# *Atlantic States Marine Fisheries Commission*

*ASMFC Vision Statement:*
*Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015.*

**Special Report to the ASMFC Atlantic Sturgeon Management Board:**

# ESTIMATION OF ATLANTIC STURGEON BYCATCH IN COASTAL ATLANTIC COMMERCIAL FISHERIES OF NEW ENGLAND AND THE MID-ATLANTIC

**August 2007**

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# ESTIMATION OF ATLANTIC STURGEON BYCATCH IN COASTAL ATLANTIC COMMERCIAL FISHERIES OF NEW ENGLAND AND THE MID-ATLANTIC

## PROBLEM

Bycatch remains an important issue in the recovery of Atlantic sturgeon populations throughout their range (ASMFC 1998). This issue is also given highest priority by the National Marine Fisheries Service (NMFS) Proactive Program for Atlantic sturgeon restoration. The Atlantic States Marine Fisheries Commission (ASMFC) requires jurisdictional reporting of Atlantic sturgeon bycatch, but the quality of available data varies. Further, in New England and Mid-Atlantic coastal waters, regions where the NMFS Northeast Fisheries Science Center (NEFSC) Sea Sampling (Observer) Program data is available, recent analyses have resulted in substantially differing estimates of bycatch and related incidental mortality (i.e., Stein *et al.* 2004; Chris Hager, Virginia Institute of Marine Science, pers. comm.). As a principal recommendation from the 2006 ASMFC Atlantic Sturgeon Bycatch Workshop, the Sturgeon Technical Committee (TC) has recommended a focused assessment of the NEFSC Observer Database, which principally covers fisheries in New England and the Middle Atlantic state waters.

## BYCATCH WORKSHOP PARTICIPANTS

During 24-25 April 2007, ASMFC and NMFS sponsored a workshop at the NMFS NEFSC, Woods Hole, Massachusetts.

Participants included:

Gary Shepherd (Host, NMFS NEFSC)
Tim Miller (NMFS NEFSC)
Christine Lipsky (NMFS NEFSC)
Jim Armstrong (Mid-Atlantic Fishery Management Council)
Chris Hager (Virginia Institute of Marine Science)
Andy Kahnle (NY State Department for Environmental Conservation, TC member)
Kathy Hattala (NY State Department for Environmental Conservation)
Erika Robbins (ASMFC, Atlantic sturgeon FMP Coordinator)
Dave Secor (Univ. MD Center for Environmental Science, TC Chair)
Kelly Place (workshop observer, ASMFC commissioner proxy)

## WORKSHOP GOALS

1. Estimate Atlantic sturgeon bycatch rates and numbers caught by fishery, state, and season for the period 2001-2006 using data from the NEFSC observer database. Develop an interpolation model based upon recent fishing behaviors that allows estimation of bycatch among fisheries, regions, and seasons.
2. From the NEFSC Observer Database, estimate bycatch mortality rates by fishery, state, season, and fishing behavior (e.g., soak time).

## REPORT STRUCTURE

This report contains six sections:

1. Estimation of Atlantic sturgeon bycatch and bycatch deaths from the NEFSC Observer Dataset (Gary Shepherd, lead)
2. Current level of coastal bycatch mortality and recovery of Atlantic sturgeon populations (Dave Secor, lead)
3. Spatial distribution of observed sturgeon encounters in commercial sink gillnets and sink gillnet fishery effort (Jim Armstrong, lead)
4. Factors associated with mortality of incidentally caught sturgeon in the Northwest Atlantic Ocean (Tim Miller, lead)
5. Presence:absence analysis of factors associated with Atlantic sturgeon bycatch (Dave Secor, lead)
6. Sink gillnet fisheries and descriptions of factors that can contribute to higher or lower interaction and retention rates (Chris Hager, lead)

## PRINCIPAL FINDINGS

### Estimates of Bycatch and Bycatch Deaths (2001-2006)

1. Sink Gillnets

   1.1. The approach adopted by the group to model bycatch for the recent period 2001-2006 is different from the method of Stein *et al.* (2004), which estimated bycatch for the period 1989-2000 using interpolation and a ratio method.

   1.2. Modeled bycatch of Atlantic sturgeon ranged between 2,752 (2002) and 7,904 (2006) with a mean of 5,143.

   1.3. Modeled deaths ranged between 352 (2006) and 1,286 (2004) with a mean of 649. Estimated mortality of intercepted sturgeon averaged 13.8%.

   1.4. Modeled bycatch was similar in magnitude to that estimated by a different approach for the 1989-2000 period (~4500 per year; Stein *et al.* 2004), but deaths were approximately two-fold less (649 per year for recent period v. approximately 1000 per year estimated by Stein *et al.* 2004). Similarly, mean mortality rate estimated for the recent period was less than that estimated for the earlier period (13.8% v. 22%).

   1.5. Because alternate methods were used for the earlier 1989-2000 and later 2001-2006 period, bycatch estimates reported here and in Stein *et al.* (2004) are not directly comparable, but similar amplitude in estimates indicate bycatch mortality of hundreds per year.

2. Otter Trawl

   2.1. Modeled bycatch of Atlantic sturgeon ranged 2,167 in 2005 to 7,210 in 2002 with a mean of 3,829.

   2.2. Sturgeon deaths (n=3) were rarely reported in the otter trawl observer dataset. This indicates low mortality rates. Because deaths were infrequent in the dataset they could not be modeled for the otter trawl gear.

2.3. Sturgeon bycatch is substantially lower than estimated for the 1989-2000 period (Stein *et al.* 2004): approximately 4,000 v. 12,000. The same caveat applies in comparing past and more recent period estimates in that different analytical approaches were used.

**Current Bycatch Levels and Atlantic Sturgeon Recovery**

1. To remain stable or grow, populations of Atlantic sturgeon can sustain only very low anthropogenic sources of mortality (<4% per year).
2. For one of the most abundant populations, the Hudson River population, current level of bycatch deaths is most likely retarding or curtailing recovery.
3. For many likely scenarios of contribution to coastal bycatch and recruitment levels, bycatch mortality for the Hudson River population exceeds those levels believed to lead to a stable or growing population. Only scenarios of low contribution rates of the population to coastal bycatch in concert with high and intermediate recruitment levels would lead to a stable or slow-growing population.
4. Other populations contribute to the coastal bycatch and populations smaller than the Hudson River population are expected to be affected to a larger degree by bycatch deaths because proportional removals have larger negative effects on less productive populations.
5. The results of the scenarios run for the Hudson River population are likely under-estimates because not all sources of mortality are included in the NMFS observer data estimate. These include unreported bycatch, poaching, and ship strikes.
6. Because deaths in New England and Mid-Atlantic waters are principally attributed to the monkfish sink gillnet fishery, changes in effort in this fishery are expected to lead to proportional changes in bycatch deaths. Similarly, means to reduce bycatch mortality in this and other sink gillnet fisheries through modification of gear deployments (e.g., soak time, presence of tie-downs) could result in substantial reductions in sturgeon deaths.

**Spatial Distribution of Sink Gillnet Bycatch**

1. Coverage of the NEFSC Observer Database is generally consistent with the distribution of fishery effort. However the Observer Program coverage in the southern Mid-Atlantic (mouth of Chesapeake through Cape Hatteras) is disproportionately high relative to reported effort.
2. Sturgeon encounters tend to occur in waters shoal of 50 meters. Although seasonal patterns exist, sturgeons are encountered in sink gillnets throughout the year.
3. Sink gillnet deployments and sturgeon bycatch were concentrated in several regions: off Cape Hatteras, the mouth of the Chesapeake, Maryland's coastal waters, the northern shore of New Jersey and New York Bight, Rhode Island coastal waters, and Cape Cod through Gulf of Maine

**Factors Associated with Atlantic Sturgeon Bycatch Mortality in Sink Gillnets**

1. The strongest gear factor associated with mortality was the increase with mesh size when tie-downs were used regardless of whether monkfish or groundfish were targeted.
2. A significant positive association of water temperature to mortality was detected when tie-downs were used regardless of whether monkfish or groundfish were targeted.
3. A significant positive association between soak time to mortality was detected when monkfish were targeted (tie-downs used).

4. A significant positive association of soak time to mortality was detected when groundfish were targeted without tie-downs.
5. A significant positive association of soak time to mortality was detected when striped bass were targeted without tie-downs.
6. A significant positive association of sturgeon length to mortality was detected when striped bass were targeted without tie-downs.

**Presence:Absence Analysis of Factors Associated with Bycatch**

1. For sink gillnet fisheries, higher incidence of sturgeon bycatch was associated with depths <40 meters, mesh sizes >10", and months April-May.
2. For otter trawl fisheries, higher incidence of sturgeon bycatch was associated with depths <30 meters.

**Interaction and Retention of Atlantic Sturgeons in Sink Gillnets**

1. The NEFSC sturgeon bycatch dataset based on observer coverage is not homogenous across or within fisheries, effort, target species, state, or areas of operation. However, patterns exist in data suggesting that interaction rates are driven by spatial and temporal variables and retention is gear dependent.
2. Increased regional movement and hence availability of migrating sturgeons increase the likelihood of interaction with sink gillnets of any type operating within migration corridors. Gear characteristics and fish size affect retention. Tie-down use appears to increase the overall size range of retained fish by increasing the susceptibility of smaller individuals.
3. Water temperature and soak time duration affect survival of sturgeons through physiological constraints regardless of capture method. Across the range of temperatures, incidence of death increased with rising temperatures. A clear relationship was apparent between increasing mortality and soak times, with soak times >24 hours resulting in a 40% incidence of death and those <24 hours resulting in a 14% incidence of death.
4. Longer soak times may also increase bycatch and related deaths by increasing the likelihood of an interaction and perhaps through a baiting effect.
5. Mortality rates appear to be unusually high in 12 inch mesh (e.g. the monkfish fishery); however, mesh size cannot be analyzed in isolation because these nets were also observed to contain tie-downs 98% of the time, and soak times over 24 hrs occurred 83% of the time for these monkfish fishery deployments.
6. Confounding gear attributes across fisheries and imprecise reporting of various gear characteristics known to affect fish retention, currently limit what can be learned from the NEFSC Observer Database regarding gear characteristics and their effect on sturgeon retention. Controlled experiments on captive fish suggest, however, that twine size, hanging ratio, and tie-down use all significantly increase the retention of fish that encounter sink gillnets.

**RESEARCH RECOMMENDATIONS**

1. Highest research priority should be given to evaluation of relative population contributions to regions of high bycatch. Molecular approaches are currently available to estimate these population contribution rates, but such studies should be undertaken through careful sampling designs to insure that genetic samples are representative of intercepted sturgeon.

2. Abundance and vital rate estimates are required for populations contributing to coastal bycatch to evaluate whether bycatch rates are sustainable on a population-specific basis.

3. The bycatch GENMOD modeling approach developed here should be used for analysis of historical bycatch (the 1989-2000 period). The model will need to be re-parameterized and refit. Also, changes in how data have been recorded by observers and within the vessel trip report (VTR) data prior to 2000 will need to be carefully considered.

4. State effort statistics related to sink gillnet and other fisheries that retain sturgeons should be combined with the VTR database to permit improved expansion of observer-based bycatch rates.

5. A detailed GIS analysis should be performed on the distribution of observed sturgeon bycatch to compare recent patterns of coastal habitat use by Atlantic sturgeon to historical ones (1989-2000). Although most sturgeon were caught as bycatch in waters <40 meters in gillnet and trawl fisheries, this depth association is expected to vary between New England and Mid-Atlantic regions and deserves additional analysis. The observer database (1989-present) could support habitat suitability mapping for Atlantic sturgeon in coastal waters of New England and the Mid-Atlantic.

6. Controlled mesocosm-scale experiments on sink gillnet interactions and retention of sturgeon, such as those recently conducted at VIMS (C. Hager, pers. comm.), should continue to investigate gear factors associated with bycatch. Gear retention studies could be conducted in semi-field systems (large ponds) and permit estimates of catchability applicable to the field.