Albemarle-Pamlico National Estuary Partnership
SAV Team

WebEx Meeting
9:30 – 11:00 AM
February 23, 2018

Meeting Notes by Tim Ellis

Participants:

Jud Kenworthy (NOAA-ret.; Team Lead)
Matthew Duvall (NRCS)
Patrick Gillam (NCDMF)
Tyler Stanton (NCDOT)
Jessie Jarvis (UNC-W)
Joe Luczkovich (ECU)
Maria Dunn (NCWRC)
Anne Deaton (NCDMF)
Dean Carpenter (APNEP)
Tim Ellis (APNEP)
Trish Murphey (APNEP)
Bill Crowell (APNEP)

Agenda/Notes:

The purpose of this meeting was to have a presentation from Joe Luczkovich on progress made towards establishing protocols and stations for the portion of the sentinel network that is in the low-salinity ("invisible") areas.

9:35 AM - Meeting started.

Joe gave an outline of his presentation, which includes material he recently presented at the 2017 CERF meeting in Providence, RI.

- 2010-2017 SONAR survey protocols for SAV in Currituck Sound, Albemarle Sound, Pamlico River, and Neuse River
- Kenworth et al. 2012 - Development of SAV monitoring protocols in NC, including rapid assessment and sentinel sites; final report available via the CRFL website.
- Accuracy estimates, change analysis, and comparisons of SONAR analyzed using Biobase EcoSound and BioSonics Visual Habitat software

Halodule (Shoal grass), *Ruppia* (Widgeon grass), and *Zostera* (Saltwater eelgrass) are the high-salinity species, but *Ruppia* does have a wide salinity range and it shows up in the low-salinity areas that Joe has surveyed.

There are ~10 species that are typically found in the low-salinity areas, including Coontail, *Hydrilla*, Eurasian watermilfoil, *Ruppia*, Redhead grass, Wild celery, and various pondweed.

Joe created a GIS interpolation of salinity in the A-P estuarine systems using data compiled by Niels Lindquist (UNC IMS). In the areas that Joe will be discussing today, the salinity ranges from ~17 down to ~4. Joe also showed a box plot diagram of salinity range for ~10 species; data taken from book on "Underwater Grasses of Chesapeake Bay". Many of the species have a salinity tolerance below ~10. Jud pointed out that these data were derived just from Chesapeake Bay and it is important to note that globally, *Ruppia* can go up to a salinity of 60. As salinity increases in some areas, changes in the distribution of some SAV species will be determined by their salinity tolerance (e.g., *Ruppia* is euryhaline).

Joe reviewed slides detailing how the SONAR method works, including the pros and cons of BioSonics vs. Lowrance (e.g., set-up and cost).

Joe also reviewed underwater camera footage.

SONAR data were uploaded to ciBioBase to classify SAV (biovolume = ratio of the water column occupied by plants). Joe reviewed examples of ciBioBase Echogram results and explains how bottom type affects how the algorithm determines what is SAV. Joe also reviewed similar echogram results from BioSonics. Algorithms for both work similarly.

A detailed overview of a low-salinity sentinel site in Currituck Sound was given, showing shore-normal transects for SONAR and randomly-selected points along the transects where underwater video was taken. Subsequent slides showed resulting estimates of SAV coverage and level of agreement between SONAR and underwater video. In areas of dense or absent SAV, SONAR and underwater video agreed 100%; however, in areas of patchy SAV, there was disagreement. Two kinds of errors: 1) False positive - no SAV on video ("gold standard") but SONAR says there is SAV and 2) False negative - Video shows SAV but SONAR says there is none. Overall, accuracy was high (~80%) at this sentinel site.

Joe reviewed a map of Albemarle Sound that depicted where SAV was found using underwater video (green areas) and where it was not (yellow areas). This was the rapid assessment approach used to identify areas of high SAV. At these areas of high SAV, SONAR was then used to estimate percent area cover (PAC). PAC was determined based on the area covered by the downward-looking sonar (i.e., 30-cm swath of the bottom X 10-m transect). They are also collecting a wider swath of the bottom using side-scan SONAR, but it takes much longer to process those data.

Jud asked that given that Joe surveyed the entire shoreline, was he able to determine what portion of all the 10-m transects had SAV. Joe said he presented this information at a previous APNEP workgroup meeting, but basically, they divided Albemarle Sound into 10-m blocks (n≈620) and said it was SAV-positive if either the SONAR or underwater video indicated SAV was present. He doesn't recall what the estimate was that Jud is asking for but both he and Jud recall that this information was previously presented to the group. Joe will try to find this information and report back to the group.

Anne asked what the 1-6 lines in the graph represent and Joe stated they are the 2014 salinity contours, based on the data his group collected while doing their surveys that year.

Rapid assessment information was then used to establish the sentinel sites, and Joe next reviewed the protocol for sampling a sentinel site. Criteria for establishing a site was that there must have been both historic and current presence of SAV at a location; however, they did pick a few places that had SAV historically but not in the current survey, to see if there would be recovery. Ten sites were picked that are 1000 m along shore and 500 m offshore (~50 ha or ~130 acres), with 40 perpendicular to shore SONAR transects (~25 m apart) and 100 random underwater video points. An example sentinel site at Edenton was reviewed. Each site of this size can be done in about a day.

Joe reviewed a few slides showing changes in SAV at the Edenton site over time. He noted that for Albemarle Sound, multiple sampling events at a site within a year allowed for seasonal data on SAV. Dean noted that for the first couple of years, they elected to sample in the spring and fall to determine which period would be the optimal time for sampling going forward. Joe agreed but also noted that there are realities to deal with when trying to sample so many sites during a short window of time. He stated that "spring" sampling could extend into July but also thought that the sampling window should be kept to earlier in the year. Dean noted that Joe's data suggest that the optimal window for sampling varies between the western and eastern portions of Albemarle Sound. Joe agreed but noted that in Kitty Hawk Bay, for example, grass was still very thick in October 2017 but that it was mostly *Ruppia*. The point is that species composition will also have to be considered when determining the optimal sampling window. Judd and Dean agreed.

Joe stated that they are also doing quadrat (1 m x 1 m) sampling in the shallowest areas of the transects where the boat can't get to, which begin at depths of 0.25 m and extend out to 1+ m where it overlaps with boat coverage. They also take core samples at these areas where they find SAV to document species composition and dry biomass.

Joe reviewed his protocol for change detection, which was developed at the Kitty Hawk Bay sentinel site. He noted that he had been contacted by Rob Emens (NCDWR) in the past regarding the thick SAV in this area and how landowners and boaters were making complaints. Joe showed a slide of differences in SAV PAC and mean biovolume between September 2015 and 2017. He noted that the difference in the size of the area that was sampled (~47 ha in 2015 vs. ~38 ha in 2017) was due to depth and what amount of water was navigable by boat at the

time of sampling. This variability in water level at a given site between sampling events is something that needed to be accounted for when conducting a change-detection analysis. Joe developed a method for change-detection analysis in R statistical software using geographic coordinates and the biovolume information from the sentinel-site sampling events (i.e., changes between 2015 and 2017). The product is a single figure (gradient) depicting spatially-explicit gain/loss of SAV within the entire sentinel site. Judd asked for discussion on how to create a single metric from this information. Joe noted that the water-level issue limits you to analyzing just the area covered fully by all sampling events, which will be smaller than the total size of the sentinel site. Still, this approach can be used to calculate a net hectare change in SAV at the site.

Anne expressed concern over the inherent temporal variability in SAV and that even if you sampled on the exact same day between years, variability in other factors (e.g., temperature) can confound our interpretations of gains and losses in SAV. Joe agreed and noted that unlike the high-salinity SAVs that are mostly perineal, the low-salinity species are not persistent through time. He gave the example of the grass bed at Kitty Hawk Bay being persistent but the one at Batchelor Bay is not (it's gone). There is a lot of variability between these sites that we will have to deal with when developing metrics. Dean noted that he thought this was analogous to the aerial surveys. Judd noted that there will likely be sites that we sample and will baffle us for many years. Joe agreed, stating that the ecology is illusive because we are still trying to understand the physical and biological factors that drive this variability. Judd noted that the fundamental decision we need to make is if our focus will be on interannual variation or interannual variation. He agreed with Anne's concerns but noted that until we start sampling these sites and collecting the long-term data, we won't be able to understand and account for how interannual variability confounds estimates of gains/losses in SAV across years.

Jud stated that the next step should be to convert Joe's scale for gain/loss of SAV to a net number. Joe said he would do that. Judd also asked about incorporating the depth data into these graphs and analyses as well. Joe felt this was also very important. Dean agreed and stated that analogous to the aerial surveys, where we can't fly on windy days due to choppy water conditions, perhaps water level should be a determining factor in the protocol for sampling the sentinel sites. Anne and Joe discussed the collection of continuous water quality (and depth) monitoring data at a site and how this would allow for incorporation of those explanatory variables into predictive models for changes in SAV. Jud agreed that this is ideal and that we could talk about this a lot more, but for now, the task is to determine if we can settle on an initial protocol for monitoring the sentinel sites. Anne asked Joe about the potential to incorporate the shallow-water data (e.g., quadrats) into this analysis as well, and Joe said he has been giving it some thought and plans to work on it more in the future.

Dean informed the group that we were running a little short on time for this session and noted that we wanted to have some time at the end for reflection and general discussion. Joe quickly presented his remaining slides.

Joe showed a slide where he used logistic regression to predict the depth at which each SONAR system (BioSonics DTX and Lowrance/BioBase) suggests there is a higher probability of SAV. Both indicate highest (100%) probability at ~0.75 m with a sharp decline from ~50% to 0% probability at depths below 1.5-2 m. These data were from Kitty Hawk Bay in 2015.

Just as in Albemarle Sound, alongshore rapid assessment transects were done in the Pamlico River to select sentinel sites.

Joe showed a similar analysis for the Riverside sentinel site in the Pamlico River from 2016, and found that the logistic regressions were similar but that BioSonics performed better at depths from ~1.5-2 m, while BioBase was slightly better at shallower depths (≤ 1.0 m). He noted that the regressions were statistically different but probably not of practical significance given the 1000s of data points driving the relationships.

Rapid assessment transects were also done in the Neuse River during Fall 2016. Following Anne's suggestion, much of the SAV was found in the tributaries during Spring 2017, rather than along the shoreline of the main stem of the river. There are 10 sentinel sites in the Neuse River, which is the most feasible number of sites right now. These sites have only been sampled once (June-October 2017) using the protocol for sentinel sites, so Joe can't due change detection yet. He went through data collected on each of these sites, including the percent area cover that was estimated. Many (i.e., sites #1-5) had very low PAC and Joe noted that through quadrat sampling and underwater video, he personally never saw any SAV at these sites. For some sites that were further upriver (i.e., lower salinity; around Trent River), there was more PAC and better agreement between SONAR and quadrat/video.

Joe's take-home points from his presentation were:

- SAV sentinel sites established in low-salinity areas of Currituck Sound, Albemarle Sound, Pamlico River, and Neuse River (27 sentinel sites, 1 d per site)
- Both SONAR methods work well and provide comparable results
- Accuracy is high relative to underwater video (80-90% agreement, lower in patchy areas) - Joe noted again the challenges he previously described with getting agreement in the Neuse River sites.
- Repeated monitoring possible (annually depending on funding); rapid results
- Change analysis revealed losses and gains of SAV
- Low-salinity SAV beds are dynamic seasonally and interannually - Joe noted again the need to measure and incorporate information on wind, depth, temperature into the predictive models for probability of SAV
- Citizen Science possibilities with Lowrance/BioBase

Jud stated that he is a little nervous about some of these accuracy issues and errors between SONAR versus quadrats/video, and that he doesn't understand why accuracy appears to be much better for sites in Albemarle Sound than it is for sites in the Pamlico and Neuse Rivers.

Joe responded that the difference in sediment composition is the primary factor. He noted that Albemarle Sound is very sandy, which allows very good SONAR detection; however, the sediment in Pamlico and Neuse Rivers is muddier with more peat/detritus, which is less conducive to clear SONAR detection. Jud agreed.

Jud stated that moving forward, he thinks we should develop metrics based on data collected just from the Albemarle Sound sites, with acknowledgement of the ongoing monitoring challenges being experienced at sites for Pamlico and Neuse Rivers.

Joe acknowledged that for these low-salinity sentinel sites, Albemarle Sound has the most SAV present, as compared to the Pamlico and Neuse Rivers.

Dean responded that he thinks the data Joe is generating from the sentinel sites is supportive of the three SAV metrics for high-salinity areas established at the team's last workshop. He noted that density class is analogous to biovolume (i.e., a measure of extent) and species composition information is being determined from the core sampling. Jud and Joe agreed.

Jud would also like to a see metric for change detection but it should be in a net category. Joe stated again that this is something he noted from today's meeting and will be working on. Dean commented that change detection is inherent in these metrics since we will be assessing trends over time.

Anne asked about revisiting Currituck Sound because there is a lot of SAV up there. Joe stated that he hasn't been back there since 2013 but can certainly revisit the site. He expressed concern over the logistics required to regularly monitor all 27 sentinel sites. If it is just Joe and his team doing the work, it is currently not feasible to visit all the sites annually, let alone twice a year. There is need for more folks to share the work load, including staff time and resources (e.g., more boats). Joe suggested getting additional help from NCDMF and through citizen science. Dean suggested that this SAV Team, or a subgroup, meet to hash out a protocol, including discussion on solutions to these logistical challenges. Dean also noted that it was always the intent to have sentinel sites regularly monitored in Currituck Sound.

Joe asked if Dean was suggesting updating the existing protocol established in 2012. Dean confirmed that he thought this was needed based on the now six years of knowledge. Dean also proposed a need to do the shore-parallel transects every five years, like the timeframe for the aerial survey, as a compliment to the annual sentinel-site monitoring. Joe noted that he had communicated with researchers in Poland after the CERF meeting about SONAR methods he was using and how they compare to their approach (i.e., they are towing an array of Lowrance transducers with a single boat to widen the swath).

Joe stated that all the things Dean was suggesting are future activities that will require new estimates of accuracy, new metrics, and more time on the water. We need a strategy to prioritize what is important because Joe and his team are working at capacity. Joe expressed a need to publish the work he has done with the protocol thus far, as well as to have more

assistance from others with collecting the data. Dean agreed and felt that a discussion on how to leverage resources going forward would be helpful.

Joe reiterated the challenges he is facing with using SONAR in the Neuse River and not being able to find much SAV. He noted again that part of the problem may have been that they sampled from July-October and perhaps they need to sample these sites earlier (e.g., May-July). That is his plan for this year.

Jud will follow up with Joe to discuss a few things further and to get a few slides, in preparation for next week's STAC meeting. Dean will follow up with Jud on moving forward with a discussion on updating the 2012 protocol (i.e., things discussed during today's meeting).

Anne asked if the priority right now was to finalize metrics for the low-salinity areas. She expressed concerns about missing important information on the SAV in the shallow water (< 1 m) and a desire to somehow incorporate Joe's quadrat and core data into a metric. Joe responded that he has had students look closely at those data for the Albemarle Sound sites and they found that for 0.25-, 0.5-, 0.75-, and 1.0-m strata, peak percent cover was at 0.75 m. There was almost always no SAV at 0.25 m, but it started to show up at 0.5 m. Joe thinks they are getting right up to 0.75 m with the boat monitoring, so he would like to do a comparison of the in-water and boat-based data at that depth to determine agreement. Anne noted that this scenario probably differs by region because SAV is dense in very shallow high-salinity zones of the southern portion of the state.

Joe reiterated the need to publish the work that has been done using the 2012 protocol before making new modifications. Dean noted that this peer-reviewed publication was an action item from the 2017 workshop. Joe acknowledged that and stated that he will be making that a priority this year.

Dean thanked Joe for his presentation and the group for attending today's meeting. Dean will be sending out a Doodle poll soon to schedule the team's next WebEx meeting.

11:15 AM - Meeting adjourned.