THE ATLANTIC STURGEON, *ACIPENSER OXYRHYNCHUS*, IN THE DELAWARE RIVER ESTUARY

HAROLD M. BRUNDAGE III AND ROBERT E. MEADOWS[1]

ABSTRACT

Records of Atlantic sturgeon, *Acipenser oxyrhynchus*, captured in the Delaware River estuary from 1958 through 1980 were obtained from the literature, unpublished data, and logs maintained by commercial fishermen who took Atlantic sturgeon incidental to their operations for other species. During the period reviewed, there were 130 Atlantic sturgeon reported captured; 64 in commercially fished gill nets and 66 incidental to fishery and ecological studies. Atlantic sturgeon were most abundant in Delaware Bay (river km 0-55) in spring and in the lower tidal river (river km 56-127) during summer. This seasonal distribution appeared similar to that described for the Hudson River estuary. Atlantic sturgeon between 800 and 1,300 mm total length were relatively more abundant in the Delaware River estuary than had been reported in other estuaries, suggesting utilization of the Delaware system during a greater portion of the life cycle.

The Atlantic sturgeon, *Acipenser oxyrhynchus*, inhabits large estuaries and Atlantic coastal waters from Labrador to eastern Florida; a southern subspecies, *A. o. desotoi*, occurs throughout the Gulf of Mexico (Vladykov and Greeley 1963).

The Delaware River estuary, historically one of the major spawning and nursery areas for the Atlantic sturgeon, once supported the largest and most profitable sturgeon fishery on the Atlantic coast (Ryder 1890). The fishery in the Delaware River estuary was extremely short lived, however, and followed a pattern of rapid decline observed in most other estuaries. The commercial fishery, which began in the mid-19th century and expanded rapidly after 1870 as smoked sturgeon and caviar gained acceptance, declined precipitously about 1900 and virtually collapsed by 1905 as the population declined (see Ryder 1890; Cobb 1900; Murawski and Pacheco 1977).

Overfishing of adults on the spawning grounds combined with late maturity appears principally responsible for this decline, although destruction of benthic food organisms by coal silt pollution and general deterioration of water quality and destruction of juvenile Atlantic sturgeon by American shad, *Alosa sapidissima*, fishermen probably contributed.

Little is known of the present status of the Atlantic sturgeon in the Delaware River estuary. As a preliminary step towards an assessment all available recent records of Atlantic sturgeon capture in the estuary were compiled. Reliable, quantitative data were found for the period 1958 through 1980. Most records were obtained from the substantial body of published and unpublished data generated by recent fishery and ecological studies. Further information was obtained via personal communication with the staffs of the Delaware River Anadromous Fishery Project of the U.S. Fish and Wildlife Service, the Delaware Division of Fish and Wildlife, and Ichthyological Associates, Inc. In addition, during spring 1979 and 1980, three commercial gill netters who had previously worked with the authors maintained logs of Atlantic sturgeon captured incidental to their operations for other species. Some 25 other fishermen were interviewed to obtain their impressions of Atlantic sturgeon occurrence and abundance. Inherent in this approach was the premise that representative trends might become apparent when a body of incidental records and anecdotal accounts are considered together. Apparent trends must be interpreted cautiously, however, since sampling gear and effort varied considerably between and within years.

To aid in the delineation of spatial-temporal trends the estuary was divided into three regions based on physiography and salinity regime. "Delaware Bay" extends from the mouth (river km 0) to the vicinity of the Leipsic River (river km 55), is shaped like a flattened funnel and has

[1]Ichthyological Associates, Inc., 100 South Cass Street, Middletown, DE 19709.

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extensive shoals along the New Jersey shore (Fig. 1). The estuary narrows considerably at about river km 56 to form the "lower tidal river" which extends to Marcus Hook, Pa. (river km 127). The "upper tidal river" extends to the fall line just north of Trenton, N.J. (river km 222). Delaware Bay is generally polyhaline (18-30 ‰), the lower tidal river mesohaline to oligohaline (0.5-18 ‰), and the upper tidal river limnetic (0.0-0.5 ‰) (Tudor 1980). These zones of salinity may be displaced considerably, however, depending upon freshwater flow, tidal stage, and local meteorological conditions.

RESULTS

From 1958 to 1980 there were 130 documented captures of Atlantic sturgeon in the Delaware River estuary (Table 1, Fig. 1); 68 in Delaware

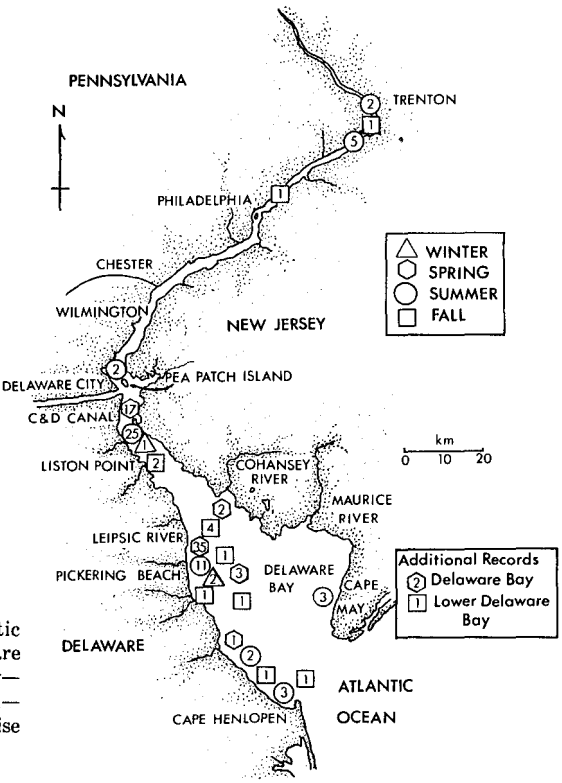

FIGURE 1.—Locations of recorded captures of Atlantic sturgeon in the Delaware River Estuary, 1958-80. Seasons are defined as winter—December through January; spring—March through May; summer—June through August; fall—September through November. Records for which precise capture locations are not known are also given.

TABLE 1.—Recorded captures of Atlantic sturgeon, *Acipenser oxyrhynchus*, in the Delaware River estuary, November 1958-July 1980.

Date	Area	River km	Salinity ‰	Temp. (°C)	Method of capture	No.	Total length (mm)	Source
14 Nov. 1958	Lower Delaware Bay	—	—	—	9.1 m trawl	1	508	de Sylva et al. 1962
Sept. 1967	Harbor of Refuge, Del.	3	—	—	9.1 m trawl	1	—	Daiber and Wockley 1968
Oct.	Joe Flogger Shoal, Del.	42	—	—	9.1 m trawl	1	—	Daiber and Wockley 1968
31 July 1968	Liston Point, Del.	77	—	—	28 cm gill net	5	814, 1,143, 1,165, 1,193, 1,431	IA, Inc.,[1] Middletown, Del.
1 Aug.	Liston Point	77	—	—	28 cm gill net	5	680, 1,157, 1,172, 1,323, 1,431	IA, Inc., Middletown
9 Aug.	Liston Point	77	—	—	28 cm gill net	1	889	IA, Inc., Middletown
Mar.-Apr. 1969	Little River, Del.	45	—	—	13-14 cm gill net	5	—	DRBAFP[2] unpubl. data
28 Sept. 1971	Delaware Point, Del.	72	3.5	22.0	4.9 m trawl	1	—	IA, Inc., Middletown
20 June 1972	Artificial Island, N.J.	79	3.0	22.0	4.9 m trawl	1	—	IA, Inc., Middletown
24 Sept. 1973	Newbold Island, N.J.	203	—	—	4.9 m trawl	1	196	IA, Inc., Middletown
Mar.-Dec. 1974	Burlington Island, N.J.	190	—	—	Cooling water intake	1	—	DRBAFP unpubl. data
23 May	Artificial Island	79	1.0	20.1	4.9 m trawl	1	340	IA, Inc., Middletown
Aug.	Bordentown, N.J.	206	—	—	4.9 m trawl	2	—	DRBAFP unpubl. data
8 May 1975	Artificial Island	79	5.0	17.5	14 cm gill net	1	700	IA, Inc., Middletown
19 May	Artificial Island	82	1.5	19.0	8 cm gill net	1	—	IA, Inc., Middletown
10-11 June	Newbold Island, N.J.	200	—	—	4.9 m trawl	1	[3]349	Martin Marietta Corp., 1976
Oct.-Dec.	Delaware Power Plant	163	—	—	Cooling water intake	1	—	DRBAFP unpubl. data
24 Mar. 1976	Artificial Island	79	0	8.6	8 cm gill net	1	765	IA, Inc., Middletown
10 May	Fishing Creek, N.J.	75	5.0	16.0	14 cm gill net	1	550	IA, Inc., Middletown
17 Mar. 1977	Little River	45	—	—	Gill net	1	1,117	Dovel 1979
4 Apr.	Appoquinimink River, Del.	82	—	—	4.9 m trawl	1	591	IA, Inc., Middletown
13 Apr.	Little River	45	—	—	Gill net	1	457	Dovel 1979
12 May	Artificial Island	86	5.0	16.0	4.9 m trawl	1	519	IA, Inc., Middletown
June	Pea Patch Island, Del.	98	—	—	Gill net	1	—	DRBAFP unpubl. data
27 June	Artificial Island	82	7.0	24.2	8 cm gill net	1	720	IA, Inc., Middletown
21 July	Artificial Island	82	5.0	28.0	8 cm gill net	1	680	IA, Inc., Middletown
18 Mar. 1978	Bowers Beach, Del.	38	—	—	Gill net	1	—	Dovel 1979
22 Mar.	Little River	45	—	—	Gill net	2	—	Dovel 1979
23 Mar.	Bowers Beach	38	—	—	Gill net	1	—	Dovel 1979
27 Mar.	Little River	45	—	—	Gill net	1	—	Dovel 1979
30 Mar.	Fowler Beach, Del.	15	—	—	Gill net	1	—	Dovel 1979
3 Apr.	Little River	45	—	—	Gill net	1	—	Dovel 1979

TABLE 1.—Recorded captures of Atlantic sturgeon, *Acipenser oxyrhynchus*, in the Delaware River estuary, November 1958-July 1980.—*Continued.*

Date	Area	River km	Salinity ‰	Temp. (°C)	Method of capture	No.	Total length (mm)	Source
7 Apr.	Little River	45	—	—	Gill net	1	—	Dovel 1979
8 Apr.	Del Haven, N.J.	17	—	—	Gill net	1	—	Dovel 1979
15 Apr.	Little River	45	—	—	Gill net	1	—	Dovel 1979
22 Apr.	Cohansey River, N.J.	61	8.0	17.0	4.9 m trawl	1	760	IA, Inc., Middletown
29 Apr.	Del Haven	17	—	—	Gill net	1	—	Dovel 1979
May	Little River	45	—	—	Gill net	2	—	Dovel 1979
3 May	Del Haven	17	—	—	Gill net	1	—	Dovel 1979
6 May	Delaware Bay	—	—	—	Gill net	2	—	Dovel 1979
10 July	Harbor of Refuge	3	—	—	Hook and line	1	1,524	Del. Dep. Fish and Wildl.
24 July	Artificial Island	80	4.0	27.0	4.9 m trawl	1	604	IA, Inc., Middletown
24 July	Elsinboro Point, N.J.	92	4.0	27.5	4.9 m trawl	1	678	IA, Inc., Middletown
24 July	Artificial Island	82	7.0	27.6	4.9 m trawl	1	518	IA, Inc., Middletown
15 Aug.	Burlington Island	190	—	—	4.9 m trawl	1	157	IA, Inc., Absecon, N.J.
17 Aug.	NE of Harbor of Refuge	1	29.0	25.2	4.9 m trawl	1	2,000	IA, Inc., Middletown
24 Aug.	Artificial Island	82	5.0	27.7	4.9 m trawl	1	690	IA, Inc., Middletown
28 Aug.	Burlington Island	190	0	25.0	4.9 m trawl	1	175	IA, Inc., Absecon
6 Sept.	Burlington Island	190	0	25.0	4.9 m trawl	1	175	IA, Inc., Absecon
20 Sept.	Artificial Island	80	7.0	23.4	4.9 m trawl	1	648	IA, Inc., Middletown
16 Apr. 1979	Old Bare Shoal, Del.	17	—	—	9.1 m trawl	1	855	Smith 1980
16 Apr.	Hope Creek, N.J.	78	—	—	14 cm gill net	1	760	Commercial fisherman
20 Apr.	Hope Creek	78	—	—	14 cm gill net	1	890	Commercial fisherman
20 Apr.	Kitts Hummock, Del.	41	—	—	13 cm gill net	1	610	Commercial fisherman
22 Apr.	Kitts Hummock	41	—	—	10-13 cm gill net	2	900, 1,030	Commercial fisherman
23 Apr.	Kitts Hummock	41	—	—	13 cm gill net	2	830, 980	Commercial fisherman
24 Apr.	Kitts Hummock	41	—	—	13 cm gill net	2	865, 880	Commercial fisherman
25 Apr.	Port Mahon, Del.	47	—	—	10 cm gill net	1	584	Commercial fisherman
25 Apr.	Kitts Hummock	41	—	—	13 cm gill net	1	660	Commercial fisherman
25 Apr.	Hope Creek	78	—	—	14 cm gill net	1	914	Commercial fisherman
26 Apr.	Port Mahon	47	—	—	13 cm gill net	1	570	Commercial fisherman
26 Apr.	Kitts Hummock	41	—	—	13 cm gill net	1	685	Commercial fisherman
29 Apr.	Port Mahon	47	—	—	13 cm gill net	1	1,067	Commercial fisherman
29 Apr.	Port Mahon	47	—	—	13 cm gill net	1	580	Commercial fisherman
30 Apr.	Kitts Hummock	41	—	—	13 cm gill net	2	711, 865	Commercial fisherman
1 May	Port Mahon	47	—	—	13 cm gill net	1	810	Commercial fisherman
2 May	Port Mahon	47	—	—	13 cm gill net	2	720, 940	Commercial fisherman
3 May	Port Mahon	47	—	—	13 cm gill net	1	890	Commercial fisherman
6 May	Port Mahon	47	—	—	13 cm gill net	1	880	Commercial fisherman
9 May	Port Mahon	47	—	—	13 cm gill net	1	810	Commercial fisherman
11 May	Port Mahon	47	—	—	13 cm gill net	1	914	Commercial fisherman
12 May	Port Mahon	47	—	—	13 cm gill net	1	965	Commercial fisherman
21 May	W of Joe Flogger Shoal	42	20.0	16.7	9.1 m trawl	1	860	Smith 1980
22 May	Offshore Smyrna River, Del.	71	13.0	18.3	9.1 m trawl	2	935, 1,117	Smith 1980
22 May	Ship John Shoal	58	17.0	18.1	9.1 m trawl	1	955	Smith 1980
12 June	Hope Creek	77	—	—	Dead on surface	1	889	IA, Inc., Middletown
21 June	W of Joe Flogger Shoal	42	24.0	19.6	9.1 m trawl	1	960	Smith 1980
22 June	Ship John Shoal	58	16.0	20.8	9.1 m trawl	2	1,190, 750	Smith 1980
12 July	Smyrna River	71	12.0	24.8	4.9 m trawl	1	960	IA, Inc., Middletown
July	Ship John Shoal	58	17.0	25.2	9.1 m trawl	1	815	Smith 1980
9 Aug.	N of Pea Patch Island	101	1.0	28.1	4.9 m trawl	1	128	IA, Inc., Middletown
25 Sept.	Bowers-Pickering Beaches, Del.	38-44	—	—	Gill net	1	1,090	Commercial fisherman
Sept.	Ship John Shoal	58	18.0	22.7	9.1 m trawl	1	1,150	Smith 1980
22 Oct.	Harbor of Refuge	3	—	13.2	4.9 m trawl	1	810	IA, Inc., Middletown
Oct.	Fourteen Ft. Bank, Del.	34	25.0	14.7	9.1 m trawl	1	875	Smith 1980
1 Nov.	Offshore Prime Hook Beach, Del.	7	27.0	11.3	9.1 m trawl	1	1,100	Smith 1980
2 Nov.	Artificial Island	80	6.0	15.0	Cooling water intake	1	936	IA, Inc., Middletown
16 Feb. 1980	Artificial Island	80	10.0	0.5	Cooling water intake	1	692	IA, Inc., Middletown
24 Mar.	Pickering Beach, Del.	44	—	—	Gill net	1	760	Commercial fisherman
25 Mar.	Pickering Beach	44	—	—	Gill net	4	457, 457, 760, 1,066	Commercial fisherman
26 Mar.	Pickering Beach	44	—	—	Gill net	1	1,220	Commercial fisherman
29 Mar.	Pickering Beach	44	—	—	Gill net	1	1,524	Commercial fisherman
8 Apr.	Artificial Island	80	1.0	9.5	Cooling water intake	1	[3]750	IA, Inc., Middletown
22 Apr.	Pickering Beach	44	—	—	Gill net	1	760	Commerical fisherman
May	Old Bare Shoal, Del.	17	27.0	15.6	9.1 m trawl	1	1,010	Del. Dep. Fish and Wildl.
6 May	Artificial Island	80	4.0	17.0	Cooling water intake	1	689	IA, Inc., Middletown
19 May	Blake Channel	40	18.0	17.5	4.9 m trawl	1	927	IA, Inc., Middletown
28 May	Artificial Island	80	7.0	21.0	Cooling water intake	1	942	IA, Inc., Middletown
24 June	Reedy Island Dike, Del.	84	—	—	Dead on surface	1	620	IA, Inc., Middletown
10 July	Sunken Ship Cove, N.J.	80	—	—	Dead on beach	1	1,010	IA, Inc., Middletown
16 July	Artificial Island	80	—	—	Cooling water intake	1	[3]637	IA, Inc., Middletown
17 July	Offshore Smyrna River	71	14.0	25.3	9.1 m trawl	1	1,035	Del. Dep. Fish and Wildl.
24 July	Artificial Island	80	10.0	28.0	Cooling water intake	1	1,015	IA, Inc., Middletown
31 July	Artificial Island	80	8.0	28.0	4.9 m trawl (surface)	1	1,230	IA, Inc., Middletown

[1]Ichthyological Associates, Inc.
[2]Delaware River Basin Anadromous Fishery Project.
[3]Converted from fork length.

Bay, 53 in the lower tidal river, and 9 in the upper tidal river. A total of 64 specimens were captured in commercially fished gill nets, most as a bycatch of operations for American shad, and weakfish, *Cynoscion regalis*. The remaining 66 specimens were taken incidental to various fishery and ecological investigations; 23 by 4.9 m bottom trawl, 17 by 9.1 m bottom trawl, 12 by experimental gill net, 9 at industrial cooling water intakes, 1 by 4.9 m surface trawl, 1 by hook and line, and 3 were dead on the water's surface or on shore.

In Delaware Bay Atlantic sturgeon were taken from March through November (Fig. 2). Catch was greatest during March through May (14-23/mo), low during July through August (1/mo), and increased somewhat during September through November (2 or 3). The spring peak was composed largely of specimens captured in 1979 and 1980 by the cooperating commercial gill netters who logged incidental Atlantic sturgeon captures while fishing shallow waters off of Kitts Hummock (river km 41) and Port Mahon (river km 47), Del., in 1979 and Pickering Beach (river km 44), Del., in 1980. Their records reflect 27 specimens taken during 20 April-14 May 1979 and 8 during 24 March-22 April 1980. Additionally, all 18 Atlantic sturgeon reported from Delaware Bay by Dovel (1979) were taken during March-May (see Table 1). Although this abundance pattern may be biased by the greater fishing effort expended during spring relative to other seasons, essentially all other commercial gill netters interviewed reported the highest frequency of incidental sturgeon capture during spring. Most Atlantic sturgeon taken in the gill net fishery are apparently below marketable size and are released. Records indicate that survival in gill nets was very high if the nets were tended daily.

In the lower tidal river Atlantic sturgeon were taken from February through September and in December (Fig. 2); most during July (16), although moderate numbers (6-10) were taken from April through August. Eleven specimens were taken in late July and early August 1968, by two part-time commercial gill netters purposely fishing for Atlantic sturgeon. These men fished, typically for a 2-wk period in summer, between Delaware City (river km 98) and Liston Point (river km 77), Del., during the late 1940's through the early 1970's. They employed essentially traditional methods, as described by Cobb (1900), and drifted 9 × 572 m, 28 cm cotton mesh

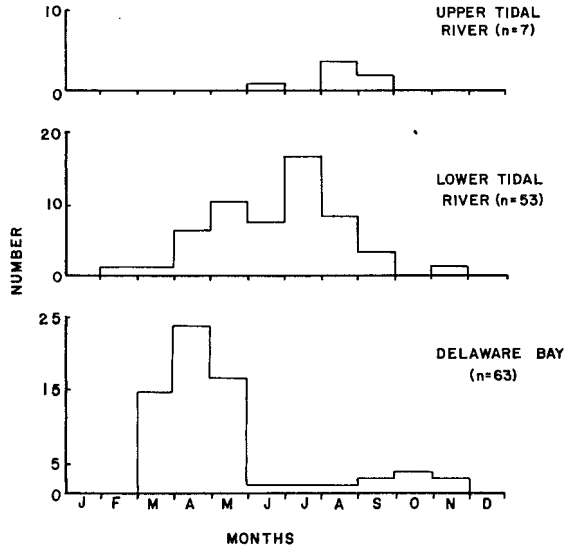

FIGURE 2.—Number of Atlantic sturgeon captured monthly in three regions of the Delaware River estuary, 1958-80.

gill nets along the bottom from about 1 h before to about 1 h after low tide (Beck[2]). These were, to the best of our knowledge, the last successful commercial efforts directed specifically at Atlantic sturgeon. Although the above mentioned 11 specimens are the only quantitative accounting of their catch available, anecdotal accounts indicate considerable success with as many as 191 specimens taken in a 2-wk period (Beck 1973).

In the upper tidal river, Atlantic sturgeon were captured in June (1), August (4), and September (2) (Fig. 2). Only one specimen was taken in the Wilmington, Del., to Philadelphia, Pa. (river km 114-170), reach. In this region mean dissolved oxygen concentrations approach zero during summer and are typically below 5 ppm during May through October (Freidersdorff et al. 1978). This fish was taken sometime during October-December 1975, when oxygen concentration was considerably higher.

Available data showed that Atlantic sturgeon occurred over a wide range of water temperature (0.5°-28.1°C) and salinity (0.0-29.0 ‰). The varying availability of temperature and salinity data by region, however, precludes further discussion. Values were available for 62% of the specimens captured in the lower tidal river but

[2]Robert A. Beck, Department of Natural Resources and Environmental Control Division of Fish and Wildlife, P.O. Box 1401, Dover, DE 19901, pers. commun. December 1978.

only 10% of those from Delaware Bay and 22% of those taken in the upper tidal river.

Length data were available for 97 Atlantic sturgeon. Reported fork length (FL) for 11 specimens were converted to total length (TL) with the relationship $FL = 0.878\,TL - 6.551$, $r = 0.999$, calculated from measurements of 19 specimens. Total length ranged from 457 to 2,000 mm ($\bar{X}$ = 885 mm; $n = 45$) for specimens taken in Delaware Bay, from 128 to 1,431 mm ($\bar{X}$ = 863 mm; $n = 48$) in the lower tidal river, and from 157 to 196 mm ($\bar{X}$ = 176 mm; $n = 4$) in the upper tidal river (Fig. 3). Based on age-length data for the Hudson River estuary (Dovel 1979), the probable age of specimens taken in Delaware Bay ranged from 0+ to ca. 20+ and from 0+ to ca. 14+ in the lower tidal river. Only age 0+ specimens were taken in the upper tidal river. No individuals in spawning condition were reported.

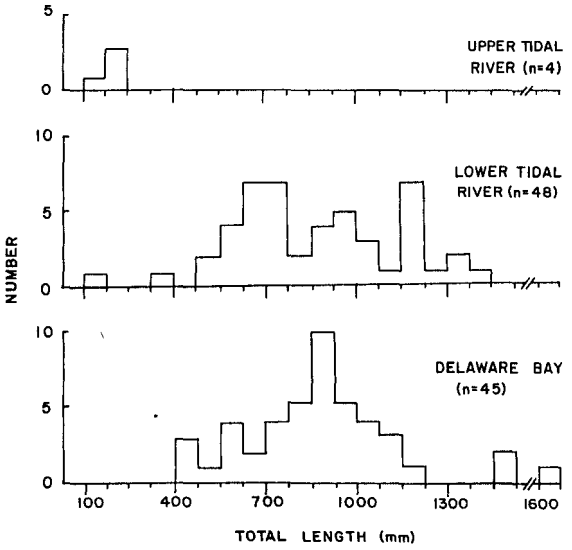

FIGURE 3.—Length-frequency distributions of Atlantic sturgeon captured in three regions of the Delaware River estuary, 1958-80.

DISCUSSION

Despite the limitations imposed by reliance on incidental catch records, a number of generalizations regarding the Atlantic sturgeon in the Delaware River estuary can be made. The data strongly indicate that there is a viable population of Atlantic sturgeon in the Delaware system which utilizes different regions of the estuary to varying degrees depending on season and life stage. A definite pattern of seasonal movement within the estuary can be inferred. In early spring substantial numbers of juvenile Atlantic sturgeon occurred in the shallow waters of Delware Bay; later in spring, abundance increased in the lower tidal river and this upstream movement continued through early summer. This is similar to the pattern described by Dovel (1979) for the Hudson River, i.e., juvenile Atlantic sturgeon overwinter in the deeper waters of the lower estuary and move upstream and inshore in spring in response to increasing water temperature. However, in the Delaware River estuary, juvenile Atlantic sturgeon ranged to the the fall line at Trenton, whereas in the Hudson River they were found only to river km 145 (Kingston, N.Y.), some 100 km below the limit of tidal intrusion.

During summer, Atlantic sturgeon were most abundant in the lower tidal portion of the Delaware River and probably use this region as a foraging ground. Numbers in this reach decreased somewhat during August, the month of maximum water temperature. Dovel (1979) reported that Hudson River Atlantic sturgeon seek cooler waters during summer and may move south before water temperature peaks. In the present study, however, no such movement to Delaware Bay during August was evident, although numbers in the bay increased slightly in September.

Abundance in the Delaware system decreased in the upper and lower tidal river in September and increased somewhat in Delaware Bay during September through November, suggesting a return to overwintering areas. Some individuals may have left the estuary at that time to overwinter in the nearshore ocean. Interviews conducted in 1978 and 1979 with commercial trawl fishermen operating out of Ocean City, Md., indicate that Atlantic sturgeon are commonly taken near the mouth of Delaware Bay in fall. Most of these fish are small, ranging from 0.6 to 1.5 m long, with occasional captures of larger individuals of 2.5-3.5 m.

Evidence on occurrence of older juveniles in the Delaware system disagrees with reports from other systems. Murawski and Pacheco (1977) reported that these fish emigrate from the estuary when they reach 760-915 mm long and do not return for a number of years until mature. Dovel (1979) found that Atlantic sturgeon between about 800 mm (ca. age 5) and 1,300 mm TL (ca. age 12) were rare in the Hudson River estuary and inferred that these individuals re-

mained at sea. However, in the Delaware River estuary Atlantic sturgeon between 800 and 1,300 mm were common and composed 62% of the measured specimens from Delaware Bay and 48% of those from the lower tidal river. It is possible that the Delaware River estuary is utilized during a greater portion of the Atlantic sturgeon's life cycle then is the Hudson. This may be associated with the relatively unimpacted condition of Delaware Bay and the lower Delaware River as compared with the heavily industrialized and degraded lower Hudson River estuary. It is also possible that an Atlantic sturgeon which has left the Hudson River may utilize other estuaries, including the Delaware system, during this portion of its life. Recapture of tagged Hudson River sturgeon in the Delaware River and more distant estuaries (Dovel 1979) may substantiate this view.

No specimens in spawning condition were recorded from the Delware River Estuary; most reported were probably immature. Most Atlantic sturgeon captured in the Delaware River estuary were <112 cm TL minimum for mature males and <200 cm for mature females reported by Dovel (1979). Larger mature specimens are almost certainly present in the estuary but are not vulnerable to the small-mesh gear typically fished by commercial fishermen and fishery biologists. Even though spawning location could not be ascertained it is perhaps signficant that the smallest specimen recorded (128 mm) was taken near Pea Patch Island, Del. (river km 101), an area historically described (Borodin 1925) as a principal spawning area for Atlantic sturgeon.

This compilation of incidental catches and a substantial body of anecdotal information suggests that Atlantic sturgeon may be far more abundant in the Delaware River estuary than commercial catch statistics and the impressions of other fishery scientists indicate (Hoff[3]). The reported scarcity of Atlantic sturgeon may be more the result of not fishing the appropriate gear in the right locations at the right times or of not monitoring fishermen who are. A more definitive status evaluation will require quantitative investigation to determine population size, mortality rate, age-specific fecundity, age at first reproduction, and spawning time and location. In any event, the value of incidental capture records and anecdotal accounts should be recognized and continued monitoring of available sources is advisable. The potential for restoration of the stock is high, based on the lack of industrial development in the lower estuary and the fact that as yet undammed, the Delaware River still features relatively natural run-off and river flow patterns. Pollution abatement programs, particularly those involved with improvement of dissolved oxygen levels in the Chester to Philadelphia reach will undoubtedly enhance this potential.

[3]James G. Hoff, Biology Department, Southern Massachusetts University, North Dartmouth, MA 02747, pers. commun. July 1980. See also, Hoff, J. G. 1980. Review of present status of the stocks of the Atlantic sturgeon, *Acipenser oxyrhynchus* (Mitchill). Southeastern Massachusetts Univ., North Dartmouth, 136 p.

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