January 27, 2020

Rear Admiral K.M. Smith
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Admiral Smith,

Thank you for the opportunity to comment on the advanced notice of proposed rulemaking, "Anchorage Grounds; Delaware Bay and Atlantic Ocean, Delaware". Specifically, our comments are directed at the designation of Anchorage B—Breakwater at the mouth of the Delaware Bay and the likely impacts on Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*), an endangered species under the Endangered Species Act (ESA). Occurring in the immediate vicinity of the proposed Anchorage B, we have recently documented what is arguably the largest known aggregation of adult and sub-adult Atlantic Sturgeon along the East Coast of North America. The aggregation is comprised of individuals that have been tagged in river systems ranging from Connecticut to Georgia and underscores the importance of the lower portion of Delaware Bay as this region provides a key foraging resources for a Atlantic Sturgeon from a broad geographic area. In essence, any modifications to this region may dramatically impact the conservation and recovery of this imperiled species across its range.

Background – Atlantic Sturgeon and Delaware River Estuary

Sturgeons (Family Acipenseridae) are among the most imperiled groups of fishes (Jelks et al. 2008, IUCN 2010), and the vast majority of species are considered endangered as the result of historic overfishing and habitat loss. Atlantic Sturgeon have been severely depleted during the last 130 years (Secor and Waldman 1999, Secor 2002) since the inception of the Delaware River fishery in approximately 1890. The Delaware River once supported what was commonly thought to have been the largest population of Atlantic Sturgeon, with an estimated 180,000 adult females (Secor and Waldman 1999). The sturgeon fishery was closed in 1998 and presently the

Delaware River is believed to support an annual spawning run of less than 300 individuals (ASSRT 2007) which is well below 1% of historical abundance.

In 2012, the New York Bight, Chesapeake Bay, Carolina, and South Atlantic Distinct Population Segments (DPSs) of Atlantic Sturgeon were declared endangered species under the Endangered Species Act (ESA) (Federal Register 2012a and 2012b). The listing determination concluded that direct mortality through vessel strikes contributed a significant risk for the New York Bight DPS. To date, much of the work examining the relationship of the shipping industry and the conservation of Atlantic Sturgeon has focused on the issue of understanding these mortality events (Simpson and Fox 2009, Brown and Murphy 2011, Balazik et al. 2012, DiJohnson 2019) although there are concerns over the impact of dredging (Reine et al. 2014) and cumulative effects of commercial anchoring on this species (Madsen and Fox 2019).

In the summer of 2014 while conducting reconnaissance work within the lower portion of Delaware Bay, we documented one of the largest concentrations of adult and sub-adult Atlantic Sturgeon yet known (Fox and Madsen unpublished data). Using data generated through this effort we secured funding through Delaware Sea Grant to begin collecting critical baseline data on fine scale habitat utilization for adult and large sub-adult Atlantic Sturgeon (Figure 1). Between July and December 2019, we utilized a combination of high-resolution side-scan sonar, passive acoustic telemetry, and directed sampling to begin characterizing this aggregation. Our study site partially intersects the Proposed Anchorage B and comprises a large swath just to the east of the area to be designated Anchorage B.

The results of our passive acoustic telemetry documented extended occupancy of this region by Atlantic Sturgeon originally tagged in river systems ranging from Connecticut (New York Bight DPS) to Georgia (South Atlantic DPS). In total, almost 200 telemetered Atlantic Sturgeon were detected which represents a considerable proportion of all tagged individuals at large between Maine and Florida. As adults, Atlantic Sturgeon undergo extensive coastal migrations returning to their natal rivers to spawn. It appears that a variety of environmental conditions have led to ideal foraging opportunities for Atlantic Sturgeon at the mouth of the Delaware Bay as evidenced by their convergence on this area. Our directed gillnetting efforts coupled with lavage sampling confirmed that Atlantic Sturgeon are feeding on benthic invertebrates including several burrowing species (e.g. razor clams, ghost shrimps, and annelid worms).

The importance of foraging during marine habitat use is linked to subsequent reproductive success. In Atlantic Sturgeon, spawning intervals vary by sex with males capable of spawning in consecutive years while females often require periods of two-five years between spawning events (Bain 1997). The reason for this protracted spawning interval in females is likely tied to energy expenditure, as females may have up to 25-40% of their weight comprised of gonads (Van Eenennaam et.al 1996, Van Eenennaam and Doroshov 1998). Ultimately the recovery potential of Atlantic Sturgeon is tied to their ability to forage during these periods of gonadal recrudescence

In addressing your request for information, we have broken down our comments into two sub-sections: 1 – direct impacts (i.e., vessel strikes) and 2 – indirect impacts (disruption to foraging habitats) as they relate to the designation of Anchorage B and its potential impact on Atlantic Sturgeon conservation and recovery.

Direct Impacts – Vessel Strikes

Although sturgeons have existed for approximately 200 million years, a combination of life history characteristics (e.g. late maturation and prolonged periods between spawning events) make them particularly sensitive to additional sources of mortality. Atlantic Sturgeon already suffer additional mortalities associated with fishing bycatch, navigation projects (e.g. channel maintenance and deepening) and in some systems including the Delaware, experience mortalities due to impacts with vessels. A recently completed study found no evidence that Atlantic Sturgeon altered their behavior in the presence of commercial vessel traffic in the Delaware River (DiJohnson 2019). These findings suggest that Atlantic Sturgeon either do not consider vessels a threat or they cannot detect them until it is too late. Given the long evolutionary history of sturgeons (≈ 200 million years) and the recent development of propeller driven vessels (<200 years) it is not surprising that Atlantic Sturgeon may not have evolved a threat response for vessels. Complicating the issue of vessel strikes is the fact that although sturgeons may be capable of locating and avoiding intense sound near their tolerable limits, the sounds of individual vessels may be masked by a combination of natural (e.g. tides, wind, or waves) and anthropogenic (e.g. vessel propulsion) noise in the surrounding area making it difficult to isolate and react to any individual noise source. Additionally, an ongoing study in the Delaware River Estuary funded by NOAA-NMFS Office of Protected Species suggests that the reporting rates of

Atlantic Sturgeon mortalities is very low (<10%) suggesting that the magnitude of vessel strikes on Atlantic Sturgeon in the Delaware River Estuary may be unsustainable and directly impeding recovery (Fox et al. 2019). The issue of vessel strikes on impeding recovery was recently highlighted in the Atlantic States Marine Fisheries Commission Benchmark Stock Assessment (ASMFC 2017) where ship strike impacts in any DPS waterbody were identified as a risk to range-wide recovery in mixed-stock aggregations.

Although Atlantic Sturgeon are actively foraging in bottom sediments, they are often seen breaching. The reasons for this jumping behavior in sturgeon have been debated and include a means of communication (Sulak et al. 2002) and buoyancy regulation (Logan-Chesney et. al. 2018).). During our surveys we commonly saw Atlantic Sturgeon breaching and often used this behavior to help direct targeted netting efforts. Additionally, our side-scan surveys indicate that sturgeon are often positioned well off the bottom. It is during these periods when sturgeon are in the mid-water column that they are likely exposed to the risk of vessel strikes in areas of deeper waters. While we are unable at this time to estimate a per-vessel exposure risk, it is reasonable to assume that increased use of the lower Delaware River Estuary by commercial vessels will result in increased vessel strikes. Importantly, the impacts on Atlantic Sturgeon will not only impact the Delaware River (i.e. New York Bight DPS) but across the species range as this is a mixed-stock aggregation as highlighted in the recently completed Atlantic States Marine Fisheries Commission Benchmark Stock Assessment (ASMFC 2017).

Indirect Impacts – Disruption to Foraging Habitats via Anchoring

There is relatively little information on the spatial and temporal impact of anchoring of large commercial vessels on benthic communities. It is these bottom environments that provide foraging habitats for a variety of fish, including Atlantic Sturgeon. Tuck et al. (2011) and Deter et al. (2017) have shown the utility of integrating bottom habitat maps with Automated Identification System (AIS) data to locate a vessel's anchor position relative to sensitive bottom ecosystems. Davis et al. (2016) have discussed ecological damage due to anchor scour of ocean-going vessels within the context of marine policy response options. In a report that examined the risks within existing and proposed United Kingdom Marine Protected Areas, Griffiths et al. (2017) cited only six studies that have provided information on the bottom "footprint" of anchoring by recreational and commercial vessels (Creed and Amando Filho 1999; Francour et al. 1999; Backhurst and Cole 2000; Rogers and Garrison 2001; Collins et al. 2010; Axelsson et al. 2012). With funding provided by the NOAA-NMFS-GARFO Office of Protected Resources, we have recently completed a study on the Hudson River in the vicinity of the Hyde Park Anchorage Ground (Hyde Park, NY) that examined this issue (Madsen and Fox 2019). Our findings show marked disruption of bottom sediments both in and adjacent to designated anchorage areas some which exceed 300 meters (m) in length and 1.5 m in depth. Our study in the Hudson River provides insights into the likely impacts of anchoring on bottom sediments in the lower Delaware River Estuary although it is important to note that vessel size in the proposed Anchorage B will likely be larger than those encountered in the Hudson (maximum size = 200 m bulk carriers) during our study. As such, the anchor size will vary accordingly so our findings are likely conservative regarding benthic impacts.

To document the spatial and temporal scale of bottom disturbance due to anchoring at the Hyde Park Anchorage Ground, a series of repeat side-scan sonar surveys over a year time period were conducted. These surveys were coupled with Automated Identification System (AIS) data provided by the USCG for the 2016 and 2017 calendar years to assess vessel departure times and general use. In areas of the anchorage ground where vessels were, or had, anchored, the side-scan sonar imaged (Figure 2): anchor chain drag scars, small ridges and intervening troughs with less than 1 meter (m) wavelengths and 0.5 m relief, created by the movement of anchor chains over the bottom while vessels are at anchor; anchor scars, oblong-shaped depressions 1-3 m wide, 5-10 m long, and 1-2 m deep, formed when anchors settle into, or are removed from, the river bottom with minimal drag; and anchor drag scars, depressions with similar widths and depths as anchor scars, but that extend for lengths up to 300 m, caused by anchors being dragged along, or slightly beneath, the river bottom as vessels respond to high winds, strong tidal currents, and/or as they slowly set sail.

Our temporal observations of anchor chain drag scars indicate that they are short-lived features. In time intervals on the order of days, bottom currents likely redistribute sediments, effectively erasing the smaller ridges and troughs associated with anchor chain drag. The repeat side-scan sonar imaging of anchor scars suggest that they impact the bottom over time periods ranging on the order of weeks to several months. It is likely that bottom current activity over time causes erosion along the edges of these scars with subsequent infilling of the troughs, creating less relief and thus less backscatter in the side-scan sonar data.

Anchor drag scars are the most impactful of the bottom disturbances associated with anchoring. They extend for the longest distances (up to 300 m), can be present for long time periods (in some cases for at least a year), and were observed throughout the anchorage ground. Even after 53 weeks of elapsed time, a few of the initial anchor drag scars imaged in our first side-scan sonar survey were still distinguishable. The drag scars show evolution with time becoming less distinct due to long-term reduction in relief along their edges and infilling of their troughs as the result of bottom currents redistributing sediments in the vicinity of these features (Figure 3).

During our surveys in the Hyde Park Anchorage Ground, it became apparent that many of the bottom disturbances created by a particular vessel were overprinted by more recent anchoring activity. For example, in one of our focused study areas, anchoring of two commercial vessels between the three-week and six-week elapsed time surveys generated anchor chain drag and anchor drag scars that erased earlier bottom disturbances. By six weeks of elapsed time, none of the original vessels' anchor chain drag scars imaged within the focused study area were present, having been removed by bottom current activity and overprinting by more recent anchoring disturbances. The repeated formation of anchor chain, anchor, and anchor drag scars as seen through the time-lapsed repeat side-scan sonar surveys, demonstrates the significant impact that anchoring activities have on benthic sediments in the Hyde Park Anchorage Ground. Similar bottom disturbances would be expected at the proposed Anchorage B site.

Although we feel it is unlikely Atlantic Sturgeon will be directly impacted (e.g. crushed during anchoring) through the process of anchoring the large-scale disruption of sediments is of concern given the key role that the lower Delaware River Estuary plays in the recovery of coast-wide populations. The infaunal communities upon which this species rely are highly tuned to their habitats and disruption of benthic habitats through the chain dragging across the surface layers of the bottom may continually reset these communities is very similar to the impacts of mobile fishing gear (e.g. benthic trawls). Over the past several decades the marine science community has come to understand both the acute and chronic impacts that mobile fishing gear has on benthic communities (Dayton et al. 1995, Jennings et al. 2001). In fact, the impacts of mobile fishing gear have been compared to clear-cutting of forests due to the role in structuring the aquatic community (Watling and Norse 1998). At present we know very little about the benthic communities in the vicinity of the proposed Anchorage B and our current study site although our initial findings suggest that the bottom sediments are predominantly sands and silts with some coarser-grained pebbles and cobbles. In sampling these areas, we encountered numerous corals and sponges indicative of community structure. Although Atlantic Sturgeon are unlikely to feed on these corrals and sponges, their presence underscores the regions' complexity that may be put at risk with the formal designation of Anchorage B.

In conclusion, we have recently documented what is arguably the largest known aggregation of adult and sub-adult Atlantic Sturgeon in the immediate vicinity of proposed Anchorage B. The aggregation is comprised of individuals from all ESA listed DPSs which underscores the region's importance as these adults are migrating here to forage. We have documented concerns that relate to potential vessel strikes and foraging habitat disturbance that could occur as a result of designating Anchorage B. In essence, what happens in the lower Delaware River Estuary will impact the conservation and recovery of this imperiled species across its range. We thank you for the opportunity to comment. If you require additional information, please do not hesitate to contact us directly.

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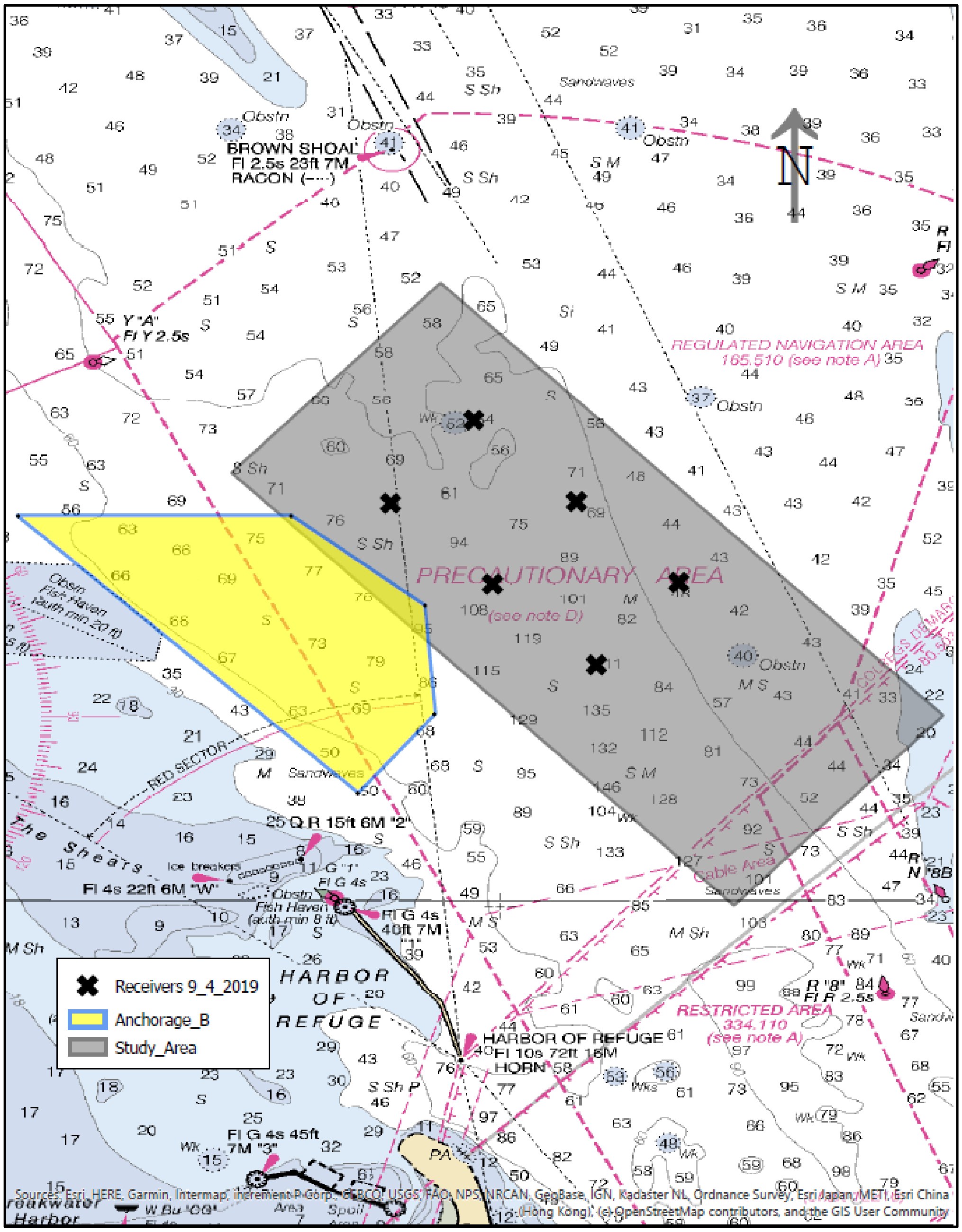
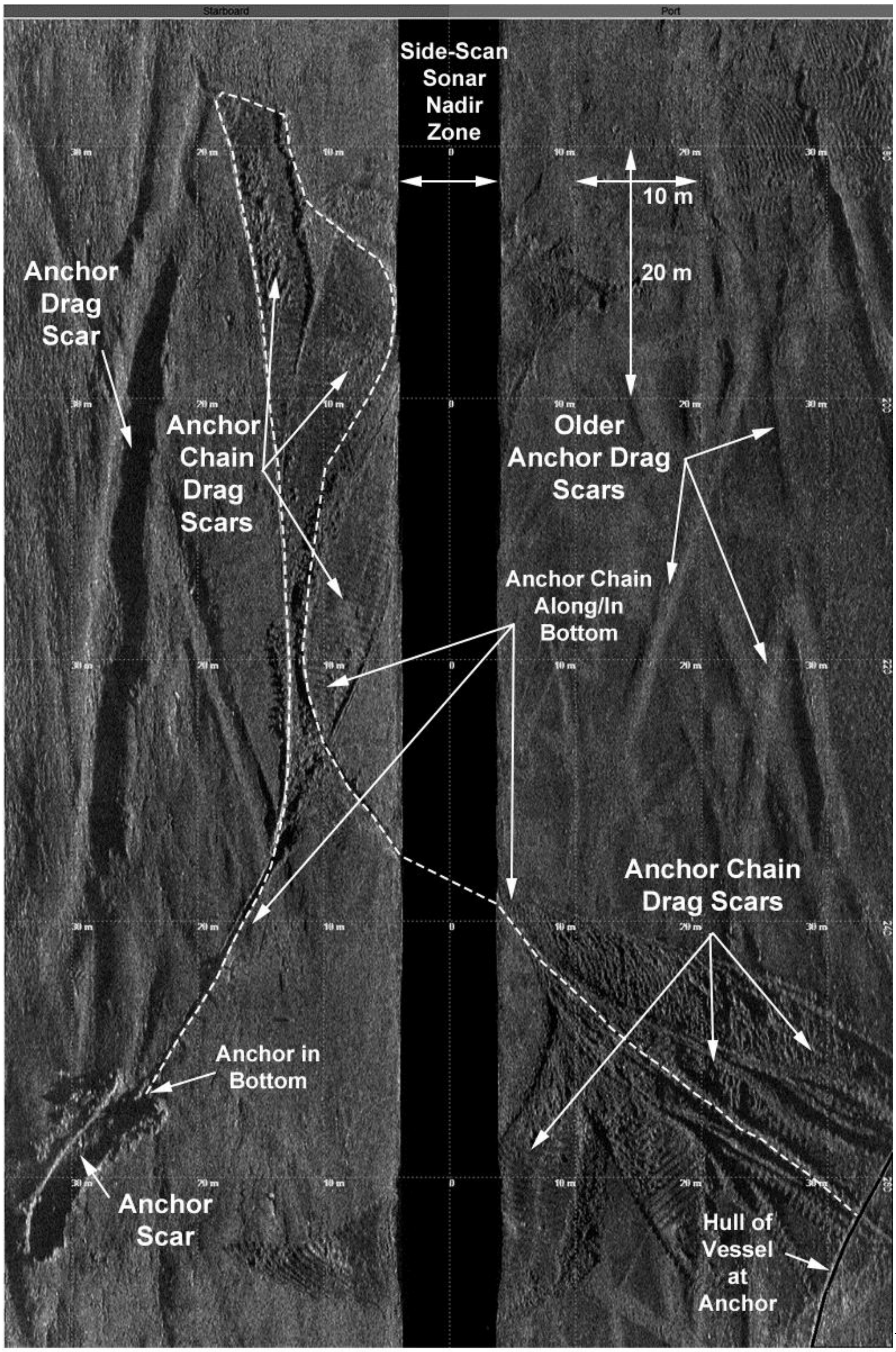


Figure 1. General location map of Delaware Sea Grant Atlantic Sturgeon study site and proposed Anchorage B. The study site is within the gray box; Anchorage B is within the yellow polygon. The crosses shown with the Atlantic Sturgeon site are the locations of acoustic receiver stations used to detect the presence of tagged fish.



Luge

Figure 2. Example of Hyde Park Anchorage Ground river bottom disturbance due to anchoring activities. Shown are an anchor scar and anchor chain drag scars created by a general cargo vessel actively at anchor and anchor drag scars generated by vessels recently (within the past year) at anchor near this site.

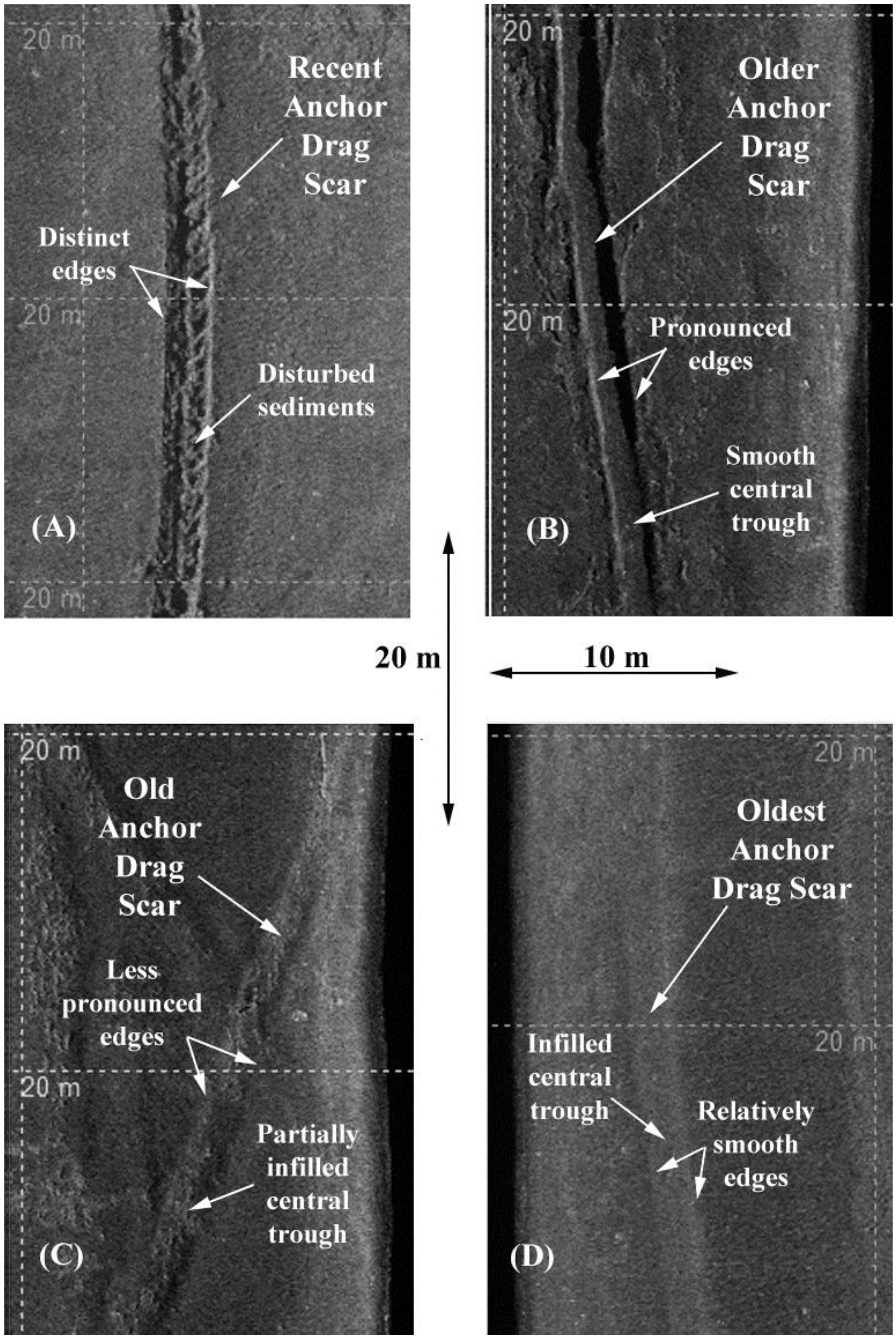


Figure 3. Relative age of anchor drag scars. Shown in (A) recent drag scar with pronounced edges and disturbed sediment within central trough. With time, and due to bottom current activity, sediment erosion, and deposition, anchor scars develop less pronounced edges and smoothed troughs (B), and are eventually infilled by sediments (C) and (D).

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