the Atlantic and shortnose sturgeon. The latter species was placed on the Federal Endangered Species list in 1973, therefore, landings after that date should be considered exclusively those of Atlantic sturgeon.

The format of this report follows that of the FAO fisheries synopsis series. Included also is a brief sketch of a questionnaire study we conducted in late 1976.

The authors accept full responsibility for content but defer to cited sources when material is quoted. Comments regarding errors in content or omissions would be greatly appreciated.

1.r IDENTITYr

1.1 Nomenclaturer

1.11 Valid Namer

Acipenser oxyrhynchus Mitchill, 1814.

1.12 Objective Synonymy

An abbreviated synonymy follows (from Vladykov and Greeley, 1963):

Acipenser oxyrhynchus Mitchill, Trans. Lit. Philos. Soc. NY, J, 1814: 462.

Acipenser sturio Linnaeus, Syst. Nat., ed. 10, 1758: 232.

Acipenser sturio oxyrhynchus Smith, Bull. U. S. Fish Comm. (1891), 1893: 190.

Acipenser cayennensis Duméril, Nouv. Arch. Mus. Hist. Nat. Paris, 3, 1867-161.

1.2 Taxonomy

1.21 Affinitiesr

Subclass - Actinopteri
Order - Acipenseriformes
Family - Acipenseridae
Genus - Acipenser Linnaeus
Species - oxyrhynchus Mitchill

1.22 Taxonomic Status

The family Acipenseridae is made up of anadromous and fresh water members of the northern hemisphere. Records date from the upper Cretaceous to recent periods. The family bears the following characteristics (from Vladykov and Greeley, 1963).

"Body elongate and fusiform. Scutes or bony shields in five rows: one dorsal, two lateral, and two ventral; all scutes very sharp and strongly developed in young individuals, but becoming progressively blunter with age or even disappearing through absorption. Skin between scutes with small ossifications. Snout protruding. Mouth inferior, protractile. Teeth absent in adults.

Barbels 4, in a crossrow in front of mouth. Gills 4, and an accessory opercular gill. Branchiostegals absent. Gill rakers fewer than 50. Opercle absent. Head covered by bony plates separated by sutures; particularly visible in younger specimens. Dermal skeleton without ganoine. Caudal fin with typical fulcra. Dorsal and anal fins behind ventrals. Pectoral fin with first ray enlarged and ossified. Tail heterocercal. Air bladder large, simple. Stomach with numerous pyloric appendages, forming a compact and rather large gland. Rectum with spiral valve.

"The family Acipenseridae is divided into two subfamilies. Acipenserini (true Sturgeons), with spiracles present, is represented by two genera: Huso, lower Pliocene to Recent, with two species; and Acipenser, Upper Cretaceous to Recent, with about 16 species. Scaphirhynchini (Shovelnose Sturgeons), without spiracles, also includes two genera: Acaphirhynchus, with two species; and Pseudoscaphirhynchus, with three species."

The genus Acipenser is defined by the following characters (Vladykov and Greeley, 1963). "Gill membranes joined at the isthmus. Spiracles present. Snout sub-conical. Tail depressed and completely mailed. Gill rakers lanceolate."

A key to American Atlantic species of Acipenser follows (Vladykov and Greeley, 1963):

Key to American Atlantic species of Acipenser

1a. Mouth width less than 55% of interorbital; average difference between TL and FL 14% of FL; gill rakers 17-27 (av. 21.6); postdorsal and preanal shields ine pairs; viscera pale, unpigmented.e

2a. In young specimens 50-70 cm long, head length 26-28% of FL; bony shields of dorsal row ovale in shape, their longitudinal length beinge greater than their transverse width; carinae on dorsal shields low, without a pronounced hook; dermal ossifications between dorsal ande lateral rows of shields only weakly developed;e spleen short, not reaching farther back thane middle loop of small intestine.e

oxyrhynchus oxyrhynchus Mitchill 1814

2b. In young specimens 50-70 cm long, head lengths 30-34% of FL; bony shields of dorsal rows rather square in shape, their longitudinal length much shorter than their transverse width; carina on dorsal shields high, typically with two strong hooks; dermal ossifications between dorsal and lateral rows of shields strongly developed; spleen long, reaching much farther back than middle loop of small intestine.

oxyrhynchus desotoi Vladykov 1955

1b. Mouth width over 62% of interorbital; average difference between TL and FL less than 12% of FL; gill rakers 22-40; postdorsal and preanal shields in a single row; viscera blackish, heavily pigmented.

3a. Gill rakers 22-29 (av. 25.4); interorbital width 34-40% (av. 37%) of HL; dorsal shields 8-13s (av. 10); lateral shields 25-32 (av. 28.3); dorsal and lateral shields pale, contrasting with dark background; length, so far as known,s not over 120 cm.s

brevirostrum LeSueur 1818

3b. Gill rakers 25-40 (av. 33.1); interorbital width 29-35% (av. 32%) of HL; dorsal shields 9-17s (av. 13.4); lateral shields 29-42 (av. 35.4); dorsal and lateral shields brownish, of sames color as background; length commonly overs 100 cm.s

fulvescens Rafinesque 1817

1.23 Subspecies

Vladykov (1955) proposed a separation of sea sturgeon occurring in the Gulf of Mexico as Acipenser oxyrhynchus desotoi. This form differs from the Atlantic (A. oxyrhynchus oxyrhynchus) in having a longer head, longer pectoral fins, strongly developed scutes and a longer spleen. Comparative morphometric counts are shown in Tables 1-4 (from Vladykov).

1.24 Standard Common Names, Vernacular Names

The standard common name is Atlantic sturgeon (Bailey et al., 1970), however the names sea sturgeon, common sturgeon, sharp-nosed sturgeon, and esturgeon noir have been used.

TABLE 1. Measurements in millimeters of sea sturgeon of the two different subspecies.

Subspecies	*A. oxyrhynchus de sotoi*		*A. oxyrhynchus oxyrhynchus*					
Locality	Gulf of Mexico		Florida	Quebec				
Catalogue Nos.	59803	59804	35376	425	442	876	508	877
Total length (TL)	580?	655	547	545	578	655	690	715
Fork length (FL)	515	595	483	485	515	580	595	620
Head length (T)	173	184	132	134	137	160	159	164
Diameter of eye (O)	12.5	12.5	10	10	10	11.5	10	12
Interorbital space (i)	38	49	36	36	38	43	43	47
Length of snout (ML)	98	97	73	74	74	84	80	86
Post orbital distance (pO)	63	74	52	64	70	77	80	83
Maximum body depth (H)	81	93	75	62	71	73	96	88
Minimum body depth (h)	18	21	17	16	17	21	20	20
Length of caudal peduncle (pc)	85	104	85	85	92	98	110	114
Width of mouth (Bc)	30	39	25	26	28	36	37	34
Length of pectoral (P)	80	97	62	64	64	80	82	86
Length of ventral (V)	44	49	32	39	39	44	47	44
Distance between P and V (P-V)	174	205	186	185	202	217	221	229
Distance between V and anal (V-A)	66	81	65	64	70	77	80	83

TABLE 2. Body proportions of sea sturgeon, expressed in percentages.

Subspecies	*A. oxyrhynchus de sotoi*			*A. oxyrhynchus oxyrhynchus*						
Locality	Gulf of Mexico			Florida		Quebec				
Body Proportions	59803	59804	Mean	35376	Mean	425	442	876	508	877
FL (mm)	515	595	555	483	559	485	516	580	595	620
T/FL	33.6	30.9	32.3	27.3	27.0	27.6	26.6	27.6	26.72	26.32
ML/FL	19.0	16.3	17.7	15.1	13.72	15.3	14.4	11.6	13.42	13.92
pO/FL	12.2	12.4	12.3	10.8	10.62	9.0	10.32	11.6	10.82	11.1
H/FL	15.7	15.6	15.7	15.5	13.92	12.8	13.82	12.6	16.12	14.2
pc/FL	16.5	17.5	17.0	17.6	17.82	17.5	17.9	16.9	18.52	18.4
p/FL	15.5	16.3	15.9	12.8	13.42	13.22	12.4	13.8	13.82	13.9
V/FL	8.5	8.2	8.4	6.6	7.6	8.02	7.6	7.6	7.92	7.1
Bc/T	17.32	21.2	19.3	18.9	21.3	19.42	20.4	22.5	23.32	20.7
O/T	7.22	6.8	7.0	7.6	7.1	7.5	7.3	7.2	6.32	7.32
I/T	22.0	26.6	24.3	27.3	27.9	26.9	27.7	26.9	29.62	28.72
Bc/I	78.9	79.5	79.2	69.4	77.6	72.2	73.7	83.7	86.02	72.32
p/P-V	46.0	47.3	46.7	33.3	35.6	34.6	31.72	36.9	37.12	37.62
V/V-A	66.7	60.5	63.6	49.2	57.1	60.9	55.72	57.1	58.82	53.02
h/pc	21.2	20.22	20.7	20.0	18.9	18.8	18.52	21.4	18.22	17.5

TABLE 3. Averages in millimeters of principal body parts of two subspecies of A. oxyrhynchus.

Subspecies	*de sotoi*	*oxyrhynchus*
Locality	Gulf of Mexico	Florida and Quebec
Number of Specimens	2	6
FL	550.0	546.3
T	178.5	147.7
O	12.5	10.6
i	43.5	41.2
ML	97.5	78.5
MV	103.0	81.0
pO	68.5	59.0
pc	17.0	17.8
H	87.0	77.5
h	19.5	18.5
P	88.5	73.0
V	46.5	40.8
P-V	189.5	206.7
V-A	73.5	73.2

TABLE 4. Measurements in millimeters of scutes in sea sturgeon.

Subspecies	*A. oxyrhynchus de sotoi*				*A. oxyrhynchus oxyrhynchus*					
Locality	Gulf of Mexico				Florida		Quebec			
Catalogue Nos.	59803		59804		35376		876		877	
Dorsal scutes	Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
1st	23	29	27	31	23	24	30	25	37	28
4th	24	32	31	35	23	25	28	24	33	27
6th	26	32	30	37	25	24	26	22	26	24
10th	20	26	23	29	23	21	26	19	28	18
Mean	23.3	29.8	27.8	33.5	23.5	23.5	27.25	22.5	31.0	24.3
Ventral scutes	Length	Height	Length	Height	Length	Height	Length	Height	Length	Height
1st	15	18	20	20	18	19	13	16	20	16
5th	20	24	23	27	20	17	15	19	18	19
10th	15	22	12	25	16	21	14	17	13	182
Mean	16.7	21.25	18.3	24.0	18.0	19.0	14.0	17.3	17.0	17.6

1.3 Morphologye

1.31 External Morphoàogy

Cf. sections 1.22 and 1.23.

1.32 Cytomorphologye

No data found

1.33 Protein Specificity

No data found

2.e DISTRIBUTIONe

2.1 Total Areae

"Hamilton Inlet on the Atlantic coast of Labrador is the most northerly point where A. oxyrhynchus has been reported (Backus, 1951). Blanc Sablon, on the Quebec side of the Strait of Belle Isle, is the next most northerly point (some specimens from this locality are in (our) collections). Atlantic Sturgeon are found regularly throughout the Gulf of St. Lawrence and in the St. Lawrence River up to Three Rivers, and odd specimens are taken even in Lake St. Peter, near Sorel, Quebec. They are found also in small numbers on the Newfoundland side of the Gulf of St. Lawrence, are well known in Nova Scotia waters, especially near estuaries, and are caught regularly in the St. John River, New Brunswick, as well as at the head of the Bay of Fundy.

"To the south, Atlantic Sturgeon are (or were) well known in the Penobscot, Kennebec, and Merrimack Rivers; indeed, they entered nearly every stream of any size that empties into the Gulf of Maine. There are also definite records of sturgeon taken off the open coast from the Bay of Fundy southward to Cape Cod (Bigelow and Schroeder, 1953), and along the coasts of southern New York. Along the Middle and South Atlantic seaboard of the United States there are several rivers that formerly maintained important fisheries: The Hudson, Delaware, Susquehanna, Potomac, York, James, St. Marys (Georgia), and St. Johns (Florida)" (Vladykov and Greeley, 1963).

Huff (1975) describes distribution of Gulf coast sturgeon as limited to the Gulf of Mexico, northern coast of South America and possibly Bermuda.

2.e2 Differential Distributione

The species is anadromous; the young are hatched in fresh water, spend up to five years there (Dovel, pers. comm.) and descend gradually to sea. They are a bottom species closely associated with estuaries.

Eggs are demersal, adhesive and occasionally occur in stringy clusters or ribbons. Eggs are laid in brackish or freshwater, possibly preferring brackish, over hard bottom of clay, rubble, gravel or shell in shallow running water or in water up to five fathoms deep, possibly in pools below waterfalls (Vladykov and Greeley, 1963). Earliest arrivals are said to spawn furthest upstream (Dean, 1894).

Juveniles remain in fresh and brackish water until they reach 760 to 915 mm in length. After emigration they may make oceanic excursions of up to 900 miles (Magnin and Beaulieu, 1963) and range to a maximum depth of at least 20 meters (Vladykov and Greeley, 1963).

Adults occasionally wander eastward across the continental shelf to offshore fishing grounds. Their maximum depth is approximately 50 meters. Riverine spawning migrations begin during February in Florida, Georgia and North Carolina, April in Chesapeake Bay, May and June in the Gulf of Maine (Vladykov and Greeley, 1963; Huff, 1975; Smith, 1907). North of Chesapeake Bay spawning has been recorded from May to early July depending on locality -- peak activity in Delaware Bay is in late May (Ryder, 1890). In the Gulf of St. Lawrence they first ascend streams in May and continue through June and July (Scott and Crossman, 1973).

Post spawning migrations to the sea occur from October through December in Florida (Huff, 1975), and from September through November in the St. Lawrence River (Scott and Crossman, 1973). Adults, probably male, have been taken in the Hudson in October and November (Dovel, pers. comm.).

3. BIONOMICS AND LIFE HISTORYe

3.de Reproduction

3.11 Sexuality

The species is heterosexual.

3.12 Maturity

In Florida active development of males begin between ca. 95 and 130 cm. Sexual differentiation occurred at

ages 2, 3 and 4. Female sexual maturity occurs at age 8-12; male sexual maturity at age 7-9 (Huff, 1975).

In the Hudson River fish of the eighth and younger age groups taken in the river were all immature (Greeley, 1937).

In the St. Lawrence River, sexual maturity is achieved by males at 22-24 years and by females at 27-28 years (Scott and Crossman, 1973).

No female sea sturgeon have been reported as being ready to spawn before reaching at least 150 pounds and an age of about 10 years. The testes of the smallest ripe male was reported from a 70 pound fish (Valdykov and Greeley, 1963).

3.13 Mating

Virtually nothing is known of spawning behavior, breeding is probably conducted by random pairing.

3.14 Fertilization

External.

3.15 Fecundity

Huff (1975) did not derive egg counts but prepared tables of maturity indices from Florida specimens (Tables 5 and 6).

In North Carolina, the mature ovaries may constitute one-fourth of the total fish weight and a female can produce 1,000,000 to 2,500,000 eggs (Smith, 1907). Ryder (1890) estimated fecundity of Delaware River fish to vary from 800,000 to 2,400,000. The largest ripe female examined by Vladykov and Greeley (1963) from the St. Lawrence weighed 352 pounds with an ovary weighing 91 pounds and contained approximately 3,755,745 eggs.

3.16 Spawning Seasons

Spawning per female probably occurs once during a season, however Huff recounted an observation of Roussow (1957) who showed A. fulvescens requires 3-6 years of extended

TABLE 5. Values for gill-netted females (Huff, 1975).

	Immature	Active	Ripe	Spent	Progressing	Resting
Mean % Gonad Weight to Body Weight	0.671	3.61	12.67	2.15	3.28	1.931
Age Range (1973)	6-121	8-171	12-261	12*	12-171	8-151
Length Range (cm)	69.8-148.0	106.7-180.31	152.4-182.9	154.9-168.9	127.0-188.0	129.5-182.9
Mean Fork Length	115.8	148.91	164.3	161.6	160.6	160.11

*1Only one specimen was positively aged in this developmental class.1

TABLE 6. Values for gill-netted males (Huff, 1975).

	Immature	Active	Ripe	Spent	Inactive
Mean % Gonad Weight to Body Weight	0.41	1.761	1.941	0.86	1.09
Age Range (1973)	4-101	7-211	9-161	*	8-22
Length Range (cm)	38.1-130.8	99.1-155.6	96.5-165.1	113.0-144.8	106.7-154.9
Mean Fork Length	107.1	121.51	128.6	129.6	128.6

*1No positively aged 1973 specimen in this developmental class.1

gonadal development before spawning and 1-2 years to recover to a resting state. He found this pattern repeated with 4-7 years between spawnings. If the concept is applicable to A. oxyrhynchus it would explain the low percentage of resting females Huff found in the Suwanee River. Vladykov and Greeley (1963) reported the Acipenseridae, even in the spring during the spawning season, have large individuals with immature ovaries found among fully mature females. This may be explained by the fact that the fish, after the first spawning, may spawn only at intervals of two or even three years. Scott and Crossman (1973) assert spawning is annual in some females and ceases only with extreme age or death. There are no observations on diel spawning activity. In the Delaware River, spawning occurred during water temperatures of 56-64ºF (13.3°-17.8°C) (Borodin, 1925).

The spawning period of the Atlantic sturgeon, throughout its range, is summarized in Table 7.

3.17 Spawning

Huff reported sturgeon to spawn over hard bottom in running water (shoals) and in pools below waterfalls. He characterized suitable bottom as typically located in and below bends, often with a rugged bathymetry varying as much as 6 m. Unsuitable bottom existed in straight reaches where sediments generally accumulated. Dees (1961) reported the spawning grounds are in running water as much as 3 meters deep over small rubble or gravel. Vladykov and Greeley (1963) assumed the sturgeon spawn in pools below waterfalls in the St. Lawrence River.

In discussing artificial fertilization, Ryder (1890) made the following comments...

"In getting all the eggs out of the abdominal cavity, I would suggest that the abdomen of the live fish be slit open in the median line, and its head raised so that the eggs may be run out into large pans to a depth of 2 or 3 inches, a little water added and the live milt put with them and gently stirred about with a feather so as to mix the eggs and milt.

"Not more than twenty minutes should be allowed to elapse after the time the milt and eggs are mixed together till they are spread upon cheese-cloth trays, one egg deep, or in a single layer. If this is not done

TABLE 7. Spawning period of Atlantic sturgeon. Because spawning times are not recorded*, inference of spawning season is only possible from reported time of the spawning migration.

Location	Beginning	Peak	End	Authority
Suwanee R., FL	February	April	May	Huff (1975)
St. Marys R., GA	February			Vladykov and Greeley (1963)
Chesapeake Bay	April			Hildebrand and Schroeder (1928)
Delaware River	Late April	May 12-22	Early June	Borodin (1925)
Hudson River	April-May			Vladykov and Greeley (1963)
Gulf of Maine	May-June			Bigelow and Schroeder (1953)
St. Lawrence	May-July			Scott and Crossman (1973)

*nIn South Carolina commercial fishermen believe sturgeon spawn after May 15th at the very earliest, andn not later than mid-July or August 1st (Leland, 1968).n

immediately the eggs will stick together in large masses, causing those at the center of these masses to be asphyxiated for want of oxygen, which under such circumstances cannot find access to adhere together in large masses, and the principal one is that if such masses are irregular and if any die, if broken, the eggs along the line of fracture of the mass will be broken and destroyed.

"The eggs will adhere very firmly to the surface of the cheese-cloth in a few hours, after which further watchfulness is necessary, in order to keep down any fungus which may appear upon the dead eggs, of which there will always be some."

3.18 Eggs

Ripe ovarian eggs are 2.6 mm in diameter. Freshly deposited eggs (unfertilized) are globular, light to dark brown with an evident germinal disc and 3 to 9 micropyles. The eggs are demersal, adhesive and attach to reeds, stones, sticks, shells, etc. sometimes in stringy clusters or ribbons. Fertilized eggs vary in diameter from 2.0 to 2.9 mm. Initially globular they become oval with development, and are colored slate gray or light to dark brown. Eggs firmly attach to the substrate within 20 minutes. The cleavage pattern is modified holoblastic. Mansueti and Hardy (1967) offer the following summary of egg development at 20°C.

1shour--first cleavage.s
1 hour and 15 minutes--second cleavage.
2 hours and 20 minutes--third cleavage.
19 hours--early gastrula.s
33 hours--embryo around 90$ of egg circumference.s
42 hours--pronephric ducts formed.s
43 hours--central nervous system formed.s
46 hours--optic vesicles formed.s
58 hours--blastopore closed.s
76 hours--embryo around ca. 320$ of circumference.s
82 hours--first movement.s

Incubation occurs within 94 hours at ca. 20$C and 168 hours at 17.8$C. Illustrations of egg stages are given in Figure 1.

.2 Larval History

No information was found on feeding habits of larval sturgeon.

The young sturgeon in fresh water eat a wide variety of bottom-dwelling plant and animal material, which is taken into the

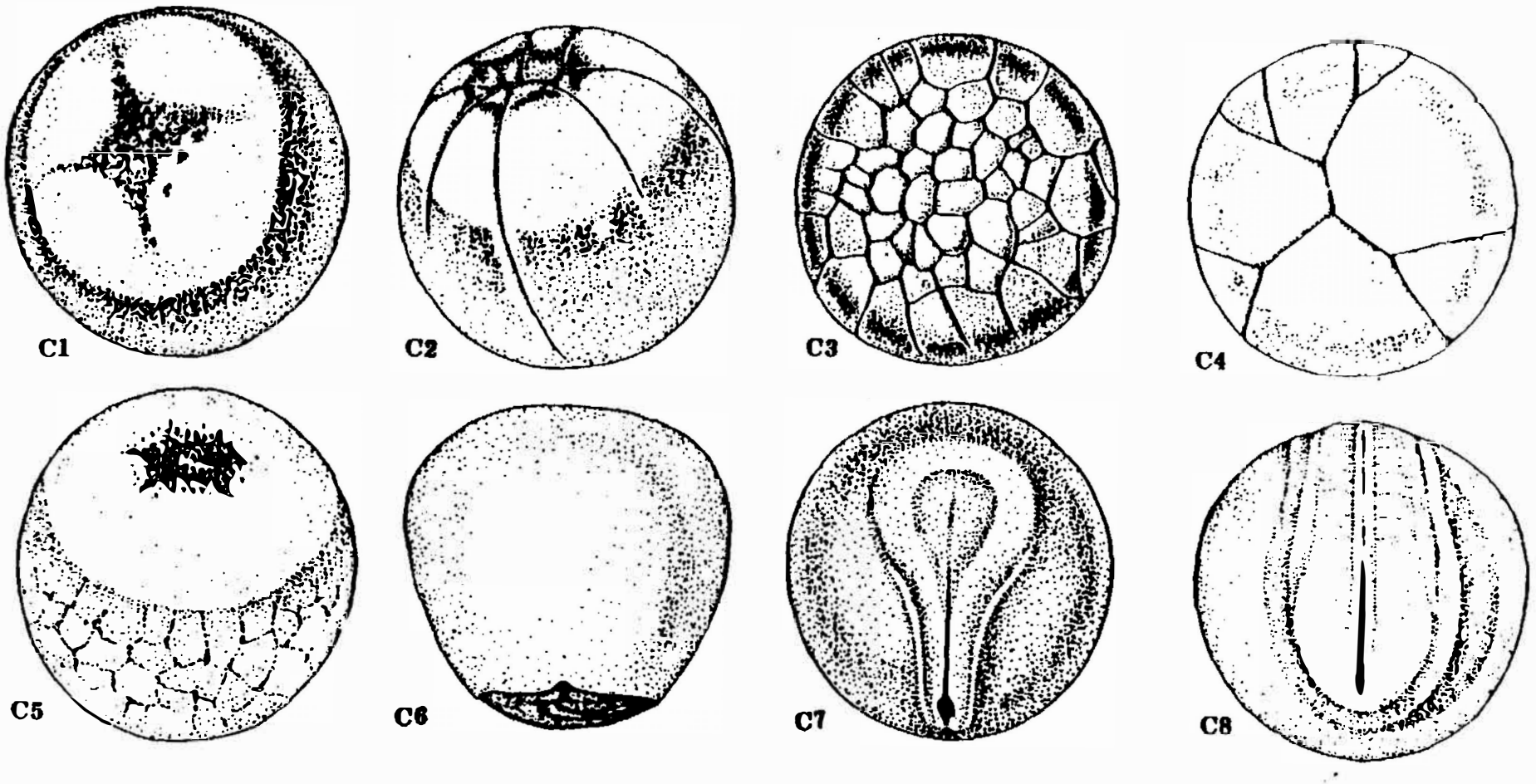

Figure 1. Development of egg at 20°C, capsule diameter 2.5-2.9 mm; yolk diameter ca. 2.2 mm; egg capsule removed; cleavage modified holoblastic. C1. Egg just before fertilization. C2. Third cleavage, lateral view; second furrow traverses yolk. C3. Sixth cleavage, 4 hours. C4. Sixth cleavage, lower pole. C5. Late blastula, 16 hours. C6. Gastrula, 28 1/2 hours. Dorsal lip of blastopore with indentation. C7. Early embryo, 43 hours. Blastopore still open; early neurenteric canal formed; 8 somites present but indistinguishable in surface view. C8. Early embryo, 48 hours. View of tail region; 20 somites present (from: Mansueti and Hardy, 1967).

protruded, tubelike, suctorial mouth, along with a good deal of mud, while the fish is rooting on the bottom with its snout and sucking in the material. Sludgeworms (Limnodrilus), chironomid larvae, mayfly larvae, isopods, amphipods, and small bivalve molluscs have been recorded (Scott and Crossman, 1973).

Stomach contents of trammel-netted juveniles in the Suwanee River primarily contained gammaridean amphipods (family Haustoriidae). These organisms are generally associated with bottom similar to the submerged tidal sand bank where these sturgeon were netted. Other food (less than approximately 5% by weight) found in five randomly preserved stomachs included isopods (Cyathura burbancki), midge larvae, mud shrimp (Callianassidae, probably Callianassa sp.), an eel (Moringua sp.), and some unidentifiable tubular animal or vegetable matter. Apparently, these small sturgeon occupy a different benthic habitat than adults consuming primarily animal material (Huff, 1975).

Newly hatched fry are about 11 mm (0.4 in) long (Figure 2). Later growth of young oxyrhynchus has not been followed, however, A. sturio in Europe reaches a length of 10.2 to 14.0 cm in 2 months (Vladykov and Greeley, 1963). Scott and Crossman (1973) reasserted what little is known of the early growth of Atlantic sturgeon as young are rarely seen. Young specimens 6.5 to 11 cm TL and 0.7-4.2 grams in weight caught in fresh water of the St. Lawrence were considered to be less than a year old. From August to October size of small individuals increased from 13.0-20.1 cm fork length and weighed from 6.8 to 47.7 grams. The young may spend as long as 3 or 4 years in fresh water before migrating to sea where growth accelerates. Hudson River Atlantic sturgeon, 27.9-86.5 cm total length, were 2-8 winters old as determined from otoliths, but 11- and 12-year-old specimens ranged from 190.7-254.0 cm total length. Specimens tagged in the St. Lawrence River over the size range of 70.6-84.7 cm fork length and 4.8-8.8 pounds yielded an estimated annual increment in length of 6.3-14.4% and in weight of 28.8-47.0%. This species retains juvenile characteristics up to 122 cm in length.

No data could be found on survival, parasites or predators of larvae. Garfish have been observed attacking schools of small sturgeon in South Carolina (Leland, 1968).

There is no evidence of prenatal care such as preparation of a nest area (Vladykov and Greeley, 1963).

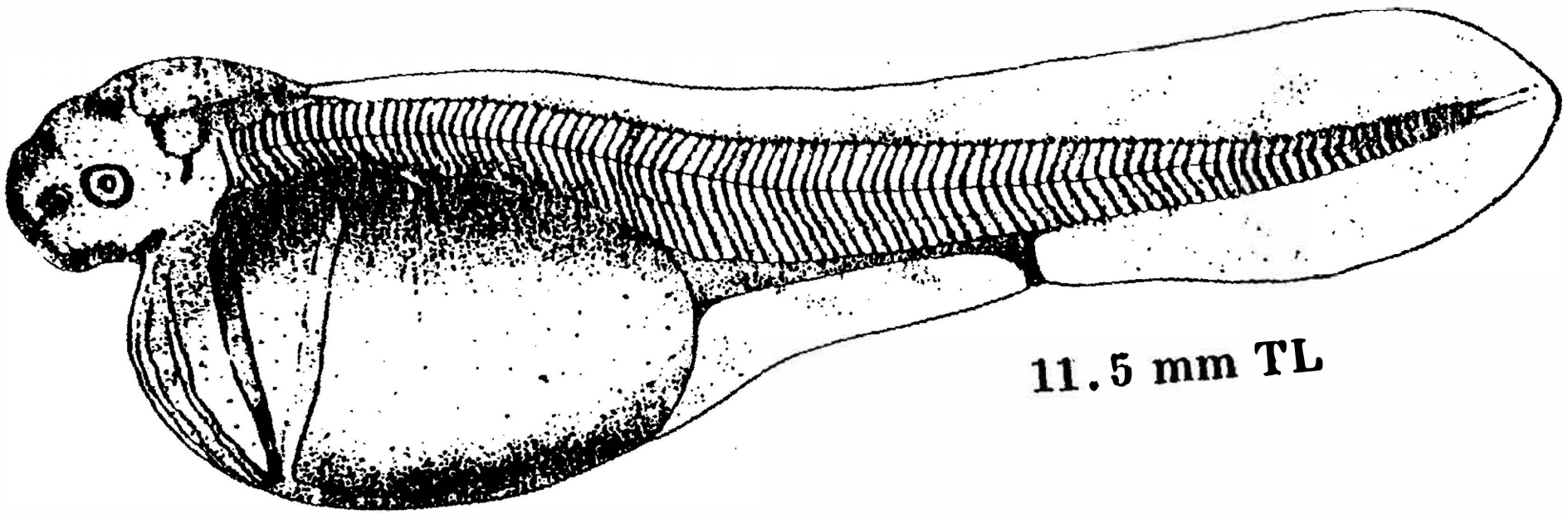

Figure 2. Larva of A. oxyrhynchus (from: Ryder, 1890).

3.3 Adult History

The adult form is illustrated in Figure 3.

3.31 Longevitye

Longevity apparently varies along the seaboard. Maximum ages reported include Suwanee River, Florida, 17 (Huff, 1975); Hudson River, 12+ (Greeley, 1937); St. Johns, New Brunswick, 16 (Dadswell, pers. comm.); St. Lawrence, 60 (Magnin, 1964).

3.32 Hardiness

No data were found on hardiness, but comments on their ability to stay alive after capture in gill nets, their size, and the protective plates suggest a high degree of viability.

3.33 Competitorse

Space competitors include catfish and gar (Huff, 1975). In more northern areas the shortnose sturgeon cohabits riverine bottom occupied by Atlantic sturgeon.

3.34 Predators

Very little is known of the predators of such large fish. It is known to be attacked and even killed by the sea lamprey. It is possible that its size and protective plates protect it from most predaceous fishes and its habitat and secretiveness from other predators. Since several species of sturgeon inhabit the same rivers, the young compete for food with one another and with other bottom-feeding fishes (Scott and Crossman, 1973).

Sharks are known to eat sturgeon trapped in nets offshore during the early season but the extent of the damage done by this voracious feeder on the free swimming sturgeon can only be conjectural (Leland, 1968).

3.35 Diseasese

Distomiasis disease caused by the digenetic trematode, Derodristis hispida, has been found in Atlantic sturgeon taken from Raritan Bay, New Jersey and submitted by Theodore Meyers to the NMFS National Pathology Registry. No other diseases of Atlantic sturgeon have been reported.

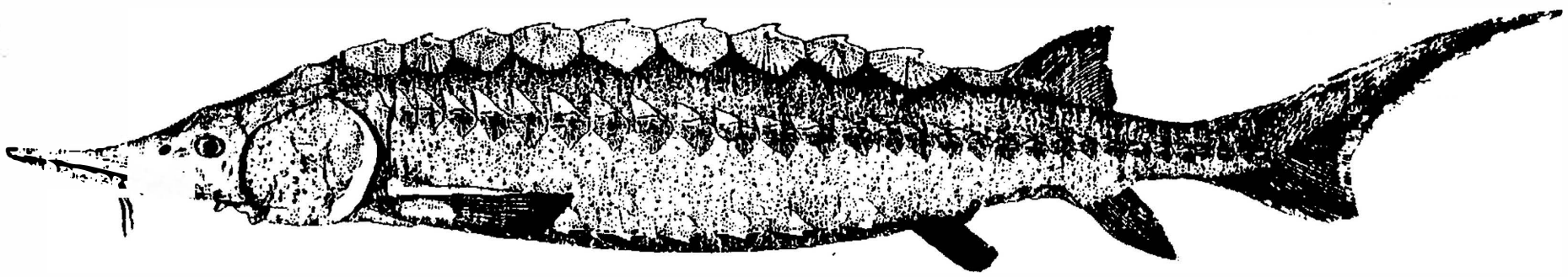

Figure 3. A mature Atlantic sturgeon collected from the Potomac River. Drawing by H. L. Todd of No. 22495 U. S. National Museum (Goode, 1884).

3.36 Greatest Size

For the Gulf of Maine, Bigelow and Schroeder (1953) state:

"About 12 feet is perhaps the greatest length to be expected today. But 18 feet, reported for New England many years ago, may not have been an exaggeration...The heaviest Gulf of Maine sturgeon reliably reported (to our knowledge), was one of 600 pounds, landed in Portland by the steam trawler Fabia from Georges Bank, December 21, 1932."

The largest Atlantic sturgeon known is apparently a 14-foot female, 811 pounds, caught at Middle Island, Maugerville, New Brunswick about 65 miles off the estuary of the Saint John River, in July 1924 (Vladykov and Greeley, 1963).

3.4 Nutrition and Growth

3.41 Feeding

The large sturgeon feed on mollusks and other bottom organisms. The fish roots in the sand or mud with its snout, like a pig (the barbels serving as organs of touch), as it noses up the worms and mollusks on which it feeds and which it sucks into its toothless mouth with considerable amounts of mud (Vladykov and Greeley, 1963).

In the sea, the larger sturgeon feed on molluscs, polychaete worms, gastropods, shrimps, amphipods, isopods and small fishes, particularly sand lances, Ammodytes. Adults apparently do not eat during migration and spawning and as a result are in poor condition by that time. They do eat in fresh water after spawning is completed and apparently quickly rebuild themselves (Scott and Crossman, 1973).

3.42 Food

From the Suwannee River:

"Stomachs of gill netted sturgeon contained partially digested, fibrous, dark green vegetable material interspersed with occasional crab hard parts (probably blue crab, Callinectes sapidus Rathbun). Relative abundance of crab parts was generally greater in stomachs of pre-spawning migrants than in those of post-spawning migrants (most post-spawning migrants had no crab parts). Opportunistic feeding is indicated: blue crabs are unavailable beyond tidally influenced portions of the river, and hence,

an unavailable dietary item in the upper river. Data indicate that post-spawning migrants spend little time feeding in the tidally influenced lower river (blue crabs are readily available there during fall), quickly moving into the Gulf of Mexico." (Huff, 1975).

From the St. Lawrence River, Quebec:

"In 27 half-grown sturgeon taken in salt water, polychaete worms (Nereis virens) were found -- 265 on the average; the maximum number in a single stomach was 1,221. In addition, the sturgeon fed on marine gastropods, shrimps (Crago), amphipods, and ispods, in that order. In fresh water, the bulk of the food consisted of aquatic insects, amphipods, and oligochaete worms; in 88% of 178 sturgeon examined, larvae of the burrowing mayfly (Hexagenia) were present. Sturgeon also eat small fishes, particularly launce (Ammodytes)." (Vladykov and Greeley, 1963).

3.43 Relative and Absolute Growth Rates

Growth of Atlantic sturgeon has been described in five studies. Greeley (1937) determined age on the basis of otolith analysis (Figure 4) whereas Mangin (1964) and Huff (1975) utilized fin ray sections for their age calculations.

Table 8 lists the mean lengths (in cm) at age for the five studies. Measurements are either fork length (FL) or total length (TL). Mangin's (1962) conversion, FL=0.867 TL + 10 mm r=0.989, was used for consistency.

Huff (1975) described the relation between age and length with the equation: Fork lengthe= 369.2326 age $^{0.5284e}$ and derived length-weight equations from Suwanee River stock (1972-72) (Table 9). He found significant differences between spring and fall samples, primarily due to gonadal weight loss.

Other similar equations have been derived. These include one by Holland and Yelverton (1973) for specimens taken off North Carolina:

$$We = 5.46 \times 10^{-6} FL^{3.10}$$

$$r = 0.98$$

$$te = 66.80$$

$$df = 184e$$

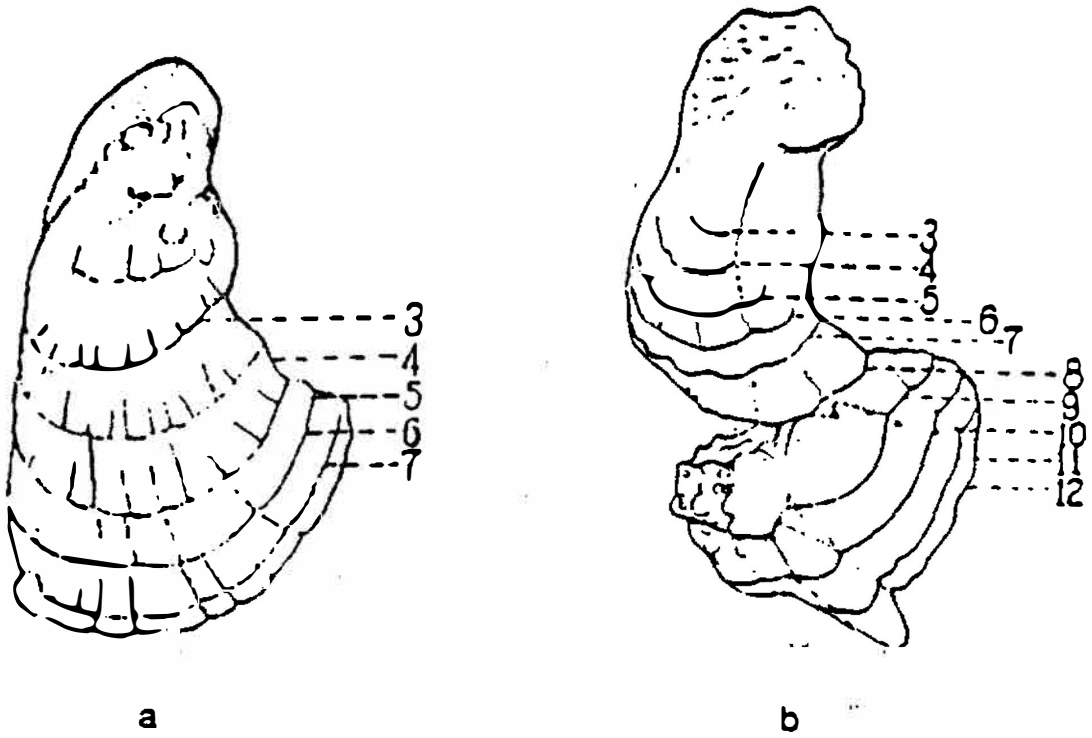

Figure 4. a. Otolith of immature sea sturgeon; length 25.3 in; weight 3 lbs., $1^{1}/2$ ozs.; Rhinecliff, N. Y., June 15, 1936; annual growth shown by numbers 3 to 7. b. Otolith of adult female sea sturgeon; length 8 ft., 4 in.; weight 199 lbs., $15^{1}/2$ ozs.; Highland, N. Y., May 21, 1936; annual growth shown by numbers 3 to 12 (from: Greeley, 1937).

TABLE 8. Age-length determinations (mean length, cm).

Age	Suwanee* (FL)	Savannah (FL)	Hudson** (TL)	Hudson** (FL)	St. John N.B.* (FL)	St. Lawrence** (TL)	St. Lawrence** (FL)
1	35.0				35.5	22.0	(20.1)
2	51.0		29.4	(26.5)	47.0	28.0	(25.3)
3	64.0		45.9	(40.8)	52.5	35.0	(31.3)
4	75.0	59.7	60.7	(53.6)	63.0	42.0	(37.4)
5	83.0	65.3	67.1	(59.2)	62.5	49.0	(43.5)
6	106.0	67.8	65.0	(57.4)	96.0	58.0	(51.3)
7	110.0	76.5	71.70	(63.2)	97.0	66.0	(58.2)
8	118.0		83.10	(73.1)	101.0	75.0	(66.0)
9	123.0				109.0	87.0	(76.4)
10	127.0		189.2	(165.0)	107.5	90.0	(79.0)
11	132.0		189.9	(165.6)	101.0	98.0	(86.0)
12	147.0		238.8	(208.0)	112.0	105.0	(92.0)
13	136.0					109.0	(95.5)
14	158.0					115.0	(100.7)
15	155.0					120.0	(105.0)
16	135.0				130.0		
17	149.0						
20						162.0	(141.4)
46						260.0	(226.4)
60						267.0	(232.5)

*Approximate values

**Converted from TL to FL

[Data from Huff (1975), White (1970), Greeley (1937), M. Dadswell (pers. comm.), Mangin (1964)]

TABLE 9. Length/weight equations for Suwanee River sturgeon (from: Huff, 1975)

Season	Sex	Exponential	N	r	Year
1.9Spring9	male	$W=2.8359x10^{-6}$ $FL^{3.2330}$	39	.906	1972
2.9Spring9	female	$W=2.4732x10^{-6}$ $FL^{3.2617}$	71	.988	1972
3.9Fall9	male	$W=1.7928x10^{-5}$ $FL^{2.8262}$	106	.811	1972
4.9Fall9	female	$W=1.2089x10^{-5}$ $FL^{2.9190}$	81	.915	1972
5.9Spring9	male	$W=6.7978x10^{-5}$ $FL^{2.5820}$	62	.932	1973
6.9Spring9	female	$W=1.5100x10^{-5}$ $FL^{2.91409}$	92	.932	1973
7.9Spring9	juv.*	$W=7.8090x10^{-7}$ $FL^{3.5576}$	106	.986	1973
8.9Fall9	male	$W=5.8406x10^{-4}$ $FL^{2.1308}$	94	.866	1973
9.9Fall9	female	$W=8.7476x10^{-4}$ $FL^{2.0525}$	87	.724	1973
Fall	male & female	$W=1.1471x10^{-5}$ $FL^{2.9240}$	187	.880	1972
Spring Fall	male	$W=2.8667x10^{-4}$ $FL^{2.2973}$	156	.862	1973

*9Trammel-netted small juveniles, all other formulae from gill-netted sub-adults9 and adults.9

From the St. Lawrence River, Mangin (1962) calculated the following equation from a mixed sample (Carlander, 1969):

$$We = 1.14 \times 10^{-6} TL^{3.18}$$

Age-length-weight data for three areas are presented in Table 10.

.5 Behavior

3.51 Migrations and Local Movements

Spawning migrations have been described in section 2.2. Evidence of oceanic migrations is apparent from studies reported by Holland and Yelverton (1973). .Table 11 summarizes recapture information of 187 releases off North Carolina.

"Two sturgeon were recaptured in Pamlico Sound and one in Albemarle Sound. One tag was returned from Mecocks, Long Island, New York which had traveled 401 miles in 65 days at a mean daily rate of 6.2 miles. One sturgeon moved about 25 miles north along the beach, and another traveled over 60 miles north of Portsmouth Island to Oregon Inlet. Sturgeon tagged in November and December north of Hatteras showed a definite tendency to move southward along the coast of North Carolina. Five out of eight recaptures came from between Cape Hatteras and Cape Fear. Three were taken in gill nets off Bear Inlet, 117 to 200 miles south from where they were released. However, during February and March this southward movement appeared to reverse. Four sturgeon tagged during this period were recaptured 5 to 401 miles north of where they were released. The remaining sturgeon were recaptured in the same area they were released. Trawls and gill nets were the methods of recapture. There was no apparent correlation between size of the fish, days out, or distance traveled" (Holland and Yelverton, 1973).

The only other results from tagging of Atlantic sturgeon are reported by Vladykov and Greeley (1963) from taggings in Quebec.

"During five years, 1945-49, a total of 1,948 was liberated at different localities in the St. Lawrence River, in both fresh and salt water. Up to December 31, 1952, a total of 47 fish was recovered. Several of them were recaptured as many as four and five times each and were subsequently reliberated. The majority of the recaptures showed

TABLE 10. Comparative age-length-weight data summarized by Carlander (1969) from original sources -- St. Lawrence (St. L.) (Vladykov and Greeley, 1963; Mangin, 1964); Hudson (H.) (Greeley, 1937); Dadswell's weight data from the St. John River (S.J.) are added in the right-hand column.

	Age	n	TL	n	wt(g)	S.J. wt(g)
St. L.	0-Aug.0	2	79	2	2	
St. L.	0-Sept.0	3	104	3	4	
St. L.	0-Sept.0	108	183	108	23	
St. L.	I0	28	221	12	27	130
St. L.	II0	17	279	6	68	270
H.	II0	3	300	3	141	
St. L.	III0	26	351	15	136	670
H.	III0	13	460	13	408	
St. L.	IV0	54	419	7	313	1,730
H.	IV0	4	607	4	1,025	
St. L.	V0	75	490	27	426	1,800
H.	V0	4	670	4	1,310	
St. L.	VI	60	580	23	698	3,800
H.	VI	4	650	4	1,347	
St. L.	VII	48	660	16	1,052	4,500
H.	VII	14	716	14	1,6340	
St. L.	VIII	25	749	11	1,7510	5,300
H.	VIII	3	830	3	3,0030	
St. L.	IX	34	970	26	2,6000	6,300
St. L.	X	49	900	45	3,1020	8,200
H.	X	10	2,1460	10	36,2880	
St. L.	X	58	980	56	4,5000	8,130
H.	X	10	2,1540	10	39,916	
St. L.	XII	33	1,0520	33	5,4000	11,000
H.	XII	2	2,3880	3	85,2770	
St. L.	XIII	29	1,0900	28	5,806	
St. L.0	XIV	14	1,1480	14	6,895	
St. L.	XV	9	1,2000	9	7,575	
St. L.	XVI	11	1,2200	9	8,936	20,000
St. L.	XVII	3	1,3300	3	10,296	
St. L.	XVIII	6	1,3920	6	13,109	
St. L.	XIX	10	1,5250	2	18,915	
St. L.	XX	10	1,6250	10	21,7720	
St. L.0	XXI	10	1,7600	10	30,4800	
St. L.	XXIV	10	2,0170	1	31,8000	
St. L.	XLVI	1	2,600	10	152,8630	
St. L.0	LX	10	2,6700	10	160,0000	
	XVIII	1	2,6550	1	102,0600	

TABLE 11. Summary of recaptured Atlantic sturgeon as of 1 November 1971, tagged offshore North Carolina, December 1968 - March 1971 (from: Holland and Yelverton, 1973).

Season	Tag No.	Date Tagged	Location	Date Recaptured	Location	Gear	Days Out	Net Naut. Miles Trav.	Weight[a] (kg)	Fork Length[a] (cm)
1969-1970	A00006	3-21-68	Avon	5-25-68	Mecocks, LI, NY	--	65	401	9.5	--
1969-1970	A00388	1-31-70	Ocracoke Is.	2-24-70	Stumpy Pt. Bay, NC	Gill net	24	35	2.3	68.6
	A00543	2- 5-70	15 mi. n. Cape Lookout	3- 4-70	Ocracoke sea buoy, NC	Trawl	27	25	11.8	108.0
	A00633	2-18-70	Portsmouth Is.	3-16-70	Ocracoke Inlet, NC	Trawl	16	5	9.5	101.1
	A00307	1-16-70	Ocracoke Inlet	3- 6-70	Ocracoke Inlet, NC	Trawl	64	5	3.1	70.4
	A00306	1-16-70	Ocracoke Inlet	3- 7-70	Pamlico Sound (#1 Lt. beacon Rodanthe, NC)	Gill net	50	45	2.0	64.0
	A00661	3- 4-70	Portsmouth Is.	3-25-70	Oregon Inlet, NC	Trawl	21	66	15.0	121.9
1970-1971	A00676	11-17-70	5 mi. s. Va. line	12-21-70	Bear Inlet, NC	Gill net	35	180	15.0	120.2
	A00782	11-21-70	7 mi. n. Kitty Hawk	--	Hatteras Bight, NC	--	--	51	4.5	80.8
	A00687	11-17-70	Currituck Light	4- 3-71	Bear Inlet, NC	Gill net	137	200	17.2	130.0
	B00216	12-10-70	Currituck Light	2- -71	Hatteras Inlet, NC	Trawl	--	100	4.5	83.0
	B00219	12-10-70	Currituck Light	12-11-70	Kitty Hawk, NC	Trawl	1	10	4.5	80.0
	B00220	12-15-70	Currituck Light	12-11-70	Kitty Hawk, NC	Trawl	1	10	4.5	78.5
	B00265	12-15-70	15 mi. s. Oregon Inlet	3-25-71	Bear Inlet, NC	Gill net	100	117	16.3	119.3
	B00269	12-15-70	15 mi. s. Oregon Inlet	12-23-70e	Albemarle Sound, NC	Gill net	8	--	2.7	69.1
						Mean	51.6	89.3	8.2	92.5

[a] Weight and length when tagged

definite mass movements toward fresh water in spring (May-June) and back to salt water in the fall (Sept.-Nov.). There were four recaptures of tagged Atlantic sturgeon of unusual interest: three liberated at Kamouaska and one at Isle aux Courdres, Quebec. After periods varying between 307-705 days, three of them were recaptured not far from Halifax, Nova Scotia, having traveled a minimum of 900 miles. The fourth fish was retaken near the Strait of Canso. The weights of these fish when recaptured, according to the fishermen, ranged between 6-24 pounds."e

3.62 Schoolinge

Although the species aggregates in rivers to perform spawning migrations, schooling in the true sense does not appear to exist for adults. Huff (1975) reports an observation of small sturgeon (less than 2.3 kg) schooled on the surface and rapidly leaving the Suwanee River in December and concluded that yearlings may participate in pre- and post-spawning migrations.

3.63 Stimulie

No studies were found on responses by Atlantic sturgeon to mechanical, chemical, thermal or optical stimuli. Dees (1961) described their curiosity as enormous. When feeding they will stop to look at any unusual object. Utilizing this characteristic, Indians and early settlers dangled bright red or green wooden decoys through spearing holes in the ice.

4. POPULATION

4.1 Structure

4.11 Sex Ratioe

Huff (1975) presents the only data on sex ratios:

"Pooled sex data (from the Suwanee River) (M301; F331) did not differ significantly from a 1:1 ratio. However, the G-statistic was highly significant for seasonal sex ratios, demonstrating considerable heterogeneity among seasons.

"Sex data partitioned and tested seasonally displayed significant deviation from 1:1 sex ratio in spring 1972-73. Fall 1972 was marginally insignificant (x^2=3.841; P=0.5; 1 df), suggesting it may be comparable to the sex ratio of fall 1973.

"Tables 12 and 13 indicate homogeneity between comparable seasons. This was tested using a posteriori test by STP (Sokal and Rohlf, 1969: 582). G-statistics thus developed demonstrated comparable sex ratios between like seasons favoring females during spring and slightly favoring males during fall.

"Sex data for spring of each year and fall of each year were combined and tested for homogeneity between contrasting migrations. The G-statistic thus developed was highly significant, demonstrating (as expected) heterogeneity of sex ratios between pre- and post-spawning migrations."

Huff concluded the differing sex ratios are indirect evidence of differential migration routes taken by pre- and post-spawning sturgeon. Assuming a 1:1 ratio overall, he finds it apparent that if females actively seek shallow water during spring and deep water during fall this would alter seasonal sex ratios in the catch.

4.12 Age Composition

No one has presented data on age composition of the population as a whole. Age composition of the Suwanee River commercial gill net catch is derived below from Huff's (1975) data:

Age Group	Percent
V	1.0
VI	7.7a
VII	23.4
VIII	32.4
IX	19.4
X	10.4
XI	2.7
XII	3.2

No data are available describing variations in age composition with respect to depth, distance offshore, density, time of day or season.

TABLE 12. Male, female, and total catch by year and season with male/seasonal total ratio (from: Huff, 1975).

	Male	Female	Total	Male Ratio
1972				
Spring	39	71	110	0.354
Fall	106	81	187	0.567
1973				
Spring	62	92	154	0.402
Fall	94	87	181	0.519
Total*	301	331	632	

* Table does not include 2 fish caught in Spring, 1973, with confused sex data.

TABLE 13. Summary of G-statistic analysis of sex ratios (Huff, 1975).

Test	df	G	Season	df	G
Pooled	1	1.364 ns	1972		
Heterogeneity	3	17.522 *	Spring	1	9.435 *
Total	4	18.886 *	Fall	1	3.334 ns
			1973		
			Spring	1	5.868 *
			Fall	1	0.254 ns
			Total	4	18.891

Difference between G-totals due to rounding error

* Significant at 5% level

ns-Not significant

Age of first capture has only been reported from the Suwanee River, Florida as age V, taken in a 10" stretch-mesh gill net (Huff, 1975). Huff also took juveniles in a 2 1/4" stretch-mesh trammel net.

Age at maturity has been covered in section 3.12. Maximum age is described in section 3.43.

4.13 Size Composition

There are no data for the whole population. Some local data exist including Figure 5 from Holland and Yelverton (1973) for Atlantic sturgeon collected off North Carolina. Their combined data show a peak at 95 cm. Modal sizes from the Suwanee River fell between 101-130 cm (Huff, 1975) with a total range of from 31-190 cm (FL). Greeley's report on Hudson River sturgeon showed a variation in fork length from 25 to 221 cm of fish varying from 3 to 13 years old. Dadswell reported (personal communication) a range of 15 to 130 cm (0+ to 16 age-groups) from St. John River, New Brunswick. From the St. Lawrence (Mangin, 1962; 1964), specimens ranged from 18 to 236 cm of fish from 1 to 60 years old.

4.2 Abundance and Density

There has been no long-term scientific sampling which would provide a relative measure of change in population size. Information from catch records are the only long-term indicator of changes in population abundance. Landing statistics are presented in Table 14 by state. Aside from these data, there are numerous accounts which testify to the former abundance of the species.

St. John River, New Brunswick

Catch data from the river were made available from Dadswell (pers. comm.) (Figure 6). He reported the present fishery is by gill net utilizing 13" mesh and according to fishermen, the population is increasing in size each year, with juveniles extremely abundant in the lower estuary.

New England - In Maine the sea sturgeon is (or was) well known in the St. John, Pennobscot and Kennebec Rivers. Bigelow and Schroeder (1953) made the following comments...

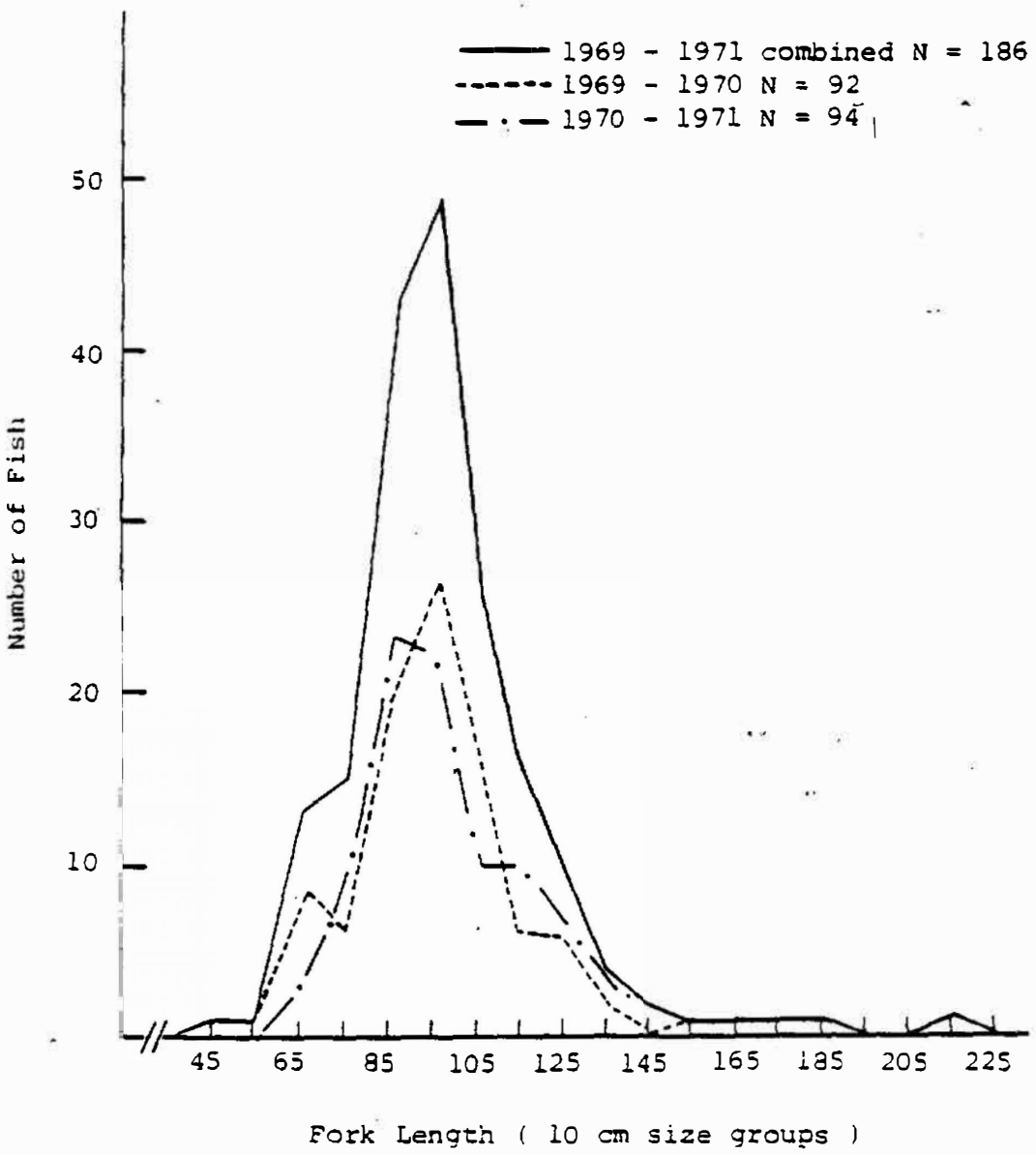

Figure 5. Length-frequency distribution for Atlantic sturgeon, offshore North Carolina, 1969-1971 (from Holland and Yelverton, 1973).

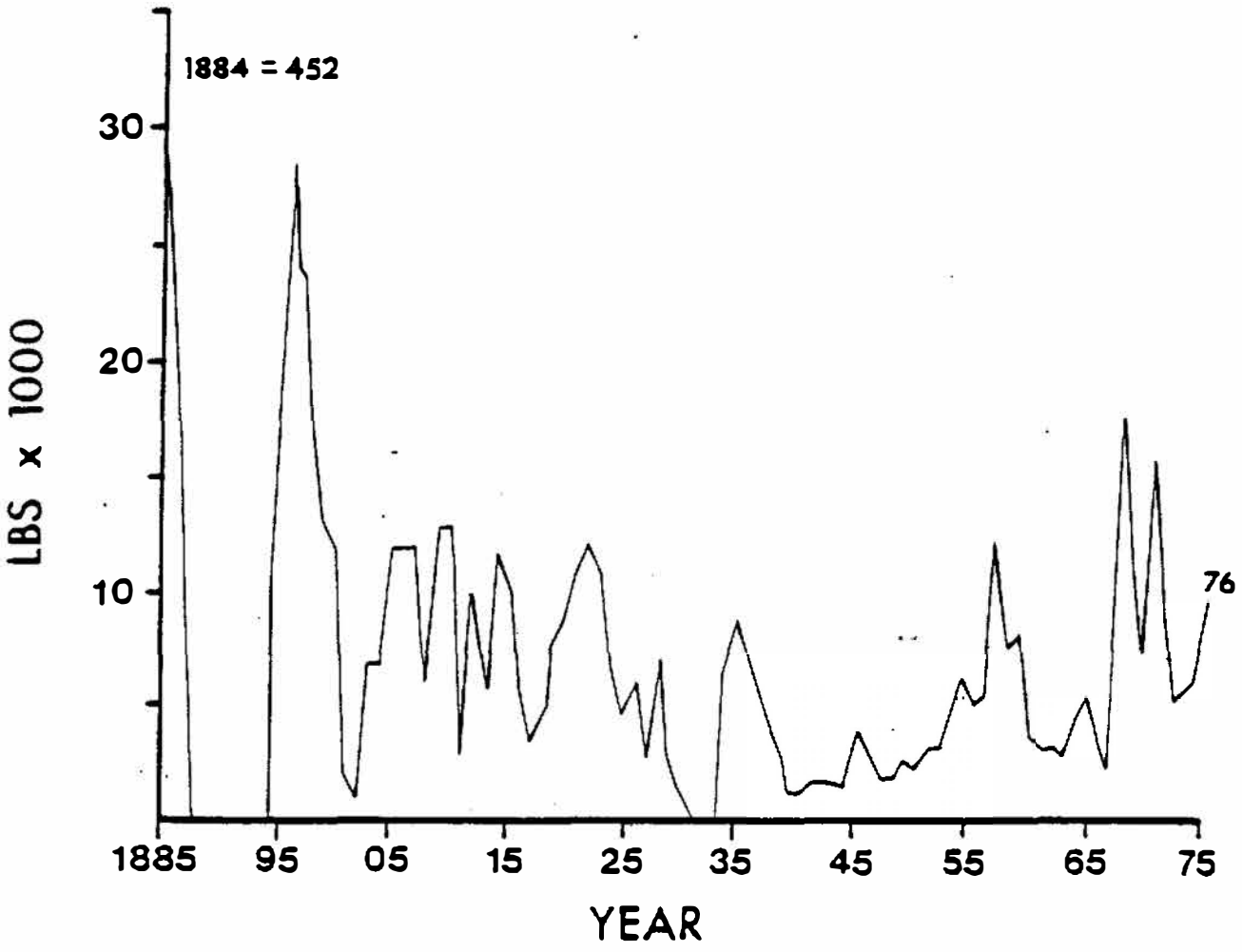

Figure 6. Annual catch of Atlantic sturgeon since 1885 from the St. John River, N. B. (from Dadswell, pers. comm.).

"It is interesting, for instance, to read that sturgeon, doubtless from the Kennebec River and cured near what is now New Brunswick, Maine, were shipped to Europe as early as 1628; ... In the Kennebec, where an intermittent fishery had long been maintained the catch was about 250 fish in 1880, yielding 12,500 pounds of meat, and not much less in 1898 (10,875 pounds). But the yearly landings were only about one fourth as great there (2,777 pounds) by 1919. And the reported landings of sturgeon from the entire coastline of Maine (including what few were brought in from offshore) had fallen to only 300 pounds in 1940, and 400 pounds in 1947."

Construction of impassable dams in the early 19th century (1807 at head of tide on the Androscoggin River and 1837 at head of tide on the Kennebec River) and increasing water pollution during the post WW-II era reduced these populations to extremely low levels. Limited commercial and sport fisheries continue to harvest small numbers of these remnant anadromous stocks (Squires, pers. comm.).

The Atlantic sturgeon, considered uncommon in Maine, is taken incidentally by commercial fishermen. From 1970-1975, the average annual Maine sturgeon landings were 1704 lbs. with a low of 318 lbs. in 1973.

Jerome, et al. (1965) reviewing the history of fishing in the Merrimac stated:

"Sturgeon fishing was a very important industry during colonial days and lasted until the late 1800's. In the early 1600's, the Merrimack River was known as one of the two best sturgeon fishing areas in the colonies. Pickled sturgeon sold for 100 shillings a keg in 1656. By 1663, the pickling industry became an important export business...

"As late as 1887, two tons of sturgeon were taken from the river in one week in August by a group of visiting commercial fishermen. This was the last recorded date for successful commercial sturgeon fishing found in this review. The sturgeon fishery lasted over 200 years and contributed a great deal to the economy of the area. It is a sad testimony to man's interference with natural resources that this great fishery has disappeared. Occasionally a sturgeon is taken or seen in the Merrimack River, but the instances are few and the fish are usually small. However, in 1938, a 230-pound sturgeon was taken above Carr's Island in nets set for blueback herring."

Historical testimony to the early significance of the resource to New England is made by Hoover (1938).

"William Wood in his "New England's Prospect" which was published in 1634, also in London, speaks of the sturgeon as follows: "The sturgeons be all over the country, but the best catching of them be upon the shoales of Cape Codde and in the River of Merrimacke, where much is taken, pickled and brought for England, some of these be 12, 14, 18 foote long." William Wood's mention of the sturgeon of the Merrimack is considered to be the first published New England record.

Hoover continues - "During their spawning migrations Common Sturgeon formerly ascended the larger rivers of the Atlantic Coast in great numbers. But the exploitation of the fishery to obtain caviar so depleted their ranks that even in rivers where no barriers exist they are on the verge of extermination.

"Since the construction of the first dam in the Merrimack at Lawrence during 1847, sturgeon have been prevented from reaching the New Hampshire portion of the river. That they formerly entered the State is attested by the following excerpt from the diary of Matthew Patten (p. 96) under date of July 6, 1761: "we catched 2 salmon that weighed $18\frac{3}{4}$ and I had them both 1 was masht in the nett on saterday night the other we catched on Monday Morning and in the Evening we haulled the catched 6 Salmon that weighed $85\frac{1}{4}$ we alowed Nathaniel Patterson one that weighed $24\frac{3}{4}$ and I had 2 that weighed $30\frac{1}{4}$ and in the forenoon I went to Thos Halls being the day appointed for holding their first meeting after Incorporation and I carried Hall 2 salmon that weighed 23 ℔ and in the evening we sett the net and catched a Storgion that weighed 94 ℔ whole and was 6 feet & 2 inches in Length and I had him." It is evident from a perusal of Patten's diary that he fished at the Amoskeag Falls at Manchester.

Galligan (1960) reviewed some of the early history of the sturgeon fishery of the Connecticut River. He recounts: "Spawning migrations were made by sea sturgeon in June and July. Their migrations were not as long as those of the salmon or shad and they are not known to pass above the Enfield Rapids Dam, 64 miles above the river mouth.

"The center of the sturgeon fishery appears to have been located in the town of Cromwell."

"In the mid to late 1800's a few crews of fishermen engaged in this rather specialized fishery for sturgeon in late June, July and August.

"One of the most popular methods of sturgeon fishing was by drifting the various reaches with large mesh gill nets. The gill nets were constructed of No. 29 to No. 32 soft lay cottom thread, had a stretched mesh size of 12 to 13 1/2 inches and were 25 to 40 meshes deep. When hung, these nets were approximately 400 feet long and 15 to 20 feet deep. A catch of four sturgeon a week was a good record for an experienced crew. Another popular method of taking sturgeon was to make a quick haul with a heavily leaded 300 to 400 foot hauling seine in the pool just above the riff. This method of fishing proved very successful when large numbers of sturgeon were present. The years 1903 through 1905 were some of the best for sturgeon fishing... at that time sturgeon roe or the flesh of these fish sold for 15 to 18 cents a pound. Although it is quite easy to exaggerate the size of these giant prehistoric fish it has been estimated that the size of mature roe or female sturgeon from the Connecticut River ran from 200 to 300 pounds. The male or buck fish were considerably smaller and ran from 90 to 135 pounds. Fishermen usually counted on an average roe fish producing 60 pounds of caviar. They figures on a price of $70 or $80 for an average female fish captured and processed (roe and flesh). A newspaper article in 1925 documents one of the last large sturgeon caught in the Connecticut River. There may well be as many sturgeon inhabiting the same portions of the river as existed one-half century ago. The occasional capture of a sturgeon by a dragger off the mouth of the Connecticut River, as well as occasional large rips found in a shad fisherman's net, and observations of the playful leaps of large sturgeon by sport fishermen at the Enfield Rapids Dam, testify to this possibility."

New York - Sturgeon fisheries on the Hudson and in other New York waters declined rapidly at the turn of the century as evidenced by Evermann (1904):

"The sturgeon fishery shows a remarkable falling off, the value of the product decreasing from $46,573 in 1898 to $8,323 in 1901. This fish is now very scarce, not only in Hudson River, but also along the south side of Long Island, where it was secured in abundance six years ago. A large percentage of the sturgeon taken in Hudson River are small-under 20 pounds in weight-and are known locally as "peelicans". In 1892 the State interdicted the capture of these small fish, and this is expected to have a beneficial effect on the abundance of mature sturgeon.

"The catch of sturgeon on the south side of Long Island furnished an instance of the development and decline of coastal fisheries. The fish are taken by means of floating gill nets with 12 or 14-inch mesh, operated during May and June, and also to a limiteda extent in September. The nets are set 1 or 2 miles from thea shore from Blue Point to Montauk Point, and especially offa Amagansett, Wainscott, and Westhampton. This fishery begana in 1892. In 1896 there were 103 men employed, using 37a boats and 223 gill nets, and the catch of sturgeon amounted toa 314,430 pounds, gross weight, worth $15,125. In 1898, whena the fishery probably reached its greatest development, 187a men used 70 boats and 454 nets, and the gross weight of sturgeon secured was 509,365 pounds, worth $43,864. Notwithstanding aa large increase in the quantity of twine used by each boat, thea average catch of fish in succeeding years showed a great decrease, and in 1901 the 57 men, using 25 boats and 257 nets,a secured only 65,130 pounds, gross weight, or sturgeon, wortha $4,801. This fishery is so unprofitable at present that ita promised to become extinct in a few years."a

A similar report for 1904 stated:

"The sturgeon fishery...has become almost extinct, the value of the output in 1904 amounting to only $1,010 (Anonymous, 1907)."

Delaware - Jordan and Evermann (1923) refer to the impression sturgeon made on William Penn and the botanist, Peter Kalm, both by its size and immense numbers which they noted. As late as 1820 thousands could be seen in the lower Delaware River.

"Not until about the middle eighteenth century did the sturgeon begin to receive attention as a food-fish. Few ate sturgeon, though occasionally a family would fry a few steaks and serve them with cream. The roe was considered worthless except as bait for eels or perch, or to feed to the hogs. From 3 to 4 cents a pound were the best retail prices that could be obtained for the meat and usually only 25 or 30 cents could be had for a whole fish. About 1870, however, the meat of the sturgeon began to command a fair price, since which time the price has greatly increased and the abundance of the sturgeon has decreased proportionally. In 1890 the average catch of sturgeon in the Delaware River was 60 per net; since that year the decrease has been gradual and rapid, until in 1899 the catch was only 8 fish to the net. The total catch for the Delaware River in 1890 amounted to 5,023,175 pounds, while in 1897 (the last year for which complete statistics are available), the amount was only

2,528,616 pounds. The taking of the roe for caviar began in this country as early as 1853, and the smoking of sturgeon was begun about four years later."

"Ryder (1890) recognized "the Delaware River and Bay is the principal resort of the common sturgeon and the seat of the only profitable fishery of the Atlantic coast. The amount of capital invested in boats, nets, and small sloops engaged in this business on the Delaware is very considerable. The experience of the dealers and fishermen shows that a steady falling off has occurred in the catch within a few years. This, coupled with the circumstance that the fishery is now only profitably conducted south of Wilmington and that the Delaware now has the only profitable sturgeon fishery north of Florida is sufficient to prove that it is high time that something was being done to stay the extinction of this fish. The total value and enormous yield of eggs of the Delaware fishery may be inferred from the fact that a single caviare packer collected and shipped about 50 tons of this product to Europe during the season of 1888. The great demand for the caviare has, within a very recent period, made the fishery profitable to the fishermen, many of whom own their boats and gill-nets. From all the information that I can gather, it is safe to assume that the annual value of the Sturgeon fishery of the Delaware must be somewhere between $100,000 and $200,000 per annum. This industry may be maintained by prompt and efficient action and to this end it is the hope of the writer that the foregoing account of experiments, results, means of maintaining and increasing this industry is through the artificial propagation of this fish, which I have every reason, to think may be successfully accomplished at a comparatively insignificant outlay."

Beck (1973) concluded that Ryder's greatest concern was for the overfishing of the sturgeon, and eventual extinction, if his warnings were not heeded. The most important event that was indicated in Ryder's report, but not considered at that period of time, was the drastic decline in sturgeon habitat. Ryder states the fishery was then only profitably conducted south of Wilmington. History shows that in the early 1800's sturgeon were abundant throughout the entire Delaware River below the fall line at Trenton, New Jersey.

"Even in those early years, pollution and poor water quality could have been having their effect on the fishes that went up the Delaware River in the spring to spawn, particularly upon the sturgeon which is strictly a bottom feeder and dependent upon the various forms of small bottom organisms which are produced in the clean fresh waters of the Delaware River.

"It is reported in the U. S. Corps of Engineers "History of Delaware River Dredging" that coal silt in the upper Delaware River was one of the major pollution problems from the years 1820 to 1940 and to quote Mr. Ryder: "It is quite certain from what has proceeded that if the minute life upon which the sturgeons subsist were exterminated, the sturgeon would also become extinct."

"It could be concluded from interviews with older residents of Delaware City and Port Penn that the great sturgeon industry in the Delaware River was in trouble. From 1888, the catch went down rapidly from hundreds of fish a season for the individual fisherman to two or three roe fish a season, if they were lucky" (Beck, 1973).

Historically the sturgeon used an area 25 to 65 miles south of Philadelphia in brackish waters of the Delaware for spawning. Young stages were taken abundantly from under the ice in tidal freshwater in mid-winter. Occasionally, sturgeon were reported as far north as Port Jervis.

Chesapeake - Historical prevalance in the Chesapeake is summarized by Hildebrand and Schroeder (1928):

"At one time the sturgeon was caught in large numbers throughout Chesapeake Bay but has become scarcer, and now it is seldom found north of the mouth of the Potomac River. Fishing is done so intensively that very few are able to reach the headwaters of the bay.

"A great decrease in the sturgeon catch occurred after the year 1897, followed by a further decline after 1904, since when it has never been taken in anything like its former abundance.

"Inquiries around the bay during 1921 and 1922 elicited the fact that sturgeons were scarce everywhere and had been for many years.

"In comparison with the present-day scarcity of sturgeons, the catches made in the following rivers during 1880 show that at one time this fish was abundant in the Chesapeake drainage: James River, 108,900 pounds; York River and tributaries, 51,661 pounds; Rappahannock River, 17,700 pounds; Potomac River, 288,000 pounds.

"It is a matter of common knowledge that at one time sturgeons were considered worthless and large numbers were destroyed annually by fishermen, who regarded them as a pest. Their value gradually became apparent, however, and a special fishery was inaugurated. Being a large, sluggish fish, it was easily captured in great numbers, with the result that each year the aggregate catch became smaller and smaller.

"At the present time most of the sturgeons are caught incidentally in pound nets, but a few are taken in gill nets.

"The rapid decline in the abundance of the Chesapeake Bay sturgeon has caused the enactment of laws for its protection. The Virginia law states that no sturgeon less than 4 feet long may be removed from the waters of the State. The Maryland law states that no sturgeon weighing less than 20 pounds may be caught or offered for sale, and that no sturgeons whatsoever might be taken during the 10-year period from 1914 to 1923."

North Carolina - Smith (1907) documented the Atlantic sturgeon's decline in North Carolina starting from a reference in 1709.

"Of the sturgeon we have plenty, all the fresh parts of our rivers being well stored therewith. The Indians upon and towards the heads and falls of our rivers, strike a great many of these, and eat them; yet the Indians near the salt-waters will not eat them. I have seen an Indian strike one of these fish, seven foot long, and leave him on the sands to be eaten by the gulls. In May, they run up towards the heads of the rivers, where you see several hundreds of them in one day.

"The available statistics of the sturgeon fishery of North Carolina show a very irregular production, owing to changing conditions, such as non-appreciation, over-fishing and increasing demand.

"Dare County now produces the great bulk of the sturgeon placed on the market, the fish being caught in gill nets. This species is now much less abundant than formerly, and in North Carolina has undergone the same diminution seen in other states. Whereas it was formerly regarded as a nuisance, and ruthlessly destroyed and thrown away whenever caught, it is now one of the most valuable of the east coast fishes.

"In some of the large shad seines in Albemarle Sound it has sometimes happened during the past 7 or 8 years that not a single adult sturgeon has been caught during an entire season, whereas, 20 years ago sturgeon were abundant here and each season the shores were covered with dead fish for which there was no sale. When the fishermen finally realized the value of the fish, they pursued the fishery so actively that the species was almost wiped out in a short time and has never been able to reestablish itself.

"In one season $50,000 worth of sturgeon caviar was prepared in the Albemarle region."

South Carolina-Georgia - Leland (1968) reviewed the history and status of Atlantic sturgeon fisheries in South Carolina. Excerpts from his account follow:

"The sturgeon fishery of South Carolina 1967 is limited to those streams rising sufficiently far inland to have a strong flow of fresh water before entering the estuarine areas bordering the Atlantic Ocean. While some small streams (Stono River, Awendaw Creek, May River and Ashley River) have a history of being sturgeon habitat many years ago, they no longer appear to attract this species, thus limiting the fisheries to the Waccamaw-Peedee, Santee-Cooper, Edisto, and the Ashepoo-Combahee systems.

"Early settlers reported both sturgeon and shad in the major rivers above the Fall Line and there are unsubstantiated reports of the fish being caught as far as Talullah Falls on the Savannah, at the foothills of the Appalachian Chain. Mill dams and water supply dams on the Peedee, Wateree, Congaree and Savannah effectively blocked fish passage however and since the 1870's at least, sturgeon have been limited to the lowland sections of the rivers.

"The sturgeon was reported in the listings of fishes by all of the early explorers of the South Atlantic Coast. The first settlers reported huge numbers of very large sturgeon in the rivers each spring.

"Before the Piedmont Plateau was settled and forest clearing caused erosion of the clay soils, the State's rivers were clear streams. Agricultural land erosion and development of water-powered mills on the Fall Line rapids blocked upstream migrations.

"The sturgeon was not regarded as a food fish by South Carolinians to any great extent until after the Civil War. During the 1870's, Swedish immigrants from Delaware began fishing the Winyah Bay area each spring. Their arrival there coincided with a decline in the sturgeon catch in Delaware Bay and the development of fairly fast rail service from South Carolina to northern metropolitan centers where both sturgeon meat and caviar were marketable commodities. No federal or state records exist to show the catch prior to 1880 but that year 2,209,150 pounds of sturgeon were reported harvested on the Atlantic Seaboard, South Carolina's share being 271,908 pounds. By 1890 South Atlantic catch had fallen to 504,799 pounds with South Carolina producing 205,962 pounds of that year's sale. The over-fishing of the Delaware-Chesapeake areas and the fact that a commercial ice plant was built in Charleston in 1877 perhaps coincided to keep this State's sturgeon fishery stable. Prior to 1877, all ice had to be brought to South Carolina by ship from New England and was very costly, sometimes as much as a dollar a pound in the 1850's.

"Despite abundance in South Carolina waters, Smith (1893), noted the decline of catch in the South Atlantic region and wrote:

> 'The most notable decline in fisheries in the 1880-90 period was sturgeon. The decrease of 80% in the yield of sturgeon during the past 10 years argues very unfavorably for the continuance of the fishery and there is reason to believe too that the record at the end of the next decade will disclose a practical absence of this valuable resource from the fisheries of the South Atlantic States.'

"By 1930 the total catch in the South Atlantic States was down to 30,474 pounds and in 1940 it was 11,500 pounds. South Carolina produced 14,964 pounds in 1930 and 3,400 pounds in 1940.

"By 1944 South Carolina sturgeon netters reported that the average size caught was about 75 pounds as compared with the 300 pounds average 15 years earlier. This was despite a three year closed season imposed on South Carolina waters by the General Assembly in 1937 covering 1938-40. The law was repealed March 21, 1940. However, both federal and state statistics clearly show the law was not obeyed.

"For all practical purposes commercial sturgeon fishing in South Carolina (from the late '30's) has been limited to less than a dozen fishermen and one dealer. In 1967 there were no licensed sturgeon fishermen of record operating solely on the Edisto,

Combahee, Ashepoo and a single sales outlet in Savannah was obtaining limited quantities of sturgeon and roe from the Savannah River. Most of the sturgeon netters feel that it is no longer profitable to fish for the species because of the uncertainty of the sturgeon population and the fluctuation of the market.

"Sturgeon nets are set offshore at the beginning of the season. During the 1967 season, the only offshore nets reported were near the mouth of Winyah Bay. The nets are usually kept offshore for about four to six weeks. They are moved inshore coincident with the arrival in large numbers of such "trash" fish as the sting ray, skate, shark, as well as sea bass, drum, tarpon and cobia. These usually arrive when water temperatures are rising and the sturgeon are beginning to move into the bays and estuaries. On March 11, 1967, three 600-foot nets off North Island produced 27 bull sturgeon.

"The coincidence of the shad and sturgeon fishing seasons in South Carolina and the resulting kill of young sturgeon by shad netters could be a major factor in the decrease in the sturgeon population. The shad fishery is a well established one, however, and any move to change methods, dates and area regulations would meet with strong opposition. There is practically no market for small sturgeon (3 to 12 pounders) and these are not taken in the sturgeon nets anyhow. The shad fishermen who illegally take them frequently kill them before tossing them overboard using a small "billy club" or baseball bat for the purpose.

"In recent years, the Cooper River has become one of the better producing sturgeon areas in the State during the April 15- June 15 period. Construction of a dam at Wilson's Landing, on the Santee River about 50 miles from the ocean, in 1942, blocked upstream migrations of all fishes at that point. However, below the dam shad fishermen reported catching large numbers of small sturgeon during the early season."

G. B. Goode and associates (1887) reported:

"On March 6 we found quantities of sturgeon moving up the river (Edisto) 40 miles above the mouth. Indeed they almost caused a closed season for the shad fishermen by running in their nets and tearing them to pieces."

"The Edisto River is the largest of the State's clear water streams and also produces the best quality sturgeon meat, in the opinion of commercial fishermen.

"The Edisto and its sister streams Combahee and Ashepoo (q.v.) were not producers of any large amounts of sturgeon during recent years; the primary reason being the fact that the State's only dealer is in Georgetown, nearly 100 miles away.

"The Edisto is practically unpolluted at this time and the clearness of its waters as well as the profusion of aquatic plants and the presence of crustacea and mollusks make it, perhaps, the State's finest potential sturgeon habitat. Edisto shad netters, however, are quite frank in stating that they kill all sturgeon because of the potential damage the sturgeon offers to shad nets when it matures. Since there are many residents of the river area who illegally fish for shad as a hobby and not commercially, it is not possible to estimate the annual kill of sturgeon but is is considerable even when based only on the statement of commercial shad netters.

"Very little sturgeon fishing has been done on the Combahee and Ashepoo rivers.

"The Savannah River forms the Georgia-South Carolina boundary and all fish caught in the river are sold in Savannah. There are no appreciable South Carolina creeks into the stem while the Georgia shore has several feeding into the river. A dam at Augusta (about 200 miles upsteam) has barred migration of all fish beyond that point for more than a century. Sturgeon were observed in the Savannah during the months of June, July, August and September about 20 miles above the heavily polluted Savannah port area to within about 50 miles of Augusta."

The most evident result of Leland's (1968) study was the discovery that fewer large (75 pounds and over) sturgeon were being taken than at any time before in the history of South Carolina sturgeon fishery. There were also fewer persons licensed as sturgeon fishermen than in the 1880's when records were initiated. Leland concluded the sturgeon is in a critical situation in South Carolina and may disappear from the State's waters. Major enemies of the fish are shad fishermen, pollution, riverside housing developments and destruction of ecological situations necessary to the sturgeon. He recommended legislation be sought immediately to correct existing negative situations whenever possible and to prevent extension of man-made problems deleterious to the fish.

A fisheries research survey of Georgia coastal waters from 1970-1973 (Mahood et al., 1974,a,b,c,d) reported sturgeon in low abundance in Ossabaw Sound, Doboy Sound, St. Andrews Sound

and Sapelo Sound. Dates of capture ranged from October to May.

Florida - A once large and lucrative Florida industry, sturgeon fishing has been reduced to a small fraction of its former importance. Ingle and Dawson (1952) reviewed records and concluded that although sturgeon are not uncommon in the bays and rivers of both the eastern and western parts of the State the supply has generally become exhausted after a few seasons in all localities where, in former years, the fishery was engaged in.

In eastern Florida, the catch of sturgeon in 1889 was 40,620 pounds, and in 1890 it was 28,055 pounds, but since that time very few have been taken.

Huff (1975) provides a history of sturgeon fishing in Florida and recognized the first active fishery in Tampa Bay.

"This short-lived fishery, conducted only during the winters of 1886-89, was abandoned in 1890 when only seven fish were caught during the previous season. Occasional sightings of sturgeon and captures of individuals in the Tampa Bay area have been reported since the fishery's demise.

"Five years later (late 1895), gill netters were sent from Cedar Keys to conduct exploratory sturgeon fishing in the mouth of Suwanee River. The expedition was successful and an active gill-net fishery, employing about 30 fishermen, was begun November 1896. Records indicate that sale of flesh and not caviar was the prime motivation of most in the Suwanee River fishery. Catch recorded for 1897 in Levy County (Suwanee River) was 9,254 lbs. (4,206 kg), worth $331, constituting the entire reported Florida sturgeon landings for that year.

"Franklin County, bordered by Apalachicola and Ocklockonee Rivers, became a prominent producer of meat and caviar by 1900. Sturgeon fishing was first begun on Ocklockonee River in 1898 (no report for Apalachicola River), and statistics for both rivers were first reported for 1900. Commercial fishing for sturgeon in Choctawatchee Bay and River, Escambia Bay and River, and Blackwater River (northwest Florida) began in 1901 with catch statistics first reported for 1902.

"Sturgeon landings for west Florida were again reported in 1917, but no specific catch data were given. Annual catch for previous years on Apalachicola River was generally estimated at 20,000-60,000 lbs. There was no mention of the Suwanee River fishery."

Huff concluded that although the history of most United States and Florida sturgeon fisheries has been one of overfishing and decline, the Suwanee River fishery has remained viable. Current fishing pressure is limited by geographical river characteristics and fishing techniques. Continued harvesting of commercial stocks is not endangered as long as current levels of exploitation by 10-in. gill net are not greatly exceeded.

Gulf of Mexico - West of Florida, Atlantic sturgeon were never exploited in large quantities. They presently appear on the endangered species list of the State of Mississippi and therefore cannot be harvested. However there is a reproducing population of Atlantic sturgeon in coastal streams of Louisiana that supports a minor commercial fishery (Davis et al., 1970). Sturgeon have been reported in Louisiana from the tributary streams of Lakes Borgne, Pontchartrain, and Maurepas (Davis et al., 1970). Gowanloch (1933) reported that Louisiana fishermen occasionally capture large common sturgeon in the waters around the mouth of the Mississippi River and also in Mississippi Sound.

We have not found any documentation of sturgeon reported in the fish surveys of Texas waters.

As reported earlier there have been no consistent, continuing studies of sturgeon as a result of standard sampling methodologies. However Mahood, et al. (1974, a,b,c,c) and Davis, et al. (1970) report on relatively short-term censuses in Georgia and Louisiana respectively.

Sound-Estuary	lb/trawl
St. Andrews	0.2
Doboy	0.3
Sapelo	0.2
Ossabaw	0.3
East Pearl River, La.	0.1 fish/trammel net days

In the historical literature, references are made to typical daily catches, with little regard to describing method of fishing or gear characteristics. However the following series of average catch per net from Cobb (1900) correlates roughly with the historical decline in the Delaware River:

Year	Catch
1890	60
1891	55
1892	43
1893	32
1894	26

Year	Catch
1895	32
1896	27
1897	20
1898	14
1899	8

There are no estimates of riverine population size available from any locations. Refer to section 5.3 for information on seasonal variation, since fishing effort generally parallels availability.

4.3 Natality and Recruitment

4.31 Reproduction Rates

No data are available on either egg production rates or survival rates of eggs and larvae.

4.32 Physical Factors Influencing Reproduction

Physical influences include pollution and construction of dams. Prominent examples are the Merrimack's dam at Lawrence (1847) which precluded movement in New Hampshire waters (Hoover, 1938), and the Connecticut River dam at Enfield Rapids (Galligan, 1960). In the Delaware most investigators blame overfishing and pollution as principal causes for the significant decrease in the sturgeon stocks (Ryder, 1888; Dees, 1961; Beck, 1973). Pollution eliminated the run in the Sampit and Lynches Rivers in South Carolina (White and Curtis, 1969).

4.33 Recruitment

No states presently have an adequate data base or programs to assess recruitment to the fishable stock. Factors which work against the stock include the relatively long juvenile phase (section 3.12). Juveniles remain in the river and may inadvertently enter and be harvested by other fisheries such as for shad in rivers or shrimp in bays and sounds (Leland, 1968). No data exist which document variations in annual recruitment or the relation of recruitment to stock size. Investigators at the turn of the century recommended rehabilitation of specific river populations by means of artificial propagation (e.g. Cobb, 1900; Ryder, 1890).

4.4 Mortality and Morbidity

The only estimate of mortality is from the Suwanee River (Huff, 1975):

"Z, calculated for aged sturgeon in spring and fall 1973, was 0.4479 and 0.9284, respectively. The mean of these two values (Z=0.6882) compares favorably to that calculated from all aged sturgeon caught in gill nets (Z=0.6212).

"Slopes of the descending limb of the age-frequency curve can be represented by the geometric mean estimate of the functional regression...

"This slope (v=0.7447), which was calculated from all aged sturgeon, ages 8 to 12, is similar to total instantaneous rate of mortality calculated for the same group of fish (X=0.6212).

"Percent survivorship between successive years from ages 8 to 12 is represented by the natural antilog of Z x 100. Z=0.6212 then; %survivorship= $e^{-0.6212}$ x 100 = 53.73%."

Drawing from Leland's statement (1968) that longnose gar have been observed attacking schools of young sturgeon, White (1970) concluded the tremendously increased gar population of the Ashepoo River can be considered a possible factor in the sturgeon's decline. Although no bioassay data on the species is available, industrial pollution has been alluded to as a factor contributing to decline (Dees, 1961).

Vladykov and Greeley (1963) summarize as follows:

"At the turn of the century, when Sturgeon were caught in very large numbers and when mature individuals were the mainstay, fishing was so intensive that very few fish were able to reach the upper waters to spawn. This was probably one of the reasons for their great decrease in subsequent years. Also, the building of dams in many important rivers (e.g. the Susquehanna, Maryland) deprived Atlantic Sturgeon of their favorite spawning areas, and pollution by wastes of all kinds from the factories and by municipal sewage from the towns and cities along the Atlantic shore aided in reducing still further the local populations."

Leland (1968) considered the shad fishermen who kill young sturgeon that become enmeshed in nets to be the most lethal unnatural enemy.

4.5 Dynamics of the Population

No data available.

4.6 The Population in the Community and the Ecosystem

The Atlantic sturgeon generally maintain a demersal existence over sandy or muddy stretches of the river. Their riverine associates are reflected in their diet (section 3.4). Other anadromous fish associated with their general habitat include American shad, alewife, blueback herring, hickory shad, shortnose sturgeon and striped bass.

5. EXPLOITATION

5.1 Fishing Equipmente

Galligan (1960) described the Connecticut gear as follows:

"One of the most popular methods of sturgeon fishing was by drifting the various reaches with large mesh gill nets. The gill nets had a stretched mesh size of 12 to 13 1/2 inches and were 25 to 40 meshes deep. When hung, these nets were approximately 400 feet long and 15 to 20 feet deep. Strange as ite may seem, gill nets were drifted without benefit of lead ore weight on the bottom, and further, they did not even have ae bottom line or maitre cord to which the leads are normallye attached. In order to add some weight to the net, however, fishermen would lay their nets out on a muddy sand bar for ae few days prior to the time of fishing. Fishermen describede such nets as being "Mudded" and obviously this treatmente allowed small grains of sand, grit or mud to become impregnated in the soft lay cotton, causing the net to sink.e

Cobb (1900) commenting on the sturgeon fisheries of Delaware Bay states:

"For the capture of sturgeon gill nets are used exclusively. These usually average about 250 fathoms in length, and are worth, all rigged ready to be put in the water, $75 each. They are usually about 28 meshes, or 21 feet, in depth and have a stretch mesh of 13 inches. About ten years ago a mesh of 16 inches was used, but owing to the decrease in the number of large sturgeon the mesh has been reduced so that more small fish will be taken. A few sturgeon are also taken incidentally at the seine fisheries along the river, but they form a very insignificant part of the total catch."

"The nets are always drifted. The fishermen generally go out about two or three hours before slack water and put their nets overboard. As the fish feed near the bottom, the nets must be arranged so as to reach close to the bottom. This is done by sinking the cork-line the necessary distance below the surface by means of extra heavy leads on the lower line, and the net is kept track of by attaching to it wooden buoys, called "dabs", by means of ropes. The fishermen drift along behind their net, usually about the middle of it. Should a buoy indicate that anything has been captured in the net, the fishermen at once take in that section, and if a fish has been gilled it is hauled into the boat and the net is reset."

Huff (1975) said:

"Five different techniques have been used to capture sturgeon in the Suwanee and other rivers of northwest Florida. Apparently, drifted gill nets were exclusively used through 1929, but in 1972 accounted for only 13% of the annual whole catch. Pound nets and runaround gill nets were introduced in Suwanee River in 1930-31. In 1932, pound nets were discontinued and replaced by more effective trammel nets. By 1945, only trammel nets were reportedly used in Suwanee River. Presently, anchored gill nets are the principally employed and most effective fishing gear used in the river."

5.2 Fishing Areas

The principal Quebec catches are made with weirs situated along the southern shore of the St. Lawrence River, from Rivière Ouelle to St. Nicholas. Some fish are also taken regularly with gill nets in the same area. Along the northern shore of the St. Lawrence, some large fish are caught in either weirs or in salmon nets, particularly in the estuaries of Rivière-aux Outardes and Rivière Manicouagan, and occasionally large fish are taken at Sept Illes (Vladykov and Greeley, 1963). In 1878 the center of the sturgeon fishery in the Hudson River was at Hyde Park (Anonymous, 1878). The present fishery extends from Bowline Pt. in Upper Haverstraw Bay, 4 miles upstream to Peekskill (Dovel, pers. comm.).

Describing the old fishing grounds of the Delaware River, Cobb (1900) wrote:

"The fishing grounds on the New Jersey side are located between Cape Shore and Fishing Creek, in Cape May County, and Penns Grove, in Salem County, the principal fishing being near Bayside. The more important fishing camps are at Cape Shore, the mouths of Fishing Creek and Cohansey River, Bayside, and the mouths of Alloways and Hope Creeks. A small fishery is also carried on in the Maurice River.

"In Delaware the principal grounds are between Mispillion Creek and Delaware City, and principal camps are at the mouth of Mispillion Creek, at Bowers Beach, Rays Ditch, at the mouth of Blackbird Creek, Port Penn, and Delaware City.

"In Pennsylvania the fishery is usually carried on from Marcus Hook and Chester. Owing to the closing of the season on June 30, the fishing by Pennsylvanians in the locality is practically a thing of the past, as the fish do not usually reach there until after that date."

Presently, Delaware sturgeon are taken as a bycatch of shad and striped bass fisheries principally in an area from Liston Point to Port Penn in the vicinity of the Chesapeake-Delaware Canal (Beck, pers. comm.).

For the Chesapeake, Hildebrand and Schroeder (1928) mention their capture in pound nets located in Lynnhaven Roads, Ocean View, Buckroe Beach, Lewisetta, Solomons, Love Point and Havre de Grace.

Writing in 1907, Smith reported the bulk of market sturgeon from North Carolina were caught in gill nets and landed in Dare County.

From South Carolina Atlantic sturgeon fisheries are from:

Cooper River (Yellowhouse Creek to Wadboo Creek)
Santee River (up to Wilson's Landing)
Edisto River (Caw Caw Swamp, Four Holes Swamp, Jennings Quarter, Young's Island, Pou's Mill and Cooper Swamp)
Combahee and Ashepoo Rivers (St. Helena Sound)
Savannah River (up to Augusta) (Leland, 1968).

Huff (1975) reports:

"Sturgeon in the Suwanee River migrated more than 200 miles (322 km) upstream, but were only netted in the first 30 river miles (48 km). In spring 1957, Jim Woodruff Dam was completed across Apalachicola River at the Georgia-Florida state line. A hook and line sport fishery developed at the dam's base beginning in August 1962. This fishing was conducted from April through June, and August through September."

5.3 Fishing Seasons

The major river fisheries are normally associated with the spring migration. A smaller fishery sometimes develops for downrunners in the fall. In the Delaware, Cobb (1900) said the fishing season began in early April and closed about the middle of June, depending

on the run of fish -- sometimes closing earlier, and again, if fish are plentiful, continuing until the end to the legal season, June 30. Ryder (1890) observed the Delaware City fishing season to peak during May and June, with fish caught during the summer and autumn until as late as September and October.

Hildebrand and Schroeder (1928) report most sturgeons in Chesapeake Bay are taken during April and May.

In Florida fishing seasons have historically varied among areas. Huff (1975) said:

"The earliest fishery in Tampa Bay exploited populations during 'winter months'. Presumably, this included December, January, and February, which presently have low monthly landings. Although sturgeon were taken during only half the time they were available (prespawning migrations, if occurring, appeared unexploited), stocks were quickly depleted and the fishery was abandoned after only three years. The early Suwanee River fishery was February 1 to May 1, which obviously excluded exploitation of fall migrations. Sturgeon fishing in Apalachicola Bay and River was from mid-April to the end of June, also excluding exploitation of postspawning migrations."

The present spring fishing extends from March to July, peaking in April. A lesser fishery operates from September to a peak in November.

5.4 Fishing Operations and Results

In general, the present Atlantic sturgeon catch is a bycatch of other directed fisheries, i.e., shad, striped bass. Statistics may include reportage of two species. For these reasons effort and intensity data are not applicable.

Annual catch by state is shown in Table 14.

6.s PROTECTION AND MANAGEMENTs

6.1 Regulatory Measuress

"Laws prohibiting the capture of Atlantic sturgeon below a minimum size or during certain periods of fishing were helpful in protecting and maintaining the species. However, even at its lowest ebb the Atlantic sturgeon in North America never was close to complete

BLE 14. Catch of sturgeon*, Atlantic and Gulf Coasts, United States** in thousands of pounds.

ar	ME	NH	MA	RI	CT	NY	NJ	PA	DE	MD	VA	NC	SC	GA	FL	AL	MI	LA
80	-	-	10	-	-	144	300	150	570	144	412	437	161	354	3	(1)	-	-
87	-	-	6	-	-	10	1295	61	2825	8	-	234	482	192	(1)	-	-	-
88	-	-	5	-	-	10	1682	63	2800	7	-	270	251	174	(1)	-	-	-
89	-	-	-	-	-	40	1592	64	1327	-	-	228	285*	212*	43	-	-	-
90	-	-	-	-	-	40	4558	59	1302	100	818	175	216*	84*	30	-	-	-
91	-	-	-	-	-	30	4526	53	1305	72	724	-	-	-	-	-	-	-
92	-	-	-	-	-	-	4489	60	1052	-	-	-	-	-	-	-	-	-
97	-	-	-	-	-	-	1951	10	467	141	585	404*	481*	157	9	-	-	-
98	12	-	9	-	(1)	428	1298	10	280	146	632	-	-	-	-	-	-	-
01	-	-	-	-	-	113	169	(1)	76	108	183	-	-	-	-	-	-	-
02	-	-	-	-	-	-	-	-	-	-	-	145	94	-	149	-	-	-
04	-	-	-	-	-	10	228	11	84	164	181	-	-	-	-	-	-	-
05	6	-	12	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
08	-	-	-	-	-	-	-	-	-	-	-	62	-	100	62	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	8	118	39	5	-	-	-
20	-	-	-	-	-	-	-	-	-	(1)	22	-	-	-	-	-	-	-
21	-	-	-	-	-	14	46	-	12	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	19	50	32	7	-	-	-
24	4	-	6	2	(1)	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	19	66	-	-	-	-	-	-	-
26	-	-	-	-	-	9	7	-	5	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	27	13	1	8	15	-	-
28	(1)	-	3	(1)	(1)	-	-	-	-	-	-	8	21	2	16	10	-	-
29	(1)	-	6	(1)	-	3	9	-	11	(1)	9	2	18	5	13	3	-	-
30	(1)	-	8	1	-	2	4	(1)	15	-	5	3	15	5	8	2	(1)	-
31	1	-	5	(1)	(1)	2	10	-	5	(1)	6	1	27	2	15	15	-	-
32	2	-	6	(1)	-	3	7	-	2	(1)	5	2	23	5	4	11	-	-
33	2	-	5	(1)	(1)	2	27	-	1	(1)	8	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-	(1)	8	2	50	12	1	8	-	-
35	(1)	-	3	1	-	8	12	-	(1)	(1)	6	-	-	-	-	-	-	-
36	-	-	-	-	-	-	-	-	-	(1)(	27	5	59	10	30	2	-	-
37	(1)	-	7	(1)	(1)	1	6	-	(1)	-	13	(1)	25	8	14	)	-	-
38	(1)	-	9	2	(1)	5	5	-	-	(1)	16	(1)	26	8	16	2	-	-
39	-	-	5	(1)	(1)	4	7	-	-	(1)	8	1	-	6	17	5	-	-
40	(1)	-	7	(1)	-	5	11	-	-	1	12	(1)	1	5	3	(1)	-	-
41	-	-	-	-	-	-	-	-	-	(1)	13	-	-	-	-	-	-	-
42	-	-	2	(1)	-	18	15	-	-	4	8	-	-	-	-	-	-	-
43	(1)	-	3	-	2	13	7	-	-	-	-	-	-	-	-	-	-	-
44	-	-	7	2	(1)	9	2	-	-	2	5	-	-	-	-	-	-	-
45	(1)	-	12	(1)	(1)	10	5	-	(1)	6	11	(1)	36	5	7	(1)	-	-
46	(1)	-	6	1	2	22	5	-	(1)	3	23	-	-	-	-	-	-	-
47	(1)	-	5	(1)	3	14	5	-	1(	4	18	-	-	-	-	-	-	-
48	(1)	-	9	2	10	19	6	-	1	4	38	-	-	-	-	-	-	-
49	(1)	-	7	3	(1)	11	4	-	10	5	12	-	-	-	-	-	-	-
50	(1)	-	7	3	(1)	13	3	-	(1)	3	16	11	17	15	3	-	-	-
51	(1)	-	7	2	(1)	7	5	-	-	4	13	4	16	5	3	4	-	(1)
52	(1)	-	4	4	2	.11	11	-	1	7	14	15	24	7	12	(1)	-	-
53	1	-	5	3	2	9	6	-	4	6	12	15	22	25	19	1	-	-
54	2	-	6	3	2	13	12	-	2	19	18	10	9	21	3	3	-	-
55	1	-	4	4	2	12	7	-	2	7	12	2	67	8	12	1	-	-
56	(1)	-	4	2	2	5	7	-	3	10	13	12	80	37	14	1	-	-
57	(1)	-	4	4	3	12	7	-	11	7	5	16	45	12	25	1	-	-
58	(1)	-	4	3	1	10	8	-	3	6	7	22	35	4	15	(1)	-	-
59	1	-	9	2	2	14	9	-	1	3	12	19	33	4	7	(1)	-	-
60	(1)	-	8	3	6	15	7	-	-	11	18	23	42	7	1	-	-	-
61	(1)	-	5	1	9	9	16	-	-	13	12	40	51	4	14	4	-	-
62	(1)	-	5	2	11	10	19	-	2	8	5	49	40	2	13	4	-	-
63	1	-	6	3	8	5	13	-	2	7	4	43	53	3	30	1	-	-
64	(1)	-	4	4	11	12	13	-	3	16	11	34	64	2	9	1	-	-
65	(1)	-	4	2(	4	6	15	-	(1)	35	22	77	50	3(	7	-	-	-
66	(1)	-	2	5	3	16	14	-	2	14	26	59	43	(1)	8	-	-	-
67	2	-	3	3	2	12	9	-	-	7	12	38	33	1(	6	-	-	-
68	(1)	(1)	3	(1)	2	12	8	-	(1)	5	13	47	44	(1)	58	-	-	-
69	3	(1)	2	3	(1)	13	7	-	-	6	19	132	40	1	12	-	-	-
70	6	(1)	2	4	(1)	14	13	-	-	4	22	120	6	4	18	-	-	-
71	(1)	(1)	2	5	(1)	8	12	-	-	3	17	78	77	4	25	-	-	-
72	(1)	(1)	3	2	(1)	4	11	-	-	4	11	154	68	8	4	-	-	-
73	(1)	(1)	2	(1)	-	4	18	-	-	8	18	56	45	3(	9	-	-	-
74	(1)	-	3	3	-	7	10	-	-	5	9	93	47	2	4	-	-	-
75	1	-	2	1	-	4	14	-	-	5	7	44	58	2	2	-	-	-

* May include A. oxyrhynchus and A. brevirostrus until 1973.
** From statistics published by U. S. Fish Commission, U. S. Fish and Wildlife Service and National Marine Fisheries Service.
* Includes caviar.
- Indicates no data found.
) Indicates under 1,000 lbs.

extermination, as some authors were inclined to believe (in 1950). There are indications, along the Atlantic seaboard, that this sturgeon is coming back. The small number of large fish taken during recent years is partially due to a reduction in the quantity of appropriate fishing gear. In New York, for instance, the 10-inch mesh nets, legally specified for taking this species areo not used in the Hudson River because fishermen do not considero it likely that enough fish could be taken to justify the expense of gear and license", Vladykov and Greeley (1963).o

Previous management devices include net regulations, closed seasons, mesh size limits and minimum retainable size of captured fish. A few fishermen are using 14-inch stretch mesh gill nets in the Hudson. The interest in harvesting is returning (Dovel, pers. comm.).

In 1891 New Jersey passed a law protecting young sturgeon.

"Be it enacted by the senate and general assembly of the State of New Jersey, that it shall not be lawful for any person or persons to cast, draw, set, anchor, drift, or stake any gilling net, or any other device or appliances of any kind whatsoever, for the purpose of catching fish commonly called or known as mammose (which are young sturgeon under 3 feet in length) in the waters of the Delaware Bay, river, and their tributaries, withino the jurisdiction of the State of New Jersey; and any person oro persons fishing with gilling nets, drift nets, shore, seine nets,o or any kind of nets, devices, or appliances whatever in theo Delaware Bay, river, or their tributaries, within the jurisdiction of the above-named State, who on lifting, drawing, taking up, removing, or underrunning any of said nets, devices, or appliances, shall find young sturgeon or mammose under 3 feet in length entangledo or caught therein, shall immediately, with care and with the leasto possible injury to the fish, disentangle and let loose the sameo and transmit the fish to the water without violence. Any personо or persons violating any provisions of this section, or having in their possession young sturgeon or mammose under 3 feet ino length, either for consumption or for sale, or who is known willfulo to destory the same, for so offending shall, on conviction thereof,o be punished with a fine of $10 for each and every fish so caught, sold, or destroyed, and in default of paying such fine, on being convicted thereof, to be imprisoned in the county jail for 30 days."o

"A few years later the State of Delaware adopted practically the same law, but as Pennsylvania has not yet taken action on the subject the law has so far had very little beneficial effect on the fishery", Cobb (1900).

In the Chesapeake, the rapid decline in abundance of sturgeon caused enactment of laws for their protection. Hildebrand and Schroeder (1928) reported that the Virginia law stated no sturgeon

less than 4 feet long could be removed from the waters of the state. The Maryland law stated no sturgeon weighing less than 20 pounds could be caught or offered for sale and no sturgeons whatsoever might be taken during the 10 year period from 1914 to 1923. Greeley (1937) noted the legal size limit in the Hudson River was 42 inches, designed to protect immature sturgeon.

A sampling of current fish regulations, directed to the harvest of Atlantic sturgeon, are listed below:

New York
- Open season - anytimes
- Minimum size - 48 inchess
- Limits of catch - nones

New Jersey
- Hudson River, New York Harbor, Sandy Hook Bays
  - Minimum size - 42 inchess
- Delaware River and Bays
  - Minimum size - 54 inchess
  - Unlawful to set net between 2 p.m. Saturdays to midnight Sundays

Pennsylvania
- Delaware River below Trenton Falls; only withs gill net, minimum mesh 13 inchess

Maryland
- Minimum size - 25 pounds

Virginia
- None

North Carolina
- None

South Carolina
- Open season - March 1 to October 1
- Minimum mesh size - 10 inchess
- Unlawful to leave net on stream bank mores than 3 days after close of season.s
- Illegal to have decomposed sturgeon in nets
- License required for nets and privileges
- Monthly catch report required from licenses holders
- Under consideration for threatened species statuss

Georgia
- Nones

Florida
- Minimum mesh size - 10 inchess

Alabama
- Nones

Mississippi
- Illegal to take or possess Atlantic sturgeon; considered an endangered speciess

Louisiana
- Nones

6.2 Control or Alteration of Physical Features

It was early recognized and cited previously in this review that construction of dams curtailed access to historic spawning areas. This has been documented for several rivers; the Androscoggin, Kennebec (Squires, pers. comm.), Merrimac (Hoover, 1938), Connecticut (Galligan, 1960), Susquehanna, Cooper, Santee, Savannah (Leland, 1968), and Apalachicola (Huff, 1975).

Maintenance dredging impacts on the habitat (Dees, 1961).

6.3 Control or Alteration of Chemical Features

Data from St. Lawrence and Hudson Rivers indicate average level of PCB in all samples of sturgeon were higher than the FDA guideline of five parts per million (Table 15). Dovel (pers. comm.) has indicated that PCB burden in immature sturgeon is greatest (5- 15 ppm). Migrating adults (150-200 lbs.) carry a lesser concentration (0.1 ppm).

At present a New York advisory exists warning that public consumption of fish taken below the Hudson's Troy Dam except for shad, should be restricted to no more than one meal per week. Infants and pregnant women should avoid ingesting any fish from this area. The presence of PCB's in sturgeon may severely restrict the development of intensive fisheries on the Hudson.

6.4 Control or Alteration of Biological Features

No data found.

6.5 Artificial Stocking

A considerable body of literature presently exists relative to the culture and propagation of sturgeon. Although most of the work was conducted by Russian scientists, Ryder (1888) showed that fertilization and culture of Atlantic sturgeon eggs was possible under hatchery conditions. Ryder's early work proved the feasibility of the methods for culture but as Cobb (1900) observed, there was difficulty in getting ripe eggs and milt at the same time. For this reason massive artificial propagation programs for Atlantic sturgeon were never attempted.

Reiger (1977) commented on the problems of sturgeon culture as follows:

"In 1888, the U. S. Fish Commission sponsored J. A. Ryder in a project to produce sturgeon fry at a laboratory on the Delaware River. He failed. Then followed other attempts elsewhere on the Delaware and at Lake Champlain-without result. In the 1910's

TABLE 15. Concentrations of PCB's in sturgeon sampled from the waters of New York.

Area	Year	Aroclor	Concentration: PPM (wet weight) Weighted Mean	Max.	Min.
St. Lawrence R. (sturgeon spp.)	1975	1242/1016	11.89	11.89	--
Hudson R. (below Troy Dam) (Atlantic sturgeon)	1970-1972	1254	6.71	7.03	5.73
	1975	1242/1016	7.69	13.48	0
	1975	1254	8.15	9.84	6.25

(From: Spagnoli and Skinner, 1977)

Canadian biologists hoped to succeed where Americans had failed. The Canadian motive was to restore the Indians' once high standard of living which had tumbled after white men taught them to eat food out of cans and feed sturgeon to their dogs. Now even the Indians' dogs were hungry.

"However, such altruistic purpose did not inspire the Canadians with any greater success than the Americans had known. Right down to the present day, dreams of sturgeon management are haunted by the turn-of-the-century boast of W. de C. Ravenel of the U. S. Fish Commission: 'As far as hatching the eggs of sturgeon is concerned, we need not worry about that. We cane hatch the eggs of any fish just as we hatch the eggs of grayling or trout in jars and on trays. If we can find a place where sturgeon spawn, we will guarantee next year to go there and propagate them.'

"Mallard ducks are not whooping cranes; and trout are not sturgeon. The problems in artificially propagating sturgeon begin with the fact that while many other species can be stripped of their eggs and milt without harming the adults, sturgeon must be killed to acquire their spawn. Next, there is no way to tell which sturgeon on the spawning ground are actually there to spawn. In the early days, dozens of apparently gravid fish often were killed and opened before one ripe female could be found.

"Finally, if you must kill many adult fish merely to obtain one pan of fertilized eggs, the odds are you will be unable to bring to maturity a better than equivalent number of sturgeon. After all, male lake sturgeon rarely mature before they are 12, and sometimes 23 years of age; females until they are 14, more often 23 years of age. Some female sturgeon have lived 33 years before reproducing."e

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APPENDIX I

Results of a questionnaire survey for data concerning Atlantic sturgeon

A questionnaire survey was conducted from November to December 1976 to assess the availability of unpublished data sources and the status of present and proposed research on Atlantic sturgeon. Standard forms were duplicated and forwarded to the appropriate officials in the Fisheries Departments of all States bordering on the Atlantic or Gulf Coasts. Additional information was secured relative to Canadian research in the St. John River from Dr. M. Dadswell, and an ongoing project on the Hudson River (W. Dovel). Survey results are listed in the following sequence: (1) name of respondent, (2) description of available data, (3) present status of local populations, and (4) present or proposede research.e

NEW BRUNSWICK

(1)e Dr. M. Dadswell, Biological Station, St. Andrews, New Brunswicke
(2) Historical landings in the St. John from 1884 to present; age-weight-length relationships; food habits.e
(3) According to fishermen, population is increasing in size each year.
(4) Present data being collected during a study of the shortnose sturgeon.e

MAINE

(1) Thomas S. Squires, Jr., Dept. Marine Resources
(2)e Published sourcese
(3)e Considered uncommon in Maine, fishermen take them incidentally.
(4)e 89-304 project between Maine Dept. of Mar. Res. and NMFS. Projecte to run for theee years (1976-1979). Studies include tagging programe and collection of biological data on shortnose and Atlantic sturgeone in the Kennebec River estuary.e

NEW HAMPSHIRE

(1)e Richard Seamans, Jr., Dept. Fish and Gamee
(2)e No unpublished data available since Hoover (1938).
(3)e No occurrence in New Hampshire waters since 1847.e
(4)e No present or proposed researche

MASSACHUSETTS

(1) H. R. Iwanowicz, Division of Marine Fisheries
(2)e Division has no published or unpublished data on Atlantic sturgeon
(3)e Uncommon occurrencee
(4)e No present or proposed researche

RHODE ISLAND

(1)s John M. Cronan, Dept. Nat. Resources, Division of Fish and Wildlifes
(2)s No data availables
(3)s Rare occurrences in coastal fish traps
(4)s No present or proposed researchs

CONNECTICUT

(1)s Cole W. Wilde, Department of Environmental Protections
(2) No unpublished data availables
(3)s Scarce in Connecticut River, although slightly more abundants than when reported by Galligan (1960).
(4)s No present or proposed researchs

NEW YORK

(1)s J. Douglas Sheppard, Div. of Fish and Wildlifes
(2)s Published and unpublished data on breeding, growth, behavior,s commercial fisheries.s
(3)s Atlantic sturgeon slightly more abundant than shortnose in Hudson.s Some catches do not enter records.s
(4)s Present and proposed research (AFS-9-R-1) William Dovel, principal investigator: three-phased project designed to compile ands summarize existing data, determine relative abundance and distributions and to calculate age, growth, size at maturity and year class strength.s

NEW JERSEY

(1)s Paul Hamer, Div. of Fish, Game and Shellfisheriess
(2)s Catch records from Delaware River, published records includes extensive historical reports by Ryder and Cobb.s
(3) Reports indicate sturgeon are reappearing in numbers in thes Delaware and seems to indicate a great potential for restorations of a commercial fishery.
(4)s None proposed by the state (c.f. Delaware River Anadromous Fishs Project, below).s

PENNSYLVANIA

(1)s Richard W. Marshall, Pennsylvania Fish Commissions
(2)s Unpublished data on commercial fisheries are available at thes Benner Spring Library, Bellefonte, Pennsylvania.s
(3) No data presented
(4)s None proposed by the state (c.f. Delaware River Anadromous Fishs Project, below).s

DELAWARE ANADROMOUS FISH PROJECT

(1) Carl Barron, Delaware Anadromous Fish Project (Rosemont, New Jersey)
(2) Previously published material
(3) Becoming more abundant in Delaware River
(4) Proposed research to review existing literature and develop a pool of knowledge on Atlantic and shortnose sturgeon for a management plan.

DELAWARE

(1) Robert A. Beck, Division of Fish and Wildlife
(2)s Unpublished data available concerning commercial fisheries ands seasonal range and distribution.s
(3)s Plentiful in Delaware River and seem to be increasing.s
(4) Nones

MARYLAND

(1)s Joseph M. Boon; Charles M. Frisbie, Dept. of Natural Resourcess
(2) Unpublished data exist concerning commercial fisheries. Hildebrands and Schroeder review data on distribution, fecundity, breeding, early life history, and growth.
(3) Landings have been declining for a long period of time; Marylands may soon propose it as an endangered species.s
(4) Nones

VIRGINIA

(1)s James E. Douglas, Jr., Marine Resources Commission and Dr. J. V. Merriner, Virginia Institute of Marine Sciences
(2) No unpublished data exist in the files of the Marine Resources Commission.s
(3) Sturgeon are infrequent inclusions in pound and gill net catches.s Endangered in Virginia and, unless severely injured, catches musts be returned to the water.s
(4) 89-304 project by Virginia, North Carolina and NMFS. Objectives of the project are: (1) determine fishing effort and catch ofs Atlantic sturgeon in Virginia, (2) determine age structure ands sex ratio of the catch, fecundity and time of spawning in Virginia,s (3) determine distribution and migration of sturgeons offshores Virginia and North Carolina, and (4) determine if shortnose sturgeon still exist inshore in North Carolina and Virginia.s

NORTH CAROLINA

(1)s B. F. Holland, Jr., Division of Commercial and Sport Fisheriess
(2)s Information is available on distribution, growth and migrations of sturgeon in North Carolina.s
(3)s Small fisheries for Atlantic sturgeon presently exist in North Carolina.s
(4)s See VIRGINIA for 89-304 project.s

SOUTH CAROLINA

(1)e David Cupka, Dept. of Wildlife and Marine Resourcese
(2)e Published and unpublished sources list data on commercial fisheries,e range and distribution, breeding, predators, migrations, behavior,e and habitat preferences.
(3) The Atlantic sturgeon is presently being considered for classificatione as a threatened species in South Carolina.e
(4) Nonee

GEORGIA

(1) Tony Reisings, Dept. of Natural Resourcese
(2) Published data are available on fisheries, range and distribution,e and habitat preferences.
(3)e No data presentede
(4) None

FLORIDA

(1)e Charles R. Futch; Dale S. Beaumariage, Dept. of Natural Resourcese
(2)e Published data (Huff, 1975) exist on commercial fisheries, historicale trends, and general natural history.
(3)e Viable fisheries exist on the Gulf Coast for A. oxyrhynchus desotoi.e
(4)e Recently completed project (Huff, 1975).e

ALABAMA

(1)e Sam L. Spencer, Divisien of Fish and Gamee
(2)e No data availablee
(3)e No data availablee
(4)e Nonee

MISSISSIPPI

(1)e W. H. Turcotte, Game and Fisheries Commissione
(2)e Unpublished commercial fisheries data exist.e
(3)e Presently on the state list of endangered species.e
(4) None

LOUISIANA

(1)e Bennie J. Fontenot, Wildlife and Fisheries Commissione
(2)e Sturgeon sampled incidental to other projects.e
(3)eRegarded as common in the State, especially in the Pearl Rivere System and Lake Ponchartrain.e
(4)e Nonee

TEXAS

No data available