

TRANSCRIPT

INTERVIEWEE: Greg Boland

INTERVIEWER: David Todd

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David Todd [00:00:02] All right. Well, good afternoon.

David Todd [00:00:04] My name is David Todd, and I have the great privilege of being here with Greg Boland.

David Todd [00:00:09] And with his permission, we plan on recording this interview for research and educational work on behalf of a small non-profit group called the Conservation History Association of Texas, and for a book and a website for Texas A&M University Press, and finally, for an archive at the Briscoe Center for American History at the University of Texas here in Austin.

David Todd [00:00:31] And I want to stress that he would have all rights to use the recording as he sees fit.

David Todd [00:00:36] And I wanted to just ask Mr. Boland, before we went any further, if that's okay with him.

Greg Boland [00:00:42] That sounds good.

David Todd [00:00:43] All right, well, then, let's get started.

David Todd [00:00:46] It is Monday, February 12th, 2024. It's about 2:45 p.m. Mountain Time, about 3:45 p.m. Central Time.

David Todd [00:00:58] My name, as I said, is David Todd. I'm representing the Conservation History Association of Texas, and I'm in Austin.

David Todd [00:01:06] We are conducting a remote interview with Greg Boland, who is based in the Colorado area, I believe in Loveland.

Greg Boland [00:01:14] Yes.

David Todd [00:01:15] Okay, good. Thank you for confirming that.

David Todd [00:01:18] Mr. Bowen received his B.S. in zoology from Colorado State and then his M.S. in biological oceanography from Texas A&M. And he put that training to work at a consulting firm, LGL Ecological Research Associates, and then, at Texas A&M University's Department of Oceanography and finally at the Department of the interior, in its Minerals Management Service and the Bureau of Ocean Energy.

David Todd [00:01:50] I guess there's a real throughline for Mr. Boland's work and career and life over the years, and that's research and conservation efforts at the Flower Gardens, which involved him doing ecological sampling, underwater mapping and monitoring, underwater photography and videography, and oversight of numerous studies and surely much more.

David Todd [00:02:15] So, I guess the plan is to find out all about the "much more" today. So, today we'll be talking about Mr. Boland's life and career, to date, and especially focus on what he can tell us about Flower Gardens Banks National Marine Sanctuary and its associated reefs.

David Todd [00:02:34] So, before going any further, I wanted to thank you again for doing this.

Greg Boland [00:02:38] Thank you.

David Todd [00:02:39] All right. Well, let's start sort of chronologically and ask you about your childhood and early years. I understand you grew up in Aurora, Colorado, and, maybe you could point to any people or events in that early period in your life when you maybe got interested in animals, the ocean, science. What was your first introduction during that time?

Greg Boland [00:03:07] Well, it's interesting. I guess I probably gravitated towards biology in early life. And I was a Boy Scout from well, even Cub Scout before in, oh, '62 or '63, I think: born in '52, so, Cub Scouts are like ten years old, ten or eleven. But, exposure to the environment of Colorado, and our family camped out a lot. So interested in animals and wildlife and things in the mountains of Colorado.

Greg Boland [00:03:42] And, graduating through school, like, junior high and high school, gravitated towards the sciences and biology specifically. So, that sort of set the path for my career and degrees later on, after even leaving Colorado. And the steps taken to get to oceanography was an interesting one.

David Todd [00:04:10] So it sounds like you had the opportunity to maybe go on some camping trips with your family and also perhaps with Scouts. Do you recall any of those camping trips that were pretty inspiring, influential or memorable.

Greg Boland [00:04:33] The family camping, I think, was frequent, I guess. And we started very young. I have a twin sister. So, I remember all of us in a fairly small tent and camping all over Colorado, mostly.

Greg Boland [00:04:48] But in Scouting, there were pretty frequent camping events. Seems like, looking back at some diaries or some memories before, it seemed like it was every two, three weeks even that an event was planned for camping out. And a couple of them were memorable. Especially there's one, it's called 50-mile hike that Scouting has, where you actually go independent, carrying everything you need, and hike over 50 miles over three days over Pawnee Pass in Colorado. So, that's pretty substantial thing as a pretty young kid.

Greg Boland [00:05:28] And then, this is probably harder to do now. I was just thinking about this. There's a thing called the Polar Bear Club, or Polar Bear Award, where you camp out when the temperature goes, drops below zero. And I've been sort of paying attention over the recent ten, twenty years, even. It doesn't get below zero very often around here anymore. Did actually not long ago. But we would be waiting for a chance to go camp out when the

temperature got below zero. So that was, you get a little badge and a star for more times that you do that.

Greg Boland [00:06:02] So, that really increases your skills, I think, for preparing for cold for one, but, you know, hiking, and then the wildlife and things that you see. Fishing - I remember fishing on that 50-mile hike where you're in the wilderness and a stream probably nobody's ever even been to, and tossing a little fly line into a nice pond and pulling out a brook trout with every single cast for folks to eat for dinner.

David Todd [00:06:28] Oh that's great. What an experience. I love sort of seeing it through your mind's eye.

David Todd [00:06:36] So, it sounds like you already had sort of the bug by the time you were in junior high for an interest in biology. And I was curious if there were classmates or teachers during grade school, or even as you moved into college and your graduate studies, who might have also sort of encouraged that kind of budding interest in natural sciences.

Greg Boland [00:07:07] That's hard to say, actually. I have kind of a distinct memory (I don't know if they do this anymore), but it was in junior high at some point. I think they probably call it middle school now. So, like seventh, eighth grade, they had these big volumes of occupations for, you know, what do you want to do when you grow up. And I did a lot of swimming. And I was always holding my breath, and swimming underwater a lot. And I wanted to get certified in SCUBA diving at some point (this was before then). But, I flipped to the part for oceanographer, and having an interest in biology, and marine biology specifically, and probably watching shows on TV and nature shows, that sort of struck my mind. And I think I marked that down at the time, as, "I want to be a marine biologist". And, it kind of just continued for perpetuity.

David Todd [00:08:08] Isn't that something? You know, you get an inkling, some sort of sense, that this might work for you, and you're, you know, a young person, maybe don't know what all that entails, but you must have had the right clues about it.

David Todd [00:08:28] So, was there any particular teacher or was this something that that was sort of engendered from just your own experience, kind of your own interests?

Greg Boland [00:08:40] I think my own interests probably - probably liking the water, swimming, being underwater anyway, and the animals and things. And then there's kind of a disconnect (it seems like it's fairly common, actually), that you long for the kind of big habitats or natural areas that you don't have in a way. For oceans: I had never been to the ocean for, you know, if you live in Colorado. And we had visited California, but not the water. But you sort of long for a career even related to those places that are way away from where you live.

Greg Boland [00:09:26] And it turned out, I had an employer, actually, in one of my major segments of career. He was from Ames, Iowa. He was a department head of the Oceanography Department at Texas A&M University. So, in the same vein, I never got interested in snow skiing until I went to Texas A&M. And everybody wanted to go skiing all the time. So, I ended up dragging folks from Texas back to Colorado, where my folks were still living to go snow skiing. I got really into snow skiing after I left it. I grow up around it without ever snow skiing.

Greg Boland [00:10:04] But no particular teachers really, I don't remember, but really enjoying classes. You know, I liked physics class in high school and the biology classes and

more kind of exposure to the oceans and the marine sciences, probably from outside venues, and, you know, other kind of media.

David Todd [00:10:32] Okay. So, something that some folks find influential, and I think you may have mentioned this in passing, is just the stuff that we live and breathe in the public media, you know, whether it's TV shows or movies, documentaries, books, magazines. Were any of those important for you?

Greg Boland [00:11:02] Probably, I think. This was funny. I just was looking at that series "Sea Hunt" from the, probably the '60s, the late '60s. And that's on some server through your smart TV. And I was watching a few of those, and I remember how much I enjoyed those, you know, back when they were original.

Greg Boland [00:11:24] And then the Cousteau era: that, you know, even predated me a bit. I think at least, the book anyway, maybe not the movie or videos, but was, called "Silent World", and that was in the early '50s. And so, Cousteau was a kind of an influence, I suppose, and their adventures and, and all of the things that they saw in all parts of the world, and SCUBA diving probably got me interested in diving as well.

David Todd [00:11:58] Yes. Well, this gives us a little bit of a personal background and maybe a good introduction to the next little chapter here that I was hoping to hear from you about. And that regards the Flower Gardens, where, you know, you were very active and involved for many years. And I thought that, as, you know, a place to start this, maybe you can just tell us about the Flower Garden, Stetson Bank, and the other structures in that area, and what their geologic origins were. I mean, why, how were they built up? What was the source of that?

Greg Boland [00:12:39] Yeah, that's a really interesting geological story. And I've done this for some kind of public announcement-type presentations before. But it kind of starts back, well, it's not quite as long ago as Pangaea, before this continent separated, but the Gulf of Mexico was completely closed for quite a while. And, there was a huge layer of salt that built up from evaporation of water that had collected in the basin. And it's like miles thick, actually.

Greg Boland [00:13:17] And as the Gulf opened up, you know, with tectonic movements and plate tectonics, etc., you know, the Gulf filled up with seawater, basically. And sedimentation began. This is early, before the Jurassic even, and sedimentation accumulated more miles thick on top of the salt layer. And that layer of mud, the weight of the mud, basically, pushed down on the salt that caused it to push up into domes. They call them, "salt domes". It's a kind of an equivalency to walking on mud with bare feet, you know, where the mud squishes through your toes in a way. So, the salt pushes up and creates mounds or elevated areas at the bottom, on the seabed.

Greg Boland [00:14:07] And that produced most of the topographic features that are important - they call, "banks". Topographic features are banks in the Gulf of Mexico, including the Flower Gardens. There's two banks there, about 110 miles off of, kind of southeast of Galveston, Texas, right straight south of the Texas / Louisiana border.

Greg Boland [00:14:33] And that salt down underneath pushed the seabed up shallow enough to where it could be colonized by all kinds of organisms, but primarily corals, which is what formed these really unique places that are, not quite technically, but, essentially are coral reefs. The coral is not very thick. It's only maybe ten, twenty feet thick, but it's been growing there for a long time, thousands of years. And, just underneath the layer is a salt

dome, a salt pinnacle or pillar, that had pushed up the seabed, bringing it up from about probably 400 feet deep to the shallowest, which is around 70 feet deep.

Greg Boland [00:15:22] So, it's a fascinating place, and it's far enough offshore, that the water is warm enough, not too cold to kill the corals in the winter. And, the depth is actually a good thing these days because it's insulating it from the warm temperatures of climate change that's really devastating reefs in other parts of the world.

David Todd [00:15:46] It sounds like it's not too hot, not too cold. It's the right porridge.

David Todd [00:15:57] And tell me how these reefs were discovered. I mean, 100 miles offshore. It's probably a pretty isolated, remote place and underwater as well. How was it first seen, located and reported?

Greg Boland [00:16:14] Yes, I understand that, it was really known or familiar by the fishermen of the Gulf of Mexico - snapper fishermen, probably primarily. And this was in the middle 1800s, when there was red snapper everywhere in the Gulf, and no regulations, of course. And, it was likely visible from the surface. You can even see it now. On nice clear water days, you can see the bottom at 80 feet deep, it's so clear.

Greg Boland [00:16:49] And so, that's, people speculate, that's how it got the name of the Flower Gardens, because it kind of looked like flowers. And then they probably brought up chunks of coral or other organisms up on anchors. So, it looked like a garden of some kind. So, that's in the 1800s.

Greg Boland [00:17:07] But, it was not really studied. There was some geological work that was done in the '50s. And the first biological surveys of any kind, just observations, were made in the '60s. And in the late '60s, they came across an opportunity to use a Navy destroyer and a number of scientists in Texas and other areas did several trips out there to survey and collect things in the late '60s.

David Todd [00:17:44] Gosh. From modest beginnings, you know, something really amazing comes.

David Todd [00:17:51] Well, as you said, you know, it took a while for this to be recognized and described. And I guess, again, this remote quality to the reef was part of that. So, I thought it might be good to talk, before we got too far along, and understand more about how people, visitors, fishermen, you know, recreational divers, might have gotten access to the reefs. Maybe you can tell us a little bit about the ships that provided you know, diving platforms, ways to access them.

Greg Boland [00:18:34] Yeah, that's one of the challenges and, probably in a minor way, kind of helped protect them in a way from a lot of traffic. Like the Florida Keys are just deluged by, you know, thousands of people a month. But, there, being so far offshore, before a commercial operation in the, I guess it was, early '80s. Before that, it was just recreational boats that knew about the area, would go out for, you know, recreational SCUBA diving.

Greg Boland [00:19:06] But the research was done on research vessels of various institutions. Gyre was a 174-foot research ship owned by Texas A&M and stationed in Galveston, Texas. It did a lot of the work there at the Flower Gardens and all the other banks as well, topographic features. There's probably 35 total. So, those big ships can take out, you

know, a lot of scientists. And they get contracts from the government and other sources to study all the banks and did that early Flower Garden research as well.

Greg Boland [00:19:44] And then, divers now are, there's only one really that remains. There was two for a while and occasionally three. But they are converted crew boats. They're used by the oil industry. They were used to ferry crew people to offshore oil and gas platforms, and they're pretty fast. They're aluminum-hulled, about 100 feet long or so. The one that's still in service called, M/V Fling is still going out pretty regularly and taking recreational divers. And they actually service or allow research entities like the Flower Garden Sanctuary to use them quite a bit to go out and do research trips as well and charter out to them.

Greg Boland [00:20:30] So, it's even on that fast boat, it's about seven hours to get out there. So, it's a ways to go and a fairly major endeavor to consider a dive trip. And typically they are three-days. You go out the night before and you spend one or two days on the Flower Gardens and stop on the way back in on the third day. So, a little expensive too, but definitely worth it, everybody says.

David Todd [00:20:57] Oh, I bet.

David Todd [00:20:59] And I guess these, these, converted crew boats, now these, you know, dive ships, they don't just have a motor and a hull, they've got to provide support for divers. Can you talk about some of the decompression chambers and mixed gas systems and other things that are required?

Greg Boland [00:21:23] Yeah, they're not that sophisticated. I have been on a ship or two that had those sort of facilities, but the Fling has probably the classical one that is similar in other places like California or wherever. So, the dive boat itself has to have an air compressor. And these days they use an enhanced oxygen mixture they call nitrox, even though air is really nitrox, but it's higher than on the 20, 28% normal. It goes to 32 or 36% of oxygen. So, they have a mixer and can fill nitrox tanks.

Greg Boland [00:22:03] But you have to have an air compressor anyway for the multiple divers. You have everybody, there's thirty-something people that have a tank. They're just lining the seats in the back of the ship. And so, you have to fill those every time they come up. And they can make up to five dives a day. So, they're filling a tank five times per day for every person on the boat.

Greg Boland [00:22:23] So, otherwise the ship is, they have triple screws, these crew boats. So, they're pretty fast. And they have to have all the standard safety things that the ships have. And, for decompression wise, it's mostly treating, you know, first aid. Oxygen treatment is the primary care if you have the bends or air embolism of some kind. And then you can evacuate by a Coast Guard helicopter. They usually call to get somebody off that boat back to shore to a real decompression chamber, like in Houston or Galveston.

Greg Boland [00:23:02] And, the only boat that I had in doing some work on was a NOAA ship. At the time, it was used for submersible, actually. It's pretty small. It was called the Edwin Link at the time. They changed that name. It was leased or used by NOAA and they outfitted it with a bell. That's for bell-diving. It's like a hemisphere on a big frame with gas bottles. And it's lowered down. And you go in, two divers go in, with umbilicals and face masks. And they lower you near the bottom, and you can go out and swim around with gas supplied from the surface.

Greg Boland [00:23:46] And that used heliox, a mixture of helium and oxygen. And, it's much better than nitrogen because at depths, deeper depths, anyway, nitrogen affects your clear thinking. It's kind of like being inebriated if you get down below, 150 feet for some people. But we did a little bit of work around 200 feet on the Flower Gardens, just on one project we had. And it was 1981, I believe.

Greg Boland [00:24:14] And, so that did have a decompression chamber and could treat people because of the oxygen toxicity you can have a problem with. If the oxygen concentration is too high, at depth, that causes problems and convulsions even, or decompression sickness, which is not so much of a problem without nitrogen being in the mix. So, that was quite a interesting expedition.

Greg Boland [00:24:42] And that was actually the same time we were doing another Flower Garden cruise on another ship right next door, you know, on another area of the same bank. So we transferred back and forth for doing stuff on both ships. So that was a good year.

David Todd [00:24:57] Well, you mentioned, the Edwin Link. And, I understand that you took trips as early as 1975 on submersibles to the banks on the Nekton Gamma was one, and the Diaphus. I guess there were maybe others. Can you talk a little bit more about those vessels?

Greg Boland [00:25:22] Yeah. Back in those days, you know, the Gamma is a little bit of a quirk there because they had used it extensively before I became a graduate student with Tom Bright at Texas A&M and did a lot of work in the early '70s. And it had kind of left the scene at the time I became a graduate student.

Greg Boland [00:25:46] And the oceanography department at A&M in College Station had obtained a new submersible called the Diaphus. It was a little two-man sub that could go to about 1200 feet. And they started using that during these fairly extensive contracts that they had obtained from Bureau of Land Management. That was before the day of Minerals Management Service was created in '82. So, in probably '74, just as I was coming in to A&M, they were beginning these projects, exploring and documenting all of the topographic features all through the Gulf, the Northern Gulf, including the Flower Gardens. And so, that included, using this new submersible, Diaphus.

Greg Boland [00:26:39] And as graduate students, there's several of us that were pretty close. We are all in the oceanography department and had little cubicles near each other and went on most of these cruises together. And, well, we wanted to help out with the submersible work. And typically, professors, you know, the senior types, would make the dives.

Greg Boland [00:27:05] There's only a pilot, there's only three, maybe three of those, that were even qualified to run that thing. And then one observer sat in front of this three-foot acrylic dome, half-dome in the front of the submersible and made the observations. And there was a real crude video system and take pictures and make recordings, audio recordings and describe all the things that they saw on these banks in the Flower Gardens.

Greg Boland [00:27:31] But we got to help in the retrieval. And the launch was not an issue, but retrieval - and they even do this with more modern submersibles - you have to get a line, a lifting line onto the submersible to lift it back onto the ship. And almost everybody has some person that has to jump in the water at some point and hook the thing up. So, we were doing that, helping the recovery of the submersible.

Greg Boland [00:27:59] And in all the work I did on these cruises, I only got to make one dive on the east Flower Gardens in 1975.

Greg Boland [00:28:08] But, as a student, a graduate research assistant, I did a lot of work back in the lab, analyzing these videotapes. It was a reel-to-reel one-inch, the reel-to-reel videotape that I guess was used in schools back then and analyzed all of these tapes, probably a couple hundred of them, at least, taken of all of the banks, several years of work, mostly analyzing the fish observations, but also correlating the habitat type and the depth of observations into, what became reports of the contract that was written at a later time, after our cruises were finished.

David Todd [00:28:55] It's such a reminder of what an exotic, foreign and, in some ways, you know, a dangerous place to go.

David Todd [00:29:05] You know, one other question I had about vessels: I think that, you also relied on some of these inflatable craft, like Zodiacs. Is that part of the gear that you might have used for access?

Greg Boland [00:29:21] For sure. Yeah, those. It's a brand, I guess, but they were really well respected. I guess they're French initially, and I think they make them in the U.S. now too. But they're quite the state-of-the-art and standard, really sturdy inflatable. They're inflatable boats. They even have an inflatable keel and roll up into a, oh, it's probably the size of a small desk, I suppose. But, it has hard flooring that you put in that keeps them rigid. And it can take a good size outboard. We had like a 40-horse outboard on one of them at one time.

Greg Boland [00:29:56] But the smaller Zodiacs, that's how you kind of get the person in the water to jump in and retrieve the sub. And then we'd dive off of them, if the ship was doing some sampling. We could take divers off to the shallow part of the reef and do a SCUBA dive while you're floating right above. So, those were quite the workhorse. We used those many, many a year, many cruises.

David Todd [00:30:23] Well and, I guess, just to set the scene a little bit more ... so, you're off 100 miles from shore. This is deep blue water. Can you describe the seas that you might see there, on both a placid day and maybe a stormy day, too?

Greg Boland [00:30:44] Yeah. I've seen a lot, I guess. Calm days, of course, are the best.

Greg Boland [00:30:52] But, the Zodiacs, we even used in pretty significant weather. When you go out there, and it's a really limited time frame - you have the research ship or charter vessel that you have available (and they're really expensive too, if you're having to pay for it). So, we've gone out in these little 12-foot Zodiacs in significant seas, you know, 8-foot seas, sometimes even a little more, where you go up over the crest of a wave, and you have to kind of move towards the bow of the boat so it doesn't flip you over backwards.

Greg Boland [00:31:28] But, the other heavy weather: there was, that's maybe a good side story was, oh, I remember the year now. I think it was '91, maybe. They called it the storm of the century for the Northeast - those huge storms. But we were on the Gyre and doing a little diving off of Alacran Reef off Mexico, to the north of Yucatan and putting in an instrument in shallow water, actually. And these looming clouds coming over the horizon. And, thought,

"Well, maybe we'd better get back to the boat, back to the ship, the Gyre, this big 174-foot ship".

Greg Boland [00:32:14] And just as we were getting on board, this front came through, and the wind got up, probably over hurricane force, I would think. And we had to move away from shallow water and had to steam around for quite some time there. And this was like 20-, probably 25-foot seas where, you know, in the back of the boat there was part of that crane area. It was above, it was on top of the deck, and then this thing was six feet above the deck, and waves were going over the stern, over the base of this little crane. So, it was pretty spectacular. We were on the second deck of the ship and the crest of the waves, you could see above your head, even then. So that was probably the worst storm I've seen, you know, wave-wise.

Greg Boland [00:33:07] That's not the biggest kind of waves there are. But, being on a ship in 25-foot seas is pretty substantial.

David Todd [00:33:14] Oh, I bet. That makes you really respect, you know, the forces of nature, Mother Nature.

David Todd [00:33:23] Well, so I guess part of these visits offshore were to map what you were seeing and try to report back with some sort of coordinates and grids and ways to orient people as to what was underwater that you were seeing and recording. And maybe as a place to start, we could talk a little bit about some of the sand flat buoys and flags and beacons and pingers that you used to try to start mapping some of these features that you were seeing.

Greg Boland [00:34:07] Yeah. The actual mapping of the banks: that was kind of done in broad way by side-scan sonar. That was cruder back then, but they had a general picture of the topography of the bank and not much more detail. But, you know, the navigation system until ... oh, wow, I forget when they invented GPS (it was scrambled for a while too). But at the time we were out there in the '70s, it was the kind of the third iteration of LORAN, called LORAN-C. And, kind of all ships used it - shrimp boats, you know - for navigation in general, everybody.

Greg Boland [00:34:55] It was a little crude in a way, because you had to have a source from land, two sources, really, for a triangulation sort of thing, to figure out where you were on a map, basically. And each LORAN unit on each ship would kind of differ, so if you didn't have the same one, you were already kind of shooting in the dark a bit because of the calibration, etc. But even the same one on the same boat, going back a separate time, you wanted to find a place where you, say, installed a photographic station or were doing some experiments, you were really hard pressed to find that spot. You just stopped when the LORAN-C said, "Here we are", and got in. And you'd be lucky to be within 1,000 feet sometimes.

Greg Boland [00:35:44] So, we had to develop little tricks and nuances on how to improve our predictability and our success rate. So, a lot of times we do a pinger, which was kind of pricey even then, that would send out a signal that would last a year or two. And you would have a receiver and you'd throw a flag in where you thought the station was or the area that you're working in. And, at one time, it was so deep that it pulled the flag underwater and disappeared under the surface since we were so far off. We were like, you know, 50 feet deeper than it was supposed to be. So, we ran out of line, and the weight of the anchor was too much for the buoy.

Greg Boland [00:36:32] But if you got a flag and then you put divers in and listened for a pinger, if it's still working, hopefully. And it was a 50/50 chance of which direction to go. So, you'd swim one way and see if it got stronger, and then back the other way, if it wasn't, and hopefully see something that you recognized.

Greg Boland [00:36:52] And then we tried towing divers. And that wasn't too bad, if you have these things called little sleds. Basically, little vanes of different materials that have handles on them that you could use with snorkel or even SCUBA gear, and dive down and get towed along behind the Zodiac and see if you see a sand flat or something recognizable. And you'd drop off and say, "Here, this is it. Here, drop another buoy here".

Greg Boland [00:37:18] So, that was time consuming for sure. So, we definitely valued the invention of GPS. And then they finally decided not to screw it up for everybody for supposed military security. And now you can find something within two or three feet.

David Todd [00:37:39] Wow. That's some progress. That's great.

Greg Boland [00:37:45] So, I think that you also were working on trying to develop some deep water environmental grids, that I guess would help give rows and columns or, you know, some sort of network that you could pin down locations within that grid. Is that right?

Greg Boland [00:38:10] Yeah, that's kind of a different era. And maybe a different story, actually. That was during my time with the Bureau of Ocean Energy Management and, and for deep, real deep waters. This is below 1,000 feet even. And, there's a concern by management, by just the general management of MMS in particular, and even Interior, over the potential impacts of offshore oil and gas development on deep water, because, you know, things were moving into deep water all the time, even from the '70s where things moved out towards the Flower Gardens. And that was deep even then at four or five hundred feet. Platform technology was just getting to that point.

Greg Boland [00:38:59] But they started developing systems for the continental slope, you know, even below 1000 feet. And now they can drill in 10,000 feet of water. But there was a general need for some way of broadly confirming that our mitigation measures, you know, the protocol or practices that were designed to reduce or eliminate environmental impact to deep water habitats, which there are many.

Greg Boland [00:39:34] There's soft mud bottom that is generally not a concern for impacts like dropping an anchor in mud. But there are hard bottoms and different kind of communities. There's even deep sea corals and also chemosynthetic communities, which is a whole story to itself, that were just discovered in the '80s that we wanted to protect because, you know, just because you don't want to destroy things if it's not necessary and it can be avoided.

Greg Boland [00:40:04] So, I was sort of the lead on figuring out a way of how we would divide up all of the continental slope of the Gulf of Mexico into some reasonable number of sectors or grids, as we called them. And one natural tendency is to say, "Okay, let's go by longitude, some number of degrees of longitude and then by depth".

Greg Boland [00:40:32] So, if you did it probably optimally that would be hundreds of areas. So, you wouldn't generalize any large area of the deep Gulf the same way. But that got too unwieldy because you'd have to assign certain requirements to study or evaluate the impacts

to that particular area. So, you didn't want to have to require that for hundreds or even thousands of grids.

Greg Boland [00:41:02] So, it ended up being, I think it was, 21 different sectors in this grid system based on, it was three depth intervals. And then, you know, from starting at about 1,000 feet, and then the deepest was 3,000. At the time it covered most of the continental slope. And then longitude into what ended up being 21 different grids.

Greg Boland [00:41:32] So, each one of those could be cleared, kind of in parentheses, cleared by an in-depth environmental assessment by whatever company, oil company, had to do some operation - drilling or survey or exploration activity of some kind that was potentially impacting. So, they did an environmental, or MMS did an environmental assessment, required a lot of information from the operator.

Greg Boland [00:42:01] And, also related to that, was at a structure, when it was anchored there or otherwise emplaced, they were required to do a survey using their remotely operated vehicle. Typically, exploration drilling platforms have this pretty elaborate, expensive, remotely operated vehicle. It's a robot submersible that they can lower down to the bottom. These are for inspections of their, underwater structures and drilling and such.

Greg Boland [00:42:35] But we required them to do these little transects away from the platform to see, to make sure that they missed these sensitive habitats. So, I think basically in all cases, except for maybe one minor one, that had proved effective, you know, our ways that we avoided these sensitive habitats using information from seismic surveys and our own mapping and information of where these places were, and they had to avoid them.

Greg Boland [00:43:11] So, it proved out pretty well. It didn't quite go through a whole history of all 21 being cleared, you could say, but, enough to where they said, "Well, I think we know what we need to know". And they dropped it a few years later. But it proved to be pretty effective. So, that was the environmental grids.

David Todd [00:43:32] Well, and just, to get a sense of the resolution of these: a typical grid might be how many feet or miles on a side?

Greg Boland [00:43:43] Let's see there, depth-wise, that was real variable because the slope drops really fast off like areas off Louisiana, it'll go from 1000 to 2000 feet in just a few miles. In other places, they were huge. They were, maybe the depth interval was 50 miles, north and south.

Greg Boland [00:44:06] And then east and west - trying to just imagine this in my mind - there was probably, oh, let me think, six, probably six vertical strata or segments. And those were, I guess about 20, maybe 30 miles, 20 to 30 miles, east and west. So those were set by longitude, but the depth could be ten miles or 15 miles, say.

Greg Boland [00:44:38] And then typically where the depth drops gradually, that's almost all similar habitat. Even though it's over a long, long distance in the deep Gulf.

David Todd [00:44:48] I see. Okay. Well, thanks for walking me through this.

David Todd [00:44:53] I thought while we were talking about efforts to map and sort of get coordinates for where features and living creatures might be, I think that you worked under

Tom Bright's direction in the '70s on a 3-D perspective diagram of these offshore reefs. Can you talk about what you were trying to do there, and what you accomplished?

Greg Boland [00:45:22] Yeah, yeah, that was the first one that he did. That was right as I came in in, well, '74 actually. And all of this information had been gathered, off the Diaphus mostly, with the observations and video and descriptions of the people making those dives. And so, all this data was present and just hard to describe in one piece from just enumerating, "I mean, we saw this fish at this depth, this fish and different habitat at this depth", so and so.

Greg Boland [00:45:57] So, Tom Bright had this amazing idea of presenting it as a perspective diagram, and using all of the data, you know, the depth of each observation and kind of the key animals and fish and corals, shallow, and different types of animals. At deeper depths, the coral disappears. And then at the very bottom it's just mud, more or less flat bottom and mud bottom, down below, say 400 feet.

Greg Boland [00:46:28] So, I got a drafting table and kind of described his inspiration and I struggled for a while and said, "How are we going to do this?", and just started drawing a line on a piece of draft paper and it was, you know, tilted, I guess, maybe 45 degrees or so, like you're looking at something at an angle, 45-degree angle, to see all of its detail.

Greg Boland [00:46:58] And so, I just did the trace of all the submersible observations over time as it went from the crest to the bottom. And so, you get the shape of the bank, basically, as if you were following the contours to the bottom, and then transfer that same graph, or same line, a distance away on the paper, and then, fill in the features in between.

Greg Boland [00:47:22] So, like at the top there are these mounds of coral. And the artist did that. I didn't try to do the pictures. But so, after sketching it out, you know, it worked out pretty well where the contours were representing the real feature in like an image, only it was just a 3-D picture. And then an artist, a guy named Jeff Turner, I remember, he signed it originally in '75 when he finished it. He drew the critters, like a manta ray at the top, and the coral heads, and then down deeper, other, other features - these nodules made out of calcareous algae. And then, at the bottom would be like brittle stars and just mud bottom, etc.

Greg Boland [00:48:08] So, that was like the model for what he did for every other bank - probably 30 something other banks. He did these 3-D perspectives. Of course, they're all different and different elevations and different perspectives of the depth contours. But it was really done really well.

David Todd [00:48:26] That's powerful to help people visualize things that, you know, the vast majority of us will never see, and to do it in an accurate way, that reflects what you measured. That's terrific.

Greg Boland [00:48:40] Yes.

Greg Boland [00:48:42] Well, so it sounds like these maps, help pin down a lot of the observations and surveys and monitoring that you did.

David Todd [00:48:52] And I think if I read right, the Flower Gardens is really remarkable in that you've got this long-term dataset of observations about that area from, I think, 1988 to 2019 with very few breaks. And, I was wondering what some of the major themes were for that monitoring that you were doing with your colleagues.

Greg Boland [00:49:21] Sure. Yeah. Maybe even to step back a little more, the industry was involved early on, in the '70s. It kind of started on the West Flower Garden Bank, and there were some monitoring done then, and even '75 was the first exploration well at the East Flower Gardens. And that was likely related to that submersible dive I made in '75 was looking for any obvious impacts from that exploration drilling.

Greg Boland [00:49:56] And then in the '80s, early '80s, there was some work, some contracts, led to LGL as one of the career paths I was on there with a consulting firm. I did a lot of monitoring through Minerals Management Service, also a big EPA study looking at general impacts of offshore oil development and set up some repetitive transects or photographic stations.

Greg Boland [00:50:31] But it wasn't really intended to be ultra long-term. They were revisited and, a general sense was determined for the health of the live coral cover.

Greg Boland [00:50:43] That's, I should step back and say that's the key organism that's building the reefs, obviously, the coral reef. The corals are the most important thing. So, you want to monitor how healthy the coral is and how much live cover has shown over time. So, that started even in the '70s.

Greg Boland [00:51:06] And then, along the way it was decided that this should be more fixed stations that are permanent, basically long-term, meaning more than just for a particular monitoring of an operation of a particular company doing some drilling or whatever and proving that that didn't have any impact at that point in time.

Greg Boland [00:51:32] But to start something that would monitor the whole status of the reef from all impacts, or just in general, just general habitat condition, and over time.

Greg Boland [00:51:44] So, this was an MMS contract to Texas A&M and that's where I was at the time, actually beginning in 1988. And the West Flower Gardens had a set of permanent posts. They were bronze, actually, that set up some permanent stations there. It was for an oil company, but they were a lot more with longevity in mind, to go back over time. And they had ended that study, though, but they were still there. But the East Bank didn't have anything like that.

Greg Boland [00:52:19] So we started in December of '88 and picked a spot. I think we decided a 100-meter grid, a 100-meter square, that we would set up a whole monitoring area that included these permanent posts, larger posts that we would take an image of. With some variations on that technique, some pins at the edge of live coral and dead coral margins, where we would take pictures of the margin of a particular coral, just only 6 or 8 inches across, and see how that living margin was doing over time.

Greg Boland [00:53:03] And then a number of other kinds of monitoring aspects, like water quality and larger transects of video, where you'd take video transects over the whole boundary of the study area, 100 meters on two sides, so like 200 meters of video transects.

Greg Boland [00:53:24] So, these stations became the first on the East Bank, and then we continued to use the ones on the West Bank. So, those have been re-photographed over every year. It was 2000 ..., what was it now? I forget the missed year. 2009 was missed. And then,

even now they're still doing it. I think they missed one year from COVID actually recently, but there's pictures of the same station that started in 1988.

Greg Boland [00:53:55] And actually the coral heads are growing, incredibly, between '88 and just recently, the last couple of years. So, those are demonstrating the extreme health of the Flower Garden coral reefs.

Greg Boland [00:54:13] And, we started (I was kind of directly involved in this) this push, I suppose, to do deeper stations. The climate thing was on people's minds, you know, even 20 years ago. So, knowing the top of the Flower Gardens was 70 feet, there's still, there's times when you would pass through green kind of fresher water near the surface, and different temperatures in the winter, you know, as you get down. And it wasn't too far from the top of the reef, even in the '80s.

Greg Boland [00:54:46] So I thought we should really set up some permanent stations down deeper on the banks, as we can do safely. So, we set up, ten. I think there's maybe 20 now, 20 stations below 100 feet. So that's a little more serious diving on air.

Greg Boland [00:55:06] But, those stations are now both on the East and West Bank. And the coral down there is even healthier than the coral on the top of the bank. So, these are probably the highest coral cover, living, thriving coral cover of anywhere in the Caribbean. It's over 50% live coral cover since measurements began, and it still is 55% now, I think. And the deep stations are around 70% live coral. So, it's really a good record on a good history of what's going on.

David Todd [00:55:46] Well, that's neat. And, I gather that that. You need to make dives, to gather all this information. And my understanding is that your first dive, a scuba dive, was in June of 1975, and I was wondering if you could just tell us about that, that first impression of being underwater and seeing the reef.

Greg Boland [00:56:15] Yeah. Yeah, that was a pretty incredible sight. Being a graduate student, I was with another student that had been with Tom Bright a year longer than me. And so, he was, you know, pretty gung-ho. And back then it was these steel SCUBA tanks. So only 72 cubic feet, about half of what people use now. So yeah, seeing it for the first time was kind of as you'd expect. I'd seen the book that Tom Bright did in the '70s and kind of knew what it should look like, but, you know, seeing it in person - the fish densities, just so amazing.

Greg Boland [00:56:51] And I forget what our task was to do, but I was burning up the air pretty fast and had to disappoint my dive buddy a bit to have to come up after like 15 minutes, rather than I should have been more like 30, because of the excitement level. So, that was a good dive.

Greg Boland [00:57:10] That was actually my first, oh, you call it open ocean dive. I'd been to lakes and offshore Mexico, you know, shore dives and things, but only like 30 or 40 dives before that. So, that was an exciting time.

David Todd [00:57:28] I bet.

David Todd [00:57:30] So, it sounds like, some of your monitoring and diving work happened under the aegis of Marine Technical Consulting Services, which, I guess Dr. Bright and you and others, started laying out in the mid '70s. Is that right?

Greg Boland [00:57:49] Yeah, that was kind of a short-lived, side business you could call it, I suppose. It was during that era that oil and gas companies were required to do these monitoring tasks that was required by BLM back then for pre- and post-drilling of, say an exploratory well.

Greg Boland [00:58:14] So, I guess they approached Tom, either for working with them or for performing the work. So, he actually created this little company that included him and Richard Rezac as a geologist, geological oceanographer, with A&M, and, one of the technicians down in Galveston, was Dave Barrow. So, that was kind of the three principals. But they hired, we kind of made good little service fees for, you know, for graduate students who were only making 300 dollars a month back then. So, "Yeah, I'll work for this little company and go out and do some diving work on the side."

Greg Boland [00:58:56] So it was, I guess, two trips out on one of their service boats, just a big old flat deck, I think it even hauled drilling mud or something, but I dove off it. I took a compressor out, dove off this big old service boat and did some photography and, you know, kind of early monitoring work, to demonstrate that their drilling muds and cuttings and things didn't get up on the reef, that they were tasked to demonstrate.

David Todd [00:59:29] Okay.

David Todd [00:59:32] Well, so while we're talking about what's on the bottom, I think it might be good to know about your benthic ecology studies and what some of your major research interests were at the time.

Greg Boland [00:59:49] Yeah. So, I guess, you know, the Flower Gardens are included in that, but, as I moved into the government job with the Minerals Management Service. That was in 1998. And the position was kind of tied to the environmental policy, or NEPA, documents that the government writes, you know, describing impacts to the offshore habitats and such, on chemosynthetic communities.

Greg Boland [01:00:24] And I had had some experience with that with the company I was with initially, the LGL Ecological Research. We had a deep sea study that I was a principal investigator for and I used a camera. I built this, or copied basically, a camera sled that was used by Woods Hole. And it had a deep sea camera and strobe and a device that would tell us how high off the bottom it would be.

Greg Boland [01:00:57] And that was used to survey 60 different stations all over the deep Gulf, went from probably 300 meters to over 3000 meters and put these images on long rolls of film, like 800 images of film on each station, and did all the analysis of those pictures. So, during those images, the camera tows, I saw, I recognized the first time that was seen in the northern Gulf are these things called tube worms. They're animals that live off of hydrogen sulfide, and other animals, called mussels, that are common things, like off California. But these were, chemosynthetic mussels living on the seabed where they live off of methane gas that is seeping out of the bottom.

Greg Boland [01:01:57] So, we saw these things on the film that I was towing around with this camera framer. And that was the first time that had been seen in the northern Gulf. They had been discovered by the Alvin submersible off Florida, I think, the year before, actually. So, that was '84. This was '85.

Greg Boland [01:02:20] And then, got a contract modification from MMS back then and got the Johnson Sea Link submersible to go out and see if we could find one of these habitats that were expected to be the source of, where these communities would live. And it was based on geological formations that are related to the salt domes again, actually, where salt domes rise up and they cause faults, and these hydrocarbons, oil and gas, seep faults and they leak to the seabed. And these communities form of tube worms and mussels and other things and even tied to deep sea coral reefs too that we can talk about later.

Greg Boland [01:03:08] But, I was a chief scientist, actually, on this first trip in '86 using the Johnson Sea Link submersible. And we had to acquire, or rent a ... it was not side-scan ... it was a penetrating sort of a sonar that would illuminate the seabed and figure out where these sorts of features, where the salt dome would come up and, it would show a wipe-out zone, where the signal is wiped out from the sonar, and a likely place where these communities might be.

Greg Boland [01:03:51] So, I saw a really classic spot, based on some other general information from maps and things. But I saw it on the sonar and launched the submersible on that area, and I got to (nobody else wanted to waste a dive if they didn't see anything), so I got to be in the sphere, the acrylic sphere of this Johnson Sea Link submersible. It's a big acrylic thing. And they can they can go down to 3,000 feet. But, came up on this mound and up the side of it and saw this first community of chemosynthetic tube worms and mussels and things for the first time in the northern Gulf and, actual bubbles coming up through the mussel beds and the tube worms were all in the same area and living off of these chemicals.

Greg Boland [01:04:41] And, what makes that really unusual is that, that's what they use for their energy. They don't need the sunshine for anything other than keeping the oceans liquid. But that's their source of food. They do use the oxygen in the seawater, but not for food. So, that was the beginning of chemosynthetic community research in the northern Gulf.

David Todd [01:05:08] Boy. That's such an alien life form. You think about all that we might see, mostly, I guess, relying on oxygen. But, this seems very different.

Greg Boland [01:05:23] So, it sounds like a lot of this was remote sensing, looking at videos and still photos. I'd love to hear about the gear that you used, to capture some of these. I think you mentioned the sled, I guess, that you would tow and that the camera would be mounted on. Is that right? And then but you had eye bolts and floats and lines and tape measures and this camera had a special framer. It sounds like a pretty high-tech rig you got.

Greg Boland [01:06:01] Yeah. Yeah. The, the deep sea one was this big frame with all of the camera apparatus inside of it, and you could control how high it was off the bottom. And actually, the camera has a link to a separate instrument called an altimeter. So, it recorded how high above the bottom it was. And so, each image had information about its depth and the altitude above the bottom. So, you could calculate the exact area that this camera was seeing. It was vertical: so, looking vertically downward. So, the target was about two square meters.

Greg Boland [01:06:42] So, part of the analysis of those images, which took over a year, was to both measure you could use a planimeter, you know, a measuring tablet to measure the sizes of fish and features and things, because you knew the exact area of that picture, and then calculate densities of, you know, this shrimp or this fish (they're pretty rare in the deep sea),

but you could still see how big they were, and things that the trawling sampling would miss, which was quite substantial in some cases. So, in the deep sea, that was really a huge plus.

Greg Boland [01:07:22] And, you know, later, in some of these big studies I did more recently, like in the 2000s, well, we'd use these big ROVs (remotely operated vehicles) and submersibles like the Alvin and they, you know, take video and have lasers that measure the separation, how big things are by the separation of the laser beams and things.

Greg Boland [01:07:45] But those were kind of hard to come by back in those days.

Greg Boland [01:07:51] As far as the Flower Gardens ... it has used a camera apparatus I designed and operated the whole time was sort of good in some ways, but it was actually 3-D video. It used two video cameras that were mounted in parallel and you would calibrate them by using, a diver or some object pulled out in shallow water and see what the separation of the image was on a TV screen. And then, so when you, you didn't have to see it in stereo all the time. You had a switch. So when you saw a fish on the Flower Gardens, you'd flip a switch and you'd get a double image, and the separation of those images you could use as a scale to see how big the fish was. So, that was kind of cool in a way.

Greg Boland [01:08:48] There were a lot of problems with cables. We'd always get a little nick and flood the cable. We'd have to take it back and get a new cable. But, it was pretty unique. And so, allowed the estimation: you could partly tell how far away you were looking to count fish. You can pan it back and forth. It had a pan and tilt mechanism, they call it, so you could turn the camera and the video all the way, 180 degrees, and then, get measurements of fish or coral heads even, and document the size of things, but mostly for fish lengths, as it's being drifted along.

Greg Boland [01:09:27] So I used that on a study from, like it was '81 to '83, believe. And ended up with 350-something hours of video, video transects over both East and West Bank. We put it down on top of the coral reef in shallow, and then just let it drift wherever the wind was blowing, basically, and lowered it down to keep it really close to the bottom, until it got down to the mud bottom.

David Todd [01:09:53] That's extraordinary.

David Todd [01:09:54] And just so I understand this, the camera, I guess, is drifting and it's looking down. How high above the seabed would it be?

Greg Boland [01:10:05] Yeah. The one, the deep sea one was looking straight down and that was two meters, like six and one-half feet. And then you would lower it with the winch. You'd have a trace on a little echo sounder. And you'd have to talk to the guy on the winch, say "Lower it, you know, one meter or raise it one meter", every couple minutes.

Greg Boland [01:10:26] And then the one on a Flower Gardens was more horizontal-looking. So, you're real close to the bottom, and too close sometimes: we'd bounce along and kind of scrape stuff. But it was looking out horizontally at the habitat and the fish, as you pan around 180 degrees. And that would drift lower and lower. You'd tilt it down some, you know, see things, if you're very high off the bottom more than a couple of feet, but, you'd try to keep it as close to the bottom as you can and look out horizontally at things.

David Todd [01:10:55] I see.

David Todd [01:10:57] And I gather that you had to illuminate this. I mean, the water's pretty clear, but it's awfully dim down there. Right? What sort of strobes and lights did you need to assist what you were recording?

Greg Boland [01:11:12] Yeah, the deep sea one had a big strobe. It had a giant battery. It was probably three feet tall and maybe six inches in diameter for just the battery pack. And then a reflector and a strobe light on the end of it.

Greg Boland [01:11:29] So, each picture it would take, it was on a timer. It would take a picture, oh, I forget now, maybe every minute or so. So, it was repetitive: enough for the charge to build up the flash again. So that was automatic.

Greg Boland [01:11:45] And then the Flower Gardens had a lamp. But that would not penetrate more than a few feet. So, that was all existing light. And the cameras there were pretty light-sensitive. So, you could see as deep as that would go there. And even at 400 feet, you could still see okay with those cameras.

David Todd [01:12:05] Okay.

David Todd [01:12:07] So, I guess a lot of the interest here was in documenting the coral cover, and I was wondering if you could talk a little bit about why the Flower Gardens, as you started to study and understand more, could support such high live coral cover. I guess you said 50 to 70%.

Greg Boland [01:12:35] Yeah. It's probably a matter of position, you could say, its distance from shore. So, one of the big problems, like Florida, Florida Keys, is water runoff, even through the carbonate rocks on shore, being so close to shore. And then that's 110 miles offshore. So, that's one big plus.

Greg Boland [01:13:04] And then the depth: the shallowest part of the Flower Gardens is like 70 feet. So, that's an insulation from warming water. It hasn't been an issue yet. There's some measurement of increased temperature but it's very small so far.

Greg Boland [01:13:22] And it's interesting. In a sense, it has actually inhibited the numbers of corals even though the coral cover is huge. It's only like 18 species, compared to the Caribbean is probably more like 50. So, there's fewer species, but much higher cover of healthy coral.

Greg Boland [01:13:47] It has just recently experienced some disease that's really wreaking havoc all over the Caribbean now. It's tissue wasting disease. So, I'm hoping it's not going to be as bad as it is other places. It took a lot longer to get there, too. So, I've heard it's not as bad as people were fearing. It's really healthy for sure.

David Todd [01:14:16] Well, that's encouraging.

David Todd [01:14:17] And, one question about the coral reefs, which I thought was really interesting, that you said some 20 years ago you started to get inklings that climate impacts may be significant and worth tracking and started looking at these deeper parts of the Flower Gardens to monitor what was going on there. How did you suspect that this might be a

problem then, and how did you make the argument that, you know, we should do some monitoring at greater depth?

Greg Boland [01:14:53] Yeah, I guess there was rumbling about warming, you know, even since industrial age, anyway. And there was evidence of ocean warming in some places especially. So, it was just sort of a no-brainer in a way. There was a little resistance about, "Oh, that's hard, or that's more dangerous diving", or whatever. It's not as easy as working as shallow as you can. But, it's better to have the knowledge upfront, you know, what's down there and how much better it could be.

Greg Boland [01:15:30] And there's a sense, too, that it could be a place for refuge in a way, if the temperatures do get so warm that corals start what they call, "bleaching", or other kind of, you know, impacts from warmer water on the top of the bank. You can move corals to deeper water. It's a whole lot easier than growing them. If you have a, you know, coral head, you know, the size of a little beach ball, it could be 50 years old. It wouldn't be easy, but I guess you could move some of those things down to deeper water where it would thrive, and then essentially be able to reproduce, you know, spawning and supply the eggs and the larvae for settling in other parts of, the deeper parts of the Flower Gardens. And so, that can be a salvation for shallow reef, even if it does have impacts up there.

David Todd [01:16:22] I see. Okay.

David Todd [01:16:25] Well, so I guess the, the corals are, you know, important in and of themselves, but they also sound like they provide the context for lots of really charismatic fauna that can be seen at the Flower Gardens and I would love to hear about those.

David Todd [01:16:47] [But I thought that while we're just switching topics here, did you want to get a drink of water? It sounds like you might be getting a little bit hoarse.].

Greg Boland [01:16:57] I've got something here, actually, so I'll probably grab something. Okay.

David Todd [01:17:06] All right. Well, if you're comfortable, let's talk about some of the really remarkable fauna that's seen at the Flower Gardens. So, I think that in reading some of your reports, I noticed that there have been sightings of a variety of different sharks - hammerhead, tiger, pelagic, bull sharks, eagle rays, manta rays. Even got to, I think, get a ride on a whale shark. Can you describe some of those encounters?

Greg Boland [01:17:42] Yeah. The sharks seem to have always been more prevalent in the winter there. Early on we, I guess, beginning in '88, and before that, too, come to think of it, we did our research trips out there all year-round. But in the winter, the sharks, somehow or for some reason, tend to congregate there more. Hammerheads can be in pretty good groups. They're not the huge schools that you see some places in the world. But seeing, you know, 10, 15 of them at a time, kind of shallower, usually. You'd look up and, you're, say, at 80ft, and you look up and see them at 30 or 40 or 50 feet.

Greg Boland [01:18:27] And then, others are on the bottom. Sometimes when you're coming up from a dive and on a down line or just kind of slowly surfacing, you'll see big tiger sharks coming towards you, and it kind of gets you worried a little bit.

Greg Boland [01:18:45] But I think a big one, in relation to Zodiac, a bull shark I remember. We kind of looked at each other and said that's, or talked about it afterwards, said that's probably 14 feet, because it looked as big as our Zodiac, which was a Mark 3, which is a little over 15 feet, but it was 14 feet in the water. We said, "That's the same size as the boat up there." So, a 14-foot bull shark was pretty good size.

Greg Boland [01:19:14] The manta rays are actually pretty well known now. They're kind of a mascot almost of the Flower Gardens. They're always in the T-shirts and posters and things of the Flower Gardens, because they're pretty commonly seen. And they, I guess, they like the top of the bank. And they are probably there for food, you know, the plankton and little fish and things that they swim through and eat.

Greg Boland [01:19:41] But they're, unfortunately, I got a bug against this. Back in the day, they come up to you actually. And they appear to, they look like they're wanting contact from humans. It could be a cleaning thing or feels good, or whatever. So, you can stroke them and their skin kind of twitches and they hang around and they stop swimming altogether. And, I think they like being rubbed. But they don't allow contact with them anymore. I think there's just a risk-averse notion that some tourist is going to, you know, really abuse that and scare or bother them too much. So, but they still hang around. They come right up to you.

Greg Boland [01:20:22] And this one video I did, I'm hoping to publish to YouTube one of these days, because I sent it to the Sanctuary and they never got around to it. But I did a video of the installation of the mooring buoys that we all did as a volunteer team in 1990. And that video where I filmed the whole thing there, one little segment is seeing a manta ray swim up to me. And so, I kind of went over to it and rubbed his back a little bit, and you can kind of put your fingers over its head basically, and you can just kind of let it tow you around a little bit. It's not really swimming away. It's just hanging there. And rub it a bit and let go. And it very slowly moves off. And so that's in that little video. But, unfortunately, you're not supposed to do it anymore.

David Todd [01:21:14] That's something. It's encounters of another kind. Pretty remarkable.

David Todd [01:21:22] So, speaking of getting rides, tell us about your adventure with a whale shark.

Greg Boland [01:21:31] Yeah, that was, I've seen a few out there, but one particular confluence of fate, I guess, was one of my very few times that I served as a boat divemaster. I was typically always on a research trip. And on this, I went through the whole of the motions to be a divemaster on the boat, and I had to have certain certifications and kind of get chosen to be one of them and get a free trip, basically, but you have to fill tanks and do all kinds of other things. But one of those was, putting out before a night dive people getting ready for night dive after you're on the Flower Gardens, the boat divemaster goes down and puts strobe lights on the mooring, and then one on the anchor line that's going down to the mooring. And then like a third one on the down line where people hang out before they get up on the ladder. So that's usually done by a single, like a solo dive as a boat divemaster.

Greg Boland [01:22:38] And, so I jumped in and did that. And I was going to take some pictures. I have a close-up attachment to an underwater camera where, you know, you can only take pictures of like a five-inch piece of the bottom. And I saw this big, what I thought was a big fish coming up, and it was like two kind of two circles. I didn't know if it was the front end of a big fish and it looked like three feet or so between them. And then, as it kept

getting closer, I figured that it was the eyes of a whale shark, with a big mouth in between. And it came right up to me. And, I knew that they were, you know, harmless. I wasn't scared of it or anything. So, as it kind of turned, I said, well, I'd heard of people kind of getting towed along with whale sharks before. And, I kind of moved over to it and kind of grabbed the dorsal fin just to keep, keep a hold of it basically, so it wouldn't get away, even though it was going slow.

Greg Boland [01:23:44] And I took a couple pictures of it. They have white spots on them. Whale sharks have big white spots all over, so I could only get like one white spot in my camera framer. And then a remora that was stuck (they have suction cups on their head), and they were upside down on top of the whale shark. I took a picture of the remora stuck on there.

Greg Boland [01:24:04] So, this was at the end of this night dive. Oh, let me back up. It was like an incredible night dive in the first place. Before that even, was these luminescent siphonophores. They're like pelagic bands or strings of organisms that are just glowing. There's no current, zero current. And just drifting along and there's bioluminescence in the water. As you move your hand, they have sparks coming off your fingers. So, that was even an incredible night dive even for that.

Greg Boland [01:24:38] And then the whale shark encounter, riding around on that, getting pretty low on air, almost out of air, really. And, figure, well, it's going to be embarrassing to swim back to the boat, you know, on the surface with a snorkel, after getting towed away by a whale shark a quarter-mile from the boat. But I looked up and then, the boat was running right above my head. Actually, I see that light from the back deck of the boat. He had brought me right back to the dive boat.

Greg Boland [01:25:13] So that was kind of the beginning of the other chapter. I got up and was telling everybody I was so excited about it. Get in your night dive. There's a whale shark swimming around us. So, get in as soon as you can. But the wind was coming up. It was getting kind of choppy. And, the powers that be, I guess the captain, decided to cancel the night dive. And they ended up even heading back to shore, you know, cutting the whole dive trip short a day.

Greg Boland [01:25:44] So we're all disappointed. And then kind of late already. And, you get to have beer or whatever, you know, when you're not diving anymore and kind of partied a bit on the way back. It's kind of get back at 2 or 3 in the morning, and I figured I might as well stay up and drive back when I get home. So, that's when I met my future wife, Gloria. She was on a dive trip on the same boat from San Antonio. So, I ran into her and started chatting and ended up hitting it off, I guess. Got her phone number.

David Todd [01:26:26] That was an extraordinary night. Lots of important things happened.

Greg Boland [01:26:32] '92.

David Todd [01:26:34] And so, you mentioned seeing bull sharks and hammerheads. And I think it's interesting that you've been diving so long, I imagine the attitudes have changed a lot since the days when Jaws was in the movie theaters. And, you know, there was this fear and maybe even anger towards sharks. And now they seem to be appreciated more. Have you seen a change in people's perspectives?

Greg Boland [01:27:10] Yeah, it's a mixed bag, I think. Still, it's definitely become less fearful in a big camp, anyway. Personally, I have never been too worried. I think a night dive with tiger sharks being around the day before would make me a little more concerned. But, being with sharks in general, there's a story there about a couple times I've dove in one of the Bahamas called Walkers Cay. They have, maybe they don't still do it, but it's a half sportfishing, half diving kind of place. And they make these big old barrels of frozen fish heads and things. Call them, "chumsickles". And they take them out to the area with a bunch of divers. You know, there's no protection of any kind. They throw this barrel full of (it's actually ice cubes) all this fish guts. And there's hundreds of sharks that come around and eat off of it.

Greg Boland [01:28:13] And the divers are just sitting around in a half circle, sort of, with the sharks swimming off around them, and never bother the people at all. So, that's know everything from reef sharks and white tips and other kind of sharks like that. And they're good size.

Greg Boland [01:28:32] Other sharks are not an issue. I've never been, of course, with a great white shark. But I've seen videos now of people that are diving without cages with great white sharks even, and they'll swim up to them and they might be interested in having a taste or seeing what that thing is made out of, if it's edible, and they just push them away, push their noses away and do just fine, even diving with great whites.

Greg Boland [01:29:00] So there's still a lot of folks that, you know, worry about something in a lake, even, still left over from the Jaws days that they're fearful of, things they don't know anything about.

David Todd [01:29:16] Yeah, I guess that's often the, the subscript is that we're scared of things we don't really know much about.

David Todd [01:29:25] So while we're talking about sights that you might have seen out near the Flower Gardens, I thought it'd be interesting to talk about some of the, I guess, non-organic, non-living, features. I think you've visited the East Flower Garden brine pool. And there are these features - a lake, a shoreline, a river, rapids. What did you see? Can you describe that?

Greg Boland [01:29:59] Yeah. It was a really fascinating discovery, actually made by Tom Bright in the old A&M submarine, Diaphus, in the late '80s. And I was with LGL then, and made that particular cruise with him. I had a chance of using the Johnson Sea Link, this four-person sub from the Harbor Branch Foundation and so that was in '91 and then again in '95, and it was with another project that was looking at decomposition of different kind of things - shells and wood - called taphonomy. It's an interesting thing. They emplaced bags and net bags, these objects, around different places.

Greg Boland [01:30:50] And one of those areas was, shoreline and actually inside of this brine pool. But how that feature came to be, this is related back to the salt domes again, where, the salt plug, the actual salt layer is not very far below the coral. This is at a depth of about 240 feet. And, there's coral mounds, carbonate mounds, all around it. But, there's what would normally be just a sand flat, there's brine. This high-salinity brine is leaking or being forced up through some kind of fissures and making this big lake, basically a pond or lake, a pool.

Greg Boland [01:31:38] And, the salinity is like 180 parts per thousand, when seawater is only 36. And then that's what makes the density so high that it looks like it's a whole separate layer. So, when you're in a submersible looking down on it, you sort of feel like you're up in the air in a dirigible or something, and you see a fish that's sort of flying over the lake. But it's actually in the water. And this brine is in this other layer down below.

Greg Boland [01:32:10] And so, the lake actually flows downhill, really, off the bank and down to a deeper level. And, where it's flowing, there's some places actually has, causes ripples, like. Almost looks like kind of a little rapid area of a stream going over rocks because of turbulence, things that swirl around a little bit, and then winds around, and there's even some erosion of the carbonate mounds left over from coral development and leaves a quite kind of precipitate on the side where it's eroding.

Greg Boland [01:32:56] And then there's bacterial growth that's probably part of the white color. This anoxic bacteria grows down in the brine. It doesn't need oxygen. It's a sulfur bacteria.

Greg Boland [01:33:09] So, it's a really interesting feature there that goes down and then empties out, down on the mud bottom, down around 300 feet or so.

David Todd [01:33:20] Gosh. It's one of these things that is just unlike anything else anywhere else. Amazing to hear about.

David Todd [01:33:28] Now, you mentioned this in passing that there are some bioluminescent features that you see - some of these plankton that light up in the ocean. Well, tell us about that, please.

Greg Boland [01:33:45] Yeah, that's not common, but it's really spectacular when you do see it. And I'm not real familiar with the species. It's from disturbance. It has these bioluminescent bacteria that live in the plankton. I think there's algae and other kind of dinoflagellates that do do this.

Greg Boland [01:34:10] So, when you're diving, you know, I've seen it in Cozumel and I guess on the Flower Gardens, of course. Another story. But, moving your hand through the water disrupts the suspended plankton that causes them to luminesce. And then, you know, there's pictures or videos of, like, dolphin. You see it on the ships when the bow of the ship is making a wake and you look over the bow and see this really bright luminescence of the water turbulence and if the dolphins are following your ship, jumping in the water, and, you know, they're leaving sparks behind them.

Greg Boland [01:34:47] So, that's a pretty spectacular thing, but not, not too common, though.

David Todd [01:34:53] Boy. It must make it all the more of a very special treat to see.

David Todd [01:34:59] So, I think one of the other real phenomena that you saw and have seen, I guess, a number of times, is the spawning of several coral species that are known to do this, including at the Flower Gardens, but I guess elsewhere as well. How did you first spot that and what did it look like?

Greg Boland [01:35:19] Yeah, that's a good story. It's one of the trips that we did in (trying to find the year here), it was '91, 1991. That was actually the year it was kind of first documented. And, we were involved in that long-term monitoring study from '88 to '92, I guess, and that we would schedule a monitoring cruise out there to when, in the summer, to when folks were seeing coral spawning in their laboratories. One of the professors in Florida, Alina Szmant, had been studying coral spawning in her lab and had it really pinned down to, people knew that was related to the full moon and had seen this in Australia, you know, in the eastern hemisphere, southern hemisphere anyway, related to the full moon, but differently than what she was seeing in Florida.

Greg Boland [01:36:31] So, we got the information from her. And there was some kind of nebulous information. I didn't really hear this directly, but supposedly some sport diver saw something the year before, in 1990, saw some smoky water in this August time frame. But I don't think they really knew, you know, what exactly they were looking at. But we were targeting this specific time, which turned out to be seven days, exactly seven days after the full moon of August, related to this work in the labs.

Greg Boland [01:37:11] And so we were on a night dive, and during that time that was sort of targeted by the laboratory experiments. It was about 10:30 at night or so. And, this was that seventh night after the full moon, and we were on a night dive. Didn't see anything for quite a while. Getting towards the end of the dive, and all of a sudden, the coral head just started releasing these egg bundles. They're little kind of BB-size for this couple of species that do it at that particular time - brain coral and a star coral. And it's like you had a snow globe and it was like in reverse direction, upside-down snow storm and all these coral eggs just came pouring out of the reef, all at the same time, on that night there.

Greg Boland [01:38:05] So, that was kind of ... we knew what that was. It's called mass spawning of broadcasting corals.

Greg Boland [01:38:16] So, I headed back up. This is a kind of a side story to the end of that dive was, coming up to this mooring. This was the first morning they had, we had put in during this mooring installation that happened the year before, in 1990. And there's this big hawser, like a three-inch line, attached to the mooring. And we had this little boat, a little Zodiac again, on the surface because we had a big research ship on the surface that we were working from. And it can't tie to that mooring. It was limited to a 100-foot length of ship.

Greg Boland [01:38:54] So we were having to shuttle divers over using the Zodiacs. It had gone off the bank and anchored in the mud, probably a mile away. And so, coming up the line, this mooring line, the Zodiac is supposed to be tied to it, to the buoy, you know, that was on the end of the line. And I think I was the first one up the line and it started getting easy to pull, like there's nothing to pull off of, to hang off of.

Greg Boland [01:39:22] And all of a sudden, this loose rope came down in my hand and there was nothing on the end of it. So, luckily, the operator, the Zodiac driver, wasn't diving with us, or else the boat would have drifted off who knows where. But he was pretty close by and we had our dive lights and such. So, got back in the boat, and back to the big ship.

David Todd [01:39:44] Wow. You know, it's a fun adventure until it's a scary one, I guess.

David Todd [01:39:55] Well, you know, something else that strikes me is that, there was this same sort of a line between things that were routine. You know, you're doing monitoring and

surveys that are, you know, iterative and pretty easy to foresee. And then sometimes, you'll see these things that have never been seen before. Certainly not there.

Greg Boland [01:40:17] Right.

David Todd [01:40:17] I mean, the spawning event. And I was wondering if you could talk a little bit about that dividing line between, you know, sort of routine science and then, and then this, you know, really exciting discovery that you might make.

Greg Boland [01:40:36] Yeah. That was one of them, for sure. We knew that it was supposed to happen, in a way, but had never been seen there before. And, and then another time, I guess a few years later, there was, you know, diving on this one, particular cruise that we stayed after the big spawning event, seven, sometimes eight days after the full moon, and you make another night dive. I think it was ten nights after. Actually, my wife was on this one. She became a research scientific diver as well, and was on this trip when we were doing a night dive.

Greg Boland [01:41:17] And then we saw a different kind of brain coral do that same spawning activity with real big egg bundles. It was, this is like pea-sized egg bundles, like twice the size, the diameter, of those smaller brain corals and the other corals. So, I guess I was the first one to see that and even wrote a little scientific paper about that. And so, somehow, I haven't really mentioned it since that time, way back when, in '94, I think.

Greg Boland [01:41:48] They don't normally stick around or, or think about diving just for that one particular species to see it spawning, you know, two or three nights after when their main effort is.

David Todd [01:42:01] Well, I guess sometimes it's about not just documenting something, but just seeing these things that are awesome and impressive.

Greg Boland [01:42:10] Yeah, yeah. And then, the deep sea imagery - that was kind of a discovery too, of these deep water organisms. And that's actually another interesting, it's kind of a publication. I was really trying to get a fuller article published in Nature magazine, but they did publish the image and I think a caption of these tube worms. And there was some deep sea coral there as well.

Greg Boland [01:42:38] But there was a fascinating relationship. I guess you could call it a commensalism, basically, where these scallops, they're like a scallop, were clamped onto the ends of these tube worms. And quite a few of them, like 20, 30 of them, on the end, just on the ends, of the worms. They weren't anywhere else - not on the bottom or on anywhere along the tube worms, but on the ends. And the ends of the tube worms, were inside of the bivalves, or the shell halves of these scallops.

Greg Boland [01:43:09] And so, I published a kind of speculative article, or submitted it to Nature. And they said, "Eh," not interested, but we'll take your picture and publish it. So, in '84, I believe, it was a discovery of this relationship of this scallop, called a *Acesta*, and a tube worm. And it turns out, probably 20 years later, there were people doing research on these tube worms and, that the scallops clamped only on to female tube worms, and they were waiting for the spawning eggs of the tube worms because since these tube worms don't eat anything, they don't have any defecation or they don't regurgitate food or anything because

they're living off of hydrogen sulfide gas, down in the rocks and this mud where their roots are.

Greg Boland [01:44:05] So, they were just clamped on there waiting for their reproduction, female eggs - not on males. They're male and female, which nobody really knew either. That was really interesting.

David Todd [01:44:16] Oh, boy. Wow. A whole new world.

David Todd [01:44:21] Well, so, I guess for sightings like that and, you know, for a plethora of other really unusual and special and rich things, the Flower Gardens have been protected, and I was wondering if you could take us back in time. I think it was 1992 when the Flower Gardens Banks National Marine Sanctuary was set aside, and I hope you might be able to fill us in about how that came about.

Greg Boland [01:44:57] Yeah, that was a kind of a long road. I'm not really familiar with some of the details, but that was a struggle that went on for quite a while.

Greg Boland [01:45:08] It was submitted or nominated to be a Sanctuary for many, many, many years, probably stretching back to the early '80s even. It was, you know, recognized how significant it was, and just had struggles with the process of Sanctuary designation or being accepted into the process. It was just so hard back then. There wasn't that many sanctuaries.

Greg Boland [01:45:35] And it began with the Monitor, the wreck of the Monitor, the Civil War ship. And I think there was only maybe eight or ten back then. So, it struggled along. And you kind of have to get a Congressional steward in a way to help get it through the process. And a couple of those fell through over the years.

Greg Boland [01:46:00] So, probably I think 1990 was this mooring buoy installation. That was an all-volunteer effort for East and West Flower Gardens, and that seemed to have inspired a number of people, both on the Hill and others that would help support it. And, it kind of in a way of said, "Wow, these people think so much about it to do all this as volunteers that maybe there's something more behind it than we realized."

Greg Boland [01:46:33] So, it was right early '92. So, really, the process, started in late '90 and through '91. And the East and West banks were designated in '92.

Greg Boland [01:46:47] And then later Stetson Bank was another addition. That's pretty interesting, being not a coral reef, but, in '96, they added that to the Sanctuary.

David Todd [01:47:02] And do you recall what the sales pitch was for the significance of the Flower Gardens? I mean, I think you mentioned that just the sort of vouching that these volunteer divers, you know, would put that kind of time and effort into rigging up those buoys maybe said a lot. But were there other arguments that were made?

Greg Boland [01:47:29] It's for the protection, basically. At that point, there was no ... Well, I think the oil and gas industry was pretty well regulated by Minerals Management Service. So, that had really served as a prime example of how industry could operate around it. This is like the most sensitive community in the entire Gulf of Mexico, really. And there's one platform that was even installed within one mile of the crest of the East Flower Gardens. And regulations were imposed on discharging of any cuttings from drilling to the depth of where it

was off the bank. So, everything stayed down near the mud bottom. And, you know, other policies, and no anchoring of the oil and gas vessels on the bank.

Greg Boland [01:48:23] But there was still a issue of anchoring of other, you know, just recreational boats and commercial fishing and spearfishing and other kind of things that would disrupt probably the delicate balance of some of these charismatic fauna of the Flower Gardens in particular.

Greg Boland [01:48:45] So, that sanctuary status really added a layer of protection for both anchoring boats, anything. Well, the moorings were installed, for one thing. And you couldn't even anchor or tie up a boat over 100 feet to the moorings. But no anchoring on the reef anywhere else either. And then no spearfishing and no commercial fishing and some of those other kinds of things that really did a lot to protect all the other important parts of that habitat.

David Todd [01:49:21] Well, it sounds like one of the big impetuses to getting the Flower Gardens protection was what you mentioned before of mooring these buoys. And, I was wondering if you could kind of fill us in on why these buoys were important, and then how a group of volunteers, including yourself and, I guess, Steve Gittings, were involved in making that happen.

Greg Boland [01:49:53] Yeah. This is part of a volunteer effort that was really led by Gary Rinn. He was the owner of that boat that I mentioned called the Fling, and did the recreational diving trips out there. He created this organization called the Gulf Reefs Environmental Action Team, in '91, right, just before we did this mooring buoy project. And I'm not, I can't really say for sure how he got everybody together, but he brought together like, oh, I don't know, about ten folks to be on this board of directors. It wasn't a membership organization, but had me and Steve Gittings and several others that worked on the Fling regularly. And then he was the owner of the Fling and then his father, actually, was the guy that incorporated the organization.

Greg Boland [01:50:53] So, the main thrust of beginning of GREAT, Gulf Reefs Environmental Action Team, was doing these moorings. He was good friends with folks in Florida Keys that did mooring buoys down there. And it was just a tremendous asset to protect the Florida reefs down there and off the Florida Keys. John Halas and Billy Causey, and brought them, with the team of volunteers. I think it was probably 25 or so volunteers onto the Fling and he volunteered or donated the use of his boat. This is in 1990.

Greg Boland [01:51:38] And, all the volunteers - it was four days - and we had a hydraulic drilling unit that had hydraulic hoses that pumped oil down to this drill head, a three-inch diameter drill. What would you call it? It's basically a hollow coring drill and a it could drill through carbonate rock. And you would use this hydraulic thing to spin the coring bit and had these moorings made out of, you called them U-bolts, one-inch solid stainless steel bar that was bent into a U-shape with little tabs on the end, and they were about three feet long.

Greg Boland [01:52:24] So, these holes were drilled at the distance of those U-bars. And so, divers would have to weight down the drill because you can't really push down while you're neutrally buoyant in the water. Had to put big strings of lead weights and push down on this drill. And it would take about, I don't know, an hour to drill these holes. And cemented these U-bars into the holes. And those became the first 12 mooring sites. There's five on the East Bank, seven on the West Bank.

Greg Boland [01:52:58] Steve and I - I don't know how we got into the task, but we thought we could know how to swim around and pick out big huge coral heads that have a dead spot on top and pretty sturdy and would hold a boat. So, we, swam around, took the Zodiac out again, and then went to the spots that would be kind of equally spaced around each bank and, picked these sights and put little buoys on them. And that's where the boat, one boat would have the big hydraulic unit in it, and another one would shuttle divers back and forth to go down and do the drilling and put in these mooring U-bolts. So, that was all done in just four days. It was pretty incredible.

David Todd [01:53:45] Hard work!

David Todd [01:53:46] Well, so, my understanding, and maybe you can help sort of wind back the time a little bit, is that there was concern about people anchoring on or near the Flower Garden reef, and that these buoys served a purpose that folks wouldn't be dropping anchors on the reef. Is that right?

Greg Boland [01:54:11] Yeah. That's basically right. It was not law back then, or regulation, but the presence of the buoys (and they weren't necessarily are all there all the time, because it was a servicing issue where somebody had to be paid or contracted to change out the buoys, and they'd be ripped off by storms and all), but, the recreational boats that were the ones that were anchoring on the reef. And there's evidence of the damage that they did from their chains and anchors, you know, mashing the corals up on the bottom. So, if they would see a buoy, you know, you would hope that they would tie into this mooring buoy rather than drop an anchor on top of the reef. So, it was supposed to be inspirational, and common sense. And they were in good spots. So, there was no reason to anchor somewhere next to it and not use the buoy.

David Todd [01:55:06] Right.

David Todd [01:55:07] Was there an incident where some anchor was towed across the reef at one point that sort of helped people focus on this as a really significant problem?

Greg Boland [01:55:22] There had been incidents. I think there was one big tanker that Tom Bright and some folks went out to assess the damage it had caused. Somebody saw this huge ship anchored where the Flower Gardens was. And, I think they saw some significant damage. I never did see pictures of that really. But I've seen myself a lot of pictures of where, you can see, obviously, where a chain was draped across a coral head and it was rubbing back and forth and basically sawing it down and rubbing across it. So, I think those sorts of images of the kind of recreational boats causing the damage was inspirational as far as a need for buoys.

Greg Boland [01:56:14] The big ships there were, you know, they happened in the past, maybe only one I can think of, but rare. And those obviously can't use buoys. They shouldn't be anchoring there at all, or even be close to it, for that matter.

Greg Boland [01:56:29] So, it was probably more of a general sense of damage caused by everyone out there, not thinking about what they're doing.

David Todd [01:56:38] Sure. I guess death by a thousand blows. Maybe not any particular big chipping away, but just, you know, it all accumulates.

David Todd [01:56:50] Well, let's talk a little bit about some of the other concerns for the sanctuaries, and a lot of your studies were intended to prevent or minimize. And I'm particularly thinking about the oil and gas industry because, you know, as you know better than anybody, the Flower Gardens is right in the middle of this really productive offshore oil and gas reservoir. And so, lots of activity. I think there was something called the High Island A-389-A that was very close.

Greg Boland [01:57:26] Right.

David Todd [01:57:26] And I was wondering if you could talk a little bit about, you know, the efforts to sort of coexist between this very special natural resource and then all the industrial activity nearby.

Greg Boland [01:57:39] Yeah, that was definitely the closest. And kind of coincidentally, it was the first exploratory well at that block, that lease block number (that's how the government divides up the area the Gulf, is by these lease block numbers). But it was, that was one in '75. Or, maybe it was a little bit before than when they drilled it.

Greg Boland [01:58:01] And BLM back then was requiring these monitoring studies to document before and after the drilling. And that didn't necessarily prevent any impacts, but they didn't see any impacts back then.

Greg Boland [01:58:18] And then, at a time before that, there was development of kind of protective measures for the drilling that was going to happen sooner or later. This was even in the early '70s. The discharges from oil and gas drilling were a concern for smothering corals, obviously. So, BLM back then had a component of one of their big studies of all the topographic features of the Flower Gardens etc. of determining what the current structure was around the Flower Gardens, and kind of addressed the question of what happens if you shunted, they call it "shunting", is where you pipe all of the drilling discharges - muds and cuttings and such - to the deep water off the banks.

Greg Boland [01:59:18] So, is that a safe thing to do? And this was one of the cruises I was on anyway was involved in a part of that work was where they, had dye packages, called fluorescein dye. And that's a really strong dye that I think I used in life jackets or, or safety vests for pilots and Navy people who could release and have a huge marker of dye that hopefully somebody would see flying around looking for you.

Greg Boland [01:59:55] But then you put these packets in this kind of an array of holders and put it on the bottom and let this dye kind of seep out of it and see where the water parcels would go from different places on the bank. And if you put muds and cuttings and just stir up the water, say, all the stuff would be down deep, say, at 400 feet, would it actually go up and get to the top of the bank?

Greg Boland [02:00:24] And then together with that was a lot of current meter studies. They had current meters of various kinds all around the bank and on top of the bank as well. And so, the bottom line was that the density of the water, and the way the currents moved, etc., and these dye study results, demonstrated that anything was put down on the bottom, on the deep bottom off the bank wouldn't get back up on top of the bank.

Greg Boland [02:00:53] So that was a really big gain in how the protection could go forward for drilling even as close as a mile away from these East Flower Gardens and that High Island 389 platform.

Greg Boland [02:01:06] So, there's never been any impacts observed at all as far as on top of the coral reef itself or anywhere on the bank. They've seen the components of the drilling muds all around the platform on the mud bottom where they put it, basically. But that's where it stayed.

David Todd [02:01:26] I see. So, I guess the densities and the ocean currents managed to keep it where it was put and not let it drift up on top of the coral reefs. Is that right?

Greg Boland [02:01:40] Right, right. That's it.

David Todd [02:01:42] Okay.

David Todd [02:01:43] So, I was intrigued by, you know, some of the Notices to Lessees that I think you worked on to try to help locate offshore activities at a safe distance, a sort of buffer zone, in effect, around these coral reefs, and the chemosynthetic communities as well. Can you tell us about how that idea came about and what, you know, maybe give an example of how all these Notices might have been drawn up?

Greg Boland [02:02:19] Yeah. That same mechanism, I guess, those were sort of already in existence for things like the Flower Gardens and these topographic features along the continental shelf. It was like in the earlier '70s and mid-'70s. So, when I got involved with the Minerals Management Service starting in '98, I had all this considerable experience with chemosynthetic communities and a little bit with deep sea corals, but more of that would come later. So, the initial avoidance for these chemosynthetic communities that were just really being discovered and understood in any way - there was only a handful of them known, and trying to figure out how they would be located by remote sensing techniques without having to see it through some deep-sea camera or something would not be practical.

Greg Boland [02:03:16] So, the only kind of criteria was don't sit things on top of them. Don't squash them or whatever. You have to know where they are first though.

Greg Boland [02:03:25] So, we started developing criteria as to what sort of features. That's kind of how we found that first one in '86. And how to use remote sensing just to map where they could be, and avoid those places. And that was the kind of the first level of these Notices to Lessees. They're documents within Minerals Management Service that have to be followed as part of the permission to continue with, you know, exploration, drilling or development drilling or whatever. It's typically exploration, because that's the first time you put a structure down or anchors or, or some other impacting activity.

Greg Boland [02:04:15] And, that was refined quite a few times, actually, from the initial. The first one was actually in 1998. It was called NTL 98-11, I believe. And it just needed more refinement as to what criteria could be used to determine where these things could be to avoid, you know, accidental impacts and make it easier for operators to know where they could be. But also, try to figure out where there could be new places that nobody knew about or refine how that could be discovered even, and avoid impacting before that happened.

Greg Boland [02:05:01] The deep-sea coral question kind of came into play during some of these big chemosynthetic community studies. We started seeing these hard-bottom areas that are really created by the chemosynthetic action of bacteria on the hydrocarbon seeps - the gas seeps and oil seeps. The bacteria actually precipitate calcium carbonate and form these structures or just, you know, rocky outcrops in the deep Gulf where normally it would just be mud bottom everywhere.

Greg Boland [02:05:38] And so, chemosynthetic communities can come and go, or they may not be that happy enough to form a community of those big animals, even though bacteria created the substrate. But, deep sea corals are more, maybe more opportunistic in a way, if there are the right conditions and depth ranges and things. And some of these reefs around, you know, 1000 feet to a couple thousand feet are pretty extensive. There's one species called *Lophelia*. It's a white kind of a branching coral that forms huge mounds that are, that are hundreds of feet across and even 100 feet tall. And so, those became a target of concern for protecting those as well as a sensitive deep sea biological community.

Greg Boland [02:06:29] So, we started lumping the deep-sea corals into the chemosynthetic communities as well to protect them. And I guess, conveniently, in a way, they occur kind of in the same place because these rocky outcrops are created by the same process and could have either one occurring somewhere, and you don't really know either way until you would actually go to look at it.

Greg Boland [02:06:57] Maybe the most recent NTL that I was directly involved in, kind of, you know, responsible for, was the refinement of distance or depth, actually both. It's a depth criteria for the protection of the deep sea corals. At one point, it had been started at 400 meters. They thought, "Well, this deep sea coral doesn't exist above 400 meters", so that's like 1300 feet or so. But we started seeing them at more like 1000 feet, so around 300 meters. So that was part of the change.

Greg Boland [02:07:40] And then another one was distances away from where activities could occur that could potentially impact a community. So, kind of a refinement of an NTL would have a little bit more buffer distance, increase the distance away that industry could do activity, impacting activity, away from what a known kind of a boundary would indicate there would be something there. And then also, the whole thing was moved up to 300 meters instead of 400 meters. So, that's just a way of using our study results to improve the protection of these kinds of, chemosynthetic and deep sea coral communities.

David Todd [02:08:26] I see. Okay.

David Todd [02:08:28] So I guess these Notices to Lessees, the NTLs that you've been discussing, were one of the ways of regulating the oil and gas activity. And then I guess part of the activity was also, you know, the regulatory activity, was to just disclose what was happening and to make sure that there was no significant impact. I gather there were Environmental Impact Statements that you worked on that maybe addressed those kinds of issues.

Greg Boland [02:09:02] Yeah. Okay. Can you maybe rephrase that? I was involved in a lot of EISs.

David Todd [02:09:10] Well, I was thinking about Environmental Impact Statements that maybe addressed concerns related to offshore leasing that might have had impacts on the Flower Gardens.

Greg Boland [02:09:22] Yeah. The Flower Gardens are a little bit unique, and those kind of had been really taken care of in earlier times, I suppose, and demonstrated that impacts were not happening, and that existing regulations were adequate. And then the deeper water though, there's like new territory and like unknown understanding of where these habitats are for one thing, and then sensitivity of what could harm them. So, there's a tie to what kind of studies that we develop.

Greg Boland [02:10:08] And that's one of the big roles that I had, was designing studies that would go into a queue for determining, you know, if it makes it through a judgment of what's significant, what's important, and what's needed for these Environmental Impact Statements. They could be funded for significant money, you know, even three, four million dollars, contracts for looking at distribution of deep sea corals, say. So, you know, the EISs and what we understand about what's known about, say, deep sea corals, and how deep they are, and if they're sensitive to sediment burial or different chemical impacts and such. So, we needed those environmental studies that we funded as well, to go out and try to discern some of those answers.

David Todd [02:11:08] I see. Okay. So, sort of leveraging the funding for an EIS to discover more about the sensitivity and location and kind of creatures.

Greg Boland [02:11:20] Yeah, yeah, yeah. So, the NEPA part of it, I guess, they had their own whole branch of the agency, and have their own funding and such. But there's this Environmental Studies program, you know, that's sole purpose is really to inform decision makers as to, you know, what needs to be decided on, what, you know, impacts are reasonable or can be avoided. And so, the Studies program targets specific questions about like, oh like, wind farms. Right now, they're, you know, looking at the effects of noise, or on fish migration, or bird strikes or whatever. So, they go out and answer those questions in order to figure out how to do things better or avoid the impacts altogether.

David Todd [02:12:11] It's so interesting - kind of figuring out those boundaries between what's known and what's unknown and what, you know, may not even suspect is out there.

David Todd [02:12:22] Well. Well, good. This helps me understand a lot of your work with oil and gas and other kind of industrial activities that might have affected the Flower Gardens.

David Todd [02:12:37] Tell me a little bit about a concern which I guess has arisen over the years and that's with exotics. I think that there's some worries about lionfish and orange cup coral at the Flower Gardens. And I was wondering if you could help fill us in on where these things originated and how they arrived, and, you know, how they can be controlled.

Greg Boland [02:13:01] Yeah. The lionfish, as I understand, originated from the east coast of Florida, South Florida, and some folks speculate somebody turned loose a pair of them from an aquarium they didn't want anymore. But they're now all through the Caribbean and Yucatan and Florida and all through the Gulf.

Greg Boland [02:13:25] So, they're beautiful fish in a way, but they're Pacific fish, and they're very carnivorous, and they are not afraid of anything, basically. There's a concern (this hasn't

been very well demonstrated or proven yet, even though they have gut contents of all these natural, occurring fish species where they are), but they eat everything they can possibly get in their mouth and really reproduce fast.

Greg Boland [02:14:02] And, so they're on the Flower Gardens and a concern. But there's occasional, they call them, "Lionfish Invitationals". They have an entire cruise now and go out and do nothing but spearfish these lionfish. This is course on SCUBA diving depths, probably above 100 feet, I'm guessing. That's controlled them, I think, a little bit anyway. They're part of a survey of the annual monitoring work. I haven't noticed any huge increase in numbers, although I haven't really seen a graph over time.

Greg Boland [02:14:47] But the concern is that they eat, especially smaller, normal fish, all the normal, reef fish populations. We did see, interestingly, I guess last time I was diving was 2019, in Cozumel. And then maybe another trip or two before that, they were just kind of showing up. They were a bit all over the place. They have divemasters where they use one of these little spears, tiny, tiny little spears that you hold in your hand basically like a miniature, and spearing them. And they let us do a little bit with every lionfish they ever saw. The divemasters are there, of course, all day, every day. And, they've actually cleared them out pretty well in the shallow reaches of Cozumel.

Greg Boland [02:15:36] So, they can be controlled, on a regular, if it's a regular culling. They seem to be able to keep them under control, but they're going to be deep. They can live up to, jeez, like, you know, 900 feet deep. So, there's places they can be that nobody's ever going to spear them. And, they're probably going to be around forever. How much harm they're going to do is still too early to say.

Greg Boland [02:16:05] The cup corals - actually saw those in the '90s, and they're a real pretty orange - big polyps and bright orange color. Saw them on platforms. They're a species of coral from Brazil and they're exotic or foreign too. And they really love platforms.

Greg Boland [02:16:26] There's a study we did with looking at corals growing on platforms, starting in 2000. I did dives on 80, like 87 different platforms. And, there's good reef-building corals on some platforms. So, that's a good thing for possible sources of larvae and, you know, recovery of corals that may not be doing well at other places. But, some platforms had this cup coral covering it, completely covering the whole structure. So, that's got to be impacting the community on some platforms.

Greg Boland [02:17:06] But that's controversial as to what platform communities are valued for. And they're definitely valuable for a lot of things. You know, for red snapper and other fish and tuna, even some are on deepwater platforms and corals growing on them.

Greg Boland [02:17:25] But, the consideration for those things when the time comes to remove the platforms is not kind of weighed very heavily. They try to salvage platforms and put them as artificial reefs in certain places in the Gulf and keep as many as they can in a way. But it's a pretty low percentage. I guess it's less than 10%. So, there's, it's gone from probably 4,000-something platforms in the early '90s to like a thousand or so now, 1,100 maybe. So, they're seeing the end of their lifetimes in oil reserves in the Gulf. They're going to be around a lot of time in deep water, especially. But not nearly as many, a quarter of what they used to be.

David Todd [02:18:17] And so, the concern is that if these platforms, the tops at least, were removed, that the cup corals may be distributed wherever those remnants go? What's the worry there?

Greg Boland [02:18:32] That's kind of hard to say. There's this platform, maybe it's an example, of being confusing a bit. The 389 platform, I got to dive on it actually when they first installed it in 1982. Got to see it three weeks after it was in there. It was rusty metal, basically. It already had fish coming to it. And got to see it over the subsequent years, all the way up to coral heads growing up.

Greg Boland [02:19:01] But there's not that much cup coral on it. And it was decommissioned about two years ago, I think. And they cut it off at about 70 feet. So, the cup coral is not a big component of that platform, and they don't see it a lot on the Flower Gardens either. So, one of the things about that species is it likes vertical surfaces. So, there are some places that it grows on platforms and covers them in just the right conditions. And it was able to propagate and, you know, cover whatever the fouling community was on that platform. Maybe it was a newer platform and nothing to have to build over.

Greg Boland [02:19:45] But, the Flower Gardens and the bank itself, they haven't seen very much there, and usually in crevices or overhangs on the coral. So, they're not too concerned about that, not that I know about. Not taking over the reef, for sure.

David Todd [02:20:00] I see.

Greg Boland [02:20:01] I don't remember them being in the well cover surveys as far as any cover of any note.

David Todd [02:20:08] Well, let's turn to, I guess, one of the major concerns and one that you identified when we first started talking this afternoon, and that's climate change. And I guess there are problems with heat and pH changes, and I was wondering if you could talk about those issues and how they may affect the Flower Gardens.

Greg Boland [02:20:41] Yeah. The temperature probably is the biggest worry. But, like we talked about before, it has such a good buffer from the surface temperatures to 70 to 80 feet, where the coral, first coral, is. Temperature is definitely a problem for all other places on shallow reefs. So, there's been some record of general increase of temperature. There's a time of year when it reaches a peak temperature, and that's when the corals where will do what's called, "bleaching". It loses its symbiotic algae inside the coral tissues. And, some places can kill it if it happens for a very long time.

Greg Boland [02:21:32] The Flower Gardens has been pretty resilient for corals that are bleached. It has very, very low mortality so far. So, if those events ... so usually about oh, 30, 30 degrees Centigrade, so around, 88 or so degrees Fahrenheit. It's related to the highest temperature that the corals are kind of used to, in a way. There's, you know, places in the Red Sea where they think 95 is just fine, but, 88 is kind of the peak temperature that the corals have ever experienced. And when it gets above that, they can bleach. And then, if it goes on for very long, or a warmer temperature and it could cause a lot more bleaching and possible mortality. The coral then could die. And then, a hard time growing back.

Greg Boland [02:22:32] So, those temperature effects are going to, it's going to keep going up basically. I kind of hate to bring up the grim news. It's like if CO2 going to zero right now, the

temperatures going to keep going up for probably ten years and stay level for a thousand years. So, that's like the heat budget of the oceans.

Greg Boland [02:22:58] And turning it around, you know, making it cooler, you have to think about multiple generations away from now. I'm not like a climatologist or climate scientist, but, you know, there's papers that say it's pretty grim as far as making it better. And CO2 is not going to zero anytime soon either.

Greg Boland [02:23:22] So, pH-wise though, there's been some observed increase in pH, which is well, I should say decrease. It's more acidic. It's acidified but it's not acid. It's never going to be acid. People say that the oceans are turning acid. A pH of 8.1 or 8.0 is not great. But pH 7 is still neutral. It's not acid. It's never going to be even close to seven. But anyway, the pH of even 7.8 or so, would not be very good for a lot of things that precipitate calcium carbonate for their shells, or corals even, to make their skeletons, would not be happy with pH in the mid 7s. So, still alkaline, but a lot more acidic than it would be now.

Greg Boland [02:24:19] And that's, that's directly related to the CO2 as well. So, whether or not that would become a problem more than temperature? Probably not likely, but still another concern.

David Todd [02:24:32] Okay.

David Todd [02:24:33] Well, I see that, that I'm probably overstaying my welcome. So, I was going to just ask maybe some, some overview questions, if you don't mind. And, they have to do maybe with just the, not the sort of details of what you've observed and done, but just, the overall impressions. And, you know, the first one that occurs to me is that for most of us mere mortals, we're pretty land-bound. We will never get to see the Flower Gardens in person. So, how do you explain to people why they are important. Why are they valuable?

Greg Boland [02:25:21] Yeah. That's a really intriguing question. I asked that about deep sea habitats as well. You know, how would we miss it if it was all gone basically. I asked my professor in graduate school, "How would you notice if all the deep sea was gone all of a sudden?" But it's, you know, it's a value of knowing about them, I think, and protecting things that you don't have to damage, that they're a unique system and so many incredible animals live there, and it's been created, and how many hundreds of years it's thrived.

Greg Boland [02:26:03] You know, tells a story about what a coral reef can be. I think it's a kind of a beacon, really, in a sense of coral reef biology. There's places in the Pacific that are doing really well. But, the Caribbean, not so much. And in Florida, you know, it's like 1% live cover, compared to 60 or 70% in the Flower Gardens. And so, people don't usually mention it, but it's really probably the most pristine coral reef in the Western Hemisphere that I could think of.

Greg Boland [02:26:34] So, it's a special place. And, still don't know a lot, not everything about it anyway. There's a huge staff now at the Flower Garden Sanctuary. So, they're investigating more and more as time goes by. And it's, the Sanctuary has been expanded even to include 14 other banks that some have a little bit of coral, but there are similar, unique little habitats of different kinds along the continental shelf of the Gulf. So, they're all protected now as a sanctuary and really an important part of the American heritage, I think.

David Todd [02:27:17] Yeah. It is, I guess, a wonderful heritage, as you say.

David Todd [02:27:25] Well, I see that you've been sitting there, kindly talking to us for a while. Let me just ask one last question. And that's just to see if we could catch something that we might have missed in the course of talking this afternoon. And that is, is there anything you'd like to add that you feel like we gave short shrift to, and that you think would be important to emphasize before we break off?

Greg Boland [02:27:56] Well, I think we covered a lot of the highlights. I think just the diversity of the Gulf of Mexico has kind of continually surprised me, being raised here in Colorado. I thought of folks vacationing at the Gulf were missing the boat, and there's not really anything special there, but habitats from the Flower Gardens to these deep sea communities that are so unique, even deep sea coral, coral habitats (I'd not hesitate to even call them deep sea coral reefs) that are rivaling anything else in the world.

Greg Boland [02:28:37] So, we're doing a good job, I think, protecting them. I kind of feel like I had a role in helping to protect especially deep water things in creating regulations and supporting them and designing studies to understand them better. So, I have a little, a little piece of the responsibility to preserve them for posterity.

Greg Boland [02:29:04] So, the Gulf of Mexico is really quite spectacular.

David Todd [02:29:10] It sounds like it is. And, thanks for giving us a little window and some words to help us picture it.

David Todd [02:29:20] So, I should say thank you, and tell you how much we appreciate you doing this. It's been a wonderful experience to spend time with you and also to learn about the deep sea, and the coral reefs, and the Gulf of Mexico in general. So, thank you.

Greg Boland [02:29:39] Yeah. Thanks a lot to you, in asking some good questions.

David Todd [02:29:42] Well, it's nice to have somebody who can answer them.

Greg Boland [02:29:48] Very good.

David Todd [02:29:49] All right. Well, I'm going to push a button here that will let you go free. We'll stop the recording and you can go back about your day. Okay?

Greg Boland [02:30:00] All righty. Thanks a lot.

David Todd [02:30:02] All right. Thank you very much. Appreciate it, Greg. By now.

Greg Boland [02:30:05] Take care.