

TRANSCRIPT

INTERVIEWEE: G.P. Schmahl

INTERVIEWER: David Todd

DATE: April 22, 2024

LOCATION: Galveston, Texas

SOURCE MEDIA: M4A, MP3 audio files

TRANSCRIPTION: Trint, David Todd

REEL: 4202

FILE: FlowerGardensReef_Schmahl_GP_GalvestonTX_22April2024_Reel4202.mp3

David Todd [00:00:02] Okay. Well. Good morning. I'm David Todd, and I have the wonderful privilege of being here with G.P. Schmahl. And with his permission, we plan on recording this interview for research and educational work on behalf of a non-profit group called the Conservation History Association of Texas, and for a book and a website that are under preparation for Texas A&M University Press, and finally, for an archive at the Briscoe Center for American History, which is at the University of Texas at Austin.

David Todd [00:00:34] And I want to stress that he would have all rights to use the recording as he sees fit. And, before we got any further, I wanted to make sure that's okay, with Mr. Schmahl.

G.P. Schmahl [00:00:45] Yes, that's fine with me. Okay. Well, great. Let's get started then.

David Todd [00:00:49] It is Monday, April 22nd, 2024, Earth Day. Very appropriate. It's about 10:10, I guess, Central Time. My name is David Todd, as I said, and I am representing the Conservation History Association of Texas. I am in Austin.

David Todd [00:01:08] We are conducting a remote interview with, G.P. Schmahl, who is based in the Galveston, Texas area. Mr. Schmahl has been at the National Oceanic and Atmospheric Administration, in various capacities, working at National Marine Sanctuaries since 1991. He served as manager at Looe Key National Marine Sanctuary, then as Lower Keys regional manager for the Florida Keys National Marine Sanctuary System. And then, beginning in 1999, worked as superintendent at the Flower Gardens National Marine Sanctuary. Also since 2010, he's served as a member of the Coral Scientific and Statistical Committee for the Gulf of Mexico Fishery Management Council. And he has written and published widely about coral reef research and conservation.

David Todd [00:02:00] Today we will be talking about Mr. Schmahl's life and career to date, and focus on what he can tell us about the Flower Gardens and associated reefs.

David Todd [00:02:10] So, with that introduction, I first wanted to say thank you. And, and then second, ask you a first question. And that would be about your childhood and early years. And I was wondering if you could point to any people or events in your early days that might have gotten you interested in animals, oceans, research and so on.

G.P. Schmahl [00:02:35] Okay. thank you, David. Appreciate it.

G.P. Schmahl [00:02:38] And, yeah, my name is G.P. Schmahl. My full name is George Palmer Schmahl, but I go by my initials and have for most of most of my life.

G.P. Schmahl [00:02:50] So, I, you know, I was actually born in Panama. My father worked for Pan American World Airways, which was one of the major airlines back in the day and stationed in Central America at the time. Pan American also ended up having contracts with what came to be NASA. And my father was transferred up to the Cape Canaveral area and worked on the space program, from some of the very early days. And so we moved to Cocoa, Florida, which is right near Cape Canaveral, Cape Kennedy now, about late 1950s, actually. And so that's where I grew up, right across the bridge from Cocoa Beach, which people are probably more familiar with.

G.P. Schmahl [00:03:46] And so that's where I spent most of my childhood and early days through high school and, you know, living close to the ocean. I lived right on the Indian River lagoon. And spent many, many days, in my younger days, you know, kind of just playing around and on the, on or around the lagoon and fishing and boating and things of that nature.

G.P. Schmahl [00:04:22] So, I think from very early times, you know, I was sort of involved with marine-type things and had an interest. I think just, I think, as most kids do, about things that they see and are around them. I think, I know my parents kind of instilled a curiosity about the world. And so, I think even as a young kid, I was interested in knowing the names of different things that I would find, you know, on or around the beach and the lagoon.

G.P. Schmahl [00:05:01] I think that's probably where my interest started. And of course, you know, as I grew up, I spent more time on the ocean. And, this is, you know, getting into the 1960s or so, and surfing became a thing. Cocoa Beach was a surfing area in the early days of surfing. And so, as a kid, I was into that too. So, I spent a lot of time on the beach, around the beach, on the water.

G.P. Schmahl [00:05:33] So. I have to say, you know, one of the things that really kind of instilled some of the interest in nature ... my dad wasn't a really big outdoorsman, type of person. We didn't go as a family, do much camping and that kind of thing. His idea of being outside was playing golf, and that's a cool thing, but, I never was very good at golf. I'm still not.

G.P. Schmahl [00:06:08] But I did, I was in Boy Scouts, and I do have to attribute a lot of the things that I would get interested in because of that experience. That's where I did go do a lot of camping, a lot of being exposed to a lot of nature-oriented things. My scout leader was a really interesting guy. He was from West Virginia, and he was, I mean, a true, proud hillbilly, you know, and he could do anything in the woods, you know? And that's where I learned, you know, start a fire without matches.

G.P. Schmahl [00:06:39] And he'd always have a slingshot with him, and he would shoot birds and squirrels and stuff, and we would pick them up and that kind of thing, you know? And I mention that, because that, the Boy Scout thing actually plays into, to later, something comes up later in my career. But I think that's what kind of started.

G.P. Schmahl [00:07:05] That was also, I think, the sign of the other times, you know, that, again, like I say, you know, this is now in the kind of the late '60s, you know, the Ocean World of Jacques Cousteau was a big thing at that time, you know, and the TV shows that would come on that he sponsored. And, you know, exploration of the oceans and the marine environment was something that caught many people's attention at that time.

G.P. Schmahl [00:07:31] You know, there was a popular TV show called Sea Hunt. And, you know, because of that, I wanted to SCUBA dive, you know, I wanted to be like Mike Nelson on

Sea Hunt. And, I was actually able to do that through Boy Scouts. I was certified as a SCUBA diver quite early on, I think I was 16 or something like that, through an Explorer Scout program. And that was something that I was very, you know, enthusiastic about and kind of shaped my life in many ways ever since that time.

G.P. Schmahl [00:08:22] Also I mention that, you know, again, at that time, you know, just the issues related to the environment were top on the minds of a lot of people. You know, this being Earth Day, I thought back - I remember the first Earth Day. I was in high school at the time, and that was kind of a reaction, as I recall, you know, from many things that were happening at the time - the Santa Barbara oil spill, you know, and in the late 1960s, when I remember when the Cuyahoga River caught on fire in Ohio, you know, and those things I think that really brought to the forefront the status of the environment, and ended up in the creation of many laws that we still have today - the Endangered Species Act, the Marine Mammal Protection Act.

G.P. Schmahl [00:09:09] All that kind of happened in the in the early '70s when I was just kind of coming of age, graduating from high school, going into college, you know. And so it was, I wanted to be like, and so I was interested in marine biology, and I have to say that the surfing thing kind of happened, too. I remember there was this guy - he was a big wave surfer. His name was Ricky Grigg. And he was in Hawaii. But he also happened to be, even though he was a world champion surfer, he was also in graduate school at the time in oceanography. And, I thought that was just the coolest thing.

G.P. Schmahl [00:09:49] And so a lot of people asked me, you know, if I wanted to be like Jacques Cousteau, and I did, of course. Everybody wanted to be like Jacques Cousteau. But I really wanted to be like Ricky Grigg, you know? I wanted to be the surfer that studied oceanography. But it didn't work out that way. But those are, I think, some of the influences I had, you know, in those times. Again, it was kind of a sign of the times.

G.P. Schmahl [00:10:11] I will say that I remember my high school counselor at the time when I was graduating, and I told him I wanted to go in marine biology, and he basically said, "Don't do that. Everybody wants to go into marine biology", because that was, you know, that was the thing then, "and you'll never get a job. It's just too crowded of a field." So, I guess I'm not saying don't listen to your high school counselor, but, in my case, I didn't let that deter me, I was still interested in doing that.

G.P. Schmahl [00:10:45] And I pursued that when I went to college. I went to Florida State University in Tallahassee and did study biological sciences. And there were some professors there at the time that were in the marine biology field that were influential for me at the time. Florida State, had and still has, a marine lab on the coast south of Tallahassee, in a beautiful area that's still kind of relatively undeveloped, area of Florida, still to this day. The address was in Sopchoppy, which is an interesting name.

G.P. Schmahl [00:11:36] And I spent a couple of, I spent a semester down at the marine lab, you know, doing field work and studying the environments in north Florida, you know, coastal marshes primarily and some, a little bit of offshore things.

G.P. Schmahl [00:11:54] And I did graduate at Florida State University with a degree in biology or biological sciences.

G.P. Schmahl [00:12:03] You know, I also say at the time, you know, that was going on, the field of ecology was developing. And most people have an idea of ecology as being more of a, you know, natural resource kind of thing, studying how things, how animals, you know, interact with each other. But I remember when I took ecology at Florida State, the professor, his name was Daniel Simberloff, said, "If you don't know calculus, you're going to flunk this course", which, kind of surprised me. But, really, ecology, you know, at the time was trying to make, you know, a very precise science out of what was, I think, I think most people thought of as kind of a more touchy-feely kind of area of interest.

[00:12:51] And that was that was really eye-opening to me. And we studied a lot of population dynamics, statistics, you know, looking at why animals are where they are, how they compete for resources, how population trends happen, related to a variety of environmental factors, how they are associated with environmental factors and food webs and all those kinds of things.

G.P. Schmahl [00:13:23] Right about the time where I graduated, there was a program going on, sponsored by the state university system, Institute of Oceanography, about scientific diving techniques. And it was called "Scientist in the Sea", or SITS, and that was run out of the Florida State University Marine Lab and I participated in that program in 1976.

G.P. Schmahl [00:13:56] And it was an incredible program. You know, I guess, excuse the pun, it was an in-depth program related to diving, and as it relates to scientific activities. And we learned all sorts of things just in basic, you know, diving protocols, but also, you know, using mixed gas in diving, surface-supplied diving, underwater navigation and the types of things that you need to know if doing field work in the underwater world.

G.P. Schmahl [00:14:33] And it included some incredible field trips. We lived on an old Navy platform off of Panama City for a couple of weeks and drove off of that platform during that period. And we also used the Florida State research vessel, the R/V , which is really a reconverted shrimp boat, to take a trip down to the Florida Keys from the upper Gulf Coast. First time I ever got seasick, and horribly so.

G.P. Schmahl [00:15:18] But the projects that we did down in the Florida Keys were really, were also quite, eye-opening and inspirational. We met up with some folks, both from the state of Florida and from the National Park Service that were specifically studying spiny lobsters down there. And we assisted and participated in some spiny lobster research that was going on, and got to dive on some of the reefs in the Florida Keys during that time period.

G.P. Schmahl [00:15:53] And I forgot to mention, you know, earlier on, when I did get certified for diving, one of the dives that we did, you know, we went down to the Florida Keys from where I was in Cocoa, Florida. And so my first actual dive on a coral reef was at Alligator Reef off of Islamorada in the Florida Keys. And that was probably in 1969.

G.P. Schmahl [00:16:19] And at that time, I didn't, I wasn't really aware of what everything was, but just the overwhelming feeling, you know, of being on a coral reef and the diversity of fish and other animals and the colors and the clear water and everything was just mind-blowing. And that stuck with me, of course.

G.P. Schmahl [00:16:50] So, that scientific diving course that I took through the Florida State University and the state university system was instrumental in getting me started really on

my career. Shortly after that program ended, I was then looking, had graduated, and was looking for a real job.

G.P. Schmahl [00:17:08] And my high school guidance counselor was right. There weren't a lot of jobs available. So, I was, kind of casting around for a little while, but then, the National Park Service, they had just developed a research program in South Florida, and started a South Florida research center based out of Everglades National Park, to service the national parks and areas in South Florida, including the Biscayne National Park, which was Biscayne National Monument at the time, Dry Tortugas National Park, which was Fort Jefferson National Monument at the time, and Big Cypress National Reserve and other places.

G.P. Schmahl [00:17:47] And so I applied for a job there and luckily I got a job with the scientist there. His name was Gary Davis. And he went on to be a very prominent person in the National Park Service and the Department of Interior. And he was their kind of go-to guy for marine protected areas, and looking at, you know, the viability and the impact of establishing no-take zones in areas and that kind of thing.

G.P. Schmahl [00:18:23] But at the time, he was a research scientist studying spiny lobsters. And so that's the job that I was hired to do. That really kind of started me off, and I kind of circle back to to the Boy Scout thing for a minute because he told me once that, you know, there's a lot of people that applied for those jobs, including people, some people, that already had their master's degree. And I didn't at that time. And he told me later, the reason he hired me was because I had put on my application that I was an Eagle Scout, and he was an Eagle Scout and involved with Boy Scouts and stuff like that.

G.P. Schmahl [00:19:00] And so, I just mention that because you never know what, when those types of things will come back to benefit you, your life and your career. And so that's where I started. You know, I started, this is like 1977 or so. And, I worked on spiny lobsters and some other projects down there. And the spiny lobster project was primarily out of Biscayne, southern Biscayne Bay.

G.P. Schmahl [00:19:32] And they were also, at that time, starting up a coral reef monitoring project at Biscayne National Monument. And, I was really interested in that, and was able to move over and take one of the positions that was involved with establishing this coral reef monitoring program, in there. For those who aren't familiar with Biscayne National Monument, which is now Biscayne National Park, it's actually a northernmost extension of the Florida Keys, even though people don't think of it as part of Florida Keys.

G.P. Schmahl [00:20:08] There's several other islands in the Florida Keys chain north of Key Largo, including Elliott Key, which is the major island in Biscayne National Park. And there's literally thousands of coral patch reefs off of Elliott Key, including some of the barrier reefs in deeper water off of there.

G.P. Schmahl [00:20:30] And so, there was a project there and it was interesting. It was designed to try to look at the impact of visitor use on coral reefs. And the study design was that, we placed mooring buoys on four of those four patches. And we also selected a very similar reefs for each of those reefs, that we did not put a mooring buoy on.

G.P. Schmahl [00:20:58] And the idea being that the mooring buoy would attract people, in addition to the fact that it, you know, helps people so they don't have to anchor on coral reefs

and protects corals that way. It does sort of draw people to those areas, too, because it's more convenient to go there.

G.P. Schmahl [00:21:15] And then we just did a variety of surveys to look at, well, you know, coral, of course, fish, and all of the other reef organisms, or many of the other reef organisms that are associated with coral reefs. And I was involved with that project through about 1983, 1984 or so, when that kind of wound down. And I did a lot of fish counts.

G.P. Schmahl [00:21:52] I worked with a couple of colleagues. One was a really great guy named Walter Jaap, J-A-A-P. He was with the Florida Department of Natural Resources at the time, and he was a coral expert. And, his colleague, Jennifer Wheaton, was a soft coral expert. Soft corals are those kind of sea whips, sea fans. Also, their scientific categories are octocorals or gorgonians.

G.P. Schmahl [00:22:26] And then I got kind of charged with looking at the other major benthic invertebrates. So, if you can imagine, you know, we basically, pretty simple stuff, you know, you go down there, and you have a square meter, just made out of PVC, you know, and a meter, of course, is about a yard. So, it's three feet on the side. And you placed that. We'd lay out a transect. We'd place those square meters down. And then basically count and categorize everything that we could inside of those square meter quadrats and those different transects.

G.P. Schmahl [00:23:06] And, you know, you'd average out and basically to see what's going on.

G.P. Schmahl [00:23:10] So, that was a tall order about everything else. Because even though coral and octocorals are the primary things that people think about at coral reefs, there's hundreds of and thousands of other types of species that occur on coral reefs and the big one were sponges and they, the sponges take up a lot of the benthic community on the space on a coral reef.

G.P. Schmahl [00:23:36] And, at that time, anyway, there were no field guides for sponges. There are now, luckily. That's a good thing. But, so it was kind of my job to try to figure out what these things are.

G.P. Schmahl [00:23:52] And for sponges, it's sometimes, it's pretty straightforward. A lot of times it's not. And they're categorized by what's known as the types of the building blocks of the skeletons that make up the sponge. And they're called spicules. And these spicules have really interesting shapes. And it turns out that those shapes of the spicules are very distinguishing to the type of species that they are associated with.

G.P. Schmahl [00:24:22] So, but that means you have to tease out these spicules and look at them under a microscope in order to do that.

G.P. Schmahl [00:24:29] So, it's not... Coral reef research's not all just fun and games, not just out there, swimming around and diving and stuff. There is a lot of laboratory work and trying to figure out what these organisms were, including visits to many of the research libraries, you know, in the country to compare them against the collections that they had, and that kind of thing.

G.P. Schmahl [00:24:56] So, it was really interesting. And I got, because of that, I got very interested in sponges. And then, after some time, I actually became pretty proficient, at least,

at the time, about sponge identification and became like a quasi-expert, at least in some of the types of sponges associated with shallow water coral reefs of Florida and the Caribbean.

G.P. Schmahl [00:25:23] And so, that was that was just great experience. And that's what I, and working for the Park Service, I also really liked being associated with the Park Service, being associated with a protected area.

G.P. Schmahl [00:25:39] And, at that time, and still, you know, there's many issues related to protection and what kind of balance that you can have between protection of resources, and at the same time, allowing access for people, because of course, that's part of the purpose of the park as well. You know, it's there for people to come in to enjoy it. And it includes, you know, fishing and taking things, you know.

G.P. Schmahl [00:26:07] And at that time, the way Biscayne National Monument was set up, there was an agreement. They were going to allow for fishing to continue, as long as, unless it could be shown that it was having a detrimental impact on the fish populations. And so that's part of the study that we were doing, you know, was going to those kinds of questions. So, it wasn't just pure research, but it was research associated with resource management questions and issues that were going on.

G.P. Schmahl [00:26:46] I don't know. You can stop me at any time if you want to, you know, clarify or ask questions, but otherwise I'll just keep going.

David Todd [00:26:54] This is very helpful. I think that there may be a couple of questions I might want to ask. Just, it sounds like you were sort of an autodidact in your very early days. Your father enjoyed the outdoors as a golfer. But, it sounds like some of these explorations of the area where you're growing up near Cape Canaveral, were on your own. Is that fair to say? Or did you have any mentors or companions in these explorations of the aquatic world?

G.P. Schmahl [00:27:35] Well, yeah. I think companions more than mentors, at least at that time. You know, a few of my friends were really into the outdoors, you know, and so together, you know, we'd go fishing and go camping. And one in particular, you know, got me interested in and let me know about this SCUBA diving opportunity, you know, the training for SCUBA diving was available, because at the time, it was the hippie days. You know, being a Boy Scout was not cool. But I stayed around doing Scouts, primarily so I could learn how to SCUBA dive.

G.P. Schmahl [00:28:21] So that was, those are those kind of things.

G.P. Schmahl [00:28:24] And I and I will say that I had and I don't remember her name. This is embarrassing. I need to look it up. But I did have a marine science teacher in high school who was influential to me as well. And, you know, she was just so enthusiastic about it. We had a lot of aquaria, tanks, you know, in our classroom where we would bring in stuff that we found at the beach or, whatever, you know, keep them for a while in tanks and stuff...

G.P. Schmahl [00:28:50] Including, I found a, before the Endangered Species Act, I found a loggerhead sea turtle baby. You know, it looked like it wasn't going to make it, you know, on the beach, because there is nesting of loggerheads in that area of Florida. Brought him back to the classroom and let him, you know, kind of recover a little bit. And then took him back out to release him in the wild, that kind of thing.

G.P. Schmahl [00:29:12] She was ... So, yes, you know, there's some teachers, you know, throughout. I think that's true for most people that have those people in their lives that really influence them.

David Todd [00:29:26] Okay.

David Todd [00:29:28] Also, I think, we often try to ask people about media influences - books, TV shows, movies and so on. I think you mentioned Jacques Cousteau and the Undersea World and his program and also Sea Hunt, Lloyd Bridges and, I was curious if there are any other programs or possibly books, magazines that you might have enjoyed looking at when you were a young person.

G.P. Schmahl [00:29:59] Well, you know, both my parents were avid readers. We'd get, you know, I think we had the whole, in addition to the TV shows, I think we had the whole ... there's a set of Jacques Cousteau books, you know, the Undersea World of Jacques Cousteau, you know, multiple volumes that we had. And they had a subscription to National Geographic, of course, you know, and those magazines were something that I would really enjoy, you know, I suppose.

G.P. Schmahl [00:30:26] And I do remember books that my parents would get me, you know - Monsters of the Deep. I remember one of them. You know, it was about these deep sea animals, you know, that are just totally bizarre. I can still remember the pages of those books like that.

G.P. Schmahl [00:30:49] So, yeah, I think my parents definitely instilled about just reading and science in general. My dad, you know, was a scientist of sort, not a marine scientist.

David Todd [00:31:07] Okay. Well, good.

David Todd [00:31:12] Well, I think the thing I'd like to explore with you is, the Flower Gardens next. I think you've given us a little bit of your background and it's fascinating. And I think that there are lots of channels from your early experience, education and early career that definitely will feed into the Flower Gardens work that you did. And I think we'll probably return to some of these experiences in Florida because it seems very relevant and useful.

David Todd [00:31:45] But maybe I could just ask you to help introduce us to the Flower Gardens a little bit. I thought it was really interesting that the unusual geographic and geological background to the Flower Gardens area. And I know that you've done some studies of how biodiversity is kind of associated with topographic features, and I thought maybe you could introduce us why is the Flower Gardens there? What's the geological story behind that?

G.P. Schmahl [00:32:24] Yeah. Well, I think I will circle back to some of the other stuff in Florida because obviously the experience that I had after college, you know, and getting a job down in the Florida Keys, and then ending up at the Florida Keys National Marine Sanctuary is what allowed me to, you know, to move into the position at the Flower Garden Banks.

G.P. Schmahl [00:32:46] But it is a pretty unique situation because you don't think of the area where the Flower Garden Banks are as being a place where you would find, typically find, coral reefs.

G.P. Schmahl [00:33:05] You know, first of all, you know, coral reefs are tropical ecosystems. And if you look at the band of, you know, latitudes around the globe, most coral reefs are associated within a band around the equator that goes up to about 24 degrees latitude, something like that. And, the Flower Gardens are up, you know, at 27, 28 degrees latitude. So, quite a bit more north than typical coral reefs.

G.P. Schmahl [00:33:36] It's in the Gulf of Mexico, which I think most people don't realize, you know, the physical conditions of the Gulf of Mexico, especially in the offshore environments, because they're probably mostly used to seeing the Gulf of Mexico from the shoreline, you know. And in Texas, if you go to the shore in Galveston, or most places on the Texas coast, you know, the water does not look like the type of water that would be where coral reefs could grow. It's typically kind of muddy, you know, because it is subject to a lot of runoff from rivers and things.

G.P. Schmahl [00:34:15] And it gets cold in the winter, you know, and, so the water is pretty chilly, you know, colder than coral reefs would grow in. And so they don't really think about that as a coral reef environment.

G.P. Schmahl [00:34:32] But as a lot of fishermen know, and oil and gas folks know, if you start going offshore in the northern Gulf of Mexico and you get 20 miles offshore, the water starts to clear up really, really much. And then once you get out to 100 miles offshore, where the Flower Garden Banks are, it's crystal blue. It's like, it's Caribbean blue. It's clear, warm water. And, you know, typical visibility at the Flower Garden Banks can be up to 100 feet. You know, 100 feet underwater is a long way.

G.P. Schmahl [00:35:10] And that's because of kind of a unique situation that happens, kind of from the oceanographic point of view, in the Gulf of Mexico as you have, if you back up and look at the Caribbean at large, there's a major water current that comes up from South America and goes all the way up, you know, through the coast of North America and spins off towards Europe, you know, known as the Gulf Stream. And, you know, Benjamin Franklin studied that way back in the day.

G.P. Schmahl [00:35:46] And so, it's this water, this mass is bringing up that warm equatorial waters up into the northern climates of the Americas, of the Caribbean and the Americas. And, comes up and goes along the edge of the eastern side of Florida and on up. But it also, part of that current, also takes a detour up into the Gulf of Mexico, and it's known as the Loop current. And so it comes up by Cuba and then part of the Gulf Stream branches off, comes up into the Gulf of Mexico, and then curves around and then back down, joins up with the main part of the Gulf Stream, right off the south coast of Florida.

G.P. Schmahl [00:36:32] And it's this loop current, it's this warm, clear water coming up as part of the Gulf Stream that comes up into the Gulf of Mexico. And that is the reason why there's warm, clear water in the area that allows coral reefs to develop, even in the northern parts of the Gulf of Mexico, as long as you don't get too close to the shoreline.

G.P. Schmahl [00:36:54] And so that's the, you know, the biggest environmental factor you need warm, clear water.

G.P. Schmahl [00:37:01] You also need the animals. Right? And in the ocean environment, most animals reproduce by putting out their gametes or eggs into the water column and those larvae travel around on the currents and then settle out in some place. And if the environment

is right, they can settle out and keep growing. So you got the warm, clear water. That's one factor.

G.P. Schmahl [00:37:31] But the other factor is that you need somewhere to settle. You need something to settle on. And that's where the kind of the geology comes in for the Flower Garden Banks. Because what you have is right along the edge of the continental shelf, the edge of the continental shelf in the Gulf of Mexico, you have a whole series of these, I'll call them, "mini seamounts". True seamounts have a specific definition that doesn't apply here. But they're small underwater mountains that kind of stick up around the surrounding seafloor, because most of the Gulf of Mexico in the northern part is not hard bottom. It's mostly soft sediment, sand and mud. And so, it's not that common that you would have an exposed rock surface and corals. And other core vertebrates need hard substrate in order to settle on.

G.P. Schmahl [00:38:27] And so, you have these little mini mountains that have these exposed rock features sticking up. And we've called them over the years, called them "topographic features" because scientists who mapped the seafloor, they go along and if they see some kind of irregularity on the sea floor, they'll categorize it in different ways. And like I said, it wasn't big enough to be called a seamount. But, it was obviously something that was quite prominent around the surrounding seafloor and created these smaller seamounts.

G.P. Schmahl [00:39:08] And it turns out the reason those are there is because of underlying geology. They are associated with what's known as "salt domes". And, these go back millions of years, you know, back when the Gulf of Mexico was a much different place. North America was just kind of being created and as that was happening, the Gulf of Mexico was kind of a shallow bay. There with a lot of evaporation. And there were these accumulations of large amount of salt.

G.P. Schmahl [00:39:47] And then, as time went on, all of this sediment came off of the continent of North America that overlaid these pockets of salt with literally thousands of feet of mud and sand and other soft sediments. Now, over time, geological time, millions of years, hundreds of thousands of years, salt, in the marine environment, you know, is more buoyant than the surrounding sediments. And so. It actually wanted to move up, you know, so it was actually moving up slowly through the surrounding, sediment layers, forcing up rocks and other things that were on top of it into these topographic features along the edge of the continental shelf.

G.P. Schmahl [00:40:38] And so, you'll hear, that the Flower Garden Banks are associated with salt domes. But, you also have to recognize that the salt is not like exposed salt. The salt is usually quite far, deep beneath the expressions on the seafloor, with some exceptions, which are really cool too. But, it's really the exposed hard bottom, the exposed rocks, that is crucial in the ability of coral reefs to develop and other types of communities, I mean, biological communities develop.

G.P. Schmahl [00:41:19] So, the Flower Garden Banks in this case, you know, were underneath some specific salt domes that pushed them up to quite, quite prominently. So, they were fairly close to the sea surface, so that's the other part of requirement for a coral reef is there has to be plenty of light. And in the case of the Flower Garden Banks, these salt dome features rise up to within about 60 feet of the surface of the ocean.

G.P. Schmahl [00:41:51] And because the water is so clear, that's still shallow enough that there's plenty of light penetration.

G.P. Schmahl [00:41:56] And so you have, corals, as I think many people know, are one of those organisms that exist in symbiosis or in cooperation with a type of algae called "zooxanthellae", that live within the tissues of the coral animals. And there's a process that goes on that they benefit, you know, this is a symbiosis that is mutually beneficial, both to the coral and to the algae.

G.P. Schmahl [00:42:29] Coral provides protection to the algae, and things can't eat it very easily and that kind of thing. And the algae provides nutrients, nutrition, to the coral. Of course, algae needs light and does that through photosynthesis. So, it's that very interesting combination of environmental factors - warm, clear water, the exposed hard substrate, and the ability, you know, being close enough to the surface to allow light penetration that has allowed coral reefs to develop at the Flower Garden Banks.

G.P. Schmahl [00:43:07] And so at some point, larvae from the Caribbean came up through the loop current and they were hardy enough to make that whole journey. And then found these exposed hard substrates, and were able to establish little baby corals. And those corals grew over the years, the hundreds and thousands of years, to create these magnificent coral features that we now can see at the Flower Garden Banks.

G.P. Schmahl [00:43:43] And, we're talking in a time range of about 7 to 10,000 years, where these coral reefs have developed the Flower Garden Banks. And again, you know, there's lots of geological changes going on over time. You know, back 10,000 years ago, the sea levels were quite a lot lower than they are now. And the area that is now the Flower Garden Banks would probably be either exposed as shoreline or, you know, kind of marshy areas. And so, it's only been in that last 10,000 years where the sea levels rose to the levels that they are now, that they turned into a totally marine environment, with coral reefs.

G.P. Schmahl [00:44:31] So that's, kind of how coral reefs got there.

David Todd [00:44:36] So that is a wonderful summary. Thank you so much. Very clear and concise about, you know, this weird sort of interaction of geology and water currents and temperatures and clarity of water and light penetration and then the larvae. That's fabulous. Thank you so much.

David Todd [00:44:56] So, I guess we've learned a lot about these coral reefs over the past 100 years or so, but I gather that that they were not always so well known. And I was hoping that you might be able to introduce us a little bit to some of the first reports of the Flower Gardens, which I guess were recorded by some fishermen and sport divers, and Woods Hole, I think was involved. You know this story much better than I, but I'd love to hear your view of it.

G.P. Schmahl [00:45:34] Yeah, it is really interesting because if you look at the history of scientific exploration at the Flower Garden Banks, it's quite recent, you know, and it wasn't really until the 1960s that it was finally sort of documented and determined that, yes, there was a living coral reef at the Flower Garden Banks.

G.P. Schmahl [00:45:59] You know, the first, I guess, exploration or discovery of the Flower Garden Banks is attributed to fishermen, probably people that were fishing for red snapper. You know, the red snapper fishery kind of started in the panhandle of Florida and off of the west coast of Florida and kind of branched out from there. And, you know, people were

looking for additional areas for that fishery throughout the late 1800s, early 1900s. And so, the first reports of these features were in the early 1900s, in the red snapper fishery, which referred to these areas as the Flower Gardens, because, the story has it, and I have to say that I've looked and looked and I can't find the actual, anything in writing that kind of documents this at the time, you know.

G.P. Schmahl [00:47:05] But this is the, there's more of a oral story that has come down, you know, and then documented later as the first researchers were trying to figure all this out. But, because of the clear water, they could look down and see the colors of the coral reef down there, and it looked like flowers, and that's why they call it the Flower Gardens.

G.P. Schmahl [00:47:28] Now, you have to also recognize that this is 100 miles offshore and at the time, being able to find a relatively small spot, offshore, 100 miles offshore, was quite difficult. There was no GPS, there was no navigation services at that time at all but usually line of sight or following compass headings and that kind of thing. And they're in sailing boats, you know, which makes it even more difficult.

G.P. Schmahl [00:47:54] So, I don't think it was heavily used as a fishery location, simply because of that, until later on when the navigation processes got better. But that was the first kind of reports. And then, also, then, in the early 1900s, more like the 1930s, when there was some extensive mapping going on all of the coastlines of the U.S., and other places, too. And then especially as interest started about oil and gas resources, which might be associated with the offshore features, there became some pretty extensive mapping of the area. And so, the first, real sort of, I guess, scientific documentation of these areas was around 1930, 1935, 1937, something like that.

G.P. Schmahl [00:49:03] And it was basically, you know, back in those days again, there wasn't the technology to map the sea floor like we can today with fancy fish-finder kind of technology. And so, there were literally lead, they were called lead lines. You know, they would drop a line with a lead weight on the end of it, and then it would hit the bottom and they'd say, "Okay, well, that's, you know, 43 meters", or whatever. And they'd make a note and then they'd go a little farther and they'd drop another line, you know. So, you can imagine how tedious that kind of research was, but it was crucial.

G.P. Schmahl [00:49:46] In that process, they found these features, these humps, you know, that were out there. The Flower Garden Banks were the most prominent of those. And some of the stuff that would come up on the weights that they'd lowered down were pieces of coral, typically, dead coral. And so, there's actually on the first nautical charts that show the Flower Garden Banks, there actually is a little notation, which is the abbreviation for coral, "CO". But that was based on, probably, dead coral skeletons that they'd picked up, you know, along the way. Didn't identify it as a living coral reef at the time. They thought it was an ancient coral reef, a geological feature.

G.P. Schmahl [00:50:39] And then over time, you know, just that intensity of research expanded. And by the early 1950s, at that point, there was strong interest in offshore oil and gas, in the northern Gulf of Mexico. And there were various other projects that went to map these features in more detail, one specifically by a researcher named, Stetson, after whom Stetson Bank is named that mapped these features in more detail.

G.P. Schmahl [00:51:27] And about that same time, there were some subsurface technology that was coming available to map what was underneath the seafloor. And that was the first

time that salt domes were kind of brought into the picture that might be associated with these features. And that's important for the oil and gas industry, because these salt domes are also very impermeable. And so they tend to trap hydrocarbons. And so, when you find salt domes, there's a high likelihood of also finding reservoirs of oil and gas resources as well. And so, they were specifically looking for salt dome-related features, not because they were interested in the coral reef necessarily, but they were interested in the hydrocarbon resources that might be associated with them.

G.P. Schmahl [00:52:22] So, I think, and I know I probably should be citing the actual references, but I don't have that stuff in front of me, so I probably will get it wrong. But, we can we can look that up.

G.P. Schmahl [00:52:31] But, as time went on, then around in the late 1950s, there's other indications that there was coral associated with these features. And there was actually a debate kind of going on in the scientific community of whether or not it could be a living coral reef. And, most people thought that it couldn't be, just exactly for the reasons that we talked about before, you know, that this is too far north, you know, the water gets too cold or, you know, it's not the right environment for coral reefs. And so, there was quite a bit of a debate that was going on.

G.P. Schmahl [00:53:12] Until a researcher, a scientist associated with the Houston Museum of Natural Science, named Thomas Pulley, who and again, this is early 1960s, I think it might be 1960, where he put together the first expedition using SCUBA, putting divers down on these features, really for the first time. And they documented and they were just amazed, you know. Yeah, they thought there might be some coral out there. They had no idea that it was, these coral heads that were these huge features that were as big as cars and larger, and all the other associated animals and associated with coral reefs.

G.P. Schmahl [00:54:01] And so it's really, in those expeditions in 1960 that were, and he actually finagled... There was a lot of Naval research going on at the same time. He actually finagled a Navy vessel to go out there. And they based their first expeditions off of a Navy vessel, using SCUBA diving. The U.S.S. Wren was one of those vessels (WREN spelled W-R-E-N).

G.P. Schmahl [00:54:35] And published, I think, in 1963, the first real account of the coral reefs associated with the Flower Garden Banks.

G.P. Schmahl [00:54:46] And like I say, and that's, you know, really pretty recent in terms of discovery of such an amazing ecosystem that we didn't even really know about until the 1960s.

G.P. Schmahl [00:55:04] And from there, at that time, the interest in offshore oil and gas was developing very rapidly. It started, of course, close to shore and was moving offshore. And exploration around the salt domes was of interest to the geologists and to the oil and gas industry scientists.

G.P. Schmahl [00:55:29] And there was a big study that was funded by the Bureau of Land Management - this is the BLM, which was the agency that was the precursor to the Minerals Management Service, that was the agency that kind of oversaw offshore oil and gas development in the early days. And they funded a very large project that was operated out of

Texas A&M University. And they called it the "Topographic Features Study". And it went on for a number of years.

G.P. Schmahl [00:56:03] This is now in the early 1970s and it went on through most of the 1970s and to not only explore the Flower Garden Banks, but, it turns out that the Flower Garden Banks, you know, are just two, the East and West Flower Garden Banks are just two of dozens of reefs and banks that occur right along the edge of the continental shelf.

G.P. Schmahl [00:56:26] And, you know, one of the primary people, involved in that study was doctor Tom Bright, at Texas A&M at the time, David McGrail, Richard Rezak, and others. You know, a large number of folks were involved in those studies in the early days. And those studies really categorized those reefs and banks and they did some very detailed studies of the East and West Flower Garden Banks and of Stetson Bank.

G.P. Schmahl [00:57:04] And we really owe a lot to those scientists, because still, in the 1970s, you know, the technology wasn't extremely well developed. And yet, you go back and read those studies. They were really precise, really good. And it's amazing that they were able to map these features in such detail, and get the information about these communities that are still, you know, state of the art today.

G.P. Schmahl [00:57:38] So, that's really kind of how the process went to identify the Flower Garden Banks and to provide information, detailed information, about those those areas.

David Todd [00:57:55] What about some of the amateur sport divers, and the Houston SCUBA Club and affiliates like that? Were they important in some of those early explorations of the Flower Gardens?

G.P. Schmahl [00:58:10] Well, they were. You know, in the very early days, the Tom Pulley expeditions in the 1960s, you can imagine in those days, this was very early in the SCUBA diving history. There weren't a lot of recreational divers at that time. There were some, but they were not ... those developed more in the late '60s, and into the '70s. But, even on those early expeditions, many of the participants were not paid scientists. They were volunteers. They were just recreational divers in the very early days of SCUBA diving.

G.P. Schmahl [00:58:51] And in fact, in the early days of underwater photography as well. I can imagine there were no underwater cameras at that time, and people would build their own underwater housings, you know, to put their cameras into, to try to document these areas.

G.P. Schmahl [00:59:06] And so, absolutely, I think from the very earliest days, especially as it related to SCUBA diving, recreational divers, volunteers, citizen scientists, we call them now, were involved. And as you got into the late '60s and into the early 1970s, they became more and more important. And the Flower Garden Banks was recognized as a wonderful place to SCUBA dive.

G.P. Schmahl [00:59:36] As you know, beyond the coral that occurs at the Flower Garden Banks, anytime you have a prominence that sticks out of the water like that, it's a place where fish and other animals like to visit and congregate. And it's a great place to see manta rays, sea turtles, sharks of all sorts, including whale sharks.

G.P. Schmahl [00:59:58] And so it became, early on, it became recognized as a destination for recreational SCUBA diving.

G.P. Schmahl [01:00:08] And at least by the 1970s, there was a large contingent of recreational SCUBA divers, you know, throughout the country. But Houston had a very active SCUBA diving community early, early on. And, the Houston Underwater Photographers Society and other groups based out of Houston were very active in helping to document the Flower Garden Banks. They became avid proponents of making sure that the Flower Garden Banks were protected.

G.P. Schmahl [01:00:44] And so, at this same time, you know, this is probably at the same time as those big studies were going on with Tom Bright. And, SCUBA interest was there. They were starting, some folks were starting to take charter trips of recreational divers out to the Flower Garden Banks.

G.P. Schmahl [01:01:00] And, but at the same time, there's also this specter of oil and gas development happening, potentially in very close proximity and maybe even on top of some of these features.

G.P. Schmahl [01:01:12] And so, folks, led by the SCUBA divers, primarily recreational SCUBA divers, became concerned about that. And wanting to make sure that we protected those areas, that these should not be areas that direct oil and gas development should occur and that kind of thing.

G.P. Schmahl [01:01:33] And so when the national sanctuary program started, and that was also in 1972, early on it was recognized, Okay, well, places like the Flower Garden Banks, you know, need to be a protected area under the National Marine Sanctuary program or by some other mechanism.

G.P. Schmahl [01:01:57] So, those folks were instrumental in nominating the Flower Garden Banks to become a National Marine Sanctuary. And that was, of course, that was a long process. But, if it wasn't for, I think, the interest of those folks, that probably wouldn't have happened - the Sanctuary designation wouldn't have happened.

G.P. Schmahl [01:02:24] So, so yes, the influence of the recreational diving community was crucial in the designation of the Sanctuary. And even before that, you know, to convince the Bureau of Land Management, which became the Minerals Management Service, to identify these areas as, essentially, as no-activity, they called them "no-activity zones", you know, and they drew lines around the Flower Garden Banks as well as some of the other reefs and banks to say, "Okay, oil and gas development can occur in these areas, but they can't occur, you know, on top, or right on top of these features."

David Todd [01:03:04] Okay, so this is great. I think you really set the stage for the awareness of the Flower Gardens and then I think you were edging in there to the protection of them as well. Now, I thought we might do a little return stitch to where we left off because you were talking about your career, which, you know, later coincides with managing the National Marine Sanctuary at the Flower Gardens. And so, I was hoping that that, you know, maybe you could return to your earlier career and how you first came to the Flower Gardens. I understand that you had earlier positions at other sanctuaries that sort of prepared you for that work, including the Looe Key site and then the Lower Keys. And I was hoping that maybe you could fill us in on that work and what you learned there.

G.P. Schmahl [01:04:07] Yes. All right. So, I'll get back up again a little bit and say, so, after my stint at the Biscayne National Park, you know, and that, I decided to go back to graduate school, which I did. I actually went to the University of Georgia, which sounds like an odd place to go for coral reef research, but there was actually a person there, his name was Jim Porter, who had helped establish some monitoring programs at Biscayne National Park, as well as a number areas throughout the Florida Keys. And I studied with him, and coming out of grad school, I actually took a job in the Florida Keys for the county down there in Monroe County in the planning and zoning department.

G.P. Schmahl [01:05:11] It's weird. This it's one of those kinds of jobs that's kind of a sidetrack, you know, because it was not a direct marine science job. It was working, you know, kind of doing the environmental permitting, you know, for the county - dredge and fill permits, dock permits, seawall permits, land clearing, things of that sort. I was the county biologist for the lower Florida Keys.

G.P. Schmahl [01:05:32] Mainly I took that job, too, because I love the Florida Keys. And it was enticing to be able to live down there and work down there.

G.P. Schmahl [01:05:43] But I mention this because I think, when I was hired for the job at Looe Key as the manager there, it wasn't just my experience as a biologist that got me that job. You know, there were a lot of marine biologists. But the fact that I had this other experience, you know, working for the county, and there was a process going on at the time where the State of Florida had a, it was called the Growth Management Act. They were worried about, too much development in sensitive areas, you know, throughout Florida and the Florida Keys in particular. And, there was a development of a management plan in the Florida Keys that would protect sensitive coastal and marine environments.

G.P. Schmahl [01:06:34] And it was quite controversial.

G.P. Schmahl [01:06:36] And, I got involved in that because I was working for the county and later for the State of Florida, working on these coastal management plans, developments of new regulations, new ways to make sure that these environments were protected.

G.P. Schmahl [01:06:59] And I'll tell you, some of the folks down there who were in the sort of the development community did not like that at all. And they didn't like me because I was the guy that was saying that they can't clear this land because it's a tropical hardwood hammock or whatever.

G.P. Schmahl [01:07:21] But, so I just mention that, like I say, because I think it was both, you know, the fact that I had the marine experience, but also this kind of coastal management, resource management experience that when in 1991, maybe right before that, the Florida Keys National Marine Sanctuary was designated. It was designated by Congressional action.

G.P. Schmahl [01:07:48] And what they did was they created this sanctuary, but they did not promulgate specific rules and regulations for it. So, it was just kind of governed by the overall Marine Sanctuaries Act, at the time, and the charge was to come up with a management plan that would guide what the National Marine Sanctuary would do.

G.P. Schmahl [01:08:14] In the meantime, there was two previous sanctuaries that were designated in the Florida Keys. One was the Key Largo National Marine Sanctuary, and it was

one of the first national marine sanctuaries to be designated. And then the other, was the Looe Key National Marine Sanctuary off of Big Pine Key in the Lower Florida Keys.

G.P. Schmahl [01:08:38] And the person who was the manager at Looe Key, they kind of promoted him to become the overall manager and to lead the development of the management plan process for the Florida Keys National Marine Sanctuary. His name is Billy Causey, a wonderful guy. And that left that job open. So, I applied for it and luckily was able to get that position as the manager off Looe Key. And Looe Key is a coral reef, off of the Lower Florida Keys.

G.P. Schmahl [01:09:13] In some ways, you know, it's about the same size as the East Flower Garden Bank. You know, it's a relatively small sanctuary.

G.P. Schmahl [01:09:22] But just to give you an idea of the difference in visitation. At that time, we estimated there was about 70,000, 70 to 90,000 people diving on Looe Key every year. Where at the Flower Garden Banks, there was about 1000 people diving on them. You know, so you can see the intensity of activity in the Florida Keys is much, much higher.

G.P. Schmahl [01:09:51] But anyway, long story short, you know, I was able to get that job as the manager of the Looe Key National Marine Sanctuary. You know, we had enforcement people that worked for us and education folks, and it exposed me to the national sanctuary program in general.

G.P. Schmahl [01:10:12] When the management plan for the Florida Keys National Marine Sanctuary became finalized, and that was in about 1996 or so, then the Looe Key and Key Largo sanctuaries got incorporated into the larger sanctuary. So, they kind of went away as separate entities. And that's why my sort of title and area of responsibility changed. I became the the Lower Keys regional manager, for the Florida Keys National Marine Sanctuary. And then there was Upper Keys regional manager and then Billy Causey, who was the overall superintendent of the Florida Keys.

G.P. Schmahl [01:10:54] And I'll say also that that development of the management plan for the Florida Keys National Marine Sanctuary was also quite controversial. And that's putting it mildly. People (I think this is true everywhere) but I think in the Florida Keys people were very wary of the federal government coming in and promulgating regulations. And there was a lot of concern that people who were involved with fishing and marine organism collection and all sorts of things were going to be negatively impacted by this.

G.P. Schmahl [01:11:33] And there was a big effort to, you know, keep the federal government out of the Florida Keys. There were big billboards that said, "Say No to NOAA", you know, and active groups that were very much opposed to the sanctuary. I would get approached in the grocery store and in other places, you know, by folks that would feel free to let me know their opinion about how they did not like NOAA or the sanctuary program, that kind of thing.

G.P. Schmahl [01:12:09] So, I'd just like to highlight the fact that these protected areas can be controversial. There was a famous meeting where some people were slicing people's tires, and they hung Billy Causey in effigy off the rear of a tree outside the Monroe County Commission officers. So, it was interesting times, very interesting. It's really interesting now because the people in the Florida Keys basically love the sanctuary, you know, and the people that were concerned about it, for the most part, have come around to see that it has not been

the thing that, you know, has put people out of business. It's actually, probably, promoted their businesses and the fact that protecting areas that they relied on for their livelihoods. And, I thought it was interesting to see that turn around.

G.P. Schmahl [01:13:13] But anyway, so all of that experience was kind of good. At the same time, in the Florida Keys, there were some troubling things that were happening. Coral diseases were becoming fairly common. And they go under various names. But there's a black band disease, white band disease, you know, that would affect, coral organisms.

G.P. Schmahl [01:13:52] The first coral bleaching was starting to occur. Well, coral bleaching has, you know, happened sporadically, in years, you know, going back to the 1980s. By the mid, late 1990s, we had some events that were very significant, where there was coral bleaching going on that resulted in pretty severe mortality.

G.P. Schmahl [01:14:19] There was vessel groundings: it was a big issue, you know, of large vessels' errors in navigation and running aground on coral reefs, which is absolutely devastating, of course, to those areas.

G.P. Schmahl [01:14:37] So, those were troubling signs. And that that, of course, has continued on to this day.

G.P. Schmahl [01:14:51] But I think about that time, you know, it was the position at the Flower Garden Banks, came available, and I forgot to mention this part, but I was actually a State of Florida employee when I worked for the sanctuary down in Florida. And I was interested in getting a federal position, primarily because I still had in the back of my mind, I wanted to work for the National Park Service because that's where I started, and that's where I thought that I would like to end up eventually.

G.P. Schmahl [01:15:27] And, then, of course, the Flower Garden Banks was just an incredibly interesting area. But I truly thought of it, at the beginning, as kind of maybe that would be a stepping stone where I could, you know, get this job and work for a while there and maybe move on to other locations.

G.P. Schmahl [01:15:47] But, I was able to, you know, I applied for the position, and I was hired as the Sanctuary Superintendent in 1999.

G.P. Schmahl [01:15:58] And, it was interesting, because at that point, I had never been to the Flower Garden Banks. I had heard of it, read about it, seen photos and things. And, the previous manager, Steve Gittings, had invited me up there to check it out, and I was always intending to, but I had never actually made it. So, I didn't really know what the Flower Garden Banks were like until I got here.

David Todd [01:16:29] Well, tell us about that first visit to the Flower Gardens. What was your initial impression?

G.P. Schmahl [01:16:37] My absolute first visit was actually to Stetson Bank. And there was a monitoring program that had been started by - we talked about recreational scuba divers - the Minerals Management Service had started a monitoring program for the East and West Flower Garden Banks pretty early on, I mean, in the late 1980s. But at Stetson Bank there wasn't a good monitoring program.

G.P. Schmahl [01:17:05] So, there was a group of recreational divers that kind of got together and formed a group called GREAT, which is Gulf Reef Environmental Action Team, to begin a monitoring project at Stetson Bank. And that was basically done, you know, by volunteers, essentially, and scientists, you know, from various universities who were interested and they would cobble together, you know, any leftover moneys they had, maybe for studying other stuff in the area, to put forward to this. And this is one that, Greg Boland, I know you I think you've talked to him already: he was one of the people, he was still a maybe a grad student at Texas A&M at that point, I'm not sure, but he helped put that program together.

G.P. Schmahl [01:17:52] But anyway, I went on one of those trips. And Stetson Bank is a good bit different than the East and West Flower Garden Bank. There's not as much true stony coral development at Stetson Bank. There is a good bit of coral there, but it's not a true coral reef. You know, a true coral reef is an area where the actual substrate that is around you was created by coral, by coral that may have died, and then other coral on top of it. So, it's even like, you know, drilled down into a living coral at the Flower Garden Banks, what's beneath it are old coral skeletons, so the new coral kind of develops on top of old, dead coral.

G.P. Schmahl [01:18:44] Stetson Bank is not like that. It's an exposed kind of a siltstone, sandstone feature that is bizarre. I mean, people have, you know, kind of likened it to a moonscape because it kind of looks like that. There are these just weird formations of these small hills and valleys, you know, created by these sandstone features. And it was just covered with organisms, you know, some coral, like I said, but a lot of sponges. Of course, that caught my eye because I had studied sponges and I was like, "Oh, wow, this is great."

G.P. Schmahl [01:19:14] And then, the fish and invertebrates and everything that associate with Stetson Bank is incredible. And so, my first dive at the Flower Gardens was at Stetson. And it was just so different than what I expected that it kind of blew me away, and on a couple of levels.

G.P. Schmahl [01:19:37] One was just the biology of it, and what was going on there. You see stuff at Stetson Bank that you don't see at the Flower Garden Banks.

G.P. Schmahl [01:19:47] And the large number of species of fish species that will utilize all of the banks. But, for some reason Stetson Bank in particular is where you get these schools of juvenile vermilion snapper and other types of fish that are commercially important, but, you know, by the thousands. They block your view, there's so many fish. It was amazing.

G.P. Schmahl [01:20:12] And, I remember my very first dive, I was so entranced by the whole ... everything that was going on, I wasn't paying attention to my air consumption. Right? I was kind of deeper and stuff than I had expected, was used to. And then, so I had a very quick return to the vessel. I didn't run out of air, but I came close. And I learned a lesson there because it's not easy diving at the Flower Garden Banks. It is relatively deep. The current is really strong, and they can vary, you know, within even the course of a dive, they can be going in one direction at the beginning of the dive, and another direction at the end of the dive.

G.P. Schmahl [01:20:53] So, I remember even finding, getting back to the boat was a little bit of a challenge.

G.P. Schmahl [01:20:57] But anyway, so that was my first dive.

G.P. Schmahl [01:21:00] And, I assisted on this monitoring program. Of course, I had a monitoring background. And so that was, I was prepared for that aspect of it. But just the logistics of doing work there at the Flower Garden Banks was such a different level than the Florida Keys. You know, the Florida Keys, you could get into a small boat - the reefs are only a couple of miles offshore - and then you come back in the evening and that kind of thing.

G.P. Schmahl [01:21:28] Whereas when you're 100 miles offshore, it's a whole different level. And you're out there for multiple days, you've got a lot of people you have to coordinate and a lot of logistics you have to coordinate. And getting everything done is quite a challenge.

G.P. Schmahl [01:21:44] So that was my first exposure.

G.P. Schmahl [01:21:46] And I also saw some manta rays. There was, at Stetson Bank, sandbar sharks are quite common. And sandbars can be, they can be quite large and they're quite curious. I'll put it that way. They'll come right up to you. Whereas most sharks, they don't want to hang around you anymore than you want to hang around them. They'll take off. These guys seem to kind of keep coming around, you know, and checking us out. So, that was a little bit unnerving.

G.P. Schmahl [01:22:23] So, that's my first dive. That whole trip was all Stetson Bank. And then later on, of course, I was able to visit the Flower Garden Banks and just the coral cover there was incredible. I mean, it's over 50%, 5-0%, living coral cover. So, you can imagine that one-meter square quadrat I was talking about before, if you put it down on a piece of the reef, half of the area within that one-meter square is living coral, whereas in the Florida Keys, at the time I left, I mean, it was down to less than 10% living coral cover as an average on the coral reefs there. And now it's declined to, I think, in the low single digits, 3 or 4%. So, it's a whole different, different type of, of community.

G.P. Schmahl [01:23:19] And just to see the magnitude of coral development at the Flower Garden Banks was just. I think, it was just incredible. I read about it and everything and, yeah, yeah, yeah, but until you see it doesn't really sink in. Yeah.

David Todd [01:23:38] Oh, what a delight. So, you know, one of the things that I wanted to ask you about at some point, and maybe this is a good place to discuss this. You mentioned, diving and how it, by itself, is its own discipline that's pretty demanding. And if you're excited about what you're seeing in the Stetson Banks, you can easily run short of air. I believe you've done a lot of diving and you've been a diving supervisor, a submersible pilot, a saturation diver at the Aquarius underwater habitat in Key Largo. I was wondering if you could just take a moment to talk about these different ways that humans can explore the undersea world, and maybe how that might have played out in your education about the Flower Gardens.

G.P. Schmahl [01:24:34] Yes. Like we mentioned, this traditional SCUBA diving aspect of it and that's a critical tool, you know, for studying these areas. But you're right. Well, first of all, I did, during graduate school, actually, is the first time that I was able to participate in a project in an underwater habitat. And this is with the old Hydrolab that was in the Virgin Islands. And my professor that I spoke of before, Jim Porter, had ongoing projects down there. And so, I was able to assist on a couple of missions in the Hydrolab.

G.P. Schmahl [01:25:18] And that's, you know, these are, essentially because they were actually, and this is again in the '70s, where these underwater habitat systems were being developed with the idea that ocean exploration was happening at such a pace that they would

be crucial in forwarding that endeavor. And there was a number of habitats that were created throughout the world.

G.P. Schmahl [01:25:53] And basically, the idea is fairly straightforward. You know, when you SCUBA dive, one thing you have to worry about is the accumulation of nitrogen in your bloodstream. And you have to be very careful. And now they have computers that figure all this out for you as you dive. But, you know, in the early days, you could figure this out on a table: you know, how long you were down, and how deep you were down, would correlate to how much nitrogen you would take up. And you had to either come up before it reached a critical level in your bloodstream, or you'd have to stop at multiple area, multiple depths, on the way up in order to let the nitrogen come out of your bloodstream.

G.P. Schmahl [01:26:38] Because if you don't, they'll create bubbles in your blood, actually, and accumulate in your joints. It can accumulate essentially in the spinal column, and affect your brain. And, the fact that they accumulate in your joints is why they would call it the bends in the early days. And divers in the early days would get the bends because they hadn't figured out what was going on yet at that time.

G.P. Schmahl [01:27:08] But, that is what limits you when you're SCUBA diving. So, if you're at 60 feet, you know, typically you can only stay down there for less than an hour at the max, you know, until that accumulation occurs.

G.P. Schmahl [01:27:22] Now, if you stay down longer than that, that's not a problem, as long as you don't come up, right, as long as you don't try to come up, because in then the nitrogen comes out of your bloodstream.

G.P. Schmahl [01:27:34] And so, the idea behind the underwater habitats is that you would go down into these habitats and you would actually saturate your bloodstream with the nitrogen. And, at that point, you can spend almost as much time as you want at that depth studying coral reef or whatever you're studying. And so, it just opened up a whole new world where you could go down, stay in the habitat, and then do these four-hour, five-hour dives instead of a one-hour dive.

G.P. Schmahl [01:28:05] And then, at the end of that process, then you have to do a very slow decompression process that takes 12 hours or more, you know, 24 hours. Where they, in the old days, they would actually come up, you know, bit by bit, changing tanks. But in a underwater habitat, they actually close it off and they repressurize the habitat itself and bring you slowly back up to surface levels, you know, of oxygen and of air.

G.P. Schmahl [01:28:41] And so, that's what underwater habitats kind of are, you know. And I did a couple of missions of Hydrolab in St. Croix in the Virgin Islands, and then, they established one in the Florida Keys, off of Key Largo. And then later on, when I was with the sanctuary program, I was able to do some missions with the Aquarius habitat there.

G.P. Schmahl [01:29:08] And so, you know, over time, it kind of flattened out, but that was, you know, those missions are still happening throughout different places in the world. But then, with other technologies that were developed, it proved that some of the other technologies were probably more efficient and less dangerous to do a lot of the exploration that the underwater habitats were providing. So over time, those became less common as a type of way to explore the ocean bottom, and especially as the development of remotely operated vehicles, really advanced and the use of underwater submersibles of various types.

G.P. Schmahl [01:30:00] And there again, this is where I kind of jump off to there because the underwater submersible part, and the remotely operated vehicle, or ROV, technology, really came into play when I got to the Flower Garden Banks. And that was something that I had never really been exposed to in the Florida Keys. But these deeper areas along those other reefs and banks that I mentioned, along the edge of the continental shelf, are much deeper than the Flower Garden Banks. And so, you can't really, except for a few, you can't really study those efficiently using SCUBA diving, and trying to put an underwater habitat down is also very logistically challenging. But you can use ROVs and you can use submersibles.

G.P. Schmahl [01:30:45] And right about the time I got to the Flower Garden Banks, Dr. Sylvia Earle, who is, you know, a famous, marine biologist, oceanographer, one of the early female SCUBA divers and proponents of marine science, served as a time as a chief scientist for NOAA. Still is active in her 80s, still diving, still promoting protection of the marine environment.

G.P. Schmahl [01:31:14] She got funding to do a project with the National Marine Sanctuary program, called the Sustainable Seas Expedition, and it was a five-year expedition right around 1999, when I started at the Flower Garden Banks. And she had worked in conjunction with these folks who had developed a single-person submersible, called the "Deep Worker". And it could be utilized down to 1000 feet or more. I think it was rated to 2000 feet. And it was very simple to operate. You could do it just with one person, like I said.

G.P. Schmahl [01:32:01] And so, she brought these Deep Worker submersibles to many of the National Marine Sanctuaries and carried out projects for the National Sanctuary program. And so, I was able to get involved with the Sustainable Seas Expedition on the ground floor. And I was able to get trained on the Deep Worker submersible and became a sort of pilot of the Deep Workers and was able to utilize those submersibles in the exploration of not only the Flower Garden Banks, but many of the other reefs and banks along the edge of the continental shelf.

G.P. Schmahl [01:32:43] And I really have to credit Sylvia Earle for bringing access to that technology, to helping do some of the research on those areas that eventually became those same areas that were part of the relatively recent expansion of the Flower Garden Banks that I think, you know, that, in 2021, after a long process, the Flower Garden Banks National Marine Sanctuary expanded to include a number of other recent banks. And, I really, think that, you know, that those Deep Worker explorations, and the mapping they have done in order to support those explorations, were instrumental in raising awareness, providing information, that resulted in the expansion of the Flower Garden Bank National Sanctuary.

G.P. Schmahl [01:33:41] And then also, I was able to dive in some other submersibles. Dr. Bob Ballard did a project at the Flower Garden Banks in 2007 or so. And of course, Bob Ballard, you know, he's a very famous oceanographer. He's the guy that discovered the Titanic, and a number of other things. He has used submersibles throughout his career. He's out of Woods Hole, or was at the time.

G.P. Schmahl [01:34:19] And he brought the Navy nuclear submarine, the NR-1e, to the Flower Garden Banks, and I actually got to ride in a nuclear submarine to explore some of the areas of the Flower Garden Banks as well.

G.P. Schmahl [01:34:38] And because of some of that experience, I got invited to go along on a totally unrelated expedition in the Gulf of Alaska, to utilize the Alvin submersible, which is out of Woods Hole. And it is the kind of the premiere submersible, in the United States anyway. And it was the submersible that made the first dive on the Titanic and other places and was able to do some deep dives in the Gulf of Alaska in the Alvin. So, I don't think I'd ever have had that opportunity to do that if I had stayed at the Florida Keys. And so, that was another kind of benefit of coming to the Flower Garden Banks was being able to get some of those experiences because that has been amazing.

G.P. Schmahl [01:35:30] At the same time, we were also utilizing remotely-operated vehicles extensively. And there's a group out of the University of North Carolina at Wilmington that has an underwater vehicle program with remotely-operated vehicles. And we utilized those systems extensively over the years to, again, to research those areas that have become part of the expansion of the Flower Garden Banks National Marine Sanctuary.

G.P. Schmahl [01:36:03] That kind of all started with Sylvia and the Deep Workers.

David Todd [01:36:08] Well, this may be a good point to explore some of these efforts to sort of shift from exploration and understanding and appreciating what is underwater at the Flower Gardens and the affiliated reefs and try to understand more about how they got protected.

David Todd [01:36:28] And, and I was hoping that you could maybe take us back to a starting point, which I guess is when the Marine Protection Research and Sanctuaries Act gets passed and I guess gives a structure for protecting these sites, back in the early '70s. Is that correct?

G.P. Schmahl [01:36:49] That is correct. And you're correct. It was in 1972, when the MPRSA, that's right, Marine Protection and Research ..., I forget what that stands for, but you just said it. It was originally passed and changed names over the years, and it did allow for a framework for the identification and the establishment of national marine sanctuaries. You know, the ultimate reason was to protect the resources for which it was, you know, identified with.

G.P. Schmahl [01:37:30] But it's interesting. You know, the National Sanctuary program is in NOAA, the National Oceanic and Atmospheric Administration, and NOAA is in the Department of Commerce, which a lot of people don't realize that either. It's kind of odd, I think, that it's in the Department of Commerce. And, NOAA also incorporates the National Marine Fishery Service. Fishery management, and everything, is part of that as well.

G.P. Schmahl [01:37:56] But I think being part of the Department of Commerce and being just in general, again, you know, the word "sanctuary" maybe is a little bit of a misnomer, because the whole, National Marine Sanctuaries program is designed as a multiple-use kind of protected area program, that again, you know, we want to encourage activities to occur in these areas, and as long as those activities aren't having a significant detrimental impact, those activities should continue.

G.P. Schmahl [01:38:36] But, so in that process, when they developed the National Marine Sanctuaries program, originally, you know, basically, people could nominate areas to be considered as National Marine Sanctuaries. And this is where it kind of comes back to some of the recreational divers. And so, in the case of the Flower Garden Banks, it was very early on,

and, you know, not long after that where the original nomination for the Flower Garden Banks happened, you know, because of the interest from recreational divers.

G.P. Schmahl [01:39:13] But for whatever reason, you know, other sanctuaries were designated. The very first National Marine Sanctuary was the wreck of the U.S.S. Monitor, the Civil War ironclad, off of North Carolina. And that was because primarily there was, some salvagers, well, it wasn't really treasure salvagers in the case of the Monitor, but they were basically taking historical artifacts, you know, taking pieces off of the Monitor, you know, just for fun or for putting in museums and things like that. And so, the integrity of the wreck was being threatened because of that type of activity. And so, it was designated as a National Marine Sanctuary. It was the very first one.

G.P. Schmahl [01:39:58] The second one was the Key Largo National Marine Sanctuary. And that was also the result of, some activities related to true treasure salvage activity. Back in the day, the State of Florida claimed jurisdiction out to nine miles on both sides of the coast. And, a famous treasure solver, Mel Fisher, who ended up finding some significant wrecks in Key West area, the Atocha and others, challenged the State of Florida, saying that the state only had jurisdiction out to three miles, which turned out to be correct.

G.P. Schmahl [01:40:48] And so, the National Marine Sanctuary program was able to step in right after that in order to designate the area off of Key Largo as a National Marine Sanctuary, because prior to that, it had been the John Pennekamp Coral Reef State Park.

G.P. Schmahl [01:41:05] I mention that just because it's interesting the way different sanctuaries got designated at the time.

G.P. Schmahl [01:41:13] And in the case of the Flower Garden Banks, there was quite a bit of resistance to the designation as a National Marine Sanctuary, primarily from the oil and gas industry. Again, there's more concern that it would restrict activities that would affect the ability to access resources. And so, even though it was originally first nominated in the 1970s, it wasn't until 1991, that the sanctuary, the Flower Gardens Banks National Marine Sanctuary was designated.

G.P. Schmahl [01:41:53] One of the things that I think instigated the sort of the interest, the "reinterest", in the Flower Garden Banks, was there was an anchoring incident, a large vessel that dropped anchor on the Flower Garden Banks, did a lot of injury to coral there because of that.

G.P. Schmahl [01:42:20] And. You know, I'll mentioned Sylvia Earle again because she was actually the chief scientist at NOAA at the time that happened. And she helped identify that and got that kind of back on the roll for the nomination process. And so, that process went through and eventually resulted in the nomination and the designation of the Sanctuary in 1991.

G.P. Schmahl [01:42:50] And so the sanctuary program kind of depends on the resource of interest. You know, that's why I mentioned the Monitor. In that case, it was a shipwreck. It wasn't a natural feature. It was a historical feature.

G.P. Schmahl [01:43:02] And there are sanctuaries that have been designated because of whales, like the Humpback Whale National Marine Sanctuary in Hawaii.

G.P. Schmahl [01:43:09] Or, you know, the coast of California kelp beds or things of that sort.

G.P. Schmahl [01:43:15] So it all kind of keys on the resource of interest that is identified as a need for protection.

David Todd [01:43:27] Well, it's interesting that, you know, sometimes it's the value of the resource, and then I guess sometimes it's some sort of a threat. I mean, you talked about these salvagers that were affecting treasure off Florida or historic sites of North Carolina.

David Todd [01:43:48] Tell me a little bit about the anchoring incident off of the Flower Garden's proposed site. How did that happen? Do you know many details about that?

G.P. Schmahl [01:44:04] So, first of all, again, there was not any kind of restriction on anchoring in these areas at that time. As far as I know, the situation with this particular vessel, you know, there's a shipping channel that runs right along, right offshore of the Flower Garden Banks in this vicinity. And these are the shipping channels that funnel into the Port of Houston, and later on into the Port of New Orleans. But a lot of vessel traffic that's going on in close proximity to the Florida and banks.

G.P. Schmahl [01:44:37] This particular situation, the way I understand it, was the vessel had some mechanical difficulties, you know. It needed to come out of the shipping channel to work on it, and basically was looking for a shallow spot to anchor, you know, because the deeper the water, the more difficult anchoring is. And so, this was a kind of a shallower point, and so they drop their anchor essentially to facilitate repairs on the vessel.

G.P. Schmahl [01:45:13] And the anchor ... And you can imagine this is a big freighter, you know, so the anchors associated with a vessel that large are huge. And so it was anchored in the coral. As usually happens, the anchor kind of drags along before it finally catches, you know? And as it drug along, you know, I think in this case, it was probably 100 meters or more, it was just turning, you know, breaking up coral, turning up coral, causing a lot of destruction in those communities as that happened.

G.P. Schmahl [01:45:49] You know, again, I think it was a recreational dive boat that was out there that that saw it. And, you know, it could have been that they made the repairs, pulled the anchor, and took off. You would never even know which vessel it was.

G.P. Schmahl [01:46:01] But they were to document that. And we were able to get people out to document the injury that was happening to the coral.

G.P. Schmahl [01:46:12] And oh, I said there wasn't any restrictions. That wasn't completely true. The Gulf of Mexico Fishery Management Council had established some protections for coral in general, prior to that time. But as this case kind of demonstrated, those restrictions were difficult to enforce. And they had difficulty in trying to get compensation from the responsible party to help with restoration or mitigation for that injury.

G.P. Schmahl [01:46:44] And so that just provided some more impetus for the need for a National Marine Sanctuary designation.

David Todd [01:46:54] I see. Okay. Well, that gives us a nice picture of how the original Flower Gardens site got protected. It sounds like the Sanctuary has expanded at least twice since then. I think you mentioned the 2021 expansion. Could you talk about that one, as well

as the previous one, I think, which happened in '96 or so, and I guess that was what allowed the Stetson Banks to be included.

G.P. Schmahl [01:47:30] Yes. In 1996, you know, Stetson Bank, as I mentioned, it was also a very popular dive site. And people that went out to the Flower Garden Banks typically also stopped at Stetson Bank for a dive because it was so interesting. And it was not included in the original designation. And so there was an effort to add Stetson Bank to the sanctuary. And that was actually done through Congressional action.

G.P. Schmahl [01:48:03] You know, I mentioned the Florida Keys was established Congressionally as well. It can happen that way, or there's a administrative process that can also happen for a sanctuary to be designated. But in this case, and it was the result of a Congressman from the Corpus Christi area. Solomon Ortiz was his name. And, I don't know if he was a SCUBA diver himself, but at least he was influenced heavily by his constituents, who were SCUBA divers and concerned about Stetson Bank. The Flower Garden Banks had been designated. And Stetson Bank, you know, was also very sensitive and needed protection too.

G.P. Schmahl [01:48:41] And he was able to do that. Got a bill passed, you know, or tacked it on to another bill that passed through Congress and established the Stetson Bank component of Flower Garden Banks National Marine Sanctuary in 1996.

G.P. Schmahl [01:49:04] That's kind of the easy way to get a sanctuary, right? Because Congress can just do it. And that's pretty straightforward. The other way is this way that I mentioned, you know, that it starts with the nomination, you know, and then NOAA will evaluate the nomination and see if the resources are to the level that it, you know, kind of falls under the criteria for a National Marine Sanctuary. And then it goes into a process where, and it is, you know, a heavily public, public participation involved, you know.

G.P. Schmahl [01:49:37] And if you're familiar with the way the federal government works, you know, you start out with a proposal, and you ask for public input. And then, you get public input from that, you know, and hold a variety of meetings that kind of thing. And then you develop a Draft Environmental Impact Statement that kind of lays out the different alternatives that you want to consider for the, in this case, the designation of a sanctuary. And typically, it includes several alternatives, you know, including a no-action alternative, what would happen if we don't do anything kind of analysis? And, again, there's another round of public participation and more input.

G.P. Schmahl [01:50:25] And depending on how things go, you revise your Draft Environmental Impact Statement to develop a Final Environmental Impact Statement and a regulatory package that goes along with the Environmental Impact Statement to implement whatever rules and regulations that you feel are necessary to provide the protection that you need for the resources that you are interested in.

G.P. Schmahl [01:50:57] And so in the case of the expansion that happened in 2021, I'll kind of back up again there. You know, there was that big study that was funded by the Bureau of Land Management back in the '70s, resulted in, you know, literally stacks of reports that we have in our office (I'm retired now), but in someone else's office, from that study. And there was a book put together, by Tom Bright, Dave McGrail and Richard Rezak, called "The Reefs and Banks of the Northwestern Gulf of Mexico". And it was kind of just a couple of compilation of the primary findings of that large topographic feature study that was done in the '70s and the '80s. And it was published in 1985.

G.P. Schmahl [01:51:53] And so, it outlined and kind of identified those other reefs and banks that had been part of that study. And there was a process that ranked all of those areas in terms of sensitivity. At that time, it was for the Minerals Management Service to identify which areas needed to be established as no-activity zones.

G.P. Schmahl [01:52:15] But that was a very solid foundation about, you know, of the value of those other recent things.

G.P. Schmahl [01:52:23] And, in fact, I'll tell you this little story. When I interviewed for the job at the Flower Garden Banks, you know, I was researching. Like I said, I had never been there. So I got the book, you know, that Reefs and Banks of the Northwestern Gulf of Mexico. And I just looked at this and it just became obvious, you know, that there's a lot more area out there that was sensitive. And they asked me, one of the questions, was something like, "Well, what do you see? You know, if you got this job, what do you see the sanctuary being in ten years?" And I said, I'm trying to be clever, you know, and I said, "In ten years, there won't be a Flower Garden Banks National Marine Sanctuary, there will be a Gulf of Mexico National Marine Sanctuary, and it will include these other reefs and banks." And I talked about, you know, these other reefs and banks.

G.P. Schmahl [01:53:17] So, I mean, so that idea kind of came with me when I came to the Flower Garden Banks. And it was interesting because not long after I got there, you know, it was time to revise our management plan for the Sanctuary and the National Marine Sanctuary Act requires the NOAA to evaluate and revise, as necessary, the management plans for these various sanctuaries. It's supposed to be once every ten years, I think.

G.P. Schmahl [01:53:55] And so, it was time to do that for the Flower Garden Banks. And we had also at that time put together an advisory council for the Sanctuary and all sanctuaries now have advisory councils. And so, we put together an advisory council, and we started a process to evaluate the management plan and revise it.

G.P. Schmahl [01:54:14] And, you know, I was a proponent of looking beyond the existing boundaries. And there were many people on the advisory council, who also were very interested in that, and knew the value of these other places. And so, that's kind of how it started. And that was in 2007 when we did that management plan review.

G.P. Schmahl [01:54:37] And in that management plan, there was a section of it that talked about expanding the Flower Garden Bank National Marine Sanctuary to include some of these other reefs and banks. And so, you can see, okay, that idea officially came up in 2007, and it took until 2021 to get it done. And that's because of the processes that are involved.

G.P. Schmahl [01:55:07] In the meantime, you know, we had those initial studies that we did under the Sustainable Seas Expedition. And through funding from various sources, you know, through Minerals Management Service, which is now, of course, the Bureau of Ocean Energy Management, funded a lot of studies to continue that research on a number of those other reefs and banks.

G.P. Schmahl [01:55:30] We utilized the remotely-operated vehicle, primarily through the University of North Carolina - Wilmington group. And, did some very detailed studies on 15 or so additional reefs and banks along the edge of the continental shelf there.

G.P. Schmahl [01:55:51] And it was a process, and it kind of went in fits and starts too. You know, there was a lot of interest in it. There's, you know, frankly, there's a lot of politics involved. And it depends on, who is in the Administration at the time, both at the highest level, I mean, who's the president and who's the head of NOAA, and who's the head of the Department of Commerce.

G.P. Schmahl [01:56:18] And so, it kind of went dormant for a while, and then there'd be interest in certain people in the agency and other places to reengage on that process. And so over time, we were able to build a case. We developed a Draft Environmental Impact Statement, I think, three different times, as we went forward.

G.P. Schmahl [01:56:47] And finally there was enough interest and things kind of came together and lined up such that, we had the necessary support to push the process through.

G.P. Schmahl [01:57:00] And it was not without controversy as well. There was still a lot of oil and gas interest, you know. They were concerned that, again, you know, it would interfere with the ability to adequately develop these areas for oil and gas resources.

G.P. Schmahl [01:57:28] And it went back and forth on a lot of processes. We utilized our advisory council extensively to work out some of those issues. And the oil and gas interests on the council and in the working groups was very influential in how the final boundaries came out in that process.

G.P. Schmahl [01:57:59] It is kind of interesting that the final push to get that that through actually came in under a Republican administration. Sometimes, you know, people think that it's the opposite. But, it's kind of interesting the way things work out sometimes.

G.P. Schmahl [01:58:27] So, I don't know how much detail you want to hear about that. That's a whole other couple of hours.

David Todd [01:58:32] Well, you know, I know there's lots we should talk about. But, it is intriguing that this process took about 15 years, if I'm not mistaken. And, you know, some of it is probably just the iterations of Draft Environmental Impact Statements, and public hearings, and public comments responding to those. That just takes time.

David Todd [01:59:01] But, I'm always curious about the big sort of political pressures that come to bear that, you know, either can make these things happen or block them. And maybe you can give us an example of why there was this oil and gas opposition, when I understand that directional drilling allows remote access to resources. What, what was the big sticking point here with the oil and gas industry, do you think?

G.P. Schmahl [01:59:37] I mentioned before that the Minerals Management Service that had identified these areas called no-activity zones, in the past. And they identify the very tops, you know, of these features. And our research had showed that the areas that were really important included a lot larger areas than just those tops of those features - so, areas outside of these no-activity zones.

G.P. Schmahl [02:00:08] I think the oil and gas industry was kind of okay with the sanctuary going forward, as long as it kind of stuck to those original no-activity zone areas. But when you start looking at these features, there's really sensitive communities that are far outside of

those areas, and it would impact the ability of some exploration and development associated with those features.

G.P. Schmahl [02:00:41] Like I mentioned before, you know, they're all associated with salt domes, the ones that we were looking at. And it turns out that even with directional drilling, there are certain technical issues related to that when it comes to salt domes that restricts or at least impedes the ability to directionally drill long distances, you know. So, it's all kind of the angle of it, you know. They can, in some cases, they can go very far distances depending on the substrates involved. But in these cases, it had to be more vertical than horizontal, I guess is maybe one way to one way to put it.

G.P. Schmahl [02:01:27] There was also, you know, concern about sort of the institutional creep of protection, when some areas get designated, things tend to expand, you know, like we were doing. And more looking down the road, that that would cause problems in the future. You know, that was the meat of it. We had people that were in the oil and gas industry that were supportive of the sanctuary in general, supportive of expansion in general. But they also had to answer to the bigger oil and gas interests, you know, the American Petroleum Institute, the National Ocean Industries Association, other groups like that who were in general just more, you know, against designations, just on general principle.

G.P. Schmahl [02:02:40] And so there was a lot of back and forth there to try to come to a compromise to draw these boundaries such that it would incorporate these sensitive areas while still allowing the ability to develop oil and gas without harming these areas.

G.P. Schmahl [02:03:01] And I have to say right up front, you know, I mean, there has been, oil gas development in very close proximity to the East and West Flower Garden Bank over the years. And, as long as there's not a major blowout (which, of course, Deepwater Horizon showed that that can happen), we have not been able to document any direct impact from oil and gas activities, which is in close proximity to the Flower Garden Banks, over the years. Right? So it is possible to explore and develop oil and gas and protect these areas.

G.P. Schmahl [02:03:48] But again, to me, it comes back to drawing those boundaries such that you don't have those direct impacts with actual drilling, anchoring - you know, things related to oil and gas activities. So, I have to say there was some stuff going on. There was a strong ... you know, I'll have to say that obviously the oil and gas industry is very powerful politically. And probably at any point could have stopped or at least slowed down this final expansion push, if they wanted to.

G.P. Schmahl [02:04:37] But, there were people in the Administration that wanted to show that there were environmental things that could happen. And so, it really came down to sort of detailed drawings of how we drew the boundaries. And I'll have to say right out front, there are a lot of areas that did not make it in the sanctuary boundary expansion that should have been in there. And hopefully, at some time in the future, we'll be able to revisit some of those areas, and maybe revise some of those boundaries such that they include those areas, because some of those areas are probably more diverse, more sensitive, than a lot of the areas that ended up inside the boundaries.

G.P. Schmahl [02:05:37] But that was the thing. That was like kind of a choice of what battles do you pick. I felt it was very important that at an expansion happen, and that the areas that that were not controversial got included.

G.P. Schmahl [02:06:03] So we went forward, you know, with that in mind and tried to tweak the boundaries as best we could to include the sensitive areas. But it was a bit of a battle and had some, some pretty spirited discussions at the advisory council level and at the administration level when these rules were being promulgated.

David Todd [02:06:30] Well, it sounds like it is a marathon, not a sprint. And, I guess you need to take your victories where you can and hope that maybe you'll get another chance to expand and protect these really sensitive spots.

David Todd [02:06:49] You know, this might be a good time just to help us understand some of the things that are pretty extraordinary about the Flower Gardens and Stetson Banks, and some of these new 2021 expansion areas. And I think that set of reefs is known for major coral spawns that are really interesting, and then extraordinary sets of animals. And then the brine seeps - I've heard of as being another issue that's really intriguing. If you could talk about any of those, that'd be wonderful.

G.P. Schmahl [02:07:29] Well, I'll start with the coral spawn because that is an amazing event. It happens every year. You know, corals, like many animals that are attached to the substrate, you know, they don't move. Right? And so, the way that they reproduce is to release sperm and eggs into the water column, and those sperm and eggs fertilize, create gametes, create larvae. And those larvae float around and find a new place to settle out.

G.P. Schmahl [02:08:01] That's how corals reproduce.

G.P. Schmahl [02:08:04] It turns out that, and you can think of it in terms of evolution. You know, it makes sense that if you're going to do that, you don't just do it haphazardly, that you, that you kind of all kind of get together and have a certain time that reproduction happens and when you release sperm and eggs at the same time, so the probability of those finding each other and fertilizing is a lot higher. And that's what happens in many marine species. And it happens with a number of coral species.

G.P. Schmahl [02:08:35] And there are other ways too, but, it's known as broadcast spawning and many of the species, and it happens to be some of the species that are the prominent ones at the Flower Garden Banks, and these are primarily the star corals and the brain corals, do this. They release their sperm and eggs about the same time and fertilization, reproduction, happens.

G.P. Schmahl [02:09:08] Well, it turns out it's not about the same time, it's exactly at the same time. And so, there's, over the years, you know, scientists have kind of figured it out. And again, going back to recreational divers, the first people that observed this at the Flower Garden Banks were recreational divers going, "What the heck is going on?" Because, what happens is corals ... some corals have separate sexes, you know, male and female colonies, other corals, have both sexes in the same colony. But either way, you know, they're releasing eggs and sperm at the same time, and it turns out to be a very precise time - about eight nights after the full moon in August, within a certain time frame, you know, just several hours, from sunset out to maybe 10:00, 11:00 at night, all of the corals are releasing their eggs and sperm at the same time.

G.P. Schmahl [02:10:00] And if you happen to come across this at that time, and it's been described as a underwater, upside-down snowstorm, you know, because these are small packets, and they're white packets of eggs and gametes that are being released from the coral

polyps. And there's literally millions of these packets coming up, you know, out of the substrate, out of the coral. And they're buoyant, you know, so they're floating up.

G.P. Schmahl [02:10:26] But you see ... it's just like everywhere around you, you see these, look like snow, kind of, except going up instead of coming down.

G.P. Schmahl [02:10:35] And so, a coral spawning event, you know, and, I think it's the fact that you have this group of species and there's such a high concentration at the Flower Garden Banks that, when they release, it's just a spectacular sight. And so, the ability to see that has become a have a thing for SCUBA divers as well. And so, to witness coral spawning at the Flower Garden Banks is quite a treat. And those trips are very highly desirable for SCUBA divers.

G.P. Schmahl [02:11:09] And so that's, coral spawning, that's one of the things that make the Flower Garden Banks unique.

G.P. Schmahl [02:11:15] One of the other things is that I mentioned large animals. This is a pretty recent recognition is that there's always been manta rays that are common at the Flower Garden Banks. But they tend to be fairly small. When I say "small" for a manta ray it's still like, you know, six-foot, eight-foot, you know, even ten-foot across, wingspan. But true adult manta rays can be closer to 15-, 20-foot, you know, wingspan.

G.P. Schmahl [02:11:46] And so, but that was just like, "Oh, well, that's just what they are at the Flower Garden Banks". But it turns out that it's more than that. Those are juveniles. And it happens that this has now been documented after a series of years of study that the Flower Garden Banks, in particular, and probably some of these other reefs and banks as well, are essentially nursery areas for manta rays. And so, we've never seen the wild birth of a manta, but it's obviously going on in the vicinity. And so, these high concentrations of juvenile giant manta rays are a regular occurrence at the Flower Garden Banks. So, that's another thing that makes these areas so special.

G.P. Schmahl [02:12:37] And the same thing with the sea turtles, both loggerhead sea turtles and hawksbill sea turtles. Loggerheads in particular, some studies that Emma Hickerson, our research coordinator at the time, did for her Master's work, tagging loggerhead sea turtles. It shows that that these are resident areas for juvenile loggerhead, or I'd say, subadult because when I say juvenile, you think of small ones. These are large, marine turtles. You'll see the same turtle there year after year. And it isn't until they reached the true adult stage is when they, especially for the males, they kind of just take off and go. Not sure exactly where they go, but they go other places in the Gulf of Mexico. But for a time in their life, this is a crucial place for these turtles. And they'll wander out from the Flower Garden Banks to feed, but they're resident there, you know, over the years as they come to maturity.

G.P. Schmahl [02:13:44] So, there's things like that that are associated with the Flower Garden Banks that really highlight how important these areas are, and I suspect that that's true for a number of other species.

G.P. Schmahl [02:13:59] You know, we see whale sharks there in the late summer, usually. Is there something going on that draws them in at that time? That's of interest. In the past, and this has gone down unfortunately over the years, but scalloped hammerhead sharks congregate there in the winter time. So, there's, again, there's something magical about the

Flower Garden Banks that kind of draws these species to congregate there, and to utilize these areas for at least part of their life history.

G.P. Schmahl [02:14:39] You know, one thing that we looked at at the Flower Garden Banks, but especially at these other reefs and banks, is that there are other types of coral communities, other than the ones we think of as typical coral reefs. Those are the hard corals, the stony corals, the ones that I talked about that do the coral spawning, ones that people are probably familiar with if they go snorkeling or diving, you know, if they went to Cozumel or places in the Caribbean, we know those as true coral reefs.

G.P. Schmahl [02:15:10] As you get deeper, and it's a light thing, because I talked about needing light, you know, adequate light for those stony corals to develop. You still have a lot of important coral communities, but they're not those kinds of corals. They're a different kind of coral. And, they are some small stony corals, mainly little branching ones. And they don't have that symbiotic algae in their tissues like the true stony corals do, up on the shallow part of the reef. But they're still corals and they still are very important.

G.P. Schmahl [02:15:49] And then you have these other types of corals, the octocorals and gorgonians, that I mentioned before that are common in shallow reefs, but these are different species of them. High densities in some cases, as you get in these lower light and environments. You also have what's known as black corals that are different type of coral. And it's also mainly, kind of sea whip kind of organisms. And these can be quite dense.

G.P. Schmahl [02:16:23] And there's a lot of other types of organisms that associate with them. You know, even though they're not building coral mounds like the top of the Flower Garden Banks, there'll be extensive areas where there's high concentrations of the octocorals and black corals and a lot of sponges down there as well - other things, you know, a lot of sea urchins and things that provide habitat for other organisms. And these have been kind of termed as mesophotic coral communities. And "mesophotic" just means "mid light".

G.P. Schmahl [02:16:59] Because if you look in the ocean, you have high-light areas, when I talked about for stony corals. And then you get these lower-light areas where there's some light coming down, but there's not enough for stony corals to develop. But there's lots of stuff down there. I mean, incredible amounts of things down there. It turns out that these are our nursery areas in their own right for a variety of species, both including recreationally and commercially important species.

G.P. Schmahl [02:17:32] And then, when you get down to about 200 meters, down to about 300 meters, there's basically no light in the ocean. There's amazing communities down there too. But they're, as you can imagine, they're a different type of community.

G.P. Schmahl [02:17:52] But in our case, that mesophotic area, that goes down from, say, 50 meters or 150 feet down to 300 meters or 900 feet, is this mesophotic area which have incredible communities, and those are the predominant communities in the other reefs and banks that are part of the expansion area. There are only two or three of those other reefs and banks that come up shallow enough, to where there's true stony coral community development. But there's all this other stuff.

G.P. Schmahl [02:18:35] And so the mesophotic community has been, on the scientific side, it's kind of been, I won't say ignored, but it hasn't been researched as much as the other parts of the ocean. And it goes back to the technology. You know, you have the shallow part which is

accessible by SCUBA diving, you know. And that's well studied. And then you have the kind of real deep stuff. And there's been quite a bit of research that's been going on in the deep ocean with submersibles and that kind of thing. But in that area in between, there hasn't been as much interest, because you couldn't get there by SCUBA diving and you couldn't really justify the use and the cost and expense of putting submersibles down in, you know, areas that were kind of thought to be kind of too shallow for a submersible, you know, less than 1000 feet or something.

G.P. Schmahl [02:19:34] And so, over the years, you know, there had not been as much research that has happened in these mesophotic coral communities.

G.P. Schmahl [02:19:41] And so when we started looking at them using remotely-operated vehicles and the smaller submersibles and that kind of thing, we were coming across all these organisms, and we couldn't identify them, you know, and we'd collect some, you know, and send them to the experts, and they go, "Well, we don't know where they are either, you know?" And it was truly, these were, you know, species that were new to science, that had not been described in studies before.

G.P. Schmahl [02:20:05] And there's been, now, there's been a number of those types of species that had been now collected and discovered at the Flower Garden Banks vicinity from the increased research has gone on in the mesophotic coral community area. And like I say, we come across these kinds of just fields of these black corals, for example, you know, down around 300, 400 feet or so. And as you drive the ROV along, you see that the rubble, the areas, were just loaded with these tiny little fish. And again, you know, we were able to capture some of those, a lot of times. Sometimes, they're just fish that lived there all their lives. But, a lot of times they're actually juveniles of other species, because they're utilizing these areas as nurseries and areas of juveniles for species.

G.P. Schmahl [02:21:21] So, that was the primary interest in other communities, that were involved with the expansion.

G.P. Schmahl [02:21:35] But every now and then you'd come across interesting geological features, you know, associated with these areas, too. In one case, the bank called Alderdice Bank, where there are these basalt spires that are just kind of sticking out of the seafloor, which are bizarre, you know, because basalt, of course, is a volcanic rock. And there hasn't been volcanic activity in this part of the Gulf of Mexico in millions of years. So, again, it's because it was these rocks were kind of pushed up from the underlying salt formations to highly spectacular kind of basalt features, sticking out of the seafloor in the Gulf of Mexico.

G.P. Schmahl [02:22:16] And you mentioned the brine seep, because, like I say, all of these are associated with underlying salt domes. And every now and then, if the condition is right, the salt dome feature comes up close enough to the seafloor that there's actually kind of a communication, there's some fissures, and faults, things like that, that allow the sort of the leakage, the direct release of salt, into the overlying seawater.

G.P. Schmahl [02:22:48] And one of these areas is associated with the East Flower Garden Bank, and it is a brine seep. It's called a brine seep because what has happened is as the salt comes and dissolves into the overlying seawater, it becomes supersaturated with salt. And so, when you have high concentrations of salt ... you know, the ocean is salty water, but it's at like 35 parts per thousand salt in solution; some of these areas where the salt is kind of being

exposed directly to the sea floor, it's at up at around 200 parts per thousand. So really salty. And it's really dense.

G.P. Schmahl [02:23:34] And so it doesn't mix with the overlying water very easily. It will, over time, you know, but for a long time, you'll get these just basically pools of really heavily high concentrations of saltwater in the ocean. And as you go along, you know, with the ROV, for example, you'll come across a pool. And it really looks like it's a pool, underwater, like you would come across a lake. Just an odd thing to see, like you don't expect to see that underwater, because you're in the water, right? You don't expect to see a lake.

G.P. Schmahl [02:24:12] But because of that really dense, high salt concentrations in these depressions that will form these salt, and they call them brine seeps, or brine lakes. And those are fascinating because there's a whole different type of biological communities associate with these brine seeps, you know, types of organisms that can't live anywhere else and other, typical marine organisms, it's too salty for them. And so, you know, I'll actually see fish kind of swimming into them and they swim in, and they don't swim out because it's literally too, too salty for even a saltwater organism. So, it's really, very interesting.

G.P. Schmahl [02:24:58] And we've come across several of these brine seeps in the areas that we studied in the expansion areas. And then, of course, there's brine seeps throughout the Gulf of Mexico. The oil and gas industry, you know, comes across them, discovers them, from time to time.

G.P. Schmahl [02:25:19] They're also, it's common to see, just bubbles coming up from the seafloor in some areas. And typically, these are methane seeps, you know, again, because the oil and gas resources, you know, associated with these salt domes. And some of that gas will work its way up through the overlying sediments and, and come out too. So, you'll see small methane seeps as well. But, of course, you know, it bubbles up to the surface. It doesn't collect and congregate on the seafloor like a brine seep.

G.P. Schmahl [02:25:58] So there's just this fascinating geology that goes along with the with the fascinating biology of these areas.

David Todd [02:26:10] Well, it's so interesting that that this is a developing story: that there are a lot of things that, you know, we know we know, and there are things that we don't know that we probably should know, and we'll hopefully figure it out in the coming years.

David Todd [02:26:31] Well, let's shift a little bit to some of the concerns that you might have about the Flower Gardens. You know, there's been a lot of effort, thanks to you and some of your colleagues, to protect these places that are very special. And I wonder as you consider the past there, and then look into the future, what do you think some of the challenges will be? You know, we've talked about oil and gas, and some of the risks there, shipping, the anchoring issues. One of the things I thought that you might have a special knowledge about because you've done an assessment of Hurricane Rita's impact, and I was curious what the effect might be of some of these tropical storms and hurricanes that come through the northern Gulf and you know, might have some impacts, or maybe not. What do you see?

G.P. Schmahl [02:27:38] Hurricanes definitely have an impact. I think, over time, the Flower Garden Banks has developed in a way that reflects that kind of impact. It is, you know, if you dive at the Flower Garden Banks, it is kind of a big mound kind of feature - large heads, and you can describe it as heads that have kind of hunkered down, you know. And you don't see

many branching corals. And that may be for a couple of reasons. And I really think that that's because, over time, there's been exposure of hurricanes that have kind of moved through the area over time. And the coral species that are best adapted to deal with that kind of situation are the ones that have survived, you know, over the long term.

G.P. Schmahl [02:28:39] There's been a few hurricanes that have impacted the Flower Garden Banks directly, and you think, you know, even at 60 feet, they're pretty deep, you know, and that gives it some protection. But you'd be amazed at the force of these storms, and the impact that they can have, because you can definitely see large, I mean, huge coral heads that have been dislodged, you know, and moved from the wave action, current action, from these storms. And those large heads have rolled around, you know, and smashed into other corals, and just kind of wreaked havoc in their own right.

G.P. Schmahl [02:29:23] But then when you step back and look at the way the whole reef has formed, you can see, "Oh, yeah, that's happened before." And we have some of these big coral heads that flipped over, over time, you know, now it exposed new hard surfaces, and things have colonized on what was the underside of this big coral head. And you see smaller corals colonizing there and growing and so it's part of the kind of the natural evolution of the reef.

G.P. Schmahl [02:30:02] So I think in terms of hurricanes in general, that is not as big of a threat as some other things, not as much as they are in some shallow, true shallow coral communities, where hurricanes can be devastating. You know, you might be familiar with staghorn and elkhorn coral, which are, you know, one of the primary rebuilding corals in the Caribbean over time. And some of those areas can be completely wiped out by a strong hurricane, because they're so fragile and just, you know, the branching formations of the way they grow.

G.P. Schmahl [02:30:55] So, but at the same time, there is still a factor. And it moves a lot of sediment around. It can bury areas, bury coral, you know, coral heads. But I guess in general, I would say that the hurricanes themselves are not the biggest threat.

G.P. Schmahl [02:31:20] I think the absolute biggest threat right now, and everybody hopefully is talking about it, is related to climate change, and it is related to warming seawater temperatures in the world's oceans. And that's happening in the Gulf of Mexico as well.

G.P. Schmahl [02:31:37] We have documented that at the Flower Garden Banks with instruments that we've had out on the reef since the 1980s, that the average seawater temperature in some areas, like 1, 1.15 degrees Centigrade elevation, you know, that it had elevated that much in that time period, which maybe doesn't sound like a lot, but in geological reference, that's crazy fast.

G.P. Schmahl [02:32:12] The reason that's a big concern for coral reefs, as you know, is that is what is related to coral bleaching. I mentioned coral bleaching in the Florida Keys. And, that is a situation when the coral is stressed to the point that the symbiotic algae in its tissues leaves: it is either killed directly or it vacates. It doesn't, it's not, conducive to their survival.

G.P. Schmahl [02:32:44] And that leaves the coral without the algae and the coral itself, the tissue, the animal part of the coral, the tissue is relatively clear, you know, and you can look right through the clear tissue of the animal and see the underlying coral skeleton below, which is white. So, the coral then looks white. And that's why they call it coral bleaching is because these corals, which are typically, you know, these vibrant greens and browns and

other colors - yellow - turn white. And it doesn't necessarily kill them immediately, but if that persists over a period of weeks, then the coral will die. The coral needs that symbiotic algae in order to survive long-term.

G.P. Schmahl [02:33:31] And we've seen that happen throughout the world, throughout the Caribbean, Florida Keys in particular. We've had coral bleaching events at the Flower Garden Banks, some of which have been pretty significant, but none of which so far has persisted long enough to cause significant mortality. And the last really bad one was like 2016, 2015, 2016. And, things are kind of cyclical, it seems like. And so, I'm afraid we're kind of due for another one soon. And this year, it's been predicted to be a particularly interesting year. In the Gulf of Mexico, there could be, you know, elevated sea water temperatures, higher than normal. But we're very concerned about that, and we have to keep an eye on it.

G.P. Schmahl [02:34:40] It's interesting. In the case of Hurricane Rita, there was a coral bleaching event that was going on at that time. And again, it's because of hot, warm seawater. And there had been kind of almost a doldrum kind of situation that had set up in the Gulf of Mexico, where there wasn't a lot of water movement. It was really, you know, it was hot in the summer, right? And so the water temperatures were heating up just from sunlight. And bleaching was going on.

G.P. Schmahl [02:35:15] When Hurricane Rita moved through. Although it did do some damage to the coral itself, it kind of stirred everything up, and the seawater temperatures actually went down, you know, because it kind of brought in some cooler water. So, there was actually almost a beneficial effect of that storm in that particular case because, the coral bleaching was mitigated because of the change in seawater temperature due to the storm, which is kind of interesting.

G.P. Schmahl [02:35:45] But I'd have to say that I think right now, and I think this is true for all coral reefs throughout the world, that elevated seawater temperature related to climate change is the number one threat to coral reefs at the Flower Garden Banks and everywhere in the world.

G.P. Schmahl [02:36:06] Another thing is coral diseases which have taken hold and decimated reefs in various places throughout the world. We've been pretty lucky at the Flower Garden Banks that, we have had coral diseases. Including one worrying event just recently in the last year or two that seems to have subsided. But if some of those diseases did take hold in the Flower Garden Banks, they can move very quickly, and kill large areas of coral very quickly.

G.P. Schmahl [02:36:47] There's one that's kind of going around in the Caribbean right now - stony coral tissue loss disease. And that has decimated some portions of reefs in the Florida Keys and other places. And so, we're on the watch for that.

G.P. Schmahl [02:37:05] Diseases, there's a possibility of treatment. It does seem that, you know, it's very difficult to research diseases in lower invertebrates. Not even sure if it's a virus or a bacteria that's causing it. It seems to respond to some antibacterial treatments. So, there's, you know, some hope about treating corals that way if a coral disease came in.

G.P. Schmahl [02:37:35] For coral bleaching, there's no real treatment that you can do because it's based on a much bigger oceanographic situation of warm seawater.

G.P. Schmahl [02:37:51] So there's a lot of research going on right now about ways to mitigate that. But they're kind of longer-term kind of solutions, if they're solutions at all. There are things like looking at ... you know, some corals seem to withstand warmer seawater and do not bleach, you know, when others do.

G.P. Schmahl [02:38:15] Okay. What's going on there? And so there's a lot of genetic work looking at it. Okay, well, there's something about this coral that makes it more resistant. Can we isolate that thing, that genotype and even kind of culture those kinds of corals, or even transfer genes from one coral to another, you know, to make them more resistant, or looking for a super coral, you know, that can withstand those kinds of things.

G.P. Schmahl [02:38:46] And, while there's been some really interesting research there, I don't really see that as a large-scale solution right now because I think we've just started that kind of research.

G.P. Schmahl [02:39:04] And then there is the physical impacts that we mentioned. Anchoring, of course. Running aground, you know. The Flower Garden Banks are deep enough that you don't really have to worry about running aground, although there are supertankers out there that have drafts, vessel drafts, that are deep enough that could run aground at the Flower Garden Banks, at the shallowest portions.

G.P. Schmahl [02:39:30] And, oil and gas activities - you know, especially when they're putting in drilling rigs. They have to stabilize their vessels, you know, with these anchor arrays that spread out actually miles, in some cases, that can cause direct physical impacts, you know. Impacts from as they're drilling, the stuff that comes out of the hole, you know, goes somewhere, right? And a lot of times those have been just discharged back into the environment: that can come back and settle on top of coral reefs and other marine communities, cause those kinds of impacts.

G.P. Schmahl [02:40:15] And just, you know, general vessel activity that's associated with oil and gas activities, even if it's not direct exploration, things like just transporting crews in and out and supplies and that kind of thing. We've had anchor incidences, you know, associated with those kind of vessels, or marine debris, and discharges of pollution from vessels and from platforms and things of that sort.

G.P. Schmahl [02:40:44] So I think those are the major threats.

G.P. Schmahl [02:40:54] And then there's a whole 'nother issue related to invasive species. And we have that, of course, at the Flower Garden Banks. You've probably heard about the lionfish. And it's a species that is from the Indo Pacific, but has become established in the Caribbean and Western Atlantic. It showed up at the Flower Garden Banks around 2010 or so. We have an active program to try to control invasive lionfish in particular.

G.P. Schmahl [02:41:29] There's a couple of invasive coral species that occur in the Gulf of Mexico. Probably came in on oil and gas platforms. Hasn't shown to be a major problem yet, but could, in the future, as well as some other marine species that are not native to the area and they can kind of throw off the balance of the ecology of these areas that can really cause impacts. So, there's that as well.

David Todd [02:42:05] This is a good, if worrisome list.

David Todd [02:42:10] You know, one thing that I think might be nice to discuss, given your experience in the Keys in creating and monitoring no-take zones. I was wondering if you could talk a little bit about how those rules were developed and how they can protect a reef like the Flower Gardens and why those rules are important.

G.P. Schmahl [02:42:38] Yes. Actually, when the Flower Garden Banks was designated, it was a bit of a compromise. But it was, it's essentially, there's aspects of a no-take zone that was incorporated with the designation in that you cannot take anything from the Flower Garden Banks except by traditional hook and line fishing. So, you can fish out there, by hook and line. And so anything you can catch on a hook, you can take, as long as it complies with the other regulations on size limits and bag limits, that kind of thing.

G.P. Schmahl [02:43:16] But you can't take any marine organism. You can't take coral. You can't take anything, you know, any invertebrate on the bottom. And you cannot spearfish at the Flower Garden Banks. So, there's aspects of some no-take at the Flower Garden Banks, already.

G.P. Schmahl [02:43:39] There's been a lot of interest in making it a true, complete no-take zone. Again, that's a little bit controversial there. You know, people like to fish out there. And I think it's a little bit incumbent on us to show that that fishing has had an impact, a detrimental impact - that it needs to be controlled further.

G.P. Schmahl [02:44:07] I have a bit of a different view, I think. You know, I think there is value to areas of true sanctuaries where nothing can be taken. Just almost on general principle there should be places in the world, you know, both on land and in the ocean where that happens.

G.P. Schmahl [02:44:30] It is obvious that in some cases, and this is shown in other areas, and probably is happening at the Flower Garden Banks too, that removal of the high level predators from an ecosystem, especially for a coral reef ecosystem, has cascading impacts down the food chain to other parts of the community. And of course, that is what is being targeted by people who fish out there. You know, they're looking for, they want snapper, grouper, you know, jacks, sharks. These are those top-level predators that, if they're totally undisturbed, are providing a service, if you will, you know, to the ecological community to keep down other types of species, that allows for the true kind of undisturbed natural balance of an ecosystem.

G.P. Schmahl [02:45:30] It's hard to prove, especially now because there's been so much fishing for so long in most places in the world's oceans that it's hard to even know what that baseline even was.

G.P. Schmahl [02:45:51] And so, there was actually in our management plan that we developed back in 2007 the idea that we are going to look at that. Because there is the opportunity, at least, that the East and West Flower Garden Banks kind of sets itself up as a very interesting research project, where if you closed one to all fishing, all take, and left the other one open, then you could compare what was going on over time and see what kind of impact that closure actually had, and did you get now, did you see more large groupers and snappers and things of that sort.

G.P. Schmahl [02:46:39] That's still kind of in the background. You know, we didn't go there when we did the expansion. But we are, I say "we" because I again, I'm retired, so I don't have

to deal with this directly. But, when we do the next revision of the management plan, hopefully, we will revisit that idea and see if there's interest in going forward with that.

G.P. Schmahl [02:47:05] And there may even be interest in establishing no-take zones, just on general principle, like I mentioned before.

G.P. Schmahl [02:47:13] There are places in the Florida Keys where during the development of that management plan that we did establish as no-take zones. And they're called sanctuary preservation areas. And some of the most common coral reefs, kind of the ones that people are familiar with if you dive down there. Looe Key was one of them. Sombrero Reef, Key Largo, Dry Rocks - some of the very popular dive sites - were established as no-take zones, true no-take zones.

G.P. Schmahl [02:47:47] And there have been some studies that have shown that that has had a positive impact. You do see more fish species inside those area, as compared to the ones that were not established as no-take zones. And that makes divers happy, right, because they go to a coral reef to see not just the coral, but to see all the fish and things that are associated with them. So there's an economic, that kind of economic benefit, that goes along with it as well.

G.P. Schmahl [02:48:21] So. I think that no-take zones are important. And they serve as a very important tool to help manage these marine areas.

G.P. Schmahl [02:48:37] But like I say, it's hard to hard to know what an undisturbed ecosystem even looks like. Because that's a long-term effort, you know, to affect these areas. So.

David Todd [02:49:01] That's very helpful. And it's almost philosophical. Where is the baseline when these areas have been used and exploited for hundreds of years maybe?

David Todd [02:49:14] Well, so let me... I know that you've been very patient with us, and I wanted to to skip through some of the remaining questions and maybe focus on some key ones.

G.P. Schmahl [02:49:26] Could I take a quick break?

David Todd [02:49:27] Of course. Please? Yes.

G.P. Schmahl [02:49:31] Five minutes, and I'll be right back.

David Todd [02:49:33] Yes. Absolutely. I apologize for not asking.

G.P. Schmahl [02:49:37] Okay.

David Todd [02:49:38] Come back whenever you're free. Thank you.

G.P. Schmahl [02:49:42] Okay.

David Todd [02:49:43] Good. Great. Well. Thank you.

David Todd [02:49:47] So, I was hoping we could resume with a question just about the Flower Gardens and what sort of special qualities it has as a protected site. You know, are

there things that we can learn from it, because it is sort of an unusual place - so far north, so deep, so far from shore, maybe more protected than other reefs. Are there, sort of lessons that you anticipate getting from the Flower Gardens?

G.P. Schmahl [02:50:20] Well, I think so. I hope so. We, like I mentioned, we have not seen a decline of coral communities at the Flower Garden Banks that has happened in almost every other coral reef, certainly in the region, and probably in the world.

G.P. Schmahl [02:50:53] Why? Why is that?

G.P. Schmahl [02:50:57] A part of it, I think, is the natural things that we've talked about - just the environment. You know, first of all, it is way off shore. And therefore, it's kind of outside of the influence, primary influence, of coastal runoff. You can look and see that on satellite images, or even after a big storm, even after Hurricane Harvey, for example, when we had all this runoff coming off of this part of Texas, you know. And it just made the water really murky, and it released a lot of other nasty stuff along with it, including nutrients and pollution of various sorts.

G.P. Schmahl [02:51:36] But you can see, you know, that even in that case, it didn't get as far out to the Flower Gardens. Well, almost. There were little fingers of it that did. But, so, it's a little bit buffered from those coastal impacts that you typically see. Coral reefs are near shore, very near shore, in many cases. And so, they're very subject to things that run off the land.

G.P. Schmahl [02:52:03] And then it's deeper than most coral reefs. 60 feet is starting to get pretty, pretty deep in coral terms. And therefore, it is somewhat buffered from seawater temperatures heating up, in general, because it's that top layer of the water that heats up quickest.

G.P. Schmahl [02:52:32] So, it's, you know, it's offshore, it's deep. And also, that location has put it kind of outside of the reach a lot of activities. We do have, you know, certainly, fishers and divers that get out there, but, it's not a casual thing. You need a, you got to be pretty serious to get out there, have a large boat, and it's expensive. So, it does not get the level of recreational activity that other reefs get throughout the world.

G.P. Schmahl [02:53:07] And so, all of those things, you know, I think have contributed to the fact that it's still in very good health, in comparison to other reefs.

G.P. Schmahl [02:53:16] You know, we like to say that it's more resilient than other coral reefs, because of that. I'm not totally sure that's the case, because it may be more able to withstand some of those types of threats, or maybe we just haven't been exposed to that level of threat yet.

G.P. Schmahl [02:53:45] I'm not sure about that, but for whatever reason, it is in good health, comparatively, to other reefs.

G.P. Schmahl [02:53:54] And so, I think we need to find these kinds of areas, you know, here and throughout the world. Where are the places that are doing good? We seem to concentrate a lot on those areas that are really going bad quickly. And we need to do that. But let's also look at these areas that are still maintaining good health and figure out why that is and if we can duplicate that in other areas, and search for those kinds of areas because in some sense, this is a kind of a bank for the future.

G.P. Schmahl [02:54:31] You know, if a lot of these other more shallow reefs, nearshore reefs, are in decline. Maybe some of these offshore reefs will be the reservoirs that keep coral species healthy enough to survive. And maybe we humans can get our act together and figure out how to look at the bigger, bigger picture, buy some time for us, so that coral reefs won't completely be decimated and disappear.

G.P. Schmahl [02:55:08] So, I think that's a big value for these kinds of areas.

G.P. Schmahl [02:55:15] And, you know, again, you can look at those species that are out there and compare them to species in shallow water areas, and some of this research is going on, to see how these areas are able to withstand the ravages of coral bleaching, for example. Is there something inherent, you know, in the genetic composition of those species?

G.P. Schmahl [02:55:46] Or the other really interesting area of research is related to the design of the symbiotic algae itself. It turns out that what type of algae also impacts the ability of a coral to withstand coral bleaching. And that might be another thing that if we can determine that and inoculate corals, more susceptible corals, with this type of symbiotic algae, perhaps that'll help.

G.P. Schmahl [02:56:13] So, I think it looks, you know, as a kind of a reservoir. And it's also kind of just a laboratory, you know, for research that can be used to inform us about the status of other reefs.

David Todd [02:56:31] Okay. And so, you've given us a sort of case for why the Flower Garden reefs and the associated banks are important and valuable.

David Todd [02:56:45] Can you sort of zoom back out and sort of talk to us in general term about why reefs, as an ecosystem, you know, around the world, are important. And, you know, whether it's ecologically or ethically. Is there some sort of a utilitarian reason that they're valuable and should be protected?

G.P. Schmahl [02:57:12] Yeah. Reefs, from the economic perspective are very important, in that they do provide habitat, nursery areas, areas or many species that are important economically, recreationally, commercially. And it turns out that coral reefs just are places where fish species go to spawn, to reproduce, to grow up, you know, and so they're just important in that respect.

G.P. Schmahl [02:58:05] Also, on the economic side, they do provide areas of recreation for people, you know, for divers and for either direct areas where people fish, or providing fish that go swim other places that can be caught and utilized for fishing. And so, there is that that direct economic relationship with coral reefs and the economy.

G.P. Schmahl [02:58:38] And then, to me, you know, they're kind of just important, just intrinsically, you know, as an area of incredible beauty. And just like a national park where you would go and see something that just takes your breath away, provides, I guess, nourishment of the soul in that way. The marine environment, and coral reefs in particular, many people say they go there for, you know, spiritual reasons, if nothing else. You know, it's just so incredibly beautiful and amazing to see nature at its best.

G.P. Schmahl [02:59:33] So, you know, for those reasons, I think these kinds of areas are important.

G.P. Schmahl [02:59:37] Typically, you know, when we're looking at it, we always have to kind of go back to the economy, you know, the economic value of these places. And that is really, really important. But to me, it's not just about the economy. You know, it's just there needs to be areas that are protected for future generations that can be able to experience just these magical places.

G.P. Schmahl [03:00:08] So I guess I'll leave it at that.

David Todd [03:00:13] Well said.

David Todd [03:00:15] So, I guess the last question I wanted to ask you, is, as you look back over your career as a, I guess oceanographer might be one way to describe it. I don't know if that's the right job title. You know, a coral expert? A marine specialist? What sort of lessons have you gotten, and what sort of value do you see in this kind of work that has really taken your interest over the years?

G.P. Schmahl [03:00:55] Oh, that's a good question.

G.P. Schmahl [03:00:59] Like I say, these areas have fascinated me since I was quite young. And so being able to work in a place and a program that I feel has had some impact in, in protecting these areas for, for the future. I mean, it's very rewarding. I feel that the work I've done has contributed, at least in some small way, as being important in just understanding these areas and in providing information to people in general about how important they are and physically protecting them through regulation and policy and management.

G.P. Schmahl [03:01:49] So I think that's the biggest thing for me. I. You know, it still comes back to how, just how, beautiful and important these kinds of areas are. And, it's hard to put it into words about that aspect of it. But if I have helped contribute in any way to maintain that and provide information about that to other people, then that has been worthwhile.

David Todd [03:02:40] Yes. You know, I bet there's an aspect of being a messenger in your career because so few of us have the chance or skill to see these places and appreciate them and have a role in protecting them. So thank you.

G.P. Schmahl [03:02:58] Yes. That's an interesting part about the National Marine Sanctuary program: there is a very large education component to it and so that's been very interesting in being able to do that part of it. Now, I'm not naturally inclined to that all that much, but to be able to get a group of people that can spread the word and be very creative in terms of how they can get the information out to the general public to inspire younger kids to go forward in their lives to make a difference and be environmentally conscious and that kind of thing is a really rewarding aspect of this job as well.

David Todd [03:03:52] All right. Well, I've exhausted a large part of your day, and I wanted to thank you, but before we split up, is there anything that you'd like to add that we didn't touch on? Some gaps, oversights on my part?

G.P. Schmahl [03:04:17] Oh, we covered a lot of territory. I think we hit on most of those. And I know that you're talking to other people as well.

G.P. Schmahl [03:04:30] One thing I didn't go into in any great detail is the monitoring program that we have had at the Flower Garden Banks, you know, and I think there's probably other people you'll be talking to or have talked to that can probably talk about that in some detail as well. But it's pretty amazing. And we have one of the longest coral reef monitoring programs in the world. And that, going back to the logistics of making that happen and keeping that going over the decades, has been quite a challenge. And, I guess people don't maybe realize what goes into getting that information that is necessary to make the decisions about resource management and that kind of thing. There's a lot of stuff behind the scenes that is really, really important.

David Todd [03:05:27] I bet that takes patience and persistence in just maintaining a program over years and years and years, and especially when climate and the overall environment is changing so rapidly. It's nice to have those big datasets.

G.P. Schmahl [03:05:40] Yeah, it's getting to be more important all the time.

G.P. Schmahl [03:05:47] Yeah. Otherwise, no, I can't think of anything immediately that comes to mind that we missed.

David Todd [03:05:58] Okay. Well, maybe the one thing that you've missed is your lunch. So, I'll let you get to that.

David Todd [03:06:06] And, thank you very much, Mr. Schmahl. I really appreciate your time. And, this has been fascinating, really valuable.

G.P. Schmahl [03:06:14] Okay. Yeah. You're welcome. And, if you want clarification on anything that I might have said, I'm glad to follow up on something. Or if I think of something "Oh, my God, I really missed it." - I'll let you know about that as well.

David Todd [03:06:26] Well, I hope we can stay in touch. Thank you very much.

G.P. Schmahl [03:06:29] All right.

David Todd [03:06:29] All right. Thank you.

G.P. Schmahl [03:06:30] Thank you. Bye.

David Todd [03:06:31] Bye now.