Movement of Shortnose Sturgeon in the Upper Chesapeake Bay, Maryland

Stuart A. Welsh,[1] *U.S. Fish And Wildlife Service, Maryland Fisheries Resources Office, 177 Admiral Cochrane Drive, Annapolis, MD 21401*

Michael F. Mangold, *U.S. Fish And Wildlife Service, Maryland Fisheries Resource Office, 177 Admiral Cochrane Drive, Annapolis, MD 21401*

Sheila M. Eyler, *U.S. Fish And Wildlife Service, Maryland Fisheries Resource Office, 177 Admiral Cochrane Drive, Annapolis, MD 21401*

Abstract: Little published information exists on shortnose sturgeon *(Acipenser brevirostrum)* in the Chesapeake Bay. During a reward program for Atlantic sturgeon (*Acipenser oxyrinchus)*, 32 shortnose sturgeon were captured in the Chesapeake Bay and reported by commercial watermen between January 1996 and January 2000. Thirteen of the 32 shortnose sturgeon were sonically tagged, and 6 of these telemetered individuals were tracked during daylight hours within the upper Chesapeake Bay. The distance (km) and time (days) between consecutive relocations were use to estimate movement rates as km/day. Localized and wandering movements of telemetered shortnose sturgeon were observed within the upper Chesapeake Bay based on extended time intervals between relocations, but individuals were rarely relocated on consecutive days. Telemetered shortnose sturgeon were generally relocated in areas that exceeded the average available water depth. These data not only provide information on movements, but also depict areas used by shortnose sturgeon and may be useful for understanding potential impacts of habitat alterations in the upper Chesapeake Bay.

Proc. Annu. Conf. Southeast. Assoc. Fish. and Wildl. Agencies 55:298–303

The shortnose sturgeon *(Acipenser brevirostrum)*, a federally endangered species, is distributed as disjunct populations along the Atlantic coast from the St. John River, Canada, to the St. Johns River, Florida (Gruchy and Parker 1980, Kynard 1997). Shortnose sturgeon occasionally move into marine environments, but generally remain within or near their natal river or estuary (Dadswell et al. 1984). Movements of shortnose sturgeon have been published for populations ranging from the Saint John River estuary, New Brunswick, Canada, to the Savannah River, South

1. Current address: U.S. Geological Survey, West Virginia Cooperative Fish and Wildlife Research Unit, POB 6125, Morgantown, WV 26506.

Carolina (McLeave et al. 1977, Dadswell1979, Buckley and Kynard 1985, Hall et al. 1991, Kieffer and Kynard 1993, O'Herron et al. 1993, Moser and Ross 1995).

The shortnose sturgeon recovery plan (Natl. Mar. Fish. Serv. 1998) recognized individuals in the Chesapeake Bay as a distinct population segment. Little published information exists on shortnose sturgeon in the Chesapeake Bay in part because few individuals were captured and reported before 1996. During a reward program for Atlantic sturgeon *(Acipenser oxyrinchus)*, 32 shortnose sturgeon were captured incidentally (i.e., bycatch) in the Chesapeake Bay and reported by commercial watermen between January 1996 and January 2000, and provided an opportunity to examine movements within the Chesapeake Bay.

Our initial objectives for the sturgeon reward program in the Chesapeake Bay involved Atlantic sturgeon (Md. Fish. Resour. Off. unpubl. rep. 2000, Welsh et al. 2002*a*). Given the number of shortnose sturgeon reported during this program, we modified our initial objectives to include the distribution and movements of shortnose sturgeon within the Chesapeake Bay. The distribution of shortnose sturgeon within the Chesapeake Bay and movements through the Chesapeake and Delaware Canal were reported elsewhere (Welsh et al. 2002*b*). Herein, we report movements of shortnose sturgeon within the upper Chesapeake Bay, Maryland.

Financial assistance was provided by the Chesapeake Bay Foundation, Maryland Department of Natural Resources, Hudson River Foundation, National Fish and Wildlife Foundation, and National Marine Fisheries Service. A. Buchanon, M. Craig, J. Gill, S. Hammond, P. Hanchin, J. Herema, M. Lawrence, B. van der Leeuw, R. Li, T. McCrobie, P. McGowan, D. Murphy, and J. Skjeveland collected data. Reference to trade names or manufacturers does not imply government endorsement of commercial products.

Methods

Thirteen shortnose sturgeon captured in gill nets or pound nets by commercial watermen were sonically-tagged (Sonotronics CT82-2E, duration time of 14 months, attached externally to dorsal scutes; MFRO 2000) and tracked by boat with a directional hydrophone (Sonotronics DH-2) and digital receiver (Sonotronics USR-5W). Shortnose sturgeon were not tracked continuously, and rarely were relocated on consecutive days. Telemetered shortnose sturgeon were primarily tracked during a separate study of Atlantic sturgeon in the upper Chesapeake Bay (an area from Kent Island northward to the head of the Bay). Two areas were searched south of Kent Island, including a single search from Sandy Point to Hooper's Island, and a search from the mouth of the Potomac River upstream to Little Falls. During tracking, researchers deployed the hydrophone every 0.8 to 1.2 km, and would travel toward a sonic signal until it was equally strong in every direction. The fish was then assumed to be directly under the boat, and water depth and geographic coordinates (determined by Global Positioning Service [GPS], Furuno GP-30, with position accuracy of approximately 50 m) were recorded.

Geographic coordinates of release locations and relocations were mapped in ARCVIEW. Distances between points of relocation were measured to estimate the minimum distance traveled during a period of time. A straight distance between 2 relocation points is a measure of "minimum distance" because a sturgeon likely does not follow a straight line between 2 points determined by telemetry. Movement rates (km/day) were estimated as the ratio of distance (km) and time (days) between consecutive relocations and were averaged to get an overall movement rate. The distance from the release location (typically the waterman's dock) to the first relocation was excluded from the average movement rate.

Results and Discussion

Of 13 shortnose sturgeons sonically-tagged, 3 were associated with the Chesapeake and Delaware Canal and their movements were reported elsewhere (Welsh et al. 2002*b*). Four of the 13 sonically-tagged individuals in the Chesapeake Bay were not relocated. We tracked the remaining 6 individuals of unknown sex (646–940 mm SL, $\bar{x} = 813$ mm; 2032–6352 g, $\bar{x} = 4517$ g) within the upper Chesapeake Bay (Fig. 1), and data on these individuals (referred to by sonic tag signals) are reported herein (Table 1).

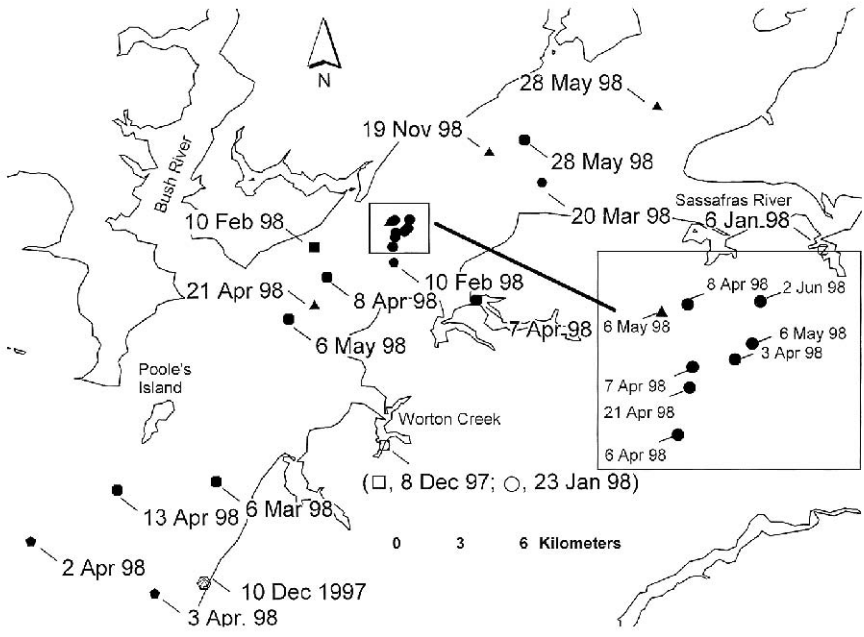

Figure 1. Release (open symbols) and relocation (closed symbols) sites of 6 sonically-tagged shortnose sturgeon in the upper Chesapeake Bay.

Table 1. Movement data (date of tagging, minimum distances, days between relocations, estimated movement rates), standard (SL) and total (TL) lengths, and weights of telemetered shortnose sturgeon in the upper Chesapeake Bay, Maryland (* = estimated distances between release site and first relocation).

Sonic tag number	Release/ relocation	Date	Minimum distance (km)	Days between relocations	Estimated distance (km/day)	Length (mm) FL, TL	Weight (g)
2-2-9	release	23 Jan 98				830, 955	4197
	relocation	3 Apr 98	11.23	70	0.160*		
	relocation	6 Apr 98	0.85	3	0.283		
	relocation	7 Apr 98	0.67	1	0.670		
	relocation	8 Apr 98	0.62	1	0.620		
	relocation	21 Apr 98	0.81	13	0.062		
	relocation	6 May 98	0.64	15	0.043		
	relocation	2 Jun 98	0.41	27	0.015		
2-3-2-7	release	8 Dec 97				646, 730	2032
	relocation	10 Feb 98	10.25	69	0.149*		
2-3-3-6	release	6 Jan 98				829, 950	5445
	relocation	6 Mar 98	30.80	59	0.522*		
	relocation	7 Apr 98	14.90	32	0.466		
	relocation	8 Apr 98	5.74	1	5.740		
	relocation	13 Apr 98	12.86	5	2.572		
	relocation	6 May 98	10.38	23	0.451		
	relocation	28 May 98	12.20	22	0.555		
2-3-4-5	release	10 Dec 97				750, 850	3516
	relocation	10 Feb 98	16.84	62	0.272*		
	relocation	2 Apr 98	18.82	51	0.369		
	relocation	3 Apr 98	5.28	1	5.280		
2-4-2-6	release	10 Dec 97				940, 1030	6352
	relocation	20 Mar 98	22.83	100	0.228*		
2-4-3-5	release	10 Dec 97				882, 990	5558
	relocation	21 Apr 98	13.74	132	0.104*		
	relocation	6 May 98	4.82	15	0.321		
	relocation	28 May 98	11.24	22	0.511		
	relocation	19 Nov 98	6.66	175	0.038		

Of the 6 individuals tracked within the upper Chesapeake Bay, 2 individuals (2-3-3-6 and 2-3-4-5) were relocated on consecutive days and had movement rates of 5.7 and 5.3 km/day. Relocations of shortnose sturgeon 2-2-9 over a 2-month period (6 Apr–2 Jun 1998) indicated extremely localized movements, but may represent tidal movements of a dead fish or lost tag (Fig. 1). Later attempts to relocate fish 2-2-9 were unsuccessful, but could be a result of a failed tag or fish movement outside of the search area. Estimates of daily movement rates (Table 1) averaged 1.12 km/day, but were underestimated because we used minimum distances between relocations and daily movement rates were estimated across large time intervals between relocations. No telemetered shortnose sturgeon were relocated in searches south of Kent Island. The mean movement rate of 4 km/day of shortnose sturgeon in the Saint John River estuary, New Brunswick, Canada (Dadswell 1979) was also underestimated by extended time intervals between relocations. Researchers that have used continuous

relocations reported higher mean rates of movement, such as 16.5 km/day (Buckley and Kynard 1985) and 21 km/day (McCleave et al. 1977). Moser and Ross (1995) tracked 5 shortnose sturgeon for up to 3 months in the lower Cape Fear River, North Carolina, and reported mean movement rates from 1.0 km/day to 14.9 km/day based on combined extended interval and continuous relocations.

Relocations of sonically-tagged sturgeon provided information on temporal distributions of individuals, patterns of movement, and depths. Previous studies on shortnose sturgeon movements indicate that pre-spawners typically move upstream, whereas post-spawners move downstream (Buckley and Kynard 1985, O'Herron et al. 1993, Kieffer and Kynard 1993). Upstream pre-spawn movements may begin in the fall, with individuals overwintering in deeper water just downstream of spawning habitat (Dadswell 1979). Localized and wandering non-spawning movements occur in summer and winter (Dadswell et al. 1984, Buckley and Kynard 1985). Currently, no published evidence exists for shortnose sturgeon spawning in tributaries of the Chesapeake Bay. Spawning times of shortnose sturgeon increase with latitude along the Atlantic coast (Dadswell et al. 1984), and occur between late March and late April in the Delaware River (O'Herron et al. 1993). Given the proximity of the Delaware River and Chesapeake Bay, we would expect spawning in the Chesapeake Bay to occur during April. Although 4 of the sonically-tagged individuals in Chesapeake Bay were relocated during April in open water areas, our data were insufficient (due to extended periods between relocations) to indicate that those individuals did not spawn. Spawning of shortnose sturgeon occurs in a relatively short time period, such as 5 to 8 days (Kieffer and Kynard 1996), and individuals do not spawn every year (Dadswell et al. 1984).

Dadswell et al. (1984) reported that shortnose sturgeon use shallower areas in summer (2–10 m) and deeper areas in winter (10–30 m). Shortnose sturgeon tracked during daytime were rarely relocated in shallow areas in the Chesapeake Bay, and occurred at depths from 2.4 to 12.8 m ($\bar{x}$ = 7.5 m, SE = 0.81). The majority of shortnose sturgeon were relocated in depths >5 m. Depths in the upper Chesapeake Bay are typically <5 m; however, the channel along the eastern side has depths up to 13 m (Lippson 1973). O'Herron et al. (1993) and Moser and Ross (1995) also reported that shortnose sturgeon in the Delaware and lower Cape Fear rivers, respectively, occurred primarily in areas deeper than the average available depth, such as navigation channels. McCleave et al. (1977) reported that shortnose sturgeon in Montsweag Bay, Maine, often used shallow water areas and movements were not associated with navigation channels. Although telemetered individuals were primarily relocated in areas deeper than the average available depth, our distributional data (Welsh et al. 2002*b*) based primarily on gill net and poundnet captures indicated that shortnose sturgeon are not restricted to the deepest areas available, such as navigational channels.

Despite biases and small sample size (6 individuals), we believe that our data are important, especially given that no other data are available on movements of shortnose sturgeon within the Chesapeake Bay. In addition to providing basic information on movements, these data depict areas used by shortnose sturgeon and may

be useful for understanding potential impacts of habitat alterations, such as site placement of dredge and fill materials in Chesapeake Bay. Additional studies are needed to determine overwintering areas and potential spawning areas of shortnose sturgeon in the Chesapeake Bay.

Literature Cited

Buckley, J. and B. Kynard. 1985. Yearly movements of shortnose sturgeons in the Connecticut River. Trans. Am. Fish. Soc. 114:813–820.

Dadswell, M. J. 1979. Biology and population characteristics of the shortnose sturgeon, *Acipenser brevirostrum* Leseuer 1818 *(Osteichthys: Acipenseridae)*, in the Saint John River Estuary , New Brunswick, Canada. Can. J. Zool. 57:2186–2210.

_____ , B. D. Taubert, T. S. Squiers, D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon *Acipenser brevirostrum* Leseuer 1818. Natl. Oceanic and Atmos. Admin. (NOAA) Tech. Rep. Natl. Mar. Fish. Serv. 14. 45pp.

Gruchy, C. G. and B. Parker. 1980. *Acipenser brevirostrum* Lesueur shortnose sturgeon. Page 38 *in* D. S. Lee, C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr., eds. Atlas of North American freshwater fishes. N.C. State Mus. Natl. History, Raleigh, N.C.

Hall, J. W., T. I. J. Smith, and S. D. Lamprecht. 1991. Movements and habitats of shortnose sturgeon, *Acipenser brevirostrum*, in the Savannah River. Copeia 1991:695–702.

Kieffer, M. C. and B. Kynard. 1993. Annual movements of shortnose and Atlantic sturgeons in the Merrimack River, Massachusetts. Trans. Am. Fish. Soc. 122:1088–1103.

_____ and _____. 1996. Spawning of shortnose sturgeon in the Merrimack River, Massachusetts. Trans. Am. Fish. Soc. 125:179–186.

Kynard, B. 1997. Life history, latitudinal patterns, and status of the shortnose sturgeon, *Acipenser brevirostrum*. Envron. Biol. Fish. 48:319–334.

Lippson, A.J. 1973. The Chesapeake Bay in Maryland: an atlas of natural resources. Johns Hopkins Univ. Press, Baltimore, Md. 55pp.

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

Moser, M. L. and S. W. Ross. 1995. Habitat use and movement of shortnose and Atlantic sturgeons in the lower Cape Fear River, North Carolina. Trans. Am. Fish. Soc. 124:225–234.

National Marine Fisheries Service. 1998. Final recovery plan for the shortnose sturgeon *(Acipenser brevirostrum)*. Prepared by the Shortnose Sturgeon Recovery Team for the Natl. Mar. Fish. Ser., Silver Springs, Md. 125pp.

O'Herron, II, J. C., K. W. Able, and R. W. Hastings. 1993. Movements of shortnose sturgeon *Acipenser brevirostrum* in the Delaware River. Estuaries 16:235–240.

Welsh, S.A., S.M. Eyler, M.F. Mangold, and A.J. Spells. 2002*a*. Capture locations and growth rates of Atlantic sturgeon in the Chesapeake Bay. Pages 183–194 *in* W. Van Winkle, P.J. Anders, D.H. Secor, and D.A. Dixon, eds. Biology, management, and protection of North American sturgeon. Am. Fish. Soc. Symp. 28, Bethesda, MD.

_____ , M.F. Mangold, J.E. Skjeveland and A.J. Spells. 2002*b*. Distribution and movement of shortnose sturgeon *(Acipenser brevirostrum)* in the Chesapeake Bay. Estuaries 25:101–104.