Comparison of split-beam and DIDSON hydroacoustic gears for conducting sturgeons surveys

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Introduction

Population estimates are required for developing successful fisheries management strategies and determining the status of rare species. When working with anadromous species in large, turbid, or high traffic river systems, split-beam hydroacoustic equipment has often been used as a non-invasive way to estimate run sizes during riverine migrations (figure 1). A disadvantage of this technology is that it is not possible to identify individual fish to species.

For species with a distinctive shape, identifying fish to genus or species may be possible using a new technology, the Dual-Frequency Identification Sonar (DIDSON). This high-definition imaging sonar not only allows for fish counting but also provides information about size, shape and swimming behavior.

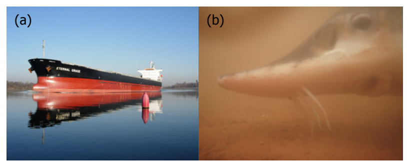

Figure 1: Boat traffic (a) and turbid conditions (b) are challenges in monitoring populations, making sampling difficult.

We compared split-beam and DIDSON technologies in controlled and field environments to assess the potential for conducting large-scale field surveys of Atlantic sturgeon (*Acipencer oxyrhynchus oxyryhnchus*) and shortnose sturgeon (*A. brevirostrum*). These two species co-occur in most large river systems along the Atlantic Coastline and are currently protected from harvest through both federal and state legislation.

Methods

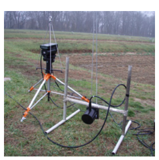

Figure 2: DIDSON (left) and split-beam (right) preparation for pond trials.

Control Ponds

In December 2006, DIDSON (Sound Metrics Corps., US300) and split-beam (BioSonics, DT-X) units (figure 2) were set up in two shallow (<2m) aquaculture ponds (University of Maryland's Horn Point Laboratory, Cambridge, MD and Delaware State University, Dover, DE) containing juvenile Atlantic sturgeon of known sizes. Atlantic sturgeon were concentrated in the ponds using seine nets to ensure individuals would pass by the field-of-view of each instrument. Instruments were oriented in the same direction to capture fish activity simultaneously so records could be matched for comparison.

Delaware River

Field trials were done in a known shortnose sturgeon wintering area in the Delaware River near Florence, NJ. The river depth was approximately 13.75m and the DIDSON tri-pod was suspended about 7 m below the boat (figure 3a). The split-beam system was attached to the boat and oriented vertically (figure 3b). Transects were done either by motoring slowly (<2 kts) or drifting passively with the current.

Figure 3: (a) lowering the DIDSON unit ~ 7m in the Delaware River and (b) vertical surface mounting of split-beam unit.

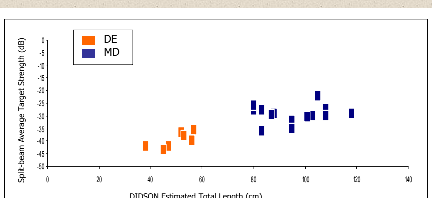

Figure 4: Compensated average target strength vs. the estimated total length of Atlantic sturgeon in Delaware and Maryland aquaculture ponds.

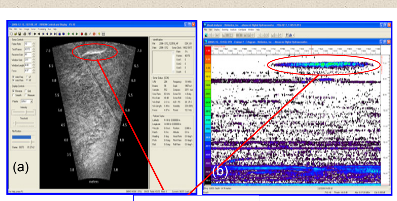

Figure 5: Example of a matched sturgeon in Maryland pond (a) DIDSON image and (b) split-beam echo.

Results & Discussion

In the hatchery pond trials, fish sizes estimated from DIDSON images showed clear separation between the two size groups of juvenile Atlantic sturgeon in the hatchery ponds. The size groups were also apparent from split-beam target strength measurements although there was less separation between groups (figure 4). Although it was difficult to use the split-beam unit in the Delaware pond due to extensive vegetation, we were able to match DIDSON images with split-beam target strengths in both ponds (figure 5).

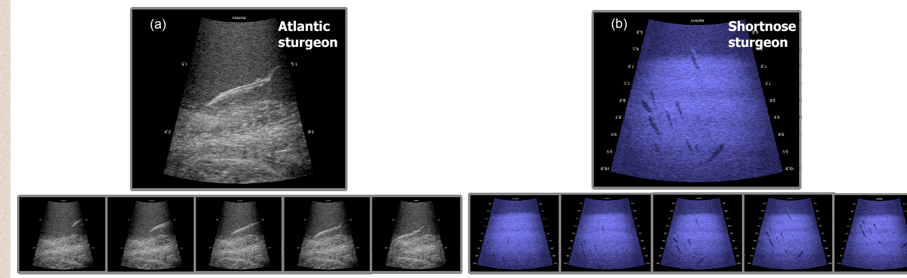

Figure 6: Freeze-frame examples of DIDSON imaging on (a) Atlantic sturgeon in Delaware pond and (b) shortnose sturgeon in the Delaware River.

Sturgeon were readily identified in both hatchery pond and field settings using the DIDSON. Images clearly showed features characteristic to sturgeons (e.g. heterocercal tail and anterior placement of pectoral fins) (figure 6). Swimming behavior was also very distinctive, particularly when DIDSON images were recorded at short range.

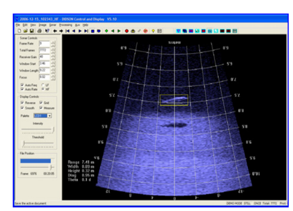

Figure 7: Screen shot of DIDSON measuring tool taken during Delaware River field trial.

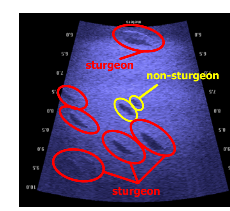

Figure 8: Visible difference between shortnose sturgeon and other fish in the Delaware River field trial.

The mean length of fish classified as shortnose sturgeon in the Delaware River trial (based on DIDSON images) was 82.1 cm (figure 7). This is larger than expected sizes of other winter fish fauna and supports classification of these fish as sturgeon (figure 8). The split-beam system did not provide clear targets that we could classify as sturgeon. During winter months, shortnose sturgeon are inactive and spend most of their time on or near the bottom. Based on our settings, fish more than 15 cm off bottom should have produced a signal distinct from the bottom signal. It was also difficult to match split-beam with a corresponding DIDSON sturgeon images because of the difference in mounting locations of the two systems (figure 3).

The DIDSON appears to be a valuable, non-invasive tool for determining population status. It may be particularly useful for sturgeons and other rare fish species where net sampling is not permitted, would be ineffective, or could result in excessive bycatch. The information it provides about fish size, distribution, activity, and behavior is valuable for species identification and for understanding sturgeon ecology.

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