EP. 8: SWMP(Y) SCIENCE

TRANSCRIPT

Kaitlyn Dirr 0:18

Hey there, my name is Kaitlyn Dirr and welcome to the NERR or Far podcast. Today's episode is on research at the National Estuarine Research Reserves, also known as the NERRs.

We have a special focus today on SWMP, the System-Wide Monitoring Program. Here to get us started and tell us more about SWMP is Keith Laakkonen, Director of the Rookery Bay NERR in Florida.

Keith Laakkonen 0:51

So research reserves and anyone who works with NOAA, we love our acronyms. And so SWMP is one of my favorites. As you said, System-Wide Monitoring Program. Which is a small way of saying that we are part of a national network and program that helps us understand how water quality and weather conditions change over time, and how it impacts the environment. We have data sondes, which are basically computerized devices, which are taking water quality readings every 15 minutes, 24/7. The only constraint on these things is battery life. We actually have a couple of these hooked up to satellites, so that anyone on their computer can see with a small delay what's going on in the water and the weather: the temperature, the salinity, what the depth is going on, what the turbidity is, so you can have an understanding of what's going on in the environment. The SWMP program helps us understand how it impacts other things such as fish, fisheries community and sharks as well. For example, Rookery Bay has been doing all the downstream monitoring for the first and largest of the Everglades restoration projects. That's Picayune Strand Restoration. So combining this water quality with his fish and shark information helps us really understand how these estuaries are behaving ecologically and how they're going to change over time due to restoration.

Kaitlyn Dirr 2:09

The ACE Basin Reserve in South Carolina is finding creative ways to use water quality and meteorological data for research as well as environmental education. Here to tell us more is Julie Binz, reserve manager.

Julie Binz 2:24

Our weather station collects basic weather meteorological data like air temperature, wind speed, barometric pressure, and precipitation. And our water quality sites are stationed at different creeks and various places in the reserve; we have four of them set up the Edisto river so that we can really monitor how the saltwater- freshwater interaction is moving with tides and storms and different types of variations in weather. So, water quality stations also measure water temperature, and salinity, pH,

dissolved oxygen, we also monitor nutrients in the water. So because these are long-term sites, they're great to observe trends over time in our weather and in our water quality, especially as storms come, which has been really cool. We've just been working with a group of other reserves to create a educational product called "Storm Stories". So we can take our data before, during and after certain large storm events that we had that affected our reserve and see what changes throughout the storm and directly after the storm in our water and weather. So that's been really cool. So it allows us to look at how our environment is changing over time both over long periods of time and then with discrete incidents. Some of our other researchers that we're partners with, with the Department of Natural Resource biologists can look at it in relation to their species data. So if they're looking at fish populations or crab populations, they can use our water quality data to look at how those factors impact all our different marine species.

Kaitlyn Dirr 4:16

Adam MacKinnon, Education Coordinator at the Sapelo Island NERR in Georgia, call SWMP a sort of "canary in the coal mine".

Adam Mackinnon 4:25

SWMP is essential to everything we do out here, whether you know it or not. So, so we have about 19, 17-19 different institutions come here to do research. So it's a place-based place to research. It's not like you go here and go out, you come here to do research, it's, this is one of the hallmarks of estuarine science. It's where modern ecology was invented out here. So SWMP, all these people come, you know, they have research projects, you know whether that be short-term, long-term, they don't need to go and collect that data, you know SWMP already has that data. And it's kind of like a... SWMP can be a great canary in the coalmine. It can tell you things are happening before you actually physically see them happening to the environment. Just incredibly powerful tool. And I always tell students, you know, all this life here, all these parameters you can look at in SWMP dictate not only what life is here, but the abundance and distribution all this stuff is dictated by those things in SWMP. So, even though I always say it's not the sexiest part of science here, it's one of the most essential parts of science out here because I say it.. all life here hinges on those parameters, right? And, you know, when we talk about pH as being logarithmic, those little tiny changes matter a great deal.

Kaitlyn Dirr 5:47

There are a variety of ways that SWMP data can be used. The North Carolina NERR has been collecting standardized water quality and climate data on the coast since 2002 as a part of this program. This data proved invaluable in the wake of Hurricane Florence when used to assess public health risks related to a climate-sensitive bacteria. So how can long-term environmental data be used to inform decisions related to public health? According to researchers at the reserve, understanding how storm surges and floodwaters change salinity can inform the medical community when and where increases in Vibrio vulnificus infections are likely to increase. V. vulnificus is the bacteria we were mentioning earlier. The

SWMP data allowed researchers to see how long salinities were changed by surge waters and stormwater runoff, important drivers behind broadening the area where Vibrio proliferates, or multiplies. The bacteria can double every 20 minutes and thus adapt to rapidly changing conditions. Warming temperatures also increased the speed with which microbes can multiply (their doubling time). We can see where areas are warming and how much or for how long. Changes in coastal land use can also change how stormwater moves through coastal watersheds. Increases in impervious surface area that go with urbanization, for example, sidewalks and roads, typically drive stormwater runoff into waterways faster, rather than percolating through soils. This can bring with it surface pollutants like microbial loads, petrochemicals from roads, and yard debris along with fertilizers and pesticides. Researchers can see how this alters salinity patterns in the waterways. Along with pollutants, it increases the volatility of salinity changes following storm events, which can be burdensome on habitats and their occupants. Also, increased urbanization and intensive agriculture increases nutrient loading in waterways, which increases the biological oxygen demand, contributing to low dissolved oxygen in the water and harmful algal blooms. SWMP data helps capture these effects over time. Improving algal bloom detection is a focus of the GTM NERR in Florida. Making strides towards this goal, this reserve is working to create the country's most comprehensive chlorophyll monitoring network. Josephine Spearman, Education Coordinator at the reserve, is here to tell us more about the important uses and applications that SWMP data and technology have for this project and others at the GTM Reserve.

Josephine Spearman 8:34

So the background explanation is: chlorophyll found in plants, including algae and phytoplankton, helps plants to photosynthesize, you know, it's associated with that green chlorophyll color. And chlorophyll...with it, there can be an abundance of light. And when that happens that chlorophyll will actually release light back out, or fluoresce. So that's a huge part of what this new method of sampling or analyzing does. So previously, scientists would monitor that, they would take a chlorophyll sample, they would filter out the chlorophyll and they would be limited by the amount of time it took to do that process. I think it happened about once a month. But it was very beneficial because they could take a look at historical data and compare it and then understand long-term changes. So with this method, it actually takes a high-frequency sensor which takes that light emission or that fluorescing and reads that. The benefits to this include that they can collect it about every 15 minutes, so a lot more frequently than once a month. And then also they can take a look at short-term changes, changes with tide, changes in a day versus night, seasonally and after storm. So there's, it's not that one's better than the other. They're kind of looking at different ways of looking at it. And so one of the big things with this project is seeing multiple reserves are working on it to see if the entire reserve system can use this method or could maybe it needs to be done more individually, depending on the reserve. And so your question is about how that- how they want to use that data. So hopefully using it for decision-makers that, you know, make decisions on water quality, also the aquaculture industry, you know, taking a look at those little clams and oysters and mussels, they're eating that plankton that has that chlorophyll in it. So helping to understand those processes better. And then also supporting educators. So for teachers to be able to use this in a classroom, to show students how to be more data-literate, but not just like, you know, look at these graphs. It's like, "hey, look at these graphs that have to do with stuff that's happening in your backyard". So it's very engaging and relatable to what's going on with them.

Kaitlyn Dirr 10:48

There's some other neat projects going on at the reserve, too. Let's see what else is in the works.

Josephine Spearman 10:53

eDNA or environmental DNA is one of the things that's going on, we're taking a look at nuclear or mitochondrial DNA that organisms release into the environment. So being able to get more information based on what kind of DNA they're finding. There's a couple of plankton-based projects that are ongoing. And I think what they're doing is building a catalogue of what type of plankton is present. So it's kind of amazing to see that you can go and get your sample of water and then determine what organisms are there from the DNA that they're finding from it and just kind of like well wait a minute, wow! So those are some of the big things that are going on right now.

Kaitlyn Dirr 11:30

We can detect species, even invasive and cryptic or rare species, in water or terrestrial habitats using eDNA from cellular material. Isn't that crazy? You might not see the organism but you can tell that it was there at some point because of skin, hair, or other eDNA sources that it's left behind. Very cool. Let's look at some other research projects across the reserves here in the southeast. One of the current research topics at the North Inlet-Winyah Bay Reserve in South Carolina is stormwater ponds and their impact on coastal water quality. What current projects are underway related to these ponds? And why are they important? Here to help us dive into this research is Erik Smith, reserve manager.

Erik Smith 12:18

Well, stormwater research has been a focus of our research outside the boundaries of the reserve for quite a while because one of the priority areas focus areas of the reserve is impacts of coastal development. And in the southeast, when developers develop the landscape to create houses and subdivisions, big residential areas, they're required to manage the stormwater runoff. As we put up homes and parking lots and roads, we create a lot of runoff every time it rains. Stormwater runoff is a, stormwater runoff can be very significant contributor of pollution to the coastal environment impacting the water quality. I think one of the projects that is going on right now that I'm very excited about is a collaboration between the reserve and researchers at the University of South Carolina looking at the role of stormwater ponds and ways to redesign ponds and find more green infrastructure, more vegetation to help improve the nitrogen removal efficiency of these ponds. Nitrogen is a plant nutrient and in small amounts, it's very important for growing plants. Anybody who's grown a garden, fertilized a lawn knows you need some nutrients, the problem is too much good thing becomes a problem and lots of nitrogen runoff into the waterways creates unhealthy growth of algae and other water quality problems. And so we're working to try and figure out if we can use vegetation in the ponds and

redesigned ponds so that they capture and retain more of the nitrogen before it gets exported to the estuarine waters in the coastal receiving waters.

Kaitlyn Dirr 14:30

Interested in technology? Another project at the reserve is aimed at using drones for saltmarsh mapping.

Erik Smith 14:37

We've started to use drones or uncrewed aerial systems, UAS, as they're more officially called, but we all know them as drones, small quadcopters and sometimes big quad copters, that are flying very sophisticated sensors over the marsh that are now really allowing us to do a much more accurate job of mapping and measuring the growth of the marsh grasses and how they respond to storm events like the recent hurricane we just had, how they're adapting and responding to rising sea level. And all of these data are allowing us to build better models of the vulnerability or resilience of the marshes to climate change. That was a really neat project that started actually as a collaboration between many, actually, in fact, all the reserves in the southeast, we got together and got some money from NOAA to sort of figure out how to develop standard protocols for the use of drones in salt marsh mapping. And that has really opened the door for all sorts of new and additional work on understanding the health of salt marshes around the southeast.

Kaitlyn Dirr 16:17

An important mapping tool that the reserves utilize is GIS, short for geographic information system. GIS is a system that helps you create, manage, analyze, and map a wide variety of data. Here to tell us more about how the NERRs use this tool is Adam MacKinnon from the Sapelo Island Reserve in Georgia.

Adam Mackinnon 16:40

I mean, we use GIS, basically, for everything we do in science now, and that was pretty new when I came on board, I actually had to take a GIS from NOAA in Charleston a long time ago. But it's such a, first of all, from education point of view, it helps you tell a story. A very, you know, picture's worth a thousand words kind of thing. And we have kind of really cool things, like we have a Georgia Coastal Hazards Portal that people go on to see things like sea level rise and how it's gonna affect the marshes, we have something called SLAMM, Sea Levels Affecting Marsh Model, and in this GIS interaction on the web, they can click on different scenarios, and see how the vegetation changes, how well that Spartina gets pushed up into the rivers. We have, we have something called Georgia Coastal and Marine Planner that you know, where you live, how that sea level is gonna change. So it tells that great story visually, even like, sea turtles, you know, I was really involved early on with seaturtle.org with Michael Coyne when he created that. And so it's cool, you can see like, I take my, track my turtles from our GPS satellite tags we put on and I can take all my satellite and that trawler data, some aerial surveys for shrimp trawlers,

overlay that then I can overlay the stranded sea turtles, which will be- you can really see how all those things interact, graphically, and it makes sense. It makes sense. It makes it easier to explain to people. Oh, yeah, makes sense now, you could talk about it, but if you can see the picture it's great. And of course, you know it has a lot of great analytical tools to it as well. But for what I use it for these days, it's just a great way to tell a story quickly and efficiently.

Kaitlyn Dirr 18:27

All of these projects are just a glimpse into the research happening at the National Estuarine Research Reserves. Scientists at these reserves do work with countless estuarine species, and through SWMP and other monitoring efforts are able to learn more about the impacts of a changing climate and coastal development on the health of our estuaries. We can even use SWMP data to predict public health risks. All of this information is crucial to making management and policy decisions on our southeastern coast. Until next time, I'm Kaitlyn and this is NERR or Far: The Reserves Are Where You Are. Thank you for listening.