Research the Resonates
Villanova CLAS Podcast
Episode 3 Transcriptions
Sustainability: Caring for Coastal Wetlands

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Guest 1 (NW): Nathaniel Weston, PhD
Guest 2 (LW): Lloyd Willis ’20 CLAS
Guest 3 (KJ): Kristen Jezycki ’19 MS

NW: Coastal wetland systems exist along a lot of the coasts all over the world, and they’re basically where the land comes down to meet the ocean. It’s what we often call, at least in temperate ecosystems, we would think of them as salt marshes, but they’re also mangroves in more tropical regions. They are systems that are inundated by tides, either occasionally, or in some cases once or twice pretty much every day.

Host: That’s Nathaniel Weston. He’s an associate professor in the Department of Geography and the Environment at Villanova University.

NW: They’re really beautiful ecosystems. In the summer there’s green grasses that are waving in the wind, and you have the estuaries that are flooding and draining on each tidal, and you see herons, blue herons, and osprey flying around.

Host: This is Research that Resonates, a podcast from Villanova University’s College of Liberal Arts and Sciences that takes you inside the labs and classrooms to learn from our distinguished faculty and students. I’m you’re host, Chelsea Gerrard.

In our first mini-series, we’re talking about sustainability. Villanova researchers are looking into some of the most pertinent issues affecting our planet today, including renewable energy, rising sea levels and climate change.

Dr. Weston and the students in his lab are interested in understanding on how climate change and land use change affect these coastal wetlands, which is really important for us to understand because we depend on them for things like storm protection and filtering out pollutants.

NW: They provide a lot of important ecosystem services. So, they are at the border of where a lot of people live at the ocean. And so one of the really important things that they do is they act as a buffer for storm surges. They also filter out a lot of nutrients. So for instance, we fertilize our lawns, our waste systems, septic systems, or municipal waste systems end up putting nutrients in the water that comes down rivers and then enters the coastal oceans, and tidal marshes tend to take those nutrients out of the water that floods the marshes. So they act as kind of—they’re sometimes called the kidneys of our ecosystems because they filter out those pollutants.

Host: If coastal wetlands are the kidneys of our ecosystems, we certainly want them to be healthy. But increasingly they are coping with two major risk factors, the first—rising sea levels.

NW: Because the salt marsh sits, basically, at current sea level, for that salt marsh to exist, it has to stay at sea level. And one the issues we're facing right now is that sea levels are rising. So, a coastal marsh needs to build material and a creep—sort of buildup of material—and build itself vertically in order to keep pace with sea level rise. And, it does that through two major mechanisms. It builds up organic material, mostly because of the salt marsh plants. The other major mechanism is the trapping of sediment that comes in on floodwaters. The water flooding a marsh on high tide brings some of that suspended sediment up onto the marsh and some of that gets trapped–the plants actually help trap that sediment—and it's the combination of both the sediment and the organic matter together that actually physically creates that marsh soil. And over time, that new soil generation allows the marsh to keep pace with sea level rise.

So the issue now is that salt marshes are experiencing sea level rise and the concern is that sea level rise is accelerating, right? So the rate at which the sea level is rising is getting faster. And these salt marshes are gonna then have to accrete more material quickly in order to keep up with sea level rise. But at the same time—and this is some of the work that our lab has done recently—is to show that the amount of sediment that's getting delivered to these marshes is going down. This has to do with the land use change in the watersheds that drain to these coastal zones.

Host: So the second risk factor is the land use change, which essentially refers to how we, as a society, are managing and modifying the natural environment. Along the East Coast—that has historically meant clearing land for farming. So folks were cutting down trees and tilling the land, which in turn, pushed a lot of sediment into streams and rivers. That's changed in recent years.

NW: More recently though, what's happened is a lot of our farming has moved out to the west, and so there has been reforestation on a lot of the East Coast. And there's been other large scale land use changes—so we've increased the development, so we're building houses and developments in cities—and so you know, for these coastal marshes the concern is that it's something of a double whammy. Right? Increasing sea level rising, decreasing sediment supply, and really the main question here is: are they going to keep up? And for a lot of these marshes we think they probably will not be able to. There will certainly be some marshes that keep pace with sea level rise, but a lot of the marsh that we see along the East Coast right now is probably going to disappear in the next 100 years.

Host: That's where Lloyd Willis comes in—he's an undergraduate student in Dr. Weston's lab, and he's doing research to predict what these ecosystems will look like in the next 100 years.

LW: I'm Lloyd Willis. I'm a junior environmental science major. So from this last summer I'm using a program called slam. I can use this and show predictions of what the sea level rise in a specific area along the Delaware River, what the sea level rise will look like. So basically, also using GIS, or geographic information systems, I can generate maps and visuals that show, over a span of 100 years, what sea level rise will look like.

Host: Lloyd is specifically looking at the wetlands along the Delaware River. To create these maps, he's using data collected from the field using surface elevation tables or SETs, for short, which measure how much soil has accumulated over a period of time. Lloyd had the opportunity to do some of this fieldwork for the first time this past summer.

LW: It's grueling work, but it's really interesting. I remember going to two, maybe three, sites on the Delaware, doing maybe, I think we did a total of six SETs I guess per site. Again, so six sets of data over periods of time showing the levels of accretion and how much sediment or material's being built up.

NW: We have I guess six sites along the Delaware River that go from fresh water down to salt water where we have these SETs.

Host: That's Dr. Weston again.

NW: Some of them, not all of them, but some of them have been out there for almost ten years, I suppose. So we're getting long term data about, you know, the response of these marshes to sea level rise and land use change.

Host: Another piece to Lloyd's research is understanding how saltwater intrusion affects these marshes. I asked him to explain what saltwater intrusion means and how it happens.

LW: When sea level is rising sea level is bringing that salt water with it. So areas like along the Delaware River that are more inland—they are freshwater. As sea level rises that salt and salinity is going to go more inland and increase in effect the usually fresh water tidal marshes.

Host: There are some unsurprising effects of saltwater intrusion—like the plant community isn't going to like it very much. But there will certainly be less obvious consequences to saltwater intruding into the marshes. Dr. Weston explains.

NW: If you put salt on a plant that's not used to salt, it's not going to be very happy. Most of our work though is focused on understanding a little bit more nuanced responses because you have that change in plant community. That then drives… potentially changes in a lot of these ecosystem services that we care about. One of them specifically is this greenhouse gas. So some of this builds on research that we've done over the last decade in the Delaware River that sort of highlighted how we thought the carbon cycle would respond one way and it actually responded in another was that was entirely surprising to us. Specifically, what happened was we, through a couple different experiences, we saw a lot higher methane release when we had saltwater intrusion than we would have thought. We actually thought methane release would go down, so there'd be less methane generation with saltwater intrusion. And counterintuitively we saw more methane release. And the reason why we would care about methane is that it's a very potent greenhouse gas, so it's about 25 times as potent as carbon dioxide once it's in the atmosphere. And so what Lloyd's work is building on some of those field experiments to then create a model to look at saltwater intrusion and – well, predict saltwater intrusion—and how the ecosystem responds, and then build on top of that a model of the change in greenhouse gas balance; So we can say for the whole Delaware

River system, if we have saltwater intrusion into this region, this is how much methane we might see get released.

Host: While Lloyd's research is looking at the future, one of Dr. Weston's graduate students is looking at what we can learn from the past.

KJ: My name is Kristen Jezycki. I am a second-year graduate student in the Masters of Science in Environmental Science program here at Villanova.

Host: Kristen is researching heavy metal pollution. Some heavy metals are naturally present in the soil, she says. But we do see an increase in these metals with things like mining, sewage treatment plants, and other industrial activities.

KJ: And so over time, with all of these activities you are seeing an increase in some of these metals in our watersheds and these can have an important impact on peoples' health. I guess one of the ways that people can really be affected by this is through infiltration into our ground water. So if these metals are being able to seep down into our aquafers and we're pulling water out of them for drinking water purposes, you know, you're gonna see a buildup of metals in people who are drinking this contaminated water. And another way is also through eating shellfish and fish that come from these systems.

Host: For her research project, Kristen gathered core samples from nine different coastal wetlands systems between Maine all the way down to Georgia. She started with at least five samples from every site, and they were each 50 - 100 cm long. It's a lot of data. But she's sectioned the samples and is working on the analysis.

NW: What's really neat about what Kristen's able to do is, we're doing data of these core sections. So, she also knows exactly the date at which the soil core section that she's measuring her metals on—she knows what date it corresponds to. So, what she's going to be able to do is create a history of metal delivery to the coastal zone from these nine water sheds over the past about 100 years is how far back our dating is able to go.

Host: Kristen doesn't have comprehensive results on this yet. But she was able to share a bit about her initial findings with me.

KJ: As I'm looking at my data I can basically plot the depth versus the concentration of the metals that I'm seeing and particularly for lead and cesium, I'm seeing a peak at around 35 centimeters, which would correlate to the 1960s. And another one of the things that I'm looking to do is kind of look at… you know, once I have all of my results I'm kind of trying to look back at some of the policy decisions that have been made over the past few decades. So specifically, the Clean Water Act and also the Clean Air Act, and kind of to see what the implementation of these policies—are we seeing a decline in our pollutions. Um, so you know, the Clean Water Act was implemented in the 1970s, so I think it will be really interesting to see if some of our policy ideas are actually working.

Host: Dr. Weston, Kristen and Lloyd say their research as collaborative and has implications across industries. That's something I've heard from every research team in doing this series on sustainability. Here's Lloyd again, talking a little bit more about that experience.

LW: All the work that we do, even though it is a lie, and can be a lie, is very important work, and it does have implications that affect the world. So my experience in environmental science and my courses has kind of just related to all the other classes that I'm taking.

KJ: Like Lloyd was saying, environmental science really has an impact on so many different fields including business, economics. I think it's really important for scientists to be able to work with the community and people in other fields and really communicate what's going on and come up with solutions for our environment.

Host: Kristen's work is part of a project funded by the National Science Foundation, and Dr. Weston regularly includes his graduate and undergraduate students in prominent, grant-funded research such as that one.

NW: As a part of this research, I continue to engage with undergraduate and graduate students. I find that, by far, the most rewarding part of what I do is having students conducting their own independent research projects within sort of a larger research program in my lab. That's the best part of what I do is to be able to spend a year or couple years with students and then send them off on their way and hopefully to do great things.

Host: Thanks for listening to research that resonates. Check out all our episodes on sustainability as part of our first themed miniseries.