Northeast Fisheries Science Center Reference Document 25-02

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ABSTRACT

Since the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) was listed under the Endangered Species Act in 2012, robust estimates of abundance have been unavailable at the Distinct Population Segment or coastwide level. We provide updated annual swept area abundance estimates of Atlantic sturgeon in nearshore areas derived from Northeast Area Monitoring and Assessment Program surveys conducted from 2007-2023. Estimates of catchability are necessary to scale the abundance estimates to represent the coastwide migratory population. A potential approach to approximate catchability is discussed.

INTRODUCTION

In 2010, NOAA's National Marine Fisheries Service was petitioned to list Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) under the Endangered Species Act (ESA). In 2012, 5 distinct population segments (DPSs) were listed; 4 DPSs were listed as "Endangered" (New York Bight, Chesapeake Bay, Carolina, and South Atlantic), and 1 was listed as "Threatened" (Gulf of Maine).

A robust index of population abundance is desirable to evaluate impacts of human activities on Atlantic sturgeon populations. Such an index can then be used to evaluate the impact of projected or actual Atlantic sturgeon incidental mortality (e.g., fisheries-related bycatch or vessel strikes). Subsequent analyses on abundance indices of Atlantic sturgeon (Kocik et al. 2013; ASMFC 2017, 2024) have not been able to provide robust estimates of population abundance at the coastwide or DPS level at this time. Until the ongoing work by the Atlantic States Marine Fisheries Commission to formally assess Atlantic sturgeon populations is completed, abundance estimates are limited to the available surveys.

The goal of this report was to update an Atlantic sturgeon abundance index for use by managers prior to completion of a comprehensive stock assessment. This report provides an update to the swept area abundance estimates of the coastwide migratory Atlantic sturgeon population derived from the Northeast Area Monitoring and Assessment Program (NEAMAP; Kocik et al. 2013).

METHODS

The NEAMAP survey is conducted from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina, in nearshore waters at depths to 18.3 m (Figure 1). The survey uses a spatially stratified random design with a total of 35 strata and 150 stations per survey for a total survey area of 12,135 square km (Kocik et al. 2013). The survey has occurred in the fall since 2007 and the spring since 2008.

The NEAMAP survey uses tow-by-tow net measurements to calculate catch per square meter as the base metric in the calculation. That is, the (tow distance) x (wingspread) measurement on tow X is the denominator for number per unit area on tow X. Tow distance is calculated as a sum from moment-by-moment recordings of location (i.e., not straight line distance from beginning and ending coordinates). For those tows where either a sensor malfunction or GPS malfunction results in missing data, average figures for the particular cruise are substituted. Swept area abundance is calculated as the sum of abundances in each stratum. Net height does not

currently enter into swept area calculations. Calculations were performed by the NEAMAP at the Virginia Institute of Marine Science (VIMS).

RESULTS

Atlantic sturgeon continue to be frequently sampled during the NEAMAP survey. In recent years, there has been an increase in swept area population estimates (Figure 2) of migratory Atlantic sturgeon in nearshore areas. Minimum swept area population estimates of Atlantic sturgeon from the fall survey range from 6,885 to 117,767 fish with CVs between 0.01 and 0.73. Minimum swept area abundance estimates from the spring surveys range from 6,510 to 144,226 fish with CVs between 0.26 and 0.66 (Table 1).

As in Kocik et al. (2013), the survey estimates are considered minimum values because they are based on the assumptions that (a) the survey gear captures 100% of the Atlantic sturgeon that occur within the path of the survey tows, and (b) all of the Atlantic sturgeon in the population exist in the areas sampled by the survey. Catchability was defined as the product of the probability of capture given encounter (i.e., net efficiency) and the fraction of the population within the sampling domain (availability). Catchabilities less than 100% result in population size estimates greater than the minimum swept area abundance. Realized efficiencies are typically less than 100% for species that have been evaluated (e.g., Miller et al. 2023). Despite advances in tagging technology and receiver coverage, the ratio of total Atlantic sturgeon habitat to area sampled by the NEAMAP survey remains unknown. Scaled abundance estimates based on survey catchabilities from 5% to 95% from the 2007-2023 NEAMAP fall and spring surveys are provided in Tables 1 and 2, respectively.

DISCUSSION

While substantial progress has been made on understanding the population dynamics and life history of Atlantic sturgeon since Kocik et al. (2013), a more robust abundance index of the migratory coastwide population has not been achieved. The updated index presented here continues to have a few flaws:

(1) Spatial Mismatch – the nearshore survey occurs from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina; however, Atlantic sturgeon are anadromous and migrate to their natal rivers beyond the area of the survey.
(2) Temporal Mismatch – mature Atlantic sturgeon migrate in spring for spawning, with females returning to coastal waters following spawning while males may remain in the estuaries until fall (Atlantic Sturgeon Status Review Team 2007).

Determining population size from a fishery-independent survey is dependent on a proper estimate of catchability, which scales the abundance index to the population size (Arreguin-Sanchez 1996). Stock assessment models can estimate catchability internally (Maunder and Piner 2015), or alternative sources of data can be used to calculate it externally (Miller et al. 2023). At this time, there is no assessment model for Atlantic sturgeon with this capability, and insufficient data is available to estimate catchability externally.

Without the necessary information to estimate catchability for Atlantic sturgeon, it may be reasonable to apply a catchability rate of another species with a similar life history or distribution. At the time of this report, VIMS has not conducted experiments on catchability with the NEAMAP survey for any species (Debra Gauthier, pers. comm.). However, NEAMAP was initially developed to provide coverage for the nearshore areas that could no longer be sampled by the Northeast Fisheries Science Center's Bottom Trawl Survey when the research vessel Henry B. Bigelow came online in 2008. Miller et al. (2023) estimated catchability for several stocks in the Bottom Trawl Survey, with values varying by stock, year, and season from a minimum of 0.15 to a maximum of 0.95 (see Appendix for details). With a migratory, anadromous life history, there were no comparable species to Atlantic sturgeon in that study. Based on our current understanding of Atlantic sturgeon distribution, the goosefish (*Lophias americanus*) has the most similar distribution of any stock in the study. Across both stocks, goosefish had mean catchabilities of 0.44 in the fall and 0.43 in the spring. Acknowledging that goosefish distribution extends farther offshore but not as far south as Atlantic sturgeon, it may be appropriate to assume a similar catchability estimate for Atlantic sturgeon until further studies are completed. The range of estimated abundances for Atlantic sturgeon with a 25-50% catchability is plausible given our current understanding of Atlantic sturgeon life history with portions of the population unavailable to the survey due to migratory pathways and timing, as well as occurrence in depths greater than 18.3 m.

TABLES

Table 1. Summary of estimated Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) abundance based on alternative estimates of catchability (q) for the fall survey. Catchability is defined as the product of gear efficiency and availability.

Year	Number	CV	5% q	25% q	50% q	75% q	95% q
2007	6,885	0.012	137,696	27,539	13,770	9,180	7,247
2008	31,976	0.332	639,524	127,905	63,952	42,635	33,659
2009	31,579	0.317	631,583	126,317	63,158	42,106	33,241
2010	33,382	0.521	667,634	133,527	66,763	44,509	35,139
2011	21,982	0.407	439,634	87,927	43,963	29,309	23,139
2012	33,311	0.366	666,214	133,243	66,621	44,414	35,064
2013	17,187	0.433	343,734	68,747	34,373	22,916	18,091
2014	49,877	0.732	997,538	199,508	99,754	66,503	52,502
2015	35,127	0.401	702,545	140,509	70,255	46,836	36,976
2016	51,489	0.415	1,029,788	205,958	102,979	68,653	54,199
2017	25,436	0.379	508,720	101,744	50,872	33,915	26,775
2018	14,092	0.483	281,847	56,369	28,185	18,790	14,834
2019	44,683	0.329	893,655	178,731	89,366	59,577	47,034
2020	33,783	0.319	675,651	135,130	67,565	45,043	35,561
2021	117,767	0.499	2,355,334	471,067	235,533	157,022	123,965
2022	65,579	0.379	1,311,576	262,315	131,158	87,438	69,030
2023	99,043	0.301	1,980,864	396,173	198,086	132,058	104,256

Table 2. Summary of estimated Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) abundance based on alternative estimates of catchability for the spring survey. Catchability is defined as the product of gear efficiency and availability. The 2020 survey was not completed due to the COVID-19 pandemic.

Year	Number	CV	5% q	25% q	50% q	75% q	95% q
2008	24,598	0.392	491,961	98,392	49,196	32,797	25,893
2009	38,232	0.362	764,632	152,926	76,463	50,975	40,244
2010	46,422	0.260	928,438	185,688	92,844	61,896	48,865
2011	52,391	0.482	1,047,814	209,563	104,781	69,854	55,148
2012	27,950	0.658	558,991	111,798	55,899	37,266	29,421
2013	26,567	0.423	531,337	106,267	53,134	35,422	27,965
2014	15,730	0.482	314,609	62,922	31,461	20,974	16,558
2015	15,335	0.510	306,700	61,340	30,670	20,447	16,142
2016	29,542	0.259	590,836	118,167	59,084	39,389	31,097
2017	6,510	0.518	130,195	26,039	13,020	8,680	6,852
2018	49,931	0.258	998,611	199,722	99,861	66,574	52,558
2019	33,565	0.295	671,300	134,260	67,130	44,753	35,332
2020							
2021	144,226	0.316	2,884,515	576,903	288,451	192,301	151,817
2022	115,200	0.311	2,303,993	460,799	230,399	153,600	121,263
2023	77,340	0.356	1,546,801	309,360	154,680	103,120	81,411

FIGURES

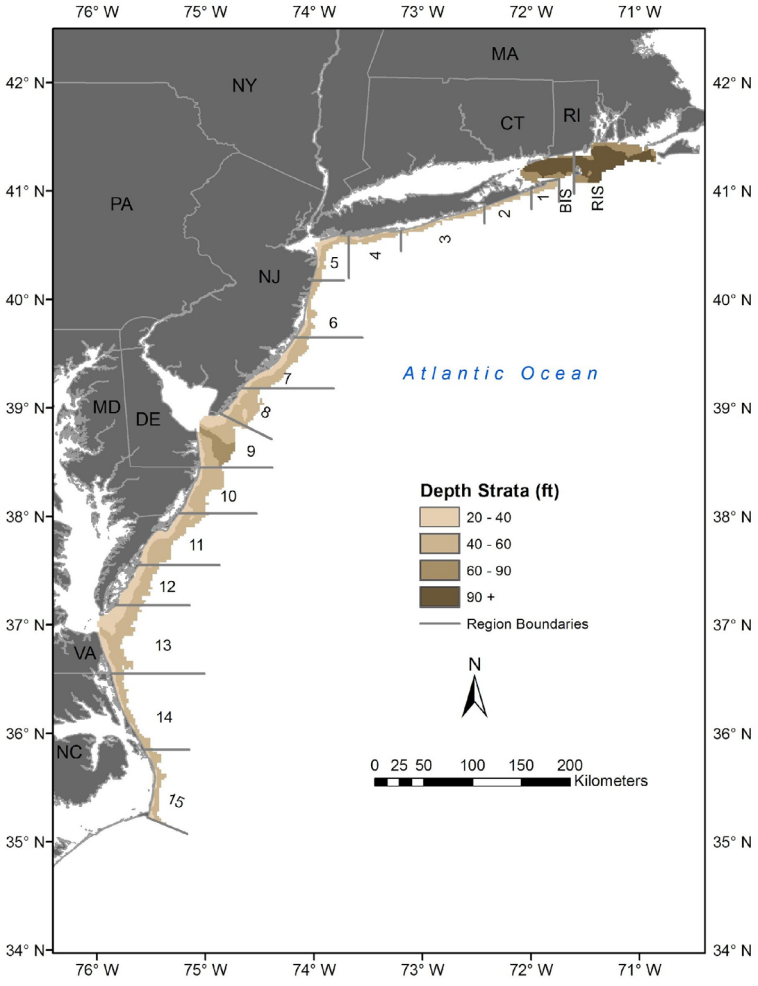

Figure 1. Stratified design of the Northeast Area Monitoring and Assessment Program (NEAMAP) survey. Sampling in Block Island Sound (BIS) and Rhode Island Sound (RIS) strata extends deeper than the 18.3 m limit due to coordination with the Northeast Fisheries Science Center (NEFSC) Bottom Trawl Survey. Image obtained from www.vims.edu on November 1, 2024.

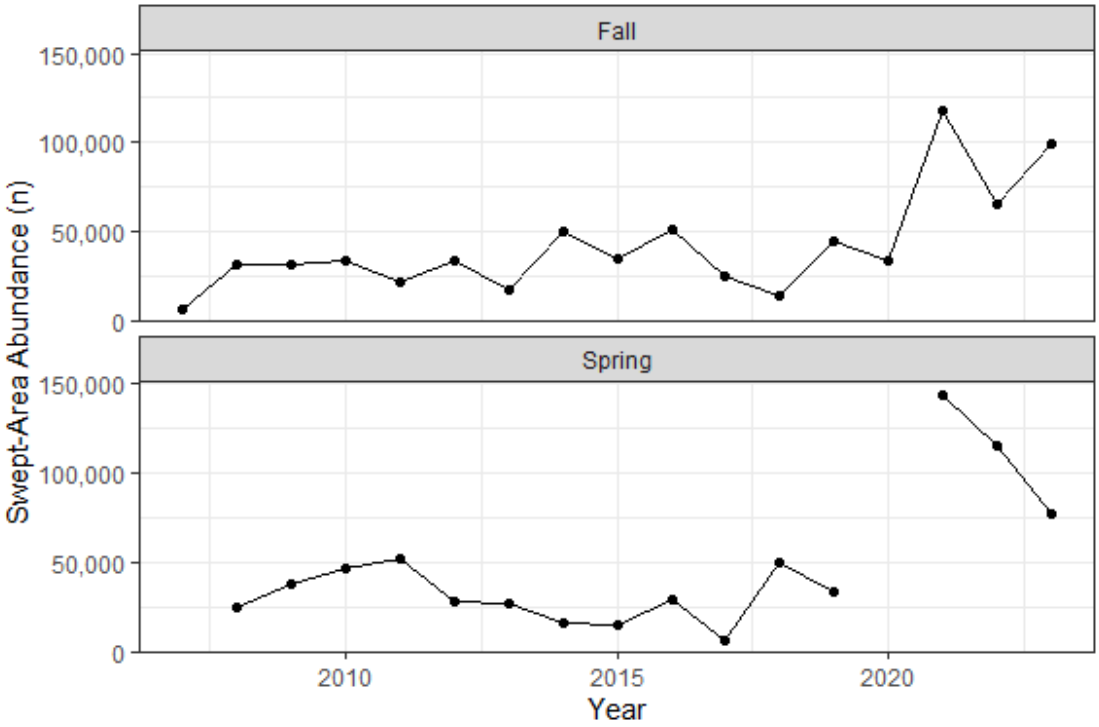

Figure 2. Fall and spring indices of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) coastwide abundance from the Northeast Area Monitoring and Assessment Program (NEAMAP) survey. Sampling was not completed in spring of 2020 due to the COVID-19 pandemic.

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APPENDIX

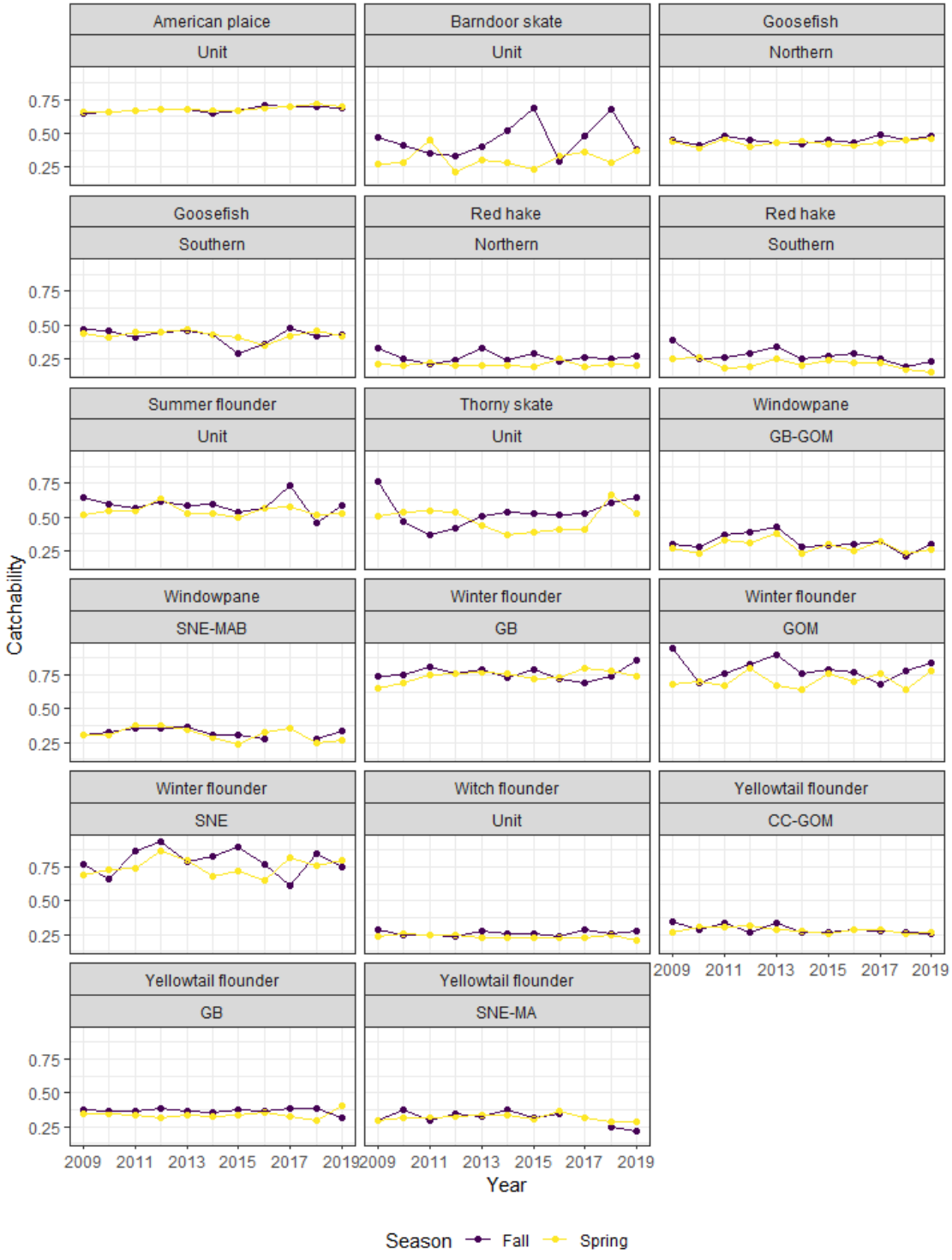

Figure A1. Fall and spring estimates of catchability by stock from Miller et al. (2023).

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