Shortnose Sturgeon Habitat Model

go to: **USFWS Gulf of Maine Watershed Habitat Analysis**
go to: **Species Table**

Feedback: We welcome your suggestions on improving this model!

Draft Date:
July 2001

Species:
Shortnose sturgeon, *Acipenser brevirostrum.* This species is federally listed as endangered.

Use of Study Area Resources:
All life stages; shortnose sturgeon occur in large coastal rivers of eastern North America, from New Brunswick to Florida (Dadswell et al. 1984). In the Gulf of Maine important numbers of shortnose sturgeon occur in the lower Kennebec, Sheepscot, Androscoggin (Maine) and Merrimac rivers (Massachusetts/New Hampshire). Historically, they occupied every major river from the St. John, Canada, to the St. John, Florida (B. Kynard pers. comm.).

Habitat Requirements:
"Shortnose sturgeon inhabit the main stems of natal rivers, migrating between freshwater and mesohaline river reaches. Spawning occurs in upper, freshwater areas, while feeding and overwintering activities may occur in both fresh and saline habitats" (NMFS 1998).

All known spawning occurs in the most upstream accessible reaches of rivers the species uses (Crance 1986, SSRT 1998, Squiers 1983). Where dams do not block passage, spawning may occur in riffle habitat, 200 km upstream of the river mouth, well above tidal influence (B. Kynard, pers. comm.). Within the study area, spawning occurs close to the bottom, in areas of deep water, with significant current, and substrates of gravel, rubble, boulder or ledge (Squiers 1983; Dadswell 1979, Squiers et al 1993, Kynard 1997 all *in* SSRT 1998).

Eggs are demersal and adhesive after fertilization (Meehan 1910 *in* Crance 1986). By 9-12 days, larvae develop into juveniles, capable of swimming in the water column; they then begin feeding and are believed to migrate downstream to lower reaches (Richmond and Kynard 1995). As they grow, juveniles use brackish water at the freshwater-saltwater interface, moving with the shifting zone of low salinity, over substrates of sand/mud/silt (Dadswell et al. 1984, SSRT 1998). Haley et al. (1996) found juveniles in the Hudson River at depths from 7 to 26 m.

Males in the Connecticut River mature at 8-12 years, and females at 9-14 years, or as late as 15 years in the St. John River, Canada (Dadswell et al. 1984). Spawning frequency in females is no more often than every 3 years, and possibly at intervals of 5-11 years (Dadswell 1979). Adults overwintering in freshwater are those that are ripening for spring spawning (B. Kynard, pers. comm.); otherwise, adults move seaward to overwinter in estuarine and nearshore areas (Dadswell et al. 1984). Maximum water depths, used in winter, are 10 to 30 m (Dadswell et al. 1984). In northern New England, sturgeon forage in estuaries throughout the summer (B. Kynard, pers. comm.). They tend to remain near the estuary of their natal rivers, but a small proportion make short distance migrations of a few miles seaward (Schaefer 1967, Holland and Yelverton 1973, Wilk and Silverman 1976; all *in* Dadswell et al. 1984).

Foraging. Adult sturgeon feed over gravel and mud substrates, in deep channels and near shore. Foods include benthic crustaceans, insects, polychaete, and molluscs, including zebra mussels (Dadswell et al. 1984, SSRT 1998). Juveniles obtain prey by somewhat randomly consuming mud from the bottom,

becoming more selective as they grow (SSRT 1998).

Habitat Mapping:
Fresh water: Crance (1986) produced a habitat suitability model for the shortnose sturgeon based on water temperature, velocity, depth, and river substrate type. Information on these parameters is not available for most rivers in the Gulf of Maine, and so we mapped riverine habitat from occurrence data obtained from several sources. Eipper et al. (1982) mapped upstream migratory pathways for anadromous and catadromous fishes throughout New England at a relatively small scale. We coded the corresponding stream segments as suitable habitat on 1:24,000 USGS digital maps (Maine, New Hampshire) and 1:100,000 maps (Massachusetts), supplemented by 1:24,000 for minor features absent from the 1:100,000 data. Eipper et al. (1982) was used for the whole study area. This general information was considerably supplemented state by state with collection data. In Massachusetts we were supplied with point data from Hartel et al. (in press), and from a GIS coverage developed by Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement. Also, Kieffer and Kynard (1996 *in* SSRT 1998), mapped Merrimac River habitats. In Maine we used maps in Squiers and Smith (1979) and Squiers (1983).

Artifacts of grid-cell mapping of riverine themes may in some cases cause habitat omissions, and in others aquatic habitat values in primarily upland areas. Fish habitats were gridded from continuous polygons/arcs derived from USGS hydrology coverages. Single line arcs were necessarily converted into strings of cells, each with a minimum width of 30 m (the cell dimensions). Even where the dominant land cover of a cell was upland, we retained the habitat value for a stream passing through the cell. As a result, some upland areas will display habitat value for anadromous fishes.

The grid process left discontinuities when converting narrow (< 30 m wide) polygon features, such as small rivers, where only part of a cell was crossed by aquatic habitat. Moreover, where National Wetlands Inventory polygons representing wetlands and water bodies differed from those of USGS, the only fish habitat we retained was that which corresponded to aquatic classes in the former. Therefore, fish habitats and migratory pathways may not appear as continuous extents of habitat, or extend to the boundaries of contiguous wetlands in all cases.

Marine habitats were mapped using occurrence information and water depth. Jury et al. (1994) tabulated the relative abundance of shortnose sturgeon in North Atlantic estuaries by season, life stage, and general salinity zone. We used Jury et al. but added the Penobscot estuary based on Squiers and Smith (1979) collections and Dadswell et al. (1984). The boundaries of those estuaries used by sturgeon were identified from salinity zone maps obtained from NOAA NOS (http://seaserver.nos.noaa.gov/projects/cads/ftp_gis_download.html, downloaded 4/5/01), and adjusted to fit our higher resolution coastline data. These boundaries then were trimmed to exclude water deeper than -30 m. While the Penobscot estuarine zones includes the large bay into which that river flows, the NOAA Kennebec and the Merrimac zones were relatively small. Therefore, we mapped as habitat areas having depths down to -30 m, up to 2 miles from the mouth of those rivers.

Habitat Suitability:
Habitat suitability for this model is scored according to our confidence that an area is likely to be used. All freshwater areas mapped from occurrence information were scored 1.0; estuarine/marine areas at the mouths of occupied rivers were scored 0.5.

Sources:
Crance, J.H. 1986. Habitat suitability index models and instream flow suitability curves: shortnose sturgeon. USFWS Biol. Report 82(10.129) 31 p.

Dadswell, M.J., B.D. Taubert, T.S. Squiers, D. Marchette and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon (Acipenser brevirostrum, LeSueur 1818). NOAA Tech. Rept. NMFS 14. 45 p.

Eipper, A., W. Knapp and C. Laffin. 1982. Anadromous fish streams of New England: upstream migratory routes. Portfolio NE-1. USDI Fish and Wildlife Service.

Haley, N, J. Boreman and M. Baine. 1996. Juvenile Sturgeon Habitat Use in the Hudson River. Section VIII: 36 pp. In: J.R. Waldman, W.C. Nieder and E.A. Blair (eds.), Final Reports of the Tibor T. Polgar Fellowship Program, 1995. Hudson River Foundation, NY. Downloaded 4/12/01 at: http://www.dnr.cornell.edu/hydro2/sturgeon/haley/haley.htm

Hartel. K.E., D.B. Halliwell and A.E. Launer. (in press) Inland Fishes of Massachusetts. Natural Hist. New England Series. Massachusetts Audubon Society, Lincoln, MA.

Richmond, A. and B. Kynard. 1995. Ontogenic behavior of shortnose sturgeon. Copeia 1995:172-182.

SSRT (Shortnose Sturgeon Recovery Team). 1998. Recovery Plan for the Shortnose Sturgeon (Acipenser brevirostrum). NOAA/National Marine Fisheries Service, Silver Spring, MD. 104 pages.

Squiers, T.S. 1983. Evaluation of the spawning run of shortnose sturgeon (Acipenser brevirostrum) in the Androscoggin River, Maine. Maine DMR Report, 13 p.

Squiers, T.S. and M. Smith. 1979. Distribution and abundance of shortnose and Atlantic sturgeon in the Kennebec River Estuary. Maine DMR Report, 51 p.