08-09-2016

Stiles, Sheila ~ Oral History Interview

Fred Calabretta

Recommended Citation

Stiles, Sheila. Interview by Fred Calabretta. *Voices from the Science Centers*. Voices from the Fisheries, NMFS, NOAA. 9 August 2016.

This oral history was produced in 2016 as part of the *Voices from the Science Centers Oral History Initiative* conducted by *Voices from the Fisheries* with funding by the NMFS Office of Science and Technology.

Voices from the Fisheries
166 Water Street
Woods Hole, MA 02543

Interview with Sheila Stiles by Fred Calabretta

Summary Sheet and Transcript

Interviewee

Stiles, Sheila

Interviewer

Calabretta, Fred

Date

August 9, 2016

Place

Milford, Connecticut

ID Number

VFF_MF_SS_001

Use Restrictions

Biographical Note

Dr. Sheila Stiles was born in Memphis, Tennessee. As a young child she developed a love for nature which led to her focusing on science in college. She majored in biology at Xavier University, New Orleans. After graduation, she had the opportunity to work at the Milford Laboratory for the summer and was asked to stay on at the end of the summer. She was the first full time African American woman to be hired at the Lab. She credits her many mentors and her love of biology as the reason for her long, successful career. Dr. Stiles has a Master's from the University of Connecticut in Zoology/Ecology and a Ph.D. from the University of Massachusetts in Fish Genetics.

Scope and Content Note

Interview contains discussions of: laboratory work on oysters, clams, and bay scallops, aquaculture, genetic experiments, pollutants and contaminants, breeding, DNA, mentoring, GMOs, karyotype, polyploidy, application of molecular genetics in marine science,

Sheila Stiles discusses her passion for science and the love of the work she does. Her upbringing and the value her family placed on education led to her drive to succeed professionally and her mentoring of students throughout her career. She explains how she came to chose a government job for the stability but chose to stay at the Milford Lab for her entire career because her love of the work. Her passion for her work is evident throughout this interview as well as the impact her mentors had on her. She details the evolution of genetic studies and how genetics can help with

future issues such as climate change and the Zika virus, for example. She talks about other universities she has collaborated with, challenges she has faced while working at the lab, and her biggest accomplishments. She also sees the need to explain the mystery of genetics and the science to the public in order to demystify the process and encourage the next generation of scientists.

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Fred Calabretta: This is an oral history interview being conducted as part of the Voices from the Science Center's project funded by the Northeast Fisheries Science Center. It is also part of the Voices from the Fisheries project that is supported by the NMFS [National Marine Fisheries Service] Office of Science and Technology. The narrator is Sheila Stiles. The interviewer is Fred Calabretta. We're located at NOAA's Milford, Connecticut Lab, and the date is August 9th, 2016. Okay. And just to start if you would just give your full name and your date and place of birth.

Sheila Stiles: Well, the date I'll just say is, early. But my name is Sheila Stiles, and I'm a widow so Jewel was my name, and I was born in Memphis, Tennessee, many years ago, greater than 50. Is that enough?

FC: Yeah, and so did you grow up there?

SS: I grew up in Memphis, yeah, and in fact I had a wonderful childhood I would say. Also, I graduated from high school, went through schools there, and I was valedictorian, by the way, of my graduating high school class, and I still keep in touch with people in Tennessee.

FC: And, maybe to talk a little bit about your education after that, and how you first got interested in science and marine science.

SS: Ok, and actually this goes back to Tennessee. I grew up in Memphis, as I said, and this was before we became addicted to television, so we used to play outside a lot, and actually I developed a love of nature without knowing later that I would become a scientist. We used to play games like catching bumble bees, and what we would do is get these jars and put holes in the tops and then go around as the bees would go to clover. We would capture them, and see how

many we could catch and put them in the jars, and this was probably when I was maybe 10 or less, or you know, younger than that. But, anyway, I think through that and then also even the clovers, I don't know if you're familiar with these little plant, clovers, that bees like, and we would make jewelry out of those by stringing the stems together. And so there was just a love of nature!

I believe that helped me later on when I went into science without really knowing that that's what I was interested in. But in high school, I was taking classes like biology, chemistry, and -- there's nothing against taking other courses like sewing, but I wasn't particularly interested in those -- and so I developed a love of science without, as I said, knowing that later on I would be a scientist. So then, after I graduated from high school, I went to Xavier University in New Orleans, Louisiana. They have a strong science department, and I didn't even know that at the time. But it just so happened that I moved in that direction, and majored in biology, not marine biology, but just biology. At that time I remember there was one student, he was actually from New Orleans, and he talked about marine biology, and I said, "Oh, that sounds interesting!", but at that time at Xavier, most of the people were students who went into science or in biology went into premed. But I wasn't sure that's what I wanted to do. However, what I decided to do was stay in biology and take the science courses even though some were a little difficult, but for the most part I enjoyed biology.

Then well, right before I graduated, I would go around to these interviews with different persons who came from companies or the government, and I said because I just have to have a job. In those days and probably to some extent these days too, I felt obligated that I needed to have a good source of income especially if I came from humble beginnings, and I wanted to be sure that I would not be a burden, that I would be able to be on my own, and my mother was an educator. She was a teacher, and so, she made sure that we felt like, even though without saying it, she would say, "You can be whatever you want to be". I had four siblings and we all went to college. So, education was stressed. So then, when it was almost time to graduate from college, from Xavier, I said "What am I going to do?", and I remember going to an interview where, I think it was Tulane or Loyola in New Orleans, and there was someone, I think she was a psychologist, and she had these little mice running around this little wheel and I said, "mm, well, that's a possibility if I can't find anything else".

And I talked to my advisor who later on, Dr. Francis, who later on became president of Xavier, by the way, and I said, "What should I do? There's a possibility of this job working for the government." At that time one of the persons who had come to interview me was from the Department of Interior, Bureau of Commercial Fisheries, which was what the agency was before 1970, I believe. So, he said, "You know what? It's a government job, why don't you go for that." At that time, they talked about government jobs being very secure, so security was very important, benefits were good, and so those were the two attributes, I guess you might say, that convinced me that I should try to go for the government job. So, as it was in those days, you took the Federal Service Entrance Exam. And so I took it, and I passed, but in the meantime, I was trying to decide still what I wanted to do. So I did get in touch with, I remember the person's name Harry Owings, Mr. Owings, and I said, "I've graduated. There's a possibility that I could

get a job in science. I'd like to take you up on your offer in terms of possible internship as a summer assistant someplace", and so he got back in touch with me and said, "Oh! We have a summer position in Milford, Connecticut." And I said, "Oh really, where's that?". Remember that I grew up in Memphis and went to school in New Orleans, so I really hadn't travelled much really north. And so, to be honest with you, at the time I said, "Oh, I don't know, I don't know where that is. I don't have any people, as far as I know, and relatives close by, I don't really know anyone."

And so, I actually started looking very hard in Memphis and I don't if you know the St. Jude's Hospital, research hospital is down there. So I actually went there, but I only had about a month, and got the letter that said I should report to Milford. So finally the time came and I had to report. He put me in touch with the Director at the time, Dr. James Hanks. He wrote me a very nice letter and he said, "Yes, we have a summer position, as an assistant, as a student, and you've graduated and you've fulfilled the requirements for starting out." And so I said, "Oh ok. Now it is time to go." And I remember I got on this Greyhound bus which took about 30 hours, but I was determined I was going to make it somehow.

FC: And what year was that?

SS: Oh see, now you're trying to... it was a long time ago! In the '60s. Do I have to say specifically what years or is that...

FC: Well, I just wondered when you started here, but..

SS: It's been at least fifty years, so mid '60s. Is that close enough or do you want me to actually...

FC: That's fine, but the other thing that's interesting is, that's a pretty major move for you. I mean you were from the south and you were from a good distance away, and as you said you didn't have family up here, and so that's quite a move.

SS: And I remember later on my mother said to me, "Oh Sheila, you went so far by yourself." And I said, "But I made it, and I'm ok". Also, I mean, I was nervous and young and a little fearful because I was going so far, and I was going to be by myself. I remember when I got off the bus, and I had the telephone number for Dr. Hanks, and I called him. I said, "Well, I'm here." And at that time there was no real bus station in Milford. So, you can imagine, it's almost like a story of a young girl coming off the bus and calling and making her connections. So I called him and he said, "I'll be right there, and I'm going to take you where you are going to be staying." And it just so happens that he took me to this place where this family was, the Barringtons and I'm still friends with, well, the son passed last year, but with his wife, but that's where I went with Mrs. Barrington. And one of the reasons he took me there, is the previous year, and I'll just share this story with you. There was a young man, a young man of color who had come for the summer, and when he arrived in Milford, all of a sudden there was no place for him to stay. And so, I think it hit the papers and there was a little bit of a problem. What happened though was, this is interesting, is that his father was a special assistant to President Lyndon Johnson. So, of course the people didn't know that at the time, and that's probably why the papers said, "Here's this situation going on." So, Dr. Hanks wanted to be sure that I did not encounter that, so he took me

to the home where the other person stayed, was able to find a place to live, and it worked out very well, and then do you want me to continue with my story, or do you have more questions?

FC: Well...

SS: That's a long story, but...

FC: And could you describe, you said Dr. Hanks, was that the name?

SS: Yes, Dr. James Hanks, and in fact, the library is named after him now.

FC: And so, he was sort of helpful to you in getting started.

SS: He was very helpful, and you might say that he was a mentor, and he wanted to be sure that I had a place to stay, and I was safe, and he knew I was by myself, and he encouraged me to continue. As a matter of fact, when the summer was ending, and I wasn't sure whether I was going to stay or not. But anyway he approached me and said, "Well, if you'd like to stay, we'd like to have you." And so I said, "Sure!" So, by that time, I was pretty well adapted and wasn't as fearful, and it worked out pretty well. I always say that whatever you do prepares you probably for the next phase, so even though I didn't go far when I left Memphis and went to New Orleans to go to school. That was probably preparing me for leaving home and being able to stay on my own for the most part, even though it didn't seem like much, but anyway, but he was very helpful and people were very friendly. I remember my first supervisor Warren Landers. In fact, I stayed with Mrs. Barrington and he didn't live too far from there, and I remember he used to walk every day to the lab and home, and it worked out very well.

FC: And what was the lab like, what was the work like at that time?

SS: Well, it was mainly culture of shellfish, which historically, I guess you know the history of the laboratory, you start it out, and it continues to be a pioneering place in terms of a lot of the techniques are called the Milford Method, and when it comes to aquaculture of shellfish. Dr. Victor Loosanoff, you've probably heard of him, he and Harry Davis were the ones who were like pioneers for developing techniques for what we call conditioning the shellfish and then getting them to reproduce out of season. Those were techniques that were developed here.

So, I started working as an assistant, as an aide. And we were working with oysters raising those, clams, and so I learned about culture of all of these shellfish, which was great as far as I was concerned, and then I'll say this, so this was mid '60s and then about 1966 or so they hired a geneticist, Dr. Arlene Longwell, and she was great in terms of pioneering work with applying genetics to marine organisms, and so the laboratory was small at that time. I think there was only one other permanent female here Dr. Ravenna Ukeles who worked with algae. I think I was the first African-American woman who came and worked here and stayed. But it was a fairly small place. In the summer they did have young people here, that's how I happened to be here that summer, so I started working with Dr. Arlene Longwell who was not only my supervisor, but a great mentor. She had worked for a well known wheat geneticist at the University of Missouri, Dr. Ernest Sears, and so she started applying the techniques, and I became her assistant, worked with her for years, and we published quite a few papers together. But applying

some of the same techniques that were used with plants because she had done a lot of work with wheat genetics. And we actually developed the first karyotype, this is a chromosome karyotype if you will, or chromosome complement of oysters, which was probably, maybe one of the first ones done with shellfish. So, basically I was culturing, but also applying genetic techniques early on to these shellfish, and I really enjoyed it. Some of it, aquaculture is not that easy. It can be very labor intensive, but if you have somewhat of a passion for it, I think that will keep you going.

FC: Did you enjoy the work though right from the beginning? Did it seem like a good fit for you?

SS: I believe so, and part of it may have been as I said out of a little fear and anxiety and hoping that I would do well. And so I think I enjoyed it. In fact, I would say yes I did. And some of it was rather intensive, but still I worked with good people, very nice to me, and so all of that helped, I think, a good environment does make a difference. Plus, as I said, maybe that early on experience with working, playing with those bees even though I'm not that fond of insects, but anyway, that helped, and maybe this is kind of the nurturing side of me. So I liked working with the oysters and the clams and culturing the animals, and then to be able to apply it to genetics really was great as far as I was concerned, because that was a rather new field, a new application, and now as you know genetics is pretty much all over the place, and it's evolved over the years and there are new applications. So, whether you're talking about humans or plants or whatever. There's always a genome project. So that even fueled my passion even more, because not only was I working with culturing the animals, but also I was applying a field that I thought was exciting, and learning the cytogenetic techniques, and learning the breeding techniques, and so since being a farmer.

But still applying techniques used historically with agriculture, I was applying them to the aquaculture. And I think that's really what kept me here all these years, because I did have a passion for it, and I did enjoy it even from the beginning, even though I wasn't sure, and especially at the very beginning what I was going to do or whether I was going to stay. But it was enough, and oh, and then I guess early on too, one of the things I did, I had an opportunity to go to Woods Hole to take a marine biological laboratory course, and that was kind of like the Mecca and it still is. If you're going to work in marine biology, that's the place where scientists go. Kind of like I said kind of like a Mecca if you will. And that was maybe a year or two after I came here, and part of that was, even though I had majored in biology, I wasn't really that well versed in marine biology or fishery biology except for the experience of working here. And so it was important for me to go back and take those courses. Well, actually I just took one course there, and I enjoyed that experience going up to Woods Hole and being at the marine biology laboratory, biological laboratory, and meeting people from all over. It was a great experience and then I came back. I live in New Haven, so I came back to New Haven and continued to work at the lab here. And another thing that happened, I guess in the 1970s, there was a threat of the lab being closed, and I don't know if you've heard about that.

FC:A little bit.

SS: Ok, so I was devastated, I was like, "How can they close the lab, this is so important." 'Cause I was a young person talking, a younger person talking. And through attrition, we lost so many people, I guess the staff dwindled to about maybe 10 or 15 people. But we had strong support from the industry, and letters were written, and of course, we didn't contact our politician, no we can't do that. So, anyway, we did have strong support, and after about a year of not knowing if we were going to stay open or closed or whatever, eventually the laboratory stayed open, and I was grateful for that, and in fact I had already interviewed at Yale-New Haven Hospital, I was going to work with a cytogeneticist who worked with humans. And so it was a matter of taking that job or staying here, of course I kept hoping and praying, "Oh, I want to stay here in Milford". Because I did enjoy the work, and eventually the lab stayed open after about a year, and then it was probably, when was it that NOAA came into existence? And so I could keep going on and on...

FC: No no, this is great, very helpful.

SS: And so then we became part of the Department of Commerce, and so of course there were other agencies, well, under the Department of Commerce, the National Weather Service, and NOAA, so it became Oceans and the Atmospheric, we were combined. For the most part it was work related to culture and breeding, and then I guess maybe in the '80s or so we started to look at effects of contaminants or pollution effects. And we were able to apply some of the genetic techniques to the, looking at effects of pollution and contaminants. And so that went on, I guess maybe to the late '90s or so. And then in the '90s or so we went back to aquaculture. But again, it's like using some of the same techniques and approaches that we were able to apply with culturing, because after all that's what it is. And then, figuring out what impacts those contaminants might have. One thing I was proud of is, during that period of time we conducted a study with hard clams - so I had worked with oysters and then hard clams - and we were able to get them from different sites on Long Island Sound and look at what we call reproductive success. And I remembered that we had to write a report, and we were collaborating, we maybe got a grant through, with EPA or from EPA, the Environmental Protection Agency. And with this reproductive success study with clams, we were collecting clams from different sites on Long Island Sound. We were also collecting water, and I just remembered, once I was interviewed by someone from I think it was the *New York Times*, well, yes, how could I forget, and I was I guess a neophyte and so I just said, "Well, I think this site was different." And of course when it appeared in the papers it was like "Oh no did I say that?" So I learned you have to be careful! So, I'm going to be a little cautious here, and because once it's in print, you can't take it away really.

Anyway, so that was that period, and like I said, I enjoyed that as well, and that brings me up to now where we've been emphasizing work on bay scallops, and I'm proud of some work that we've done there, where we've actually developed what I call genetic lines through breeding bay scallops. And that work actually was, it followed pretty much logically from the work we had done with oysters. We had conducted breeding studies primarily tried to improve growth rate. It just so happens that before we started working on the pollution effects, we actually developed a line of oysters that were faster growing. About the time we started to switch over to pollution

effects, we were giving away some of our animals, and it just so happens that we gave some of our faster growing animals, oysters, to someone who eventually used those to develop disease resistance. So you never know what you're going to do or what's going to happen later on. And breeding is long term. It's not the same as saying "oh, ok this year we're going to have this and next year we're going to have that", and just getting animals from the wild. What you want to do, of course, is have them, sustain them over a period of time, especially if you are selecting is like selecting for food or plants or animals or whatever. And part of the reason we started working with the scallops was that the populations had declined.

And as a matter of fact, the story goes, am I taking up too much time? That a few scallops were taken to China, about 26 or so. What happened is, there was tremendous production, and for a while, only thing with 26 animals, then you have all of your breeding based on those few animals. There was a problem with inbreeding depressions. So the populations crashed. As a result of that there was a visiting scientist who came here to work with us and determine if some populations were more genetically diverse than others, and therefore they wanted to import these scallops that showed the most genetic diversity, and that was interesting in itself. Subsequently I was invited to go to China at least one time and present based on my work with the scallops. So I just threw that in there.

So the work is continuing and one of that, well I shouldn't get into that, but I was going say that I'm proud of, we've developed this line where there are phenotypic striped shells. And we actually have a line that we call the Milford Line. In New York, they call them skunks. And they have striped shells. And the purpose of that particular line, what we're trying to do is identify them in the field, and therefore you can see stripes, you can't see DNA all the time, but you can see animals that are out there that look different. And then you know whether you are restoring them or making a difference.

In fact, we just started some work with one of the scientists from our New Jersey laboratory. He's a field biologist, Clyde MacKenzie, and our portion, or our component, was to provide animals that had striped shells, so that he could take them to the field actually in Massachusetts, and then put them out and then be able to identify whether they were recovering or not. We've actually developed that line, and I don't know if you want me to show these, I know this is not visual, but here is a few of our little animals with the striped shells. Those are baby scallops.

FC: So they were, were they developed specifically so that they could be recognized visually to help with the studies and the fieldwork?

SS: We did. Well, we did not create them, these were found in nature, but what you do as if you're doing any kind of selective breeding is you increase the frequency. So no, we did not create them, but what happened is we realized that they were in the wild populations and the natural populations, but at a very low frequency. They had these identifiable markers on the shells that you could put out. And you knew that if you increased the probability really, increasing the frequency, if you know you can increase the frequency of these, you can identify them in the field, and know that you're making a difference. Quite often people would say, "well yes, we're going to put animals out, and we know that we're making a difference". These you can

see if you're putting out, so that's the whole basis of this recent project. In fact, we just looked at these today. A month ago is when we actually transferred two million larvae to the field biologist Clyde MacKenzie. He took them up to Massachusetts. We have a person there, a contact there, Rick Karney, at the Martha's Vineyard Shellfish Group, and he actually took them as larvae, and he grew them out so they would settle and they were going to be transplanted to two sites on the Cape.

FC: Now do they have the same DNA make-up as the others? They just have this...

SS: Well, that's a very good question. In fact, that's the other thing that we're working, so not only are we looking at what we call the phenotypic characteristics, we look at genotypic characteristics, and so, that's something we're investigating. Whether the striped shell ones are similar enough or different enough. So, we do believe that right now- well, we're not sure- but that's one of the projects that we're working on, and in fact we collaborate, that's another area that I've been involved with, we collaborate with the university, with some geneticists there, where we have some of our striped shell animals, and non-striped shell animals, and so we're continuing that work to see if they are different in terms of answering your question of DNA make-up. Now, what we found for the most part is, using the technique that we use what we call mitochondrial DNA, and we didn't look at a lot of, I guess you may say, targeted sequences where we could say, "oh yes this is, these are different or they're not." So, as a follow up, we're planning to see if there is a definite difference.

FC: And in this kind of research, and I'm not very knowledgeable about it, but at what point when you have these variations are you dealing with a distinct or a new species?

SS: Well, that's a good question. It's not a new species, but sometimes you have subspecies. A good example of that is found in the hard clam. Actually there are hard clams that have what we call plain shells, and then there are some that kind of have this zig-zag pattern, and they're called notata clams. That's a subspecies, so it's not really a totally different species, but a sub-species. And what has happened with that is that some of the, at least one commercial company was using that as their brand, similar to what you're asking about here. And we know that those are genetic differences as a subspecies, but anyway what happened is this person was using it as his brand, but then everyone started to use it as their brand as well, and, of course, then it lost its' purpose as far as this commercial operation was concerned. So, we do know that at least at subspecies level, we can use those markers to identify those different groups, and we think that this might be something similar. But, it may not be to that level, it may not even be at the sub specific level. It's like having a variety of plants. So it may not be necessarily a sub specific level, but we are looking at the DNA of those and we've been sampling. We haven't done as much work in that area, because the main thing is we want to do applied genetics, so that's involved more of the breeding, but we did collaborate, as I said, with Yale. And actually, in a summer program where they have students, so there was the opportunity for outreach, it was called a Scholar Program, and what happened is high school students actually extracted the DNA, ran what we call a PCR [polymerase chain reaction], that's kind of amplifying. It's like going to the scene of a crime - and that's what I like about genetics - it's going to the scene of a crime and you'll just have a little bit of DNA there, so you can amplify it, and that revolutionized

molecular biology and molecular genetics, because you could have just a little bit of DNA, and what you can do is, through this process of heating and cooling, computerized heating and cooling, you were able to extend the amount of DNA material that you have there. And that's why a lot of these shows like CSI, they talk about, "oh yes, well, we have this and that", but as you know DNA is big in forensic science, and that's what I like about genetics, it's like solving a mystery, and it's like solving a puzzle, so I don't know if that answers your question, in a roundabout way I guess.

FC: Yeah, and the genetics theme seems fascinating, because you were involved in it pretty early on, and now it's just, you mentioned earlier, it's just kind of exploded, and people recognizing what we can learn from it.

SS: That's right, that's exactly right and I think that's partly why I've stayed so long, because I do find it to be very interesting, and it's evolved, and it's still evolving. I mean every time you turn around there's something new, and there have been people who have been, I guess exonerated or proven innocent, because they found that the DNA didn't match, or whatever, and it's used for a lot of purposes. Not only, and people hear about the human genome project, but they don't know all of these other projects for different organisms. So that's another fascination for me, is realizing that I can do the breeding as well as the molecular, as well as the other component that I haven't talked much about is, we've provided animals to other groups, schools, agencies, business persons, especially if they're starting out and they want to know if they can try to grow these, develop a hatchery. And so, we've provided animals, we're not trying to compete with the industry or anything like that, but providing opportunity, "oh yes, you can try these, you can test them." So we have provided animals to different groups and individuals.

And as a matter of fact, there's a person in Bridgeport, and he's come to us a couple of times, he said, "Well, I just want a few, I want to try, I have this area where I want to try them out, the scallops. And can I have a few of them?" And we said, "sure." And then also we have a contact on Block Island, in Rhode Island, who is taking some of our animals, and then there was a person that I met recently. She has a place in Mystic, and ..Sally McGee.. I think is her name. Oh my goodness, I don't know if I should say names, but that's okay. But anyway we've provided a few for her. And we don't know how it's going to work out, but we do try to help any way we can. And I feel as a public facility in the sense that that's what we're about, for you to be able to see if something is going to work or not. So we do provide animals, and especially Stonington and Niantic, because that's where we get our brood stock, and so we reciprocate by spawning the animals and then giving those back. So, we did quite a bit in terms of the community too, as I said, giving the animals out, and schools like I'm on the advisory committee with the Sound School, I was previously, and now they're trying to bring that group back. And so I've been involved with the Sound School, and in fact I have a student now, I don't know if you have time to do a little touring thing today.

FC: Probably not.

SS: Well, maybe I'll just show you. But anyway we have a student, and I quite often will have students that I mentor, and so, that's kind of where I...

FC: Do you enjoy that part of it, like the outreach or working with students?

SS: Oh yes. As a matter of fact, I used to do that, I used to go all over the state. Norwalk Community College used to have a program, and I went for about five years, and I said I'll take to my dog and pony show, I like to take animals. Because it's one thing to talk about science, I think the best way to teach science is hands on. Because that's what I like to do as well, but also I think that's the best learning experience and exposure. So for about five years straight, I participated in this program where they were trying to interest young girls or females in high school in science in what they call the STEM [Science, Technology, Engineering, Math] areas, so that was one of the first programs that I remember where they were really pushing that, and this was maybe 10-15 years ago. And I used to go all over the state, you know, whenever I was asked, and in fact here I was involved in kind of a satellite program that was run through the Rockefeller Foundation coupled with Howard University. I had summer students who came, plus there was another program, the Summer Youth Employment Training Program from years ago. You hired local students, I guess that was a special government program, and we have a lot of students from Milford who came in and quite often I would supervise and mentor. And I still do that, and I said there's a young man from Roger Williams University, he is a senior. In fact we just set up a project yesterday, where we were trying to see if these crabs have preference for these scallops with different shell colors, and we have them out in the tank farm. But anyway aside from that, he went to the Sound School, and I said, "Well, what would you like to do?", and he said, "Well, I'm really interested in marine biology", and that's why he's going to Roger Williams, and he said he likes culturing, so I said, "Well, you're at the right place." And he did recently ask me about possible employment opportunities because he's a senior, so I'm making a list for him of different contacts, but no, I do enjoy it, and what's interesting, sometimes I'll have the little kids there, and when you first go in and you first start showing them the animals, because I take them out, I want them to touch them and feel it. "Oh I don't know", they're afraid, but then after a while I notice they're keeping the fish out of the water and sometimes we have animals that we have at our open house, and I always participate in the open house. So, we don't always have the animals that we might need, so I said, "I can go to the supermarket and get a lobster." And so I'll go and buy a lobster especially when we don't have any when the boat doesn't go out and we can't get the animals. So I try to make do, and I'll take them out, and like I said, at first they're squeamish about it, oh no, and then the next thing I know they're petting it and so just to experience that is so important, and also that's the best way for people to gain and experience in terms of science, because in the past I think people said "no, that's too far out, or not something I could do" and in fact the students through this outreach program that I told you that I work with at Yale so they took a tour, and I said how many want to be scientists, and a lot of them didn't raise their hands, and I said, "Well, what would you like to be?" And so one said, "Well, I want to be a judge." And I said, "Yes, but do you realize that there might be someone who comes before you, a case that involves DNA?" "Oh yes!" So I said, "The more you know, the more information you have, the better you are able to do whatever you do in life." So anyway.

FC:I wanted to ask you a little bit more about the genetics, and just thinking, I mean it just seems like…Well, it's a fascinating branch of science, and it's resulted in all sorts of knowledge

in your field and other fields. Do you think it still hasn't been fully tapped? Do you think in the marine science field that more can be done with genetics studies?

SS: Oh definitely. And hopefully we can do some of those things, that's what we're doing and as a matter of fact because I have been here a while, I've seen it evolve even in terms of where we were doing some of those early studies. And one of the areas that I did not talk about is something called polyploidy. And that involves having an extra set of chromosomes. And people might say, "oh, that's so far-fetched." It's still not genetic engineering, but what it involves, because it's the same genetic material. Usually when they're talking about GMOs or something, they're talking about transferring genetic material that's totally different from a totally different kind of organism, but with polyploidy what happens is, with an extra set of chromosomes. For example if you have two sets that's a diploid, three sets that's a triploid, the triploid is sterile. And because it's sterile it diverts this energy from reproduction to growth. So that's a big thing in marine science. In fact, now, if you see advertisements regarding oysters or different marine organisms, primarily oysters, they're talking about diploids and triploids. So, it's already evolved, and so I can see it going even beyond that.

And as a matter of fact, one of the projects I worked on, in terms of even with working with polyploidy and knowing that there were extra sets of chromosomes, and just before I forget, to make that analogy, some of the fruit that you eat is extra-large and it's seedless. It's the same principle. So, because animals are sterile, they grow faster and bigger. So it has already evolved to that point. Now, the next step will be ok, Dolly, cloning, but they don't tell you how many Dollys there were who didn't make it, you hear about the success stories.

So I believe there's a lot going on and these things could be applied to marine science, and they are being applied. It's just that right now, there are some issues in terms of identifying what are the real problems with getting these animals to survive and grow. Well, part of that, if you think about where we are now, there's a greater awareness of environmental issues, climate change, global warming. So, in terms of what genetics can do is maybe develop varieties that can thrive and grow and survive. Not everything is going to die off unless it's the same, and what we believe in is diversity and variety, because just like any organism, if everything is the same and a disease comes along and wipes it out, and there are probably examples in human history where populations have declined substantially because there was like a plague that pretty much killed everything. But if you find that there are some differences, and that's where genetics can play a role, then some groups are better adapted to certain things, even like with the Zika. So there are things, and one of the controls that they are using there, and I tend to think of things as being kinda of related, that's why I can kind of jump to different things like this with the Zika virus, what they decided to do is mate sterile animals with females. Males primarily are sterile, and then the offspring don't develop. So that's what they're talking about even now in Florida with how to control these populations. So you can apply this maybe to some invasive species or conversely use some other genetic techniques to build up the ones that you want, that you desire.

So yes, I think marine science can play a role. And that's why I said I can kind of look at some of these other organisms and issues and see some application. So yes, I think there are still some things that can be done, like the DNA, like even the example of mating animals if some are sterile, or even this polypoid…well, polyploidy especially applied to oysters. But some of the basic information was developed years ago, and so we're just getting to the point where there are actually selling animals that are triploid. The only thing is that those aren't always as stable as they should be, and it used to be to show you how things have evolved. It used to be used a chemical to induce this polyploidy. Now, even though at some point you might still use the chemical, what they're doing is getting what they call tetraploids that have four sets of chromosomes mating those with animals that have two sets of chromosomes, and that's how they're getting the triploids. The only thing is, it's not always clear where those original triploids came from and where those tetraploids came from.

So, yes, it is evolving, but there is more that can be done. And so as I said, one of the things I've done is see the evolution when we were first starting out with the chromosome karyotypes. That served as the basis for them moving into polyploidy, if you don't really know what the diploid number is. It's like when they first came out with the human genome, you know, and they were off by a couple of chromosomes, but anyway, so yes, I do see that there could be greater applications in marine science, especially with the molecular genetics, and in fact we had a meeting here, I don't know if I should say that, last week. Someone came up from Rutgers and they said, "Well, what is one of the best things we might do in terms of collaboration, what kinds of projects", and someone said, and in fact it was the guy who was leading the meeting, he said, "I think we should have a genetics center of excellence, and try to work on some of these issues, but we need to bring in economics, we need to bring in changing environments." A lot of these species that are experiencing migration patterns that are changing because the water is too warm here and they are moving to Maine if you will. Well, we have to think about what's the future. And so yes, I think that some of these studies that may seem basic, eventually they do pay off.

FC: It sounds as though there's an interesting exchange in the different fields of science, or something that's going on in land agriculture or even in the study of human genetics might relate to something you're doing, and you may be doing something that they're very interested in.

SS: That's exactly right. And that's one of the things that I brought out when I was working with Yale, the geneticists there in this outreach program. And I'll just share this. What happened is, the students were conducting genetics studies but what they were doing was using cheek cells, taking swabs, but that was around the same time as this pandemic, with the swine flu, I think it was. So the National Science Foundation or one of the organizations in the government that provides funds said, "Well, we really don't want you to use human cells for this because of this pandemic. We don't know what might happen." And so that's what why I came on with the scallops. Some of the same techniques are, I might say, are overarching in terms of what information you can provide. So maybe you can't do everything on humans. Now, for example, they're using zebra fish to do some elementary studies that they can't do on humans. And so you're right, having those animals that we can use as tools and also apply some of these techniques that you might not be able to do, like with higher organisms, or with humans, of

course. Yeah, so there's something to be learned, I think, from all over and different organisms and the variety of organisms.

FC: Have you had some finding that were very, very surprising or even startling to you?

SS: Well, to some extent, yes. One was that, what I told you about, when I was interviewed by the person from the *New York Times*. What happened was one of the cytogenetic techniques, you can do it at an early stage when the eggs are first fertilized. With the hard clam, we were looking at different sites. We collected the animals in the water. And so, and I know I made this observation myself, I said, "something is wrong with these eggs so early on, but we'll wait and see what happens, what the result will be." Turns out that particular site, a lot of the animal larvae were dead. And that's why I said I was kind of misquoted, because I didn't say that this site was killing everything, but somehow it came across that way. But anyway, so in a way that was kind of surprising to me because I had not seen that kind of direct correlation previously I don't think. And actually, some of my research work with oyster embryos and larvae for my dissertation, was related to a bioassay that I did with PCBs [polychlorinated biphenyl], and petroleum aromatic hydrocarbons. And so I know that these organisms can be very useful in terms of bioassays to test different materials, but that was a really surprising result, because I had not seen that clear cut correlation before that I could recall. The other thing was, these animals that have the striped shells. I mean it's one thing to talk about, it's one thing to see it, and to know that you can produce those, and it is a genetic trait. So those, that was surprising, in a sense. The other thing that wasn't so surprising, but I'm glad that we did it, was we developed a technique whereby the larvae have shells, and that was one of the stages where you don't always see, you can't see, what's going on. So what we did is use this cytogenetic technique, that we used for looking at the chromosomes, we were actually able to decalcify the shells, and you could actually see through the shell, and see the cells. And I said "well, maybe this is a precursor to stem cell research." So you never know. So in a sense those were surprising, but then as I said it's kind of like a puzzle or mystery, and when you see something that really works, you're really happy about it.

FC: So, it is in some ways a little bit like detective work.

SS: Yes. And that's interesting because I remember years ago, I haven't really said my age, but I used to listen to the radio [laughter], and I loved mystery stories. But that natural exposure when I was young and catching the bees, and doing some other things with little insects so to speak that kind of helped with my curiosity.

FC: So you like that part of it, the discovery.

SS: Yeah, very much so, and I said, it's maybe the passion that's kept me going for a number of years.

FC: How has technology changed or influenced your work or given you new tools?

SS: Well, again I have to go back to the DNA work as well as the karyotype. Just all of the genetics if I can say that. Those discoveries, as a matter of fact, I have some contacts through a national technical association, and a lot of those individuals are from NASA, and so I was

contacted by someone there who said, "You know, we might do some DNA sequencing, and we might send some of those organisms up to space", so in a way that would influence how much I might do in terms of DNA sequencing, and also - well, not just for that reason - but that's kind of like the next step in terms of actually identifying certain sequences that you could use for gene expression and you might not know what's going to happen, so that influences the technology. And also just having the opportunity to do something in molecular genetics, I think that's the new technology. By the same token, there's that other side of me to say, "ok, but how does that fit in with the breeding." Eventually you want to show something, that it makes a difference, that it's not something that's too far out or doesn't have practical application, is something that is useful. So that technology, I think as long as you apply it correctly and for the right purpose. And sometimes you're ahead of your time in a sense because people aren't quite there.

I remember working on the karyotype of the oyster and who would have thought that would have led to further studies with polyploidy today with shellfish. And the reason why those were very important is that in the Chesapeake Bay area, the oyster populations had declined substantially. And so there was a move to bring some animals in from another area, from another country, another continent. And, so the regulators said, "Ok, you can bring them in, but they have to be sterile". So, that's when there was actually this big push for polyploidy because these triploids would be sterile. However, what happened is, is as I've said with the analogy of fruit that's supposed to be seedless, it's the same principle, but occasionally you find seeds. They couldn't guarantee that it wasn't 100%. So they had to take all the animals out of the water. The other thing that I can think of, and this is not anything we've done, but they talk about GMOs a few years ago, and apparently something was done with soy and tomatoes, and at some point someone said, "Oh no, we don't want you to use those techniques. We don't want you to do this, those are GMOs, we don't want you to do that." And I'm not saying I'm for or against them, I'm just saying that by the time they try to recover all of that, a lot of the grain, I mean how are you going to separate, how are you going to get it all back. And that's what happened with these animals they put in the water, they turned out, they weren't all sterile, so then they had to, how do you know those animals didn't reproduce in the water? And one of the reasons I have kind of an appreciation for how people feel about GMOs, is that I was involved actively for a number of years with the International Council for the Exploration of the Sea, the short name is ICES, and they have a genetics working group, and I attended a few meetings, I went to Iceland, Denmark, in fact, what did I do, I was a co-convener for the 100th anniversary in genetics. And there was some concern, what about GMOs? And at that time, really, there was a lot of negative feeling, even among geneticists, and I remember a couple of them, they were from other countries, "Oh, you Americans will eat anything!" So I just said... And now, I don't know if you've heard recently there's this big fish, Aquabounty from Canada, and supposedly it's been approved for marketing in the U.S. But I don't know if it's actually started to happen yet, because there are people still protesting saying, "we don't want those here." But anyway I don't know if I answered your question somewhere in there.

FC: What are some of the greatest challenges or most difficult aspects of your work or in your career?

SS: Well, sometimes not having the resources and support that you really need to do something. Like I have a lot of ideas as you can see, and sometimes I can move forward. Sometimes it's a challenge, for example, even having these animals, the challenge was, that even though we planned this and proposed it back in the fall, there was no guarantee we were going to have animals to provide on July 18th. That was a big challenge. Plus, I guess you might say that we're competing interests because we had a major program we do at the same time. Well, it's difficult to have these major projects, major other activities, plus there are some other things that are going on, and if you don't have the support, if you don't have the funds or the staff, in fact at one point we were told, "Don't work with scallops. Work with mussels." But it's not that easy. If you're talking about genetics, you're not talking about something you can just go out and grab. You're talking about generations, and once you lose that, it's difficult to start all over again. And, so that's one of the challenges is not always having the resources that you need. But for the most part, we've been a little resourceful, you can scale back to some extent instead of having 10 lines, maybe you have five or three or two. And also, of course like I said, having the support, and having barriers. And it's not always that easy, especially, I know, as a female sometimes, and it's better now than it used to be I must say. But it's had its' challenges. But it's better than it used to be, but it still isn't where it should be.

FC: When you began, I think you mentioned it earlier, you were one of the first females in the field?

SS: Yes, that's right, I was one of the first.

FC: And possibly the first African-American female.

SS: Yes, that's true too, and it's been hard, at different times. Overall, it hasn't been hard enough for me to say, "Oh I'm quitting," or, "I'm going away", or something. And you can probably tell that I've enjoyed it enough and it hasn't been overwhelming enough that I'm ready to leave or anything, of course you never know. But it hasn't always been easy, I'll just say that, and there's still challenges. Still challenges, I won't go into those challenges. I'll just leave it there.

FC: And what do you see as your most important contributions in the field?

SS: Well, I think I've kind of said that one is the development of this Milford Line with the striped shell animals, and that's a fairly…it's not something that I discovered, per se, because people talk about seeing these animals, but I think we're one of the first ones to say, "let's systematically see if we can produce these animals and sustain that marker from one generation to the next." I think that's an important contribution as far as I'm concerned. I think being able to see the cells of the larvae using the cytogenetic technique. That's a major contribution. And I think, one of the things that I did early on was look at inbreeding in oysters, and found out that there was a fairly high frequency of inbreeding depression early on, like if you mated full sibs across full sibs, that was inbreeding depression, even in that first generation, and that was manifested by the larvae being smaller, higher mortality, and even in terms of the fertilization at that early stage, that you can see sometimes the sperm was not fertilizing the egg. So to me, I think that was a significant contribution. So those are just a few. I mean, I could look and see if there are more. And then even with the study that I bring up about the hard clam reproductive

success, and seeing that correlation with the early stage when the egg is first fertilized, and then subsequently seeing that same group showing in effect in that the larvae were dead.

FC: What do you enjoy most about the work if you had to describe it that way?

SS: Well, what I think what I enjoy most is kind of the mystery of it, being a detective, and also there's that nurturing part of me wanting to see these animals grow and thrive and survive. But I think it's mostly the mystery that fuels that passion, as well as sharing, as I said, with others. So you asked of one and the most, but all of these are very important.

FC: It's interesting because people in your field at your level of experience, to me, you have this insight into a world that most of us don't know much about or don't understand. So it's kind of an interesting thing.

SS: Well, to that I say, then I think we need to do a better job because I find it exciting. I've been told that people can tell that I like what I'm doing, and that's one of the things that I think we can do, better marketing, or sharing what we know and taking the mystery out of it, and that's why a lot of times if you've noticed examples that I give, I try to give examples that are relevant to a person who maybe doesn't appreciate that…well, that this is what it takes to get to this point. But, when I told the young lady who said, "I wanted to be a judge or a lawyer" and I said "but suppose you have a case that involves DNA." And it isn't just about whether scallops have striped shells, it's also about what does the DNA tell you. We all have it. It serves a purpose. We can use it for good primarily, or in other cases where they've experimented with humans, for bad. But for the most part, it's for good. And you just have to stay in there long enough to see, kind of the fruits of your labor. But I think we could do a better job sometimes of taking the mystery out of it. We don't always understand it, everything ourselves, so we're still working on it, and some of the things that people say were gospel and this is it, and then later on they find out, well, no. I think it was a few years ago they talked about cold fusion or something and it turned out, well they couldn't repeat it. Part of what science is about also is being able to repeat it, and one of the things you asked what I was most proud of, what of the things I'm proud about in terms of that line. Now even though that's something, the striped scallops were already in nature, but the fact that you could increase that frequency by breeding them, so that was a genetic characteristic, and see that that's what happened, and then to have one of your colleagues in New York, I think he sent an email, he asked "well, how do you do this and so forth", and then to see something that he wrote later on when he gave us credit for saying that they used that and saw an increase. I mean it's not just about what we do, but how we share the information and how it's used. But we still could do a better job of marketing. And even though sometimes it's been a little difficult when you're doing outreach and you have different audiences, but you think about it, for example, like I said the kindergartener and you know, you show them the animals, and even though they might not fully understand all about it, they know what they see, and each group that comes through I say, "Well, why are these important?" Because I like to make it interactive, and they say, "because we eat them!" And I say "Yes!" So I think there's a way that you can market things and share your enthusiasm and explain things no matter what the age group is, and just showing the animals. And for example, the spider crab, it looks like a spider, so a lot of times I don't say what it is, I like to have some interaction, I say, "well, what does that look like to you?"

"Oh!" So I think there are ways that we can do things and maybe do it a little better in terms of explaining science and sharing what we know, and like I said, I'll say to the students and they hear a lot about DNA, and I'll show them the instruments that we have, and we have just a very basic molecular biology lab, and I said, "This is the one, if you watch CSI where they say, 'Oh yeah I need to replicate this DNA because there's just a little bit at the scene of the crime." But they hear it every day. I mean there are a couple of things that have happened recently and a lot of times all the evidence they have is DNA.

FC: So that's something they can relate to.

SS: They can relate to it, every day. If there's, unfortunately it's usually with a crime that's been committed, and they say they're going to check the DNA, it used to be just the fingerprints. So in a way, DNA that's what you're talking about the fingerprints. So I think if you try and relate things to people, the mystery is kind of taken out of it, and that helps, and just like I was telling you about the polyploids where that doesn't really mean anything. But if you say seedless grapes, they're extra-large. Strawberries, they're extra large, seedless, but they're not marketed as polyploid, they're marketed as seedless. So you find a seed occasionally don't you, yes.

FC: That's interesting. Well, is there anything else that you'd like to add or anything that we didn't talk about that we should have talked about?

SS: Well, I think in one way or another, I probably talked about everything whether you asked me or not.

FC: We covered some good ground so that's good.

SS: Basically I think that you can see that I really enjoy the work. But there have been some challenges as I've said, but that's for another story, maybe I'll write a book. I don't know if there's anything that wasn't covered, that I didn't cover. I think I've gone through most of my life experiences. The discoveries and contributions, educational background.

FC: Your key projects and research interests and stuff. Well, that's good.

SS: I don't know if there's anything else. Can I call you if I need to add anything? Is that alright? And I don't know if you want me to show you some examples.

FC: Sure! Yeah!