Exploring the Viability of Side Imaging Sonar to Enumerate Paddlefish (*Polyodon spathula*)

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Introduction to Issue

- Paddlefish are one of the most popular native game fish in the state of Oklahoma

- CITES Appendix 2 Species

- Paddlefish have a large benefit to the tourism and economy of Oklahoma

- Population in decline across range

- There is a need for new population monitoring techniques


Question and Hypothesis

- I hypothesized that paddlefish could be observed and enumerated using side imaging sonar, however, I believed that the most viable option for this type of study will be its use in river systems during their spring spawning run. This is when the majority of fish are more closely restricted to a smaller, easier to sonar chart, area.

- Address possible issues with the use of Side Imaging sonar in identifying and counting Paddlefish.

- Address the pros and cons of using this survey method in lakes versus rivers.

- Establish background knowledge necessary to determine viability of use in population monitoring.

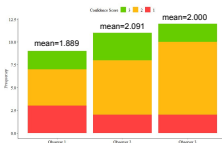## Results, Discussion, and Management Implications
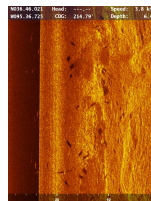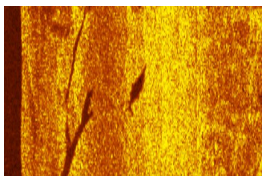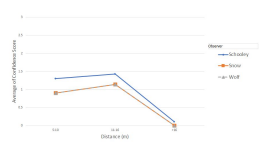

Reservoir System Confidence Scores
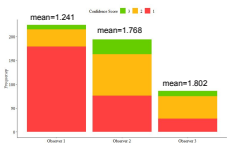
River System Confidence Scores
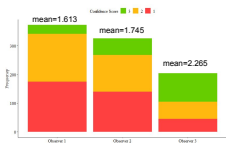
Replica Confidence Scores

Mean of Replica Confidence Scores vs Distance from Boat

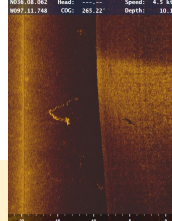### Utilizations in Paddlefish Management
- Presumed paddlefish and paddlefish replica are confidently observed in both lake and river systems.

- River system surveys have highest confidence score averages, suggesting that spawning season riverine surveys are most viable for enumeration.

- Data from replica tests was useful in diagnosing ideal conditions in which to capture sonar images of paddlefish. Paddlefish parallel to boat at distances <16m from sonar at depths in the bottom half of the water column are of highest observation quality. If Paddlefish are suspended in the upper half of the water column, despite total depth, they are unlikely to be observed when farther than 5 meters from the boat. Future enumeration methods should take these variables into account.

- Shows paddlefish movement, behavior, and habitat utilization in various seasons.

Issues in Paddlefish Management
- High variability amongst observers expresses a need for a larger study group, increased training, and collaboration.

- Improved method for paddlefish verification needed.

- Fiberglass paddlefish replica needs design improvements for underwater orientation.

- Paddlefish are only observable with sonar when oriented parallel to the direction of the boat.

Study Design

- Recorded Humminbird Side Imaging sonar from a bow mounted transducer over two~ 34 km long boat paths across the length of the Arkansas River Arm in Keystone Reservoir.

- Recorded Humminbird Side Imaging sonar along one ~ 17 km long downstream boat path on the Verdigris River upstream of Oologah Lake. These transects took place during an active spawning period, validated by the presence of Paddlefish eggs and Paddlefish through angler observations. (Paddlefish will swim upstream into rivers from reservoirs during their spring spawning season).

- Purchased a 64 inch fiberglass replica paddlefish from Archie Phillips Taxidermy. I filled this replica with ballistics gel to emulate the consistency of living tissue, then constructed a weighting and floatation system in order to suspend the paddlefish in the water column.

- The replica paddlefish was suspended at different heights and orientations to the boat above various water depths. Transects were ran along the replica and sonar images were recorded. Sonar image below shows the replica paddlefish. The various heights and orientations were noted to analyse how relative position affects the ability to observe and assign confidence scores.

- I personally analysed all transects using Reefmaster 2 software, observing only the first 25 meters from the boat on each side. I analysed the right side of boat independently of the left. Speeds during playback were kept at either real time or 2X speed. Presumed paddlefish were counted and assigned a point with a "Confidence Score" of 1 (low confidence), 2, or 3 (high confidence). This score reflects how confident the observer is that what he/she counted is a paddlefish.

- The Verdigris River transect, highest quality transect from Keystone Reservoir, and replica transects were then given to two ODWC Fisheries Biologists for analysis. They analysed all transects using the same criteria and software aforementioned.

- Confidence scores from each individual were counted, plotted, and averaged to show how the variables associated with each habitat system affected scores. Data was analysed in Excel and plotted in RStudio.

Sources: Nealis, A. 2013. Characteristics of two self-sustaining populations of paddlefish in northeast Oklahoma. Master's thesis, Oklahoma State University, Stillwater

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Lareau, K.M., Ridgway, J.L., Mueller, A.T., Faulkner, J.D.A. and Calfee, R.D. (2019), Semiautomated Process for Enumeration of Fishes from Recreational-Grade Side-Scan Sonar Imagery. North Am J Fish Manage. doi:10.1002/nafm.10373

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Flowers, H.J. and Hightower, J.E. (2013), A Novel Approach to Surveying Sturgeon Using Side-Scan Sonar and Occupancy Modeling. Marine and Coastal Fisheries, 5: 211-223. doi:10.1080/19425120.2013.816396