Preliminary Results from La Florida: A Land of Flowers on a Latitude of Deserts

Webinar Transcript

Speakers:
Thomas Smith, USGS Southeast Ecological Science Center

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Ashley Fortune: Good afternoon everybody from the U.S. Fish and Wildlife Service's National Conservation Training Center in Shepherdstown, West Virginia. My name is Ashley Fortune. I'd like to welcome you to today's broadcast of the NCCWSC's Climate Change Science and Management Webinar Series. This series is held in partnership with the U.S. Geological Survey's National Climate Change and Wildlife Science Center. Today's webinar will focus on the topic of "Preliminary Results from La Florida: a Land of Flowers on a Latitude of Deserts". Our speaker today is Thomas Smith, Research Biologist at the USGS's Southeast Ecological Research Center. We'll introduce our speaker in just a moment, but I'd first like to remind you of a few logistical details.

With the number of attendees that we have today we're going to be changing things up a little bit. If you have a question throughout the presentation, Tom said it would be fine for you to unmute your phone. To do that, you will unmute your own phone and then press "star six" to remove the global mute. Then you can ask your question.

We will also have time for questions at the end of the presentation if you would like to wait until then. All right. Dr. Shawn Carter, Senior Scientist at the USGS National Climate Change and Wildlife Center, in Reston, Virginia will now introduce our speaker. Shawn...

Shawn Carter: Thanks, Ashley. And thank you to everyone joining us today. Today it's my privilege to be able to introduce Tom Smith, who as Ashley mentioned, is Research Ecologist with The Southeast Ecological Science Center for the USGS. He's been there since 1994. There, his research focuses on climate change and climate change impacts on the structure, function and dynamics of coastal wetlands, such as mangroves, forests and marshes. He's particularly interested in sea level rise, disturbance and alterations in temperature and precipitation patterns. Currently, he is the lead principle investigator on a multi-institution research project that's applying the results of climate model downscaling to issues in Everglades restoration. With that, I'd like to introduce Tom and his talk today, which is "Preliminary Results from Florida, The Land of Flowers".

Tom Smith: OK. I guess I can take it away, Shawn. Is that correct?

Shawn: Yes.

Tom: All right. First, folks, thanks for taking time out of busy schedules to show up and listen. This project was one of the original 19 funded about three years ago, in the first call from the National Climate Change and Wildlife Science Center. I was very fortunate, for one, to come up with a really catchy name, and two, to get a whole bunch of really good colleagues to do the work. We are going to talk about preliminary results from La Florida, a Land of Flowers, which does in fact exist on a latitude of deserts. Here is a map of the globe. Here's Florida looking nice and green. If you were at Miami Beach and you swam across the ocean you'd come ashore in the Sahara Desert and the desert belt. The northern desert belt extends all the way around Northern Mexico, Texas, whatever. It's only the coast of China which also sort of is a La Florida-like habitat. What folks didn't realize was that Cairo, Egypt, over here, actually lies one and a half degrees of latitude north of Orlando.

I put that fact in the abstract to the proposal. I subsequently heard from several people that folks were pulling out their Google and looking. And said, "Wow, the guy's right." We also found -- we're doing downscaling. This is the domain for which the climate team is doing the downscaling. Mainly in the southeast. We're doing what's called "dynamic downscaling".

We're actually solving the equations of motion. We have what's called a Regional Spectral Model, that is embedded within the larger Global Climate Model. We're downscaling to approximately a tenth of a degree, by a tenth of a degree of lat and long. Depending on where you are in the grid, it's probably 12 kilometers on the side here and 10 by 10 in the northern portion.

The climate team initially tested the downscaling with standardized temperature and wind data sets. Because if you can't reproduce what's already known, you may as well give it a break. That resulted in a paper. Our downscalers are Vasu Misra, Lydia Stefanova up at Florida State and a couple of their students. They were kind enough to put me and Nathaniel Plant. Nathaniel's a Coastal Geologist here in St. Pete.

We then looked at two well-known global reanalyses, the R2 and the ERA40. These were used in NARCCAP. We compared our downscaling results with those data sets and again found very good agreement between the downscalings. These two analyses were done in the now time for the period 1970 to 2000. We hadn't gone out into the future yet.

We're using several different AOGCMs. We can't use all of them because the dynamical downscaling is computer-time expensive. We're using the Community Climate System Model.

This is the NCAR model. We had completed the 20th and the 21st centuries for current vegetation. We still have to finish past and future vegetation.

This looks very similar because with the Hadley Center Coupled Model, the UK Met Office Model, we're pretty much in exactly the same place. We finished current vegetation for both 20 and 21st centuries, and we still have to finish the past and future vegetation.

And then we're using the Princeton Geophysical Fluid Dynamics Lab model. We're in the same place with that. We just made the decision to do the current vegetation first for the present time and the future time, get those done, and then we'd work on the other stuff.

The data are available here, free to download for anybody who wants it. This is, we put the data at the floridaclimateinstitute.org, their facility. Resources, datasets, regional downscaling. You go there and you'll get a screen that looks something like this.

Here we go down and we find, OK, Lydia gave the downscaling some bizarre names that I'm not even going to try to interpret, but here's a CCSM for the twentieth, twenty-first century. Current vegetation with daily time steps. Here's one above it, if you really want data overload, you can get it with hourly time steps.

There's a lot of data being produced by the climate team on La Florida. The scenarios: past is sometime in the 1870's, we're going to do that one last. I haven't quite picked what time period we want. Present is '71 to 2000. The future is 2038 to 2070.

The sorts of things we're getting from this, changes in precipitation and temperature, timing of the seasonal cycle, changes in phenologies. Is it getting warmer earlier? Those sorts of things that are important for conservation biology, conservation for the agricultural sector.

Freq. changes in derivative products. Chill days, heat, frost, wildfire threat.

Regional circulation. Winds and then precipitation, evapotranspiration, surface temperatures. Lots and lots of different variables are coming out of the downscaling group.

Here's just an example. This is downscaled summer: June, July, August. On the top, we have output from the CCSM model. On the bottom we have output from the Hadley Center Model.

And so here on the left is the CCSM output for maximum surface temperature, which the way these models spit it out, it's always at two meters, so it's about six feet. OK. And here it is for the Hadley model. They are not in complete agreement, but they're both sort of predicting fairly substantial increases in maximum temperature for the summer in the future, not as much by the Hadley model as by the CCSM model.

Both are also predicting some increases in minimum temperatures, and this is sort of interesting, because here the Hadley model has slightly higher increases in minimum temperature than the CCSM model.

And then when we look at precipitation, the CCSM is really predicting a drying, a lot of...that peninsular Florida will dry, and I'm concentrating on peninsular Florida, rather than the entire southeast U.S. The Hadley model predicts much less drying, just a little bit, but not nearly as much as in the CCSM model.

Let's look at wintertime, and for temperature, its a fairly similar story. The CCSM model is predicting higher winter temps for maximum temperatures, not much of an increase for the minimum temperatures, and the Hadley Model for both max and min is predicting a little bit of an increase.

The interesting thing here with...is now we look at rainfall, OK. Here the CCSM is predicting a slight drying in winter, but the Hadley model is predicting an increase in precipitation so the two models for winter are predicting...their signs of the prediction are opposite. So it just highlights the need for users of models' data to really understand what they're getting and the interpretations that can be put to it. It's sort of a "buyer beware" situation if you just grab it and start using it. You really need to understand the data.

But we are using it [laughs]. We have grabbed it, and we, the ecologists on La Florida, are definitely using the data, and I'll show you a few examples. Basically, the downscaled climate outputs are being used as inputs -- and "will be", I should have changed to "are being" used as -- inputs to a set of current and new USGS models used in both our ecology group and by our hydrology group. Now, I'm only going to focus on the ecological models.

So we had two groups of ecologists on the La Florida team. One group based up in Gainesville at the Florida Cooperative Fish and Wildlife Research Unit. They were actually doing a lot of fieldwork out on the Suwannee River and the Waccasassa Flats, which is up in this region -- anybody familiar with Florida, Cedar Key and their wonderful seafood festivals about right there.

And then another group, a larger group, not doing fieldwork, just doing modeling, concentrating on sort of the lower Everglades, Lake Okeechobee through the water conservation areas down through the Big Cypress Preserve, Everglades National Park, Biscayne National Park.

So let's look at Suwannee and Waccasassa Flats first. Why do people care about that area? The Fish and Wildlife Service cares about it a lot because they have the Suwannee River National Wildlife, the Lower Suwannee National Wildlife Refuge, which is the home to this little beast.

This is the Florida Salt Marsh Vole. It is critically endangered, and with concerns over sea level rise, climate change, if we have decreasing precipitation and less water flow in the Suwannee River, are we going to have increasing salinities in the marshes at the mouth of the Suwannee River?

So the Fish and Wildlife Service was interested in getting some data on these things prior to the Florida co-op group getting out there. Only about 15 or 20 of these little guys had been captured.

So it took them a couple of years, but they finally devised a trap that worked really, really well. You get pictures of the critters and can see what they're doing, and so anyway...and they got more than the vole so here's a Gulf Coast mink. I had no idea there was such a critter as a Gulf coast mink, but there's a picture of one going into one of the co-op unit's traps out there on the lower Suwannee Refuge.

And here's another trap in which three little voles are having a party. There are two of them there nuzzling each other, and one looks like it's gone to sleep in the food bowl. But they got very good documentation, and you notice this picture was not taken all that long ago. It was [laughs] March 1st, 2012 so it's less than a year old.

They did try a whole variety of trapping small mammal sampling techniques, got a paper out of it. I supplied a copy of this to the National Climate Change and Wildlife Science Center, and hopefully it will get up on the La Florida web page up there soon.

The other thing they've done and haven't published yet, they've been doing some modeling to try to determine how the voles are distributed and how they will be distributed if climate does in fact change. So when they were going out and doing their sampling they would sample vegetation around every one of their trap arrays.

So they'd get species. They'd get biomass. They'd get types of vegetation. They'd get data on soils, on frequency of inundation, and those sorts of things. And so then with all of that data they subdivided it and said, "OK, what do these data look like just for those areas where we caught voles?"

So they got that subset, but they had done stratified sampling throughout the wetlands out here so they had hundreds and hundreds of data points. They also used aerial photographs, which they had digitized, scanned, and imported into their GIS system, and they were able to construct models.

And this is the potential vole habitat distribution in the present. This doesn't mean that if you go out to this little spot right here you're going to catch a vole. OK, anybody who's done occupy modeling with animals should realize that just because there's a patch of suitable habitat, that patch might not be occupied, and so that is really true for this little vole.

So what happens when you model potential vole habitat with one meter of sea level rise? So here's sort of the outline of the...that's not the whole...there's stuff in there that's not refuge, but that's primarily the refuge.

And through their modeling they were able to determine that a lot of this stuff we've overlaid that last slide, but you can see there should be, that their models predict an upslope migration of potential habitat, and a fairly large concentration of potential habitat on this little peninsula here. And this is Cedar Key down here. There's the road that comes in. So with one meter of sea level rise these little beasts appear to stand a pretty good chance.

OK, major change in subject. Let's go down to the Everglades and look at what's going on down there. And when you're dealing with the coastal everglades and southwest coastal Florida, the Ten Thousand Islands, and Biscayne Bay, and stuff like that, it's...you've got to deal with manatees and seagrasses. There's no way around it. So how are the downscaled climate future casts being used to look at manatees and sea greases?

Well, my colleagues up in Gainesville, basically, just…you need a simple approach. I mean I say, "KISS" -- keep it sweet and simple -- a simple approach to compare biological implications of different scenarios of restoration of the Everglades, sea level rise, climate change. And two types of models that they are using, one's called the Habitat Suitability Index, an HSI, and another one is called a Spatially Explicit Species Index, or an SESI model.

They don't require extensive data sets. They incorporate spatial and temporal variation. They allow relative comparisons of different scenarios, and they model potential habitat suitability. Again, as I was saying about the voles up there in Waccasassa Flats, just because there was a yellow dot on that map didn't mean that there was going to be a vole there. It just meant that the habitat had potential suitability.

So how do they do this? Well, they use hydrology models, and here's where the downscaled data comes in, because when you're dealing in the coastal Everglades up here, and this is time one, time two, time three, they're taking the climate, downscaled climate outputs for precipitation, and those are...precipitation influences water depth, and if you have a lot of rain and water comes up you're going to have a lot more runoff.

So there are relationships between precipitation, water depth, runoff, and if you have runoff in these coastal estuaries where the manatees and seagrasses are found, that's going to alter salinity, and so there is a HSI model for the submerged aquatic vegetation that has salinity, which is sort of a proxy for runoff and whatever, and then it also has temperature. So our downscaling is also giving us surface air temperature, and they've developed a relationship to take the surface air temperature and turn it into a water temperature.

OK, these go into this model, and it gives you a suitability map for where you should, where is SAV most likely to occur. And here are two species that they have been working with that are very different -- Halodule wrightii, and Vallisneria americana. And here is the habitat suitability for salinity, and here's salinity on the bottom scale.

And you can see that that Halodule is really abundant in that middle range, 20, even at the hypersaline areas, and there are areas in the coastal Everglades that do go hypersaline in the dry season. And then Vallisneria there is hardly any overlap. Vallisneria, it really likes low salinity areas. You get above five, six parts per thousand and it very quickly drops off and it's rare to find it anywhere close to 20.

Again, they have different temperature. Vallisneria likes it warmer, and Halodule can handle it a little colder, and their peak tolerances are about 10 degrees off. And these are just light photosynthesis curves that I'm just going...or light with depth curves that I'll skip for today.

So here is a suitability index. Brad Stith is the ecologist up in Gainesville, and Cathy Langtimm has been doing this work. And the suitability index is relatively simple. It's the salinity times temperature times the light depth relationship. You take the cube root. That's your HSI, and it's calculated for each grid cell in the study area for each time step. OK, and the one assumption they make is that the HSI for a cell depends only on what's in that cell, that it's independent from the neighboring cells.

So that's a simplifying assumption that we'll get loosened up here in the future, because we know that with water flow one cell is obviously connected to another, but they couldn't -- this is not a hydrodynamic model. So, anyway, for Vallisneria this goes back a few years.

Here are estuaries. All of this is Everglades National Park, Whitewater Bay. This is the lower end of Shark River Slough. This is Lassmans up here, a big series of back bays in behind Lassmans, and a big bay up on Shark River Slough, and Brad's model predicts that these are the most, the highest suitability for Vallisneria.

I've got study plots all over there. I boat all over there all the time, and the only places I've ever seen Vallisneria are way up these creeks [laughs] so he got that one spot on. I didn't talk about his uncertainly analysis, but he also has a method to do uncertainty, and the highest uncertainty happens to be in the same area where Vallisneria is most common.

And it turns out that one of the characteristics of this seagrass is the fact that it comes and goes with great rapidity. You can go out and pull up to a shoreline in July and there's Vallisneria everywhere. You go back the first week of September, and it's gone so just one of the quirky facts of that plant.

They've also been looking at thermal refugia for Florida manatees, produced a paper on it, and they will be incorporating the downscaled temperature data into a new model of these thermal refuges. Evidently, salty water accumulates on the bottom. It is denser. So the fresher water on the surface of some of these estuaries... It can get cold and then hot and cold and then hot. The manatees will just sit on the bottom in the warm salt water for several hours and just stay warm.

Go up, get a breath and then sink right down to the bottom. Two more characters in the Everglades restoration play. This is the Snail Kite. It is a critically endangered kite that's found in the Everglades. Not just Everglades National Park, but up through other parts of the Everglades ecosystem. And they are named Snail Kites because that blob right there is one of these.

This is a female Apple Snail. She has crawled up out of the water and is laying her eggs, her clutch of eggs, on the stem of a marsh plant. She has to get the eggs above the water. If they get flooded, the eggs don't make it. So, there's a very strong relationship between water depth and also temperature, it turns out, as factors for Apple Snail eggs to develop and hatch and for the small snails to survive.

This is some work by Don DeAngelis in our center that was done a few years ago. And trying to look at areas where Apple Snails will be common, in relation to the various water depths in Everglades. So this is southwest Everglades National Park. This is one of the water conservation areas.

This is another conservation area. That little bit is Loxahatchee National Wildlife Refuge. Here is the city of Miami. They ran a couple of scenarios back then. They have a model. It runs and it is still being used. They tried a scenario where they ran several dry years in a row, to see what they got, in terms of where are good areas for Apple Snails to recruit.

And for a series of wet years, where are good places for Apple Snails to recruit. The model uses water depth, which we know is a function of precipitation. Also, water control, which is also taken into consideration in their model. But clearly in the wetter years the snails were doing better. The big question is how wet is too wet? This says, "Add lots of water."

But if you add a whole bunch of water will you flood the eggs? So it's not just that wetter is good. There's going to be some threshold up there. What Don will be doing is he will be taking the downscaled precipitation data and also the temperature data, plugging it into his models, and re-running them for, what will potential apple snail breeding look like in a future climate?

So that's a work still in progress. Crocodiles, I'm not going to say too much about crocodiles, except that they are down there. There is a model currently being dusted off that will also include the temperature and precip as it drives salinity.

We're also using the downscaled data to predict range expansions for invasive species. David Fairchild, in the late 1880s to early 1920s, worked for the U.S. Department of Agriculture in South Florida. His job title was Plant Importation Specialist. He cruised all over the world collecting seeds and returning them to what is now the botanical garden that bears his name in Coconut Grove.

And planting them in the horticulture industry in Florida. Several thousand species of plants have been imported, and God knows how many insects came along with them. This little bit right here was pointing at some mangroves on this island in the Southern Philippines. He did, in fact, import a number of mangroves and plant them at the Fairchild Tropical Botanical Garden.

In the introduction, Shawn mentioned that I work with mangroves, so I've got to return to mud. We were searching. We'd heard that these things had been introduced. We got allowed by the Tropical Garden to come in and look. Lo and behold, here's one Lumnitzera racemosa. Yes, it's gotten loose. [laughs] This is a few miles away from that big old Lumintzera racemosa and its seeds on the edge of a tidal creek.

Its seeds were getting washed out. This is just a wall of Lumnitszera racemosa. Then there are dwarf red mangroves, Rhizophora. You can get down on your hands and knees, under the Rhizophora, and there are just thousands and thousands of Lumnitzera seeds. It's been declared an invasive exotic plant. It's gone on the exotic plant list by the Florida Exotic Plant Control Council, what-have-you.

There's another one that he introduced. The Kampong was his private residence in Coconut Grove. We found this thing called Bruguiera gymnorrhiza growing at the Kampong. It's flowering and it is fruiting and producing viable propagules. What's worrisome about that...ignore my buddy here. This is actually a picture in Australia. Here is Bruguiera gymnorrhiza growing quite nicely in a non-tidal, freshwater marsh dominated by Eleocharis cellulosa.

Eleocharis cellulosa is pantropical. It is abundant in the Florida Everglades. The question is, could it ever get over there? We documented some of this in a paper that we published two and a half years ago. One of the things we're doing with the downscaled climate data is trying to predict where these things could potentially move to. Here is the current range of mangroves in south Florida.

I just had someone walk into my room and then turn around and walk out. Here is the northern limit, a little further north on the Atlantic coast, than on the gulf coast for the natives. So what is the potential range expansion for these things? Will they move north? We're developing what are called climate envelope models, with the program, MaxEnt.

And trying to examine various scenarios with temperature for various areas and changes in temperatures, and what does that mean to these species. Basically, here is some real world data. This is the average coldest month temperature now, for Charleston, Appalachicola, Jacksonville, St. Pete and Daytona Beach. This is the coldest monthly average with climate change, using the CCSM projections.

Everything goes up. Then we asked the question, OK, even if the mean goes up a little bit, variance may increase. So what would be the projected future lowest low temperature? On hourly time steps? These were those data. And some of the species that we're dealing with can certainly tolerate a couple of hours at -3°C. Some can even tolerate a couple of hours at -5°C. So there is a potential for northward range expansion of these things.

Some of the other things that we're doing with the project. First, I've already said, all the climate data are on the web. You've got the website. Download to your heart's content. We have project liaison officers with a number of agencies. Glen Landers is the Climate Change Coordinator for the U.S. Army Corps of Engineers, Jacksonville district.

Steve Traxler is the Science Coordinator for the Florida Peninsular LCC. He's with U.S. Fish and Wildlife Service. So we've been working with our client agencies. We are hoping to have some data dissemination and application workshops, assuming sequestration doesn't prevent all travel and workshops. The project scientists, Vasu Misra, Lydia Stefanova, Eric Chassignet at FSU.

They did the AOGCM downscaling, produced a future-cast. Eric Swain, Florida Water Science Center is doing the hydrology models. Franklin Percival, Wiley Kitchens, Christa Zweig, all with the coop unit at UF. And Mike Allen, who's with the Department of Fisheries and Aquaculture at UF, are doing the Suwannee and Waccasassa ecology.

The critter models that I've been talking about, Don DeAngelis, the Snail Kite. Brad Stith is doing the crocs. Excuse me, manatees. Dan Slone, crocodiles. Susan Walls, who I didn't mention or show any of her stuff, is using the downscaled data in actual occupancy models for herptiles at two sites in Florida. Nathaniel Plant is doing uncertainty analyses. Rachel Pawlitz, our Outreach Coordinator in Gainsville, will be helping me set up outreach and data workshops.

I'm the lead PI and do all the project coordination. These people are smart enough and dedicated enough, they don't need any coordination. They know what to do. And then I'm doing the climate envelope models for the exotic mangroves. That really is the end. It is time for questions.

Ashley: Thank you very much, Tom. We are going to open it up for questions. I'm going to remove the global mute.

Automated Voice: The conference is now in talk mode.

Ashley: All right. Everybody is off mute now. If you could just take a moment to mute your own phone. You can use your mute button or press “star six” to mute it. If anybody has any questions, go ahead and unmute your phone, and ask Tom.

Tom: I'll ask a question. Are we going to make this PowerPoint available on the NCCWSC website, so people can download it if they want to?

Emily Fort: This is Emily Fort, from the National Center. We certainly will and we also are recording this and we'll post that up, as well.

Tom: OK.

Nikhil Advani: This is Nikhil Advani with the Nature Conservancy. Towards the beginning you were talking about the Salt Marsh Vole. You mentioned doing species distribution modeling with that. Did you actually use MaxEnt for that?

Tom: No. I did not. Email me your email address and I will give you the gals at UF. Christa Zweig, a postdoc at UF, did the modeling for the vole. She would be able to answer that question and I will get you in touch with her.

Nikhil: Great. Can you give us some insight into the MaxEnt results, if you do have any?

Tom: Not yet. [laughs] It's a bear of a program to run. A lot of people are starting to go away from it. So we are struggling to find alternate methodology.

Nikhil: I've been getting into it for the last year or so. I just did a search today on Web of Knowledge. There were about 30 papers in the last year that used MaxEnt, in at least the keyword search, for future climate change modeling. From what I've gathered, it still seems to be, at least amongst others, the most commonly used out there. I know GARP is another one, but I think that's being used less and less.

Tom: Yeah. I've got a couple of papers that basically have slammed MaxEnt and several others of the approaches. We have a group in south Florida that are using MaxEnt and then another methodology called Random Forests. I forget which program they use to do the Random Forest. They are looking at a suite of endangered vertebrates in far south Florida. I can get you in touch with them as well.

Nikhil: Great.

Ashley: If you have any more questions, you can also text chat your question into the chat box that's located on the bottom, right-hand side. [pause]

All right. Tom, do you have any closing remarks? If we don't have any...

Tom: Nope. Just thanks for listening in. We'll get this thing posted so folks can get to it. My email is tom_j_smith@usgs.gov. Very simple. Email me with any questions if you've got them.

Ashley: Thank you very much, Tom.

Transcription by CastingWords