2006

Assessment of Sturgeon Bycatch, Bycatch Mortality and Other Regulatory Discard Mortality in Virginia's Winter/Spring Striped Bass and Other Gill Net Fisheries

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By
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Background:

There were numerous objectives for this two year project. In general, objectives for the 2006 portion followed those proposed in 2005. The first was to evaluate sturgeon interactions with the anchored gill net striped bass and other fisheries in the spring and the fall. The second was to evaluate sturgeon interactions in the striped bass fishery and to some extent, other anchored gill net fisheries. Third, was to determine the effects of various mesh sizes and gauges on bycatch and mesh/gauge specific size distributions. The fourth was to gather critical abundance, mortality and DNA data on sturgeon in Virginia waters. Fifth, was to collect baseline sturgeon bycatch data in order to develop spatial, temporal and/or gear alteration techniques to reduce or eliminate sturgeon bycatch mortality in Virginia. Sixth, was to supply sturgeon for the VIMS and USFWS tracking effort into the upper James River in an effort intended to identify essential habitat and remaining spawning grounds. Seventh, was to continue preliminary observations of whether the striped bass discard mortality assumed by ASMFC to occur in Virginia's fisheries is accurate, since the assumed discard mortality rate is converted to pounds and essentially deducted when calculating Virginia's striped bass quota. Lastly, this projects intent was to engage Virginia's commercial fishermen in the proactive collection of vital data and potentially, of genetically diverse brood stock possibly needed to effect a restoration of Atlantic Sturgeon to greater abundance so it may fulfill its function in the marine ecosystem.

Various publications were created through data gathered by this project or as out growths based upon samples collected though this project.

Some papers thus far include:

Virginia Marine Resource Sturgeon Compliance Report to ASMFC, 2005

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Hager, C.H. 2005. A Comparison of Gill net labeling methods for fisher identification. VIMS Marine Resource Report No. 2005-8, VSG-05-07. Attached.

Hager, C.H. 2005. Mesh Specific catch compositions and size distributions occurring in Virginia's 2005 winter-spring striped bass gill net fishery, VIMS Marine Resource Report No. 2005-7, VSG-05-06. Attached.

Wirgin, I., C. Grumwald, J. Stabile, and J. Waldman, 2007. Genetic Evidence for Relict Atlantic Strugeon Stocks Along the Mid-Atlantic Coast of the USA, North American Journal of Fisheries Management, in press online only.

Two students were involved in the research and a host of videos, newspaper, magazine articles, outreach efforts, powerpoints and posters were connected with this project's efforts.
A few included:

Video
VIMS Overview Video, Sturgeon Necropsy with Dr. Jack Musick, research featured

PBS Film on Atlantic Sturgeon, Eggs to Die For., research featured

National Geographic Society, five clips on website related to current sturgeon research and historic role at Jamestown

Magazines
College of William and Mary, Alumni Magazine, June 2006, research mentioned

National Geographic Magazine Atlantic Sturgeon Article (in press), research featured

National Fishermen, front page article

Crest Magazine, VIMS News Letter

Newspaper Articles
Front page Article, Richmond Times Dispatch, Richmond Va., May 4th 2005, research featured

Front page Article, Daily Press, Newport News, Va., May 4th 2005, research featured

Front page Article, Gazette Journal, Gloucester Va., May 5th 2005, research featured

Front page Article, Virginia Pilot, Norfolk Va., June 10th 2006, research featured

Outreach
Led discussion of upcoming bycatch issues including protected species at Maryland's Commercial Watermen's and Aquaculture Trade Exposition 2005, NMFS staff, Industry merchandise manufactures, and watermen were in attendance

Created display, posters and ran Sea Grant booth at the Watermen' s Museum Heritage Day Celebrations in 2005 and 2006, event is well attended by watermen of lower bay

Hager, C.H. 2005. An Introduction to Virginia's Bycatch Challenges: Past, Present, and Future Research, different versions given to VIMS Fisheries staff, professors and students, Maryland's Commercial Watermen's and Aquaculture Trade Exposition 2006, and Rotary Club

Provided educational materials on Atlantic sturgeon (historical population dynamics, causes for stock decline, and impediments to recovery) to Bass Pro shop Hampton materials will accompany live fish provided for display aquarium by USFWS.

Placed Atlantic sturgeon in Virginia Living Museum to help them with 1607 display

Power Points
Hager, C.H. and K. Place, 2005. A Preliminary Assessment of Sturgeon Bycatch in Virginia's Gill net Fisheries, evolving versions given to ASMFC, ASMFC Sturgeon Tech Committee, ASMFC Sturgeon Bycatch Workshop, and Virginia Sturgeon Restoration Committee

Hager, C.H. and K. Place 2005. An Introduction to Virginia's Bycatch Challenges: Past, Present, and Future Research, different versions given to VIMS Fisheries staff (professors and students), Maryland's Commercial Watermen's and Aquaculture Trade Exposition 2006

Posters
Bushnoe, T. and C. H. Hager, 2005. Estimated Atlantic Sturgeon Habitat in Virginia, outreach material

Hager, C.H. and T. Bushnoe, 2005. Atlantic Sturgeon Population Dynamics and Reasons for Failed Recovery, outreach material

Hager, C.H. 2005. Sturgeon Bycatch in Virginia's Spring Striped Bass Gill Net Fishery and the Effects of Gear Alterations on Catch Composition, to be submitted to ICES, Boston 2006

Over arching project objectives:

1) Surveyed bycatch in the spring and fall striped bass fisheries through the observer program in 205 and 2006, recorded species, morphometrics, location, gear parameters, physical conditions, and benthic habitat type at time. All of these attributes were stored in a data base for later analysis by Sea Grant researchers.

2) Established a condition code and estimate sturgeon mortality. A condition code was never established due to allocation of time to more traditional research goals.

3) All fish were scanned for sturgeon captures for PIT tags and USFWS T bar Floy © and PIT tags used to mark and monitor captured fish.

4) DNA was collected and spines collected for aging. DNA analysis of samples federal agencies (Wirgin et al. 2007, King and Henderson personal communication) proved not only that a unique genetic stock exists in the Chesapeake and that reproduction is ongoing in the James River, but that the genetic diversity is much broader than scientists had suggested previously. This discovery is extremely important and was pivotal in NMFS

Biological Review Team's decision to suggest listing the species by distinct population segments. Aging work is ongoing but preliminary analysis suggest that not only is the native stock more robust that formerly realized, but that it contains many more large older individuals.

5) Quantify temporal population using tag returns, if possible. This work has not yet been done because tag number is not robust enough at this point. However, with the continued efforts that this study began such estimations will be possible.

6) If catch quantity and data allows, use poisson (log linear) regression analysis to examine extent of external parameters influence on sturgeon interactions in order to develop a predictive model that can be used to minimize such interactions. A factor based model was attempted, however, this approach was abandoned due to numerous conflicting factors that negated approach. A more direct approach mesocosm approach was used by Hager (2007) to explore the gill net gear parameters that contributed to sturgeon retention. This research was extremely successful and built on what was learned in this study.

7) The fishery independent survey in the James River not only quantified the effects of various mesh sizes on catch composition during spring spawning run but has also become the states standard survey for sturgeon emigration into the James. This survey not only satisfies the states obligations under ASMFC to monitor sturgeon within its borders but has mutually benefited numerous other researchers by supplying fish including those from the Army Corp of Engineers, Virginia Commonwealth University, USFWS, and VIMS.

8) Collect genetically diverse sturgeon broodstock of Chesapeake Bay origin for possible hatchery based stocking efforts to augment natural reproduction of the species in Virginia waters if the naturally occurring reproduction is deemed insufficient for restoration. Fish attained through this program were also sent to Maryland to assist in the captive rearing program that is being conducted by Maryland Sea Grant and Maryland DNR.

This project provided CPUE estimates of sturgeon bycatch in the striped bass fishery. It investigated factors such as mesh size, twine size, gear design, temporal factors, spatial factors, benthic habitat composition and other factors that may influence sturgeon interaction occurrence. It provided field base estimates of catch composition and species specific size distribution and mortality estimates in various mesh sizes which is of increasing importance as regulations governing striped bass fishery change. Field based estimates of such factors are the only method that can truly distinguish if the intent of a given regulation is being achieved or if regulations are increasing mortality rates through regulatory discards that outweigh intended conservation efforts.

Introduction

Two species of Acipenseriforms occur along the east coast of North America and within the Chesapeake Bay and both are protected. Due to an unusual combination of morphology, habits and life history characteristics; sturgeon are highly vulnerable to impacts from human activities particularly fishing (Boreman 1997). The short nose sturgeon (*Acipenser brevoristrum*) which primarily inhabits fresh waters and is listed as endangered under the ESA and the Atlantic (Acipenser oxyrinchus) which is currently protected from intentional harvest by the ASMFC. Due to a lack of population recovery the distinct population segments of the Atlantic are likely to be listed as threatened in 2008. One of these segments originates within the Chesapeake and thus this listing could have profound effects on the region and its fishers.

Though protected, the Atlantic is still suffering from potentially significant mortality due to bycatch in numerous gears (NMFS, current observer data). Their longevity (Boreman 1997, Kynard 1997), late maturation and inconsistent spawning intervals combine so that even modest fishing mortality can significantly affect their reproductive potential (Boreman 1997, Morrow et al. 1998). NMFS Northeast region observer data suggests that anchored gill nets have the highest bycatch rates and are particularly devastating due to an average immediate mortality of 22% (Stein et al. 2004). Virginia harvests the majority of its finfish using anchored gill nets (VMRC, report data) in fact the gear is the primary method of harvest applied in the state's most economically valuable inshore fishery for striped bass. This study was undertaken by Sea Grant in cooperation with commercial fishermen, the USFWS, and VIMS in order to provide baseline data to improve sturgeon management in Virginia.

Methods

The primary objectives were to assess the size, condition, relative abundance (CPUE) and stock structure of sturgeon taken as bycatch in Virginia's anchored gill net fisheries. A two part methodology was used to investigate ongoing commercial fisheries in 2005 and the spring of 2006. An observer program collected data on board commercial vessels and a reward program was established for commercial watermen. Both methods of fisheries dependent analysis attained characteristics of sturgeon taken as well as temporal, gear and spatial parameters associated with interactions (fish could be taken in any gear). A fisheries independent gillnet investigation was conducted in the James River using 5, 6, 7, 8, 10, 12 and 14 inch stretched mesh webbing in 2005 and 2006 (see figure 1).

years fished	05-06	05-06	05-06	05-06	05-06	2006	2006
stretched mesh (in)	5	6	7	8	10	12	14
mesh depth (#)	25	25	25	25	15	10	10
bundles fished	2	2	2	2	2	2	2
twine size	0.52	0.57	0.9	0.3	0.9	0.9	0.9
length hung bundle	335	335	335	335	335	300	300
hanging ratio	7/12	7/12	7/12	7/12	7/12	1/2	1/2

Figure 1: List the net characteristics of gear fished in 2005 and 2006 in the fisheries independent section.

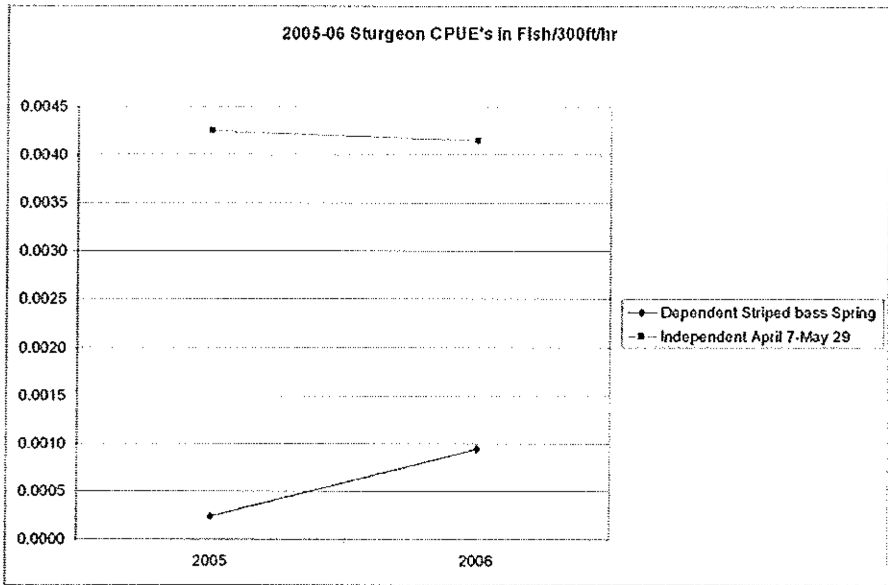
The James was selected because it is the last river in Virginia believed to contain a spawning population of Atlantic sturgeon and historically commercial catches in the river were significant. Fish of adult size were to be collected for tracking investigations into habitat use and resident times and a captive breeding effort being conducted by Maryland Sea Grant respectively. The fisheries independent investigation was conducted in a location of historical interactions with gear of known and intentionally varied construction. Controlled collection efforts with varied gear of known construction provided a non-bias data set for comparisons with catch statistics reported in the reward and observer programs. All retained fish were to be T tagged, PIT tagged, and DNA samples attained to determine fish's origin. A sub-sample of fish were to be aged by pectoral spine sampling and another held to estimate survival, tag retention and failure rates. In addition to bycatch assessment, sonic transmitters were to be placed in adult fish to assess habit usage and resident times.

Results and Discussion

A 4% (n=508, 05-06) mortality was estimated based on fishermen's reports. This lower mortality may appear intentionally misleading at first, however, this estimate is the same as that reported by scientist as having occurred in staked shad gill-nets located in the James and York Rivers (Olney, 2005 unpublished, .040 (n=25)). This is encouraging because the report data is the most robust data set collected and similar finding suggest that log books or fishers reports can be used to estimate such parameters as long as trust is maintained.

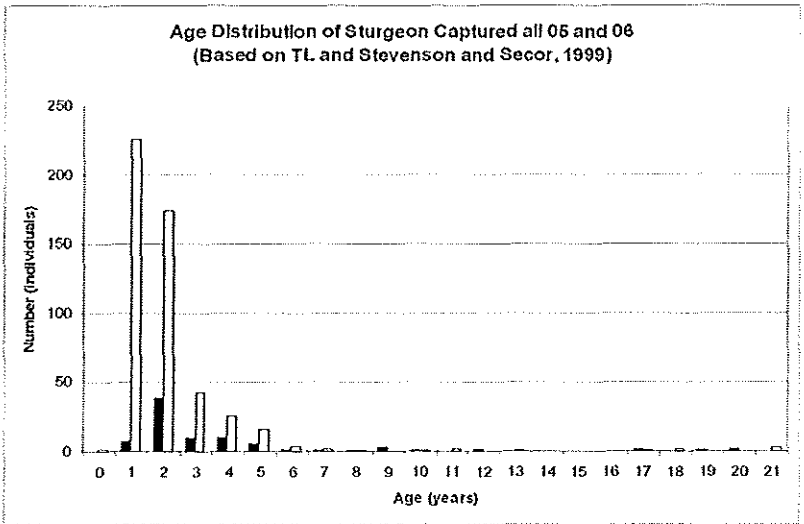
Catch per unit effort (CPUE) estimates were calculated based upon dependent observer data (n=15) and independent data collections (n=254) in spring of 05 and 06. Dependent data provided a means of comparing sturgeon bycatch in Virginia's striped bass fishery between years and to that occurring in other states spring fisheries. CPUE's are reported in net hrs (Collins, 1996) a unit that represents 300ft (90m) of net fished for an hour. The sturgeon CPUE in Virginia's striped bass fishery was .0004 in 05 and .0009 in 06 with an average between years of .0008. CPUE are at least an one to two orders of magnitude less than that recorded in South Carolina's American shad gill-net fishery according to Collins (.013 - .008, 1994-6). Collins observed an instantaneous mortality range from .18 to .06 (1995-1996). An average rate of .07 was observed in Virginia's striped bass fishery (05-06, n=15). This reduced rate may be due to the lower water temperatures in which the fishery occurs. Collins (1996) suggests that sturgeon bycatch mortality may occur more quickly in water ≥18 C°. Our data supports his theory. Mortality increased from 2% to 14% when temperatures exceeded 17 C°.

The independent portions of the study were conducted from April through May in 2005 and from January through May in 2006. Temperature is likely an important factor affecting movements and stress during gillnet interactions, therefore, only the CPUE and instantaneous mortality determined during the overlapping period of April 7-May 28th are presented. The CPUE in 05 was .0042 and .0041 in 06. Instantaneous mortality was .08 in 2005 (n=24) and .05 in 2006 (n=63) resulting in a pooled estimate of .06.

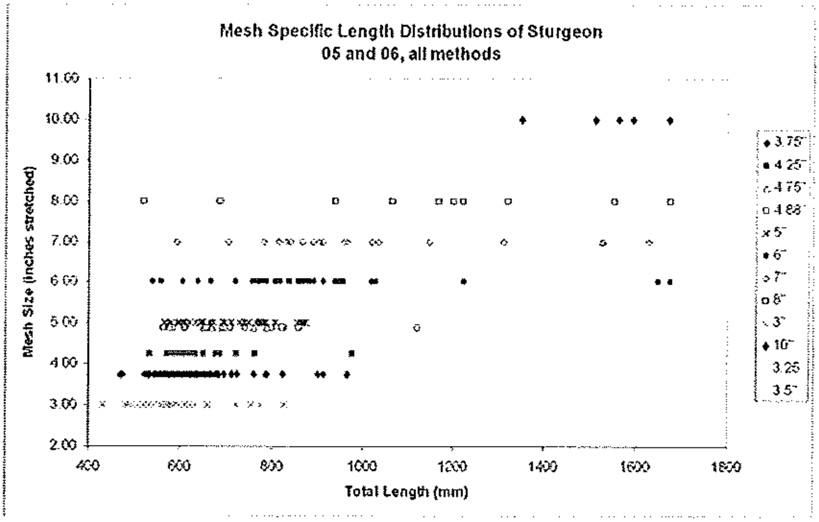


Fishery dependent observer data suggests that interaction rate doubled between 05 and 06 but rate augmentation is not evidenced in independent trials in the James River where gear and effort were controlled. This finding suggests that something altered fishers approach in 2006 and this unintentionally augmented interaction rates. Substantial alterations in the regulations governing striped bass harvest occurred in 2006. In 05, eight inch mesh was the dominant mesh size observed. In 06, fishers were forced to target smaller fish due to a managerial decision to split tags into large fish and small fish quotas. This was done to reduce the average size fish being taken in the fishery and thus prevent reductions in the ASMFC set quota. In response, fishers fished reduced mesh sizes farther up the tributaries where such striped bass were more available.

Due to the life history of Atlantic sturgeon the species is not equally distributed within the estuary. Juveniles occur within the bay's mainsteam and its tributaries in much greater abundance than adults (figure 2).



Juveniles spend several years within the tributaries (Scott and Crossman and actually move downstream into deeper brackish waters during cold water periods (Dovel 1978; Hoff 1980). Five and six inch nets can be highly effective at catching these juvenile fish and can even hold larger fish if constructed of substantial webbing (Figure 3).



Observed increases in sturgeon bycatch are likely due to increased use of reduced mesh sizes within tributary habitat known to contain a higher population of juvenile sturgeon normally and an augmented population of sturgeon in general during the spring due to the anadromous spawning habits of the species.

Tag returns

Tag returns from this project have already begun to provide much needed information on the distribution, movements and habitat preferences of sturgeon in the Chesapeake. Recoveries suggest that juveniles (< 650mm) evidence dualistic migration patterns (Kynard, pers. com.). Some remain in the lower middle James during the winter months while others overwinter in near shore coastal waters. Coastal recaptures suggest that coastal fish migrate north in shallow water and join tributary residents in late March through April. Recapture data in both the James and York Rivers suggest that some fish show site fidelity within the tributaries in the spring. All juveniles recaptured in the James (January-April) occurred within 6 miles of original capture location and occurred in brackish water near the freshwater interface. Many of the juvenile fish recaptured in the York River had been held and were subsequently released (late March to late April) in a central location near the mouth of the river. Nine percent of these fish were recaptured with 66% of these recaptures occurring at original capture sites down river (2.5 to 8 miles). In 2005, a fish was captured five times from April 8 to May 18 in this same region. Extended residence time and multiple recaptures of numerous fish suggest that this region contains preferred habitat. DNA analysis of fish collected from this location possess haplotype frequencies that differ significantly from all other locales coastwide including a sample of fish < 50 cm from the James (Wirgin, 2007). This study has and will continue to expand our understanding of sturgeon and methods to reduce bycatch, with continued efforts such knowledge will pave the way for the species' restoration to its rightful abundance within the ecosystem.

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Final Report 2005 (year 1)

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Abstract

An assessment of sturgeon bycatch in Virginia's 2005 gill net fisheries was made using three methods.

1. An fishery independent survey in the James River was undertaken using a wide range of specific gear and observers to tag fish, collect DNA and record the results.
2. A fishery dependent survey was conducted by placing observers on commercial fishing vessels engaged in their normal fishing practices.
3. Selected commercial fishermen were recruited to participate in a report/reward program. They were required to submit log sheets and pictures of sturgeon interactions, and some of them to tag the fish and collect DNA as well.

One hundred and fourteen Atlantic sturgeon were recorded in 2005. We collected pictures, lengths, locations and other data from the captured fish. Also, we applied T-bar tags and collected DNA from most of the fish taken. Additionally, we inserted electronic PIT tags into many fish which will serve as a permanent identification number for them.

We observed 24 sturgeon in the fishery independent survey in the James River which were caught in a wide range of the net configurations we deployed. There were two mortalities which represents an 8% bycatch mortality rate for that part of the study.

There were five sturgeon observed in the fishery dependent survey, but there were no mortalities observed, perhaps due to the relatively small sample size.

There were 85 fish caught by fishermen during the report/reward program. They reported a mortality rate of 4%. It should be noted that staked gill nets observed by scientists in an American Shad monitoring study also reported a 4% bycatch mortality of sturgeon. It should also be noted that the mortalities we recorded tended to be during the time of year when the water temperature was the warmest.

Two of the fish were eventually recaptured and we captured one which had previously been tagged in Connecticut.

Three of the larger fish were sent alive to the Horn Point Lab in Maryland for use in captive breeding efforts. Two were successfully spermiated and the gametes cryopreserved for future breeding efforts.

The project is ongoing into 2006.