General Session

Advanced Technologies in Marine Fisheries

Gulf States Marine Fisheries Commission

73rd Annual Meeting
Tuesday, October 18, 2022
San Antonio Marriott Riverwalk
San Antonio, Texas

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Gulf States Marine Fisheries Commission
Technical Coordinating Committee

General Session
Advanced Technologies in Marine Fisheries

Tuesday, October 18, 2022
8:30 a.m. – 12:00 p.m.

Agenda

8:45 Welcome remarks – *Dave Donaldson*

8:50 Saildrone Overview – *Matt Womble*

9:20 Life History Investigative Tools for Gulf Sturgeon – *Meg Lamonte*

9:50 - BREAK -

10:00 Chesapeake Bay Foundation Oyster Monitoring Technology Challenge – *Doug Myers*

10:30 Mapping and Remote Sensing for Oysters in Texas – *Emma Clarkson*

11:00 Continuous Video with AI to Monitor Recreational Fisheries – *Tiffanie Cross*

11:45 Questions

12:00 ADJOURN

Summary

The environment around us is always changing. For scientists and managers to keep up, a dynamic approach is required, which often means using the most cutting-edge technologies and equipment to keep pace. Practitioners are charged with learning about and monitoring the habitats and creatures that live in our oceans and estuaries. But, it can be a challenge to study them because they often have complex life cycles, or inhabit places that are difficult to get to. Over time, as technologies have become more advanced, innovative and new tools have been developed to help collect data, and better understand the ecosystems and marine life that make up the fisheries our stakeholders depend on. Technologies such as drones, satellite tags, remote underwater vehicles (ROVs) and automated underwater vehicles (AUVs), acoustics, and genetics are all important tools that can be used to improve our understanding of marine fisheries, and collect important data to help guide management. The general session focuses on some of the newest and most innovative advances in these technologies from in and outside the Gulf Region, and how some of them may be applied to manage Gulf fisheries.

Saildrone Overview

Matt Womble (Saildrone, Inc.)

Matt gave an overview of some of the capabilities of Saildrone's Unscrewed Surface Vehicles (USVs) and highlighted some of their global operations. Their USVs are able to overcome spatial and temporal limitations that traditional ocean-monitoring assets face by using wind and solar energy. This allows USVs to complete year-round missions covering tens of thousands of nautical miles without returning to port for maintenance or fuel. Their drones are capable of completing missions that focus on regulatory and enforcement monitoring (e.g. surveillance, intelligence, reconnaissance), ocean mapping (e.g. single and multi-beam bathymetry, telecommunications, and oceanography), and ocean data collection. Various sizes of USVs, ranging from 23 to 72 feet long, are able to serve different roles depending on mission objectives, and perform well in harsh ocean conditions. A mission control interface allows users to have access to real-time data through a secure phone or web application, which also enables fleet management, mission planning, and advanced collaboration features. In the U.S., Saildrone has recently done fisheries-related work conducting acoustic surveys for hake and coastal pelagics on the Pacific Coast, pollock surveys in the Bering Sea, and tracking seasonal movements of Alaska red king crab. They have also recently completed ocean exploration and mapping missions, including a 2022 bathymetric mapping mission in the Aleutian Islands. In 2019, Saildrone partnered with University of Southern Mississippi and NOAA to complete their first shallow-water multibeam bathymetry mission in the Gulf of Mexico. Other interesting work they've done includes collecting data from inside active hurricanes along the Atlantic Coast to understand rapid intensification, and collecting real-time meteorological data in areas lacking ocean data buoys. A video of the full presentation from Saildrone is available at the following link.

Life History Investigative Tools for Gulf Sturgeon

Meg Lamont and Mike Randall (U.S. Geological Survey)

Meg introduced the presentation, and explained instead of focusing specifically on Gulf Sturgeon, it focused on the broader topic of marine animal telemetry, sensors and analyses. Mike Randall outlined the various decision factors that investigators consider when determining which type of technology may be best suited to help evaluate the specific question(s) being asked by investigators. New technologies offer many advantages over past technologies, such as automation, around-the-clock detections, reduced effort, high data intensity, less data gaps, and most are smaller, cheaper, and faster. Some of the technologies used to monitor marine animals include acoustic and satellite telemeters, logging tags, cameras, sonar, and drones, which can all be synthesized together to paint a very clear picture about animal life history. Machine learning and network analysis are some of the techniques used to synthesize the different types of data provided by different technologies. However, some advantages of new technology can come with tradeoffs. Acoustic and satellite telemetry technology, for example, can use passive arrays to increase spatial and temporal scale while reducing effort. But, these systems have spatial limitations and may require tracked animals to surface for data transmission. Future technologies will continue to advance and provide new pathways to collect various types of data. Some of the challenges in the Gulf of Mexico that technology has yet to overcome are weak integration of acoustic telemetry networks, no systems in place for integration of satellite tagging data, and lack of linkages between animal and environmental data. A video of Meg and Mike's full presentation is available at the following link.

Chesapeake Bay Foundation Oyster Monitoring Technology Challenge

Doug Myers (Chesapeake Bay Foundation)

Doug started by providing an overview of some of the recent oyster restoration efforts in the Chesapeake Bay region. He explained oyster monitoring efforts in the past were comprehensive, but were somewhat destructive and counterintuitive to the goals of restoration. Less invasive alternatives to the standard sampling techniques, such as underwater photography, have been considered, but the Chesapeake Bay is limited by water clarity. After identifying problems affecting the ability to use underwater photography to assess oyster restoration areas, scientists worked with professional photographers to develop a standardized technique using a "clearwater box" to collect a photo repository from sample sites. Buoyancy from the "clearwater box" allows it to be stabilized and positioned to look straight down on the target site, while a clear lens of distilled water separates the camera's lens from the objective below. This allows for the camera to capture images from a clear "birds's-eye view" of oysters and associated fauna that can be easily measured. It also allows identification of reef-associated species without destructive sampling. After developing a robust photo database, engineers from Northrup Grumman were then brought into the team to help develop a system that trains computers on what oysters look like and how to use photos to characterize the health of an oyster reef. Oyster reefs of varying degrees of health were categorized on a scale of zero to three (0=no oysters; 1= <50% coverage; 2= >50% coverage, height <1 adult oyster; and 3= >50% coverage, height >1 adult oyster). Engineers were also able to integrate hydrophones to record high-resolution sounds from oyster reefs from different categories, and determine differences in the sound frequency profile for oyster reefs that fit into each category. Using machine learning and algorithms, they are able to integrate these technologies to accurately monitor and assess oyster restoration areas. Currently, they are in the process of developing software and finalizing protocols to use these technologies and equipment to take passive samples that do not require disturbing restoration sites. A video of Doug's full presentation is available at the following link.

Mapping and Remote Sensing for Oysters in Texas

Emma Clarkson (Texas Parks and Wildlife Division)

Emma began by describing the need to identify changes in oyster habitats, and their extents for resource management and restoration purposes. In Texas, oyster habitat is exclusively in shallow bays with turbid waters that present challenges to the use of traditional sonar used to map bottom substrates. The two approaches for mapping oyster habitat are the use of scientific sonar for system-wide surveys, and recreational sonar that can be used for rapid assessments. Sidescan sonar produces an image of the seafloor based on the backscatter of the acoustic signal sent out by the equipment. Single beam echosounders, or "fish finders," can also be used for mapping. Depending on the characteristics of bottom substrates, they enable trained users to decipher smooth simple bottom from rough complicated bottom based on the profile of the echo trace that is returned. Hard and soft bottom are also able to be identified by this profile. Knowing how to properly use the two types of sonar can enable practitioners to effectively use sonar for oyster restoration. Oyster restoration sites can often be identified using recreational sonar equipment (e.g. Humminbird or Garmin), which is usually lower cost than other sonar, and can easily fit most vessels to be rapidly deployed. After site selection and as a precursor to restoration planning, various types of surveys, such as sidescan, bathymetry, and pre-restoration sampling could be conducted to aid in implementation of a successful restoration projects. Overlaying information collected from these three types of surveys can allow practitioners to be very precise in planning. Post-restoration verification can also be assessed using echosounder and multibeam sonar to measure the accuracy and placement of materials according to the design plans. Texas Parks and Wildlife Division not only uses sonar technology for oyster restoration, but also for producing system-wide benthic maps of oyster habitat along the Texas coast. The data and maps they produce from these efforts are hosted on ArcGIS online so they can be easily accessed by the public (https://tpwd.texas.gov/landwater/water/habitats/coastal-fisheries-habitat-assessment-team/). A video of Emma's full presentation is available at the following link.

Continuous Video with AI to Monitor Recreational Fisheries

Tiffanie Cross (Florida Fish and Wildlife Commission/ Fish and Wildlife Research Institute)

Tiffanie provided an overview of the recreational fishery in Florida, including their current monitoring methods and how they've begun to test using camera-based methods to integrate machine learning and artificial intelligence (AI) into their future monitoring methods. Florida has over 700,000 saltwater anglers in the state. The majority of anglers and trips in Florida are on board private boats, which makes it difficult to monitor given the various challenges (e.g. pulse fisheries, high effort, high spatio-temporal variability, and large areas) they must consider. Specifically, recreational reef fishing is primarily an offshore boat-based fishery that operates from distinct inlets with short seasons that are highly regulated. General surveys are unable to monitor these derby-type fishery events very precisely. To help overcome these challenges, their ongoing monitoring efforts are concurrent and overlapping, but still have inherent sources of error and bias, so there is a need to validate the accuracy of estimates generated from these surveys. Using a network of cameras that can be used to monitor recreational fishing effort that is reviewed by humans and uses machine learning is one way these surveys could be improved in the future. Machine learning allows for near real-time counts on a year-round basis. It can fill gaps in observer coverage, improve cost efficiency, increase precision, and refine survey methods to better improve our understanding of the fishery. Florida decided to develop a pilot study to test the feasibility of using AI to continuously monitor recreational boating activity along Florida's Atlantic coast. For the first year, they installed camera-based vessel monitoring systems at three sites with the goals of refining existing algorithms using videos from Florida sites that detect, classify, track, and count vessels entering and exiting inlets. Next, they will evaluate the performance of the algorithms when compared to human observers. Some lessons learned during the pilot include logistical considerations related to working with partners and acquiring permits, equipment exposure to elements, sun glare, power and cellular network outages, and weather damage. Despite the numerous challenges that presented themselves during the first year, the iterative processes required to train and develop the machine learning algorithms proved to be mostly successful in detecting, tracking, and counting recreational fishing vessels. Preliminary results indicate one advantage of using the camera-based system is its ability to capture boat trips outside of normal observer hours. However, one disadvantage when compared to human review is the algorithm undercounted consistently. It is worth noting the human real-time observer undercounted as well when compared to human review. Future improvements that could be implemented to improve the camera-based monitoring system include optics improvements, testing cross-channel views, refining algorithms for night detection, improving algorithm performance, and adding additional sites. A video of Tiffany's full presentation is available at the following link.

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