Dr. Paul Montagna, Part One

Interviewed by Jen Corrinne Brown
February 23, 2017
Corpus Christi, Texas

Jen Brown: All right. It is February 23rd, 2017. This is Jen Brown. I'm here at the Harte Research Institute with Paul Montagna, and we are here to talk about his work as a marine biologist, and his work particularly on freshwater inflow. So, do I have your permission to record this interview?

Paul Montagna: Yes, you do.

JB: Thanks. Perhaps a good starting point would be for you to tell me a little bit about your background and early life.

PM: Well, I grew up in New York City, believe it or not (Montagna laughs). I'm always surprised when I say that because I don't feel like I have any affinity to New York any longer, but I went to college on Long Island at Stony Brook, then a Master's at Northeastern University in Boston, and then I did a PhD at the University of South Carolina.

JB: Okay, and what drew you to studying science and biology?

PM: You know, in a way, it was an accident (Montagna laughs). I like to say that life's like an escalator, you get on at the bottom floor, and you don't know what's on the second floor until you get there, and that's kind of how I wound up in science. I started out thinking I wanted to be a high school biology teacher, and then I remember when I was in a senior in college, I had to take a student teaching course, when I actually got into the classroom, I realized I didn't like it and I felt woefully unprepared for it. So I decided, well, maybe I'll try graduate school instead because I was enjoying my science classes, and the rest, as they say, is history. You know, I never really intended to go to graduate school when I was an undergraduate, I was just preparing to graduate and be a high school teacher, and that didn't happen.

JB: Hm.

PM: Then, once I got into graduate school, the whole world opened and I discovered all kinds of things that I had no idea existed, and here I am today.

JB: What opened up for you in graduate school?

PM: Well, it's interesting. I was incredibly naïve as a graduate student compared to the students I have come in and working with me today. I kind of showed up not really knowing what I wanted to do, and when I was asked what you want to work on for research, I said I think I'd like to study forests and trees, and the guy said, we don't have anyone who studies forests here, but we all do coastal ecology and we work on salt marshes and estuaries, and this light bulb went on

in my head, oh yeah, that's what I like because I always spent a lot of time playing on the beaches, and I always went fishing with my father in the bays, but it never occurred to me that something I was having fun at would actually be something I would do for a living, and when the professor suggested I work on something I actually like, it was like this big light bulb went off in my head, oh, you mean work doesn't have to be misery, and I can combine fun and what I really like with what I do for a living? It was like a revelation to me. Again, it just kept building from there. It's interesting at this point, that was a long time ago, that was like 1971, and here we are so many years later, and I've never worked outside of a university environment or outside of a research setting in my entire life. I've been pretty lucky overall I think.

JB: Yeah, and can you just, as a whole, describe your work in those last thirty years?

PM: It's been remarkably diverse. I've worked on everything from rivers to the bottom of the deepest parts of the oceans (Montagna laughs). I've worked in every part of the globe, from off the coast of Africa, from off the coast of Asia, from the Arctic to the Antarctic. I've been very well-traveled, and I've studied a huge variety of topic areas, and again I think both of those, both my spatial geographic coverage of marine science, and the variety of topics that I've worked on, I've worked on everything from bacteria to giant clams and (Montagna laughs), and it's just been very diverse throughout my entire career.

JB: And, you kind of mentioned that your professors when you were doing your master's were focused on estuaries. Is that how you got interested in it?

PM: Yeah, at the time, there was a big focus on estuaries and salt marshes in New England, that's when I was living in Boston, and that's how I got started on estuary work. It's kind of interesting, I kind of alternated, because from there I moved to Oregon State, where I started working as a research assistant on deep sea work, then I went to South Carolina where I worked on estuaries again, then I moved back to California, to the West Coast, as a postdoc and I worked on deep sea work again, and then I came here and I started working on estuaries right again, but then also I started picking up on the deep sea work again while I was living here in Texas. At various parts of my life, I've alternated between focusing on one or the other, and that's even been true in my professorship. It seems like I'll spend a few years focusing on the estuaries, then a few years on the deep sea again, and then back on estuaries (Montagna laughs).

JB: Um-hm. Why do you think estuaries are so significant in terms of both the science and then also the conservation?

PM: Well, it's interesting. Estuaries in the coastal zone make up only five percent of the world's oceans, but it's ninety-five percent of the world's productivity, marine productivity. They're clearly very important just for providing food for people, but the other thing that's really important that people don't realize is that they provide an incredible buffer for storms, they provide natural protection during hurricanes and other big storms When estuaries get degraded, you lose two of those important, what we call ecosystem services, benefits to people, they no longer buffer the coast and we see storm effects get greater and greater as we degrade estuary systems and of course we have less food production, whether that's oysters, fish, or crab, or shrimp, or other things that have what we call estuarine-dependent lifestyles and are really

important to people. And the third thing that I think is super important is that estuaries are natural filters. They have this ability to naturally clean the environment so when we have a natural estuary, and the estuary is in a healthy state, it literally will remove all the pollution for us, completely free of charge. And yet, the opposite is true, once they get degraded, they can be overloaded just like your vacuum cleaner gets overloaded and no longer sucks the dirt out of your rug. If an estuary gets overloaded, it has this, what we call assimilative capacity, and once that gets filled, the pollutants will start to build up, build up, build up, and then all kinds of nasty things happen, the water turns ugly colors, it might get a little smelly, we might actually get toxic events like red tides occur, so that's why a healthy estuary is so important to people.

JB: Um, how has the science changed over time?

PM: Oh gosh, dramatically. You know, let me rephrase it, in some ways not at all and in other ways, it's nothing at all like it was thirty, forty years ago when I started. So it's funny, you go back to the eighteenth, nineteenth century, and what people did was, you know there was this famous saying, learn from nature, not the books, and the whole concept of the eighteenth-, nineteenth-century naturalist was you go to the shore in the summer and you study the things that live there, and you learn from nature itself. To a large extent, we still do that part of it, we still do a lot of looking and seeing, so to speak, but what's changed dramatically are the tools. Again, the early days, microscopes had just been invented and that was the high tech instrument of the day. Today, we've got a lot more tools available than microscopes, ranging from genetic tools to instruments, electronic instruments, you know, we can't be in the environment every minute, every day, and having censors and remote sensing is dramatically important because it allows us to collect information when we're not there.

JB: Have the questions changed at all?

PM: Yeah, they've gotten more in depth. One of the interesting things—one of the interesting changes in my career, just in the length of time I've been doing this work, is when I started, the United States was remarkably polluted, in fact, you know, there's this, I can't remember the name of it, the famous river in Pennsylvania that literally caught on fire.

JB: Cuyahoga?

PM: Yeah, the Cuyahoga River, and that caused of course ultimately the passage of the Clean Water Act. When I first started, a lot of the research was about degradation of water quality. Well, because of the Clean Water Act, that's largely been resolved. Today, the questions are a little different, and the pollution questions are very different today, and today we find it's not so much about pollution but it's about habitat degradation because we don't have quite—we don't have any particular, specifically focused act that tries to stop habitat degradation per se. So, the big problems today are things like sea level rise, climate change, the continual development of the coastal zone that leads to degradation of habitat. We've lost more than fifty percent of all the coastal habitats that existed when the United States became a country, and we don't have something analogous to the Clean Water Act that basically resolved our pollution problems to resolve our habitat problems, instead there's this patchwork of rules and regulations, a lot at the state level, some of the federal level, and we find it very, very difficult to understand what the

tradeoffs are when we build new developments in the coastal zone, and what we might lose. So, that's an important research topic today, and what we're going to do about it has become really, really complicated. What was nice again about when it was just water pollution was our only problem, you could limit discharges in the water, we could build treatment plants so that what we do put in the water is a little cleaner. Well, what are we going to do, start pulling developments out of the coastal zone? No, that's not going to happen (Montagna laughs). Are we really going to limit what people can do with the property they own? That can't happen in most states in the United States, there really isn't strong rules against coastal development anywhere, although people they think there are, there are really not. The habitat degradation problems, and can we actually restore habitat or enhance existing habitat. It turns out, that's been a lot more difficult than we thought it would be when we first started doing these things in the 1980s. The focus has changed a lot from pollution to habitat, is the punchline.

JB: Have you noticed due to development, and climate change, and sea level rise around here?

PM: Oh, the Texas coast is going to be the ground zero for climate change effects because we have one other thing going on here that isn't going on anywhere else in the United States, and that's something we call subsidence, so because of, believe it or not, primarily water withdrawal from below the ground, but also obviously oil and gas withdrawal from below the ground, the land on the Texas coast is sinking. Consequently, when we add the small amounts of sea level rise that have happened over the last hundred years to a much larger amount of land subsidence over the last one hundred years, we actually have the highest sea level rise rates almost in the entire world along the Texas coast. And we're already seeing dramatic changes in some places, we're seeing, you know, higher erosion rates, and we see higher losses of habitats because of that, and I think over the next thirty to fifty years, the changes will be really, really dramatic. That won't occur over my lifetime, but it certainly, you know, in our children's lifetime, they will have to live with these consequences, not our grandchildren's, our children's lives. But things are changing very rapidly right now. To me, one of the most interesting things about the climate change debate is that a lot of people say, well, you know, it's all based on models, all these predictions, and who knows if the models are right, and that's true, but what you need to realize is that those models have been consensus models, meaning that they've been compromises, and in fact, the kinds of changes we see in 2015, 2016, 2017, today, are these that were predicted to happen in 2030 in the past (Montagna laughs). So in fact a lot of the changes are happening much more rapidly than those models predicted, because those models were actually very conservative. They eliminated the outliers, so to speak. Again, that's why I say our children will see big changes in their lifetimes.

JB: Hm. You had mentioned that Texas was also—took the lead in terms of water law and inflow into estuaries. Can you talk a little bit more about that?

PM: Yeah, it's kind of amazing. You know, I moved here in 1986, and in 1985, the legislature passed a law that required that any new water permits would have to consider the effects on downstream bays and estuaries, and, of course, this also follows on a very devastating drought in the 1950s where people first started noticing big changes in coastal resources when the salinities went sky high. Texans have always been very concerned about protecting bay health, and understanding that rivers flowing to the coast were largely responsible for bay health along the

Texas coast. Now, that law was enhanced dramatically in 2007 by something we call Senate Bill 3, which required that we essentially define environmental flow regimes for every bay and basin in the entire state. We have this long history going back to the fifties to certainly 1985, where the state has enacted laws that protect flows to the coast, that protect the bays and estuaries. What's interesting is there are really only two other states in the country that have laws like that. Florida passed laws like this in the 1990s, in the early 1990s, California didn't pass a law like this until 2010 so Texas has been one of the national leaders when it comes to the issue of environmental flows and protecting downstream receiving bodies of those freshwater flows.

JB: And what was it about Texas particularly?

PM: As I said, I'm not a native Texan, but I've been living here more than thirty years now, and I think the one thing that makes Texas really unique is the people who live here seem to have a much closer appreciation of the land and the environment, people seem to live in the environment more, and to appreciate the benefits of the environment, and receive a lot of benefits from the land, whether we're talking about oil and gas or cattle, it doesn't really matter, or even farming, it doesn't really matter, you know, much of the state is still very rural, and the people who live have a very close contact with the land and the landscapes, and understand the limited natural resources that exist and appreciate it a lot more than I think people in the cities do.

JB: Hm. So they passed this '85 law, and there were obviously some problems with it that led to the changes in 2007. Can you talk a little bit about the pros and cons of this 1985 law?

PM: Well, when I first moved here, which was'86, the state was just starting to gear up to try and figure out how much water does the bay need after all, how much freshwater does a bay really need? I was part of a large team that was asked to research this question. At first, I thought, wow, this is going to be very easy, all we got to do is figure out what lives along salinity gradients. Well, in reality, it took me twenty years to figure out how to ask those questions the right way, and a big part of the problem was the way the '85 law was conceived. It was really conceived to protect harvestable resources like red drum, and black drum, and oysters, and shrimp, and blue crab. The problem is that flow doesn't affect natural resources directly, it only affects natural resources indirectly, and that's what took us about twenty years to figure out. What river flow to the estuary really does, is it changes the water quality of the bays, it brings in nutrients and sediments that can build habitats, and it also dilutes the salinity in the bays, and it's the combination of these three things that create what I like to call estuary condition, and the biological resources then respond to those conditions. When Senate Bill 3 was passed in 2007, it changed our management goal. It changed our goal from trying to manage the bays to produce just seven species to trying to maintain the ecological soundness, what ecological soundness was basically moved us toward an ecosystem-based management approach, and now what we do is we try and manage our coastal systems to protect the entire ecosystem and not worry about winners and losers in terms of individual, particular species.

JB: And can you talk more about your role in writing and working on Senate Bill 3?

PM: Yeah, I was very fortunate because I'd worked on this environmental flow issue for a very long time, I was asked to serve on a legislative study committee in 2004 that that tried to define what was—what environment flow regimes were needed, and then the legislative study committees are the ways in which the legislature determines, do we need a bill and what should the bill contain? But in 2005, the water bill didn't make it through the session. In 2006, the governor asked me to serve on yet another environmental flow committee to try and come up with what was needed, and it was actually in that group that we really were able to write a real strong document that said, we want to make sure that what we're protecting is the ecosystem as a whole, and in particular, we defined a sound environment as something that was going to maintain a complement of native species over the long term. What we got into this definition was the concept of manage for a healthy ecosystem, and the second most important thing was manage for sustainability. Those exact words actually wound up in Senate Bill 3, which did get passed in 2007. I was pretty fortunate to be able to have an impact so that science had an impact on crafting what I think is a pretty good law.

JB: And the governor at the time was?

PM: I guess that was Rick Perry.

JB: So Rick Perry appointed all the members of the committee?

PM: Yes.

JB: Who else was on the committee?

PM: Oh gosh, hopefully I can remember. I remember it was Bob Brandes, Larry Hauck, George Ward, and Kirk Winemiller.

JB: We can add it back into the transcript later.

PM: I'll have to go back and look, I think there were four of us, as I recall. We'll have to add that later.

JB: Uh, were they all scientists?

PM: Yeah, scientists and engineers.

JB: And how did the committee process work?

PM: Well, um, the two different committees were really different. In 2004, that was a legislative study committee so it was a very large committee, there was about twenty people on it, and you would go to these meetings, there'd be presentations, and we'd sit around and talk about things, and eventually we wrote a report. In 2006, what we were asked was, hey can you do a quick update of that 2004 report? Does anything need to be added? Has anything changed? Is there still a need for legislation? And, as I recall, the report we wrote in 2006 was really short, it was probably only a couple pages long. I don't even recall if we had any meetings, we might have

done the whole thing over conference calls. Can't remember (Montagna laughs). Long enough ago that I can't remember all the details.

JB: And, uh, when it was a smaller committee it worked better in terms of writing and deciding how the language would be put forth?

PM: You know, I think we were really fortunate because very like-minded people, and I assume this was by pure chance, very like-minded people got appointed to that committee. Yeah, we had no problem, very rapidly coming to a very widely-held consensus. It was easy to develop a consensus, you know, among the small group of us who were working on it, and the words flowed real quickly. It was very easy the second time around (Montagna laughs).

JB: Did the bill encounter any opposition when it was in the legislature?

PM: Oh, I don't know those details, I didn't get involved, I wasn't involved at that point. I know a lot the people who were involved, but typically all environmental bills, there's quite a bit of give and take (Montagna laughs). Some things get in that you wished weren't there, and some things get taken out that you wished didn't get taken out. Yeah, there's always a lot of give and take, particularly on environmental bills. One of the things, and I'm not even sure that this was a part of the discussion, but one of the things that's not in Senate Bill 3, that I wished that got put in, for example, was this concept of conjunctive use. In the state of Texas, we don't recognize, in a legal sense, the connection between groundwater and surface water, and that leads to some real technical problems when we try and manage even surface waters because, the reality is, scientifically and geologically, they certainly are connected. Springs certainly do feed the rivers (Montagna laughs) and the streams in the state, and yet that recognition doesn't really exist, so all the surface waters in the state are treated as state-owned resources, but groundwater is treated as private property for whoever owns the ground above it.

JB: And, did you try to work any of these changes into that bill?

PM: No, not me personally. It's funny, whenever we do things that have legal ramifications, we've got to be a little more careful to stay in our lanes (Montagna laughs). I leave those kinds of things to the hydrogeologists, and me being primarily a person of ecological and biological background, I kind of stick with trying to describe the natural resources and ecosystems effects.

JB: Okay, and in terms of why there's that continued disconnect, do you think that will change in the future?

PM: No. I think it was brought up in the last legislative session, and it was knocked down before it could even get any legs. There's a real strong—there are strong proponents for individual property rights in the state of Texas, and you know, once you have a right, it's hard to take it away (Montagna laughs). I don't really see how that can ever change. I do think the state is going to have to address how we manage groundwater resources in connection with the surface waters at some point because, at some point, the system's going to start breaking down. You know, the funny thing, and this may be cynical from a scientific point of view, but it strikes me that we really don't address problems unless we're in a crisis, which is a shame because if we could

address some problems before there's a crisis, we can avoid them, but pick your favorite topic. Again, I mentioned we didn't have a Clean Water Act until rivers started catching on fire. Look at Flint, Michigan, they didn't really address their pollution problem until it became a crisis. This is so often the problem that I see with environmental issues is that we really don't address them until there's a crisis. We'll probably have to wait until we have some kind of a crisis before we do it again, and that crisis will be severe droughts, springs going completely dry, things like that.

JB: You mentioned in your book that that 2011—or 2007, excuse me, law created an adaptive management process and more stakeholder involvement in that process. How successful do you think that's been in the last 10 years?

PM: Yes, it did, and of course that's not quite ten years old now because, that's only maybe two legislative sessions old, so it's only about four years, and the big success story here is so the adaptive management process kicked in after environmental flow regimes were recommended for every bay and basin system, and that was somewhere around 2011–2013 time frame, and the legislature did provide about two million dollars in each session, the last two sessions I think, to further this adaptive management process. The point is they're putting some money behind it so it actually can work. The concept is, in those initial reports, environmental flow regimes were recommended, and what we want to know now is, is that working? Do those things need to be revised? Were they based on good science, on good data, or is there are data we need to refine those? The whole concept of adaptive management is once we pass a rule, let's go back and see if it's working, and if it's not, let's tweak it and fix it again, so there's this cycle of do a study, make a rule, do some monitoring or studies to see if that rule's working, tweak the rule, and back again. As far as I can tell, it looks like it is working. I haven't been too intimately involved in too many of the programs. In fact, I haven't been involved in any of them, come to think about it. I guess I really don't know how successful it is. I will say that, as I look at what I thought some of the big problems were, they're not necessarily being addressed, and some of the things that were being addressed, I couldn't figure out why did they think that was a priority, but, you know, again, I haven't been intimately involved in writing those agendas, and I wasn't successful in competing for any of the projects, I'll have to admit. I haven't been too involved in the processes that have evolved over the last couple of years.

JB: And what big problems do you wish they would have addressed?

PM: I still think there's a lack of generalized monitoring, particularly for the things that are the most important because they're at the base of the food chains, and don't get looked at at all. The state has an enormously successful statewide fishery monitoring program that's run by Parks and Wildlife. We look at the top of the food chain, and we've got a ton of information about that, but that's also focused on adults, and the problem is that evolved in the 1970s, when the main goal was how do we manage the fisheries in the state? Well, because that's the only statewide database, guess what? People try and use that to answer every question we have, even questions about inflow. When you look at that, you come to the conclusion, wrongly by the way, well fish don't care about salinity and inflow. Well, the problem is that they do, it's just we're looking at the adults, and it may not be adult stages that are responding to what we call the nursery habitats that have the low salinities and the high nutrients and the high productivity. That's really what's missing, we're missing a lot of information on nutrient loads, nutrient concentrations, primary

production, the processes, the ecological processes that build fish. Senate Bill 3 really is focused on, let's have a sound, healthy environment, which means we want to make sure we have information about these fundamental ecological processes. Yet, I still don't see people making that the priority for what we really need to be measuring and monitoring throughout the state, particularly if we're going to define inflow regimes because again, as I said, inflow doesn't drive the biological resources directly, particularly those at the highest tropic levels. It's driving the physical, chemical processes of nutrient cycling, and salinity dilution, and those things are building the primary producers like the microalgae, and the phytoplankton, and the sea grasses in the ecosystem, and those are the things that are having the more direct responses. I would have liked to have seen more focus on the things that are directly affected by inflow in the bays and estuaries, rather than things at the higher trophic levels.

JB: Okay, and the bill also had that stakeholder involvement. Can you explain why the committee thought that was important to include?

PM: You know, at the end of the day, water is diverted for municipal, agricultural, and industrial uses, and that's what we mean by the stakeholders. There's always this—the problem that had always existed is that the environment is also a user and requires the flow itself. Is it a river if there's no water flowing in the river? Is it still an estuary if there's no freshwater diluting the saltwater? And the answer to those questions obviously is no. On one hand, there's the environmental, scientific issues related to inflow needs for the environment, but on the other hand, water is probably the foundation for prosperity for all people. We have to always balance the need for water for people and water for the environment, and I'm an eternal optimist. I still believe that even in areas that are water-stressed, like it is in South Texas, we can figure out ways to take care of both.

JB: Do you think there are any issues that still need to be addressed besides the conjunctive use or better monitoring, in terms of Texas water law.

PM: Oh gosh, yeah I think, and a lot of this will be getting out of my wheelhouse again, I really think there's got to be ways to engineer solutions, and there's got to be ways to better price what water's really worth. The problem is water is free. What we pay for, what the taxpayer and the water user pays for is really only the distribution, the pipes and the plumbing, and that creates the problem that we don't value the water. If we don't value it, how can we come up for the true value for it? How can we really portion it correctly? And then of course, what we've really got to figure out is, can we engineer systems that are not so leaky? Our water systems are leaky in two ways, not only are there literally leaky pipes, and it's been estimated up to fifteen percent of the water is lost through leakage alone, which if you think about it, is disastrous in its own right, but the biggest problem I see is building reservoirs because once you bring the water to the surface, then it's subject to evaporation, and typically evaporation is the largest user of water in the state of Texas (Montagna laughs). Particularly in our area in Corpus Christi, you look at the city only uses about 100,000 acre feet a year, and the environmental flow regime that's required is about 100,000 acre feet a year, but we lose about 200,000 acre feet a year, maybe 3 actually, to evaporation (Montagna laughs). The bottom line is, if we think about all the users, people, the environment, and the atmosphere, the atmosphere is actually taking the largest amount of water right now. I can't help but think that we need to come up with engineering solutions to make new

water, and the way we do that is by plugging the leaks, trying somehow to figure out how to limit evaporation, and then the third big promise is desal. The problem is, people always want to say, well, desal is too expensive and building a surface system is still the cheapest way to do it, but as I say, that's because you don't look at all the costs. If you only look at what it costs to construct a pipe versus a desal plant, sure, or dig a ditch, or dig a hole in the ground, which is a reservoir, sure it looks cheaper, but you're not looking at lifecycle cost of the water, and the need of all the users, including the environment. For example, with desal, there are ways to make it very cost effective. For example, there's a lot of groundwater that has just a tiny amount of salt in it, and it means it's not drinkable. Well, that would be a lot cheaper to desal and probably be just as cost effective as surface water development as trying to desalinate high salinity water like we have in the coastal areas. I think there's always been a mismatch in the way that we've tried to design our desal plants with where the water—where the cheapest water to desal might be, and then we have the other problem of what do with the briny effluence, where are you going to put that so it doesn't cost more problems than exists? And then finally I think there's a fourth opportunity to create new water and that's reuse. Right now, we pump water out of our sewer systems, directly into our bays and rivers, the trouble is we have to design water systems based on gravity so it's cheap to move water around, which means that we take water out of the top of a system, and we put it back in at the bottom (Montagna laughs). If there would be ways to actually pump it back upstream so that we can enhance our river flows and the flows to our estuaries, I think that would be a way to literally create new water. I think there are a lot of—I would love to see the civil engineers and engineering community think a little bit more about how we might create new water for the systems, particularly in the more water-stressed areas of the state, meaning the south and western parts of the state. Obviously, this is not an issue in the northeastern part of the state where they get plenty of rainfall, but it's certainly an issue in our part of the world.

JB: Have there been any problems locally with drought and rivers drying up?

PM: Oh yes. In fact, we talk about the hydro-illogical model (Montagna laughs). When it's raining, people don't worry about water, and when it's a drought, we're all consumed with how we are going to solve our water problems. We alternate between this wet and dry cycle dramatically. One of the things about South Texas in particular, I think our normal condition is drought and it only gets punctuated by occasional, very large tropical storms, and also the El Niño events when we do get an unusual year, every once in a while, with high rainfall. During the dry times, we see large, large problems, particularly in this part of the state. We see hypersaline conditions, so this is saltier than ocean sea water, and here is the interesting thing. An estuary is everything between fresh and sea water conditions, and there are all kinds of organisms that have adapted to live between fresh and sea water conditions, but there's really nothing that has adapted to live in above sea water salinities, or what we call the hypersaline conditions. Hypersaline environments are quite stressful to living organisms, and we see dramatic degradation of estuary health whenever the salinities get too high, and we certainly see the river beds go completely dry, and we certainly see the creek beds go completely dry, and we see no water flowing to the coast at all during dry times, that's a very common condition in the lower, southern part of the state, but we're starting to see this even in the central part of the state and further north.

JB: Um, in your book, let me just find it here, you talk somewhere about how Texas is the perfect place to study estuaries and especially in these shifts in climate with El Niño and La Niña. Can you expand a little bit about that?

PM: Yeah, if you think about an estuary, an estuary is where the ocean water mixes with freshwater, so that means all estuaries are going to be slightly different because they're going to be slightly different amount of tidal mixing, slightly different amount of river flow coming in, and then of course, the size of the bays matter too, the depth and the area, basically I'm talking about the geological conditions, and then of course the climate, how much heat, how much evaporation, how much rain comes down. If you take these four big things: tidal mixing, river flow, climate, and the geological background, you can imagine them as all having settings or being dials, and you can imagine there's an infinite number of settings that each one of those dials can be put on, which means every estuary is a little bit different. When I first moved here, and I started looking at the estuaries along the Texas coast, I was absolutely stunned because one of those variables, the geological setting, was held constant, and the tidal settings are basically held constant. The only thing that is different along the Texas coast is the climate and river flow. Along the Louisiana border, we have about 55 inches a year of rain on average, and that declines to about 25 inches of rain a year at the Mexican border. Climate wise, the rainfall only drops by half, but there's also a soils gradient, with more clay in the northeast and more sand in the southeast. What this translates to is a thousand-fold decrease in the amount of runoff from the northern estuaries to the southern estuaries in the state. What that means is we have all these estuaries aligned perpendicular to the coast, and they lie on this gradient, and they're all dramatically different in terms of inflow and climate. It's like nature create a perfect experiment for us so that we can pair inflow effects just based on the inflow patterns alone because both the tidal variables and the geological variables have been held constant. The entire Texas coast is what we call microtidal, the tidal range is very small, and the entire Texas coast is very flat, and we have what are called bar-built estuaries, they're the barrier islands in the front, a bay in the back, and it's a very flat, fed by some river systems. It's just been an absolute—for a scientist who studies inflow effects in estuaries, it's been the perfect place to set up these kinds of long-term studies?

JB: And what have you learned from these long-term studies?

PM: Well, I told you that one of the things we learned was how to ask the questions the right way (both laugh). That was the first, biggest lesson, and again what came out of that was what I like to call the domino theory, that inflow affects primarily estuary condition, and the biological communities are responding to estuary condition, and understanding the linkages between the physical, the hydrology of water flowing to the coast, and what we call biogeochemistry of how the nutrients are cycling within the bay waters, and then how the biology responds to all of those conditions. There have been lots and lots of different studies on all of those various components. And then, of course, we've discovered that—and a lot of this has an effect primarily on what we call an estuary-dependent lifestyle, and these are organisms, it's really interesting, a lot of organisms that we consider important like shrimp, and even redfish and blue crab, they actually spent part of their lifecycle offshore and they migrate between the estuaries, the bay systems, and off shore, but what they do is, the babies actually are the ones that grow up in the bay systems, and we call those nursery habitats. Understanding the importance of the link between inflow is

really on the juvenile life stages. We had to charter our studies on specific stages to get the right answer, so to speak, on what the inflow needs really are. That's been another really important discovery. The other big one, I think, is this whole concept of what I like to call the salinity zone habitat. When I first started, there was this idea that there was a continuous gradient from the river to the sea, and what we've discovered is that that's not really true, and we thought habitats were things like oyster reefs and sea (reef??) beds and marshes, and one of the major discoveries that I've made over the years is that the water body itself has different long-term average conditions, and those change not as a continual gradient, but rather as sharp gradients and so we have like fresher zone habitats, and medium salinity zone habitats, and marine zone habitats. Those three kinds of zones seem to exist in large parts of the bays, and even if the salinity varies quite a bit within those geographic areas, it's remarkable how much fidelity the biology has to those sites, even under variable salinity conditions. I think it's because of two things. One, the long-term average and the long-term variability. The second thing that's important is how those long-term averages, how they play out along specific seasons. A lot of things that are adapted to spawning at certain times of the year. The best example is probably oysters. Oysters in our part of the country spawn in May and October. But when do we get our normal freshwater pulses? Spring rains and fall hurricanes (Montagna laughs). What we've discovered is if we have a dry year and we don't get a spring rain, those oysters still put out the exact same amount of babies, and all those babies still land on adult oyster shells and start to grow, but by June and July, they're all dead. It's only during—only if we get a nice rain in May or April, will those baby oysters grow up and still be around. And the same thing would be true for the fall sets, if we have a fall without any tropical activity, those babies won't do as well. You know, again, the lessons here are how important the seasonal delivery of inflow is, and again, this was one of the real big advances in Senate Bill 3, when we had to develop this concept of regimes, meaning, let's worry about when the flow comes as well as how much flow is coming.

JB: The example you mentioned in your book in terms of drought problems and problems in Texas was here in Corpus Christi, correct?

PM: Yes.

JB: In the late eighties. Can you talk a little bit about what happened then?

PM: Yeah, it was the nineties, actually, as I recall. It was really interesting, I do believe that the drought in the nineties, in this part of the state of Texas, had a greater impact than the drought of the fifties, which really set the standards for droughts in the rest of the state. Basically, what we saw happen was all the shrimp and oysters disappeared. The biggest problem about—well, when the shrimp disappeared, the shrimpers weren't happy, because they lost the commodity that they fished for and they lost some money, but one of the worst things about oysters disappearing is oysters are also what we call habitat engineers, or foundation species, so they're not only a living resource in the bay, they create habitat themselves. When that habitat disappears, the things that depend on that habitat start to disappear, and we've seen in dry periods, even in Baffin Bay more recently in the 2000s, the 2010s actually, in the early 2010s, we saw what was call a wasting disease, where people were catching black drum in Baffin Bay and the Laguna Madre that were, their flesh was all like jelly, they were literally starving because they didn't have these filter-feeding organisms that depend on lower salinities to grow. So, you know, black drum

exclusively feed on mollusk bivalves, they've got those big grinding plates so they love to find on things like oysters and clams, and oysters and clams are both filter feeders and they depend very heavily on freshwater inflow to create phytoplankton that fall on their heads so they can eat them, and again, the low salinity conditions so that their babies can grow. We can see direct effects throughout the food chain when we have droughts as well.

JB: Have the threats to estuaries changes over time?

PM: I'd say the biggest change is just more and more coastal development. It's not so much as it's a different kind of a threat as much as it's an increasing threat. The statistics have been true for my entire career, the greater part of the population of the United States lives on the coast. Well, the funny thing is that's been increasing over time. The coastal populations continue to grow, which means water needs of the cities on the coast continue to grow, which means land keeps getting converted from natural areas to developed areas. We build more and more industry, particularly in this part of the country, on the coast, primarily because of the chemical industry. It's just an increasing population is the increasing threat, really.

JB: Um-hm. Um, one of the things that I found really interesting in your book was how you struggled over how to define what is healthy. Can you talk a little bit about that?

PM: Yes. As I pointed out from the very beginning, from the eighties, when I started working on this issue, we always worked hand in hand with engineers because it was the engineers who had to figure how to implement some kind of water management strategy. And I can remember, when we first started talking about, well, is this bay healthy or not healthy, they would look at me like I'm crazy, and they said, Paul, wait a minute, the environment can't be healthy or unhealthy. For example, think about a desert and a tropical rainforest. There are a lot of trees in a tropical rainforest, and there are not a lot in the desert, but that doesn't mean the desert's unhealthy, the desert has its own health conditions, and eventually, what I realized was, yes, that's exactly how I'm going to define it. What I discovered over the years is we had to have a way to define words that might be intuitively obvious to a scientist, but meant nothing to someone else, let alone the general public, let alone the engineers. The point is that the engineers who were skeptical about this concept of environmental health were instrumental in making me be very, very careful on what all these words meant, and what we did is we came up with a definition that basically says health is assessed when indicators are in a normal range. Basically, what I'm doing, I'm using the same exact analogy as human health. If you wake up in the morning and you feel bad, you go to the doctor, and what does he do? He measures your temperature, and if it's 99, he says, oh, take an aspirin and go home. If it's 101, he might give you a prescription for an antibiotic. If it's 103 or 104, he puts you in the emergency room. What does he have? He has an indicator, your temperature, and he has an acceptable range, and he's got several ranges where he can judge good health, poor health, severe threats, you know, imminent danger to your health. Basically, we use that exact same analogy. What we've developed over the years is a series of indicators of estuary condition, and then we try to define what's the normal range for these indicators, what makes it complicated in the environment is that our ranges are enormous. So, again, with the human health analogy, normal's 98.6, maybe 99 or a little bit over 100 is out of range. Well, what's the normal range for salinity? Well, it's from freshwater to seawater, which is like zero to 35 parts per thousand. That's really big range.

The other thing is that these things might vary over space, and they vary seasonally, when we have a rainy season and a dry season. We've had to develop normal ranges both geographically and temporally. It's just that are ranges are large, but the remarkable thing is, it's still pretty darn easy to figure out when something's not within the normal range, even given the fact that our ranges are large. We spent a lot of time—and again this is why earlier on, I said I think the most important thing we need to do is have monitoring programs of our fundamental variables, whereas now we only have monitoring programs of our fisheries harvest variables, which aren't affected directly by inflow. The reason we need those monitoring programs is so we can identify the normal range. If you think about it, we're making the worse kind of mistake, if because of a lack of data, we create rules and regulations that are too restrictive. A good analogy is the Clean Water Act. The Clean Water only regulated pollutants, and early on, we had very high levels that were deemed unacceptable. Those levels get lowered over time as we understanding more about what the natural variability of the environment is, as we develop machines that are more sensitive to detecting a changing environment, and as we understand better the human health effects or the other environmental health effects. That's probably one of our biggest problems today is our estimates for inflow needs are still pretty coarse because we lack so much of this basic information about the nutrients, and the water levels, the chlorophyll levels, and what the primary producers are doing, and how those natural cycles are going on. Those are the things that drive the higher tropic levels that people find desirable. People go to the coast, not to look at the phytoplankton, they go to the coast to go fishing for redfish, or flounder, or black drum, right? The hardest sell over the years to convince the people who only care about redfish, that if you want to build more redfish, it's the field of dreams, you got to build a healthy bay and estuary, and if you build it, they will come, and if the bay and estuary is not healthy, they are going to disappear. I can prove that, but still selling that to the stakeholders like the Coastal Conservation Association, who just wants to make sure there are more redfish in the bay, is always tough because it's just hard to make those leaps from the abstract to the concrete. Everyone understands a two-foot-long redfish and holding it up in front of a camera (Montagna laughs), but how do you take a picture of just some bay water and come to the conclusion, that's great redfish habitat? It's harder. We always have this hard sell when it comes to what we know what we need to have good, what I like to call honest broker management of the environment. As a scientist, I like to think I'm an honest broker, meaning I'll give you the best technical information I have in an unbiased way, and we want to be sure that we don't give people information that would cause rules to be too onerous or too lax, either way. And then of course it's the advocates on each side that will argue whether those rules are too onerous or too lax. That's their job, that's the role of the environmentalist. I'm not an environmentalist, I'm an environmental scientist, and as a scientist, I want to make sure that we have sufficient information of high technical quality that can guide management decisions in the best possible.

JB: How well do you think science has guided policy over time in Texas?

PM: Well, in Texas and everywhere in the country, it's been enormously important, but one of the things that I've discovered over the years is that science is only one of the pillars of scientific decision making. It's not like decisions are made based on science alone, that never happens, we always take into account the social needs, the political needs, and of course the legal, the economic needs, and we've got these legal boxes that we operate in. We may know this is the exact right thing to do, but the laws may not allow us to do it that way. This is how laws change

over time, I do believe, we have a great example between the ’85 law and the 2007 law, it’s certainly improved our ability to manage the coast in a dramatic way, and I think it was the 2007 law that was strongly influenced by science along the way that said we need to worry about the whole ecosystem if we want to build redfish, not try and mange it from the top down, but manage it from the bottom up. I think we see this happen all over the place. Now, science also gets used in the process by advocates in bad ways. For example, let’s say a policy maker doesn’t really want to do anything. What they often do is say, well, what we need is another study, so we kind of get in the cycle of endless studies because people don’t want to make decisions. And the opposite happens sometimes. People want to do something, even though the scientific facts don’t support their point of view, then they’ll argue, well, we can’t study it to death, we got to do something today. The bottom line is science plays a role, but it’s never the only thing that’s driving decisions.

JB: Is there anything that you want to add about estuaries or environmental flows that I missed?

PM: Well, I think the most interesting thing is how this issue has changed in the thirty years that I’ve been working on it. When I first started working in the eighties, and this was certainly true through the nineties and even the two thousands, anything related to water was always thought of as just a local issue or a state issue, and it was impossible to get federal funding to do the kind of science we were interested in doing, but what’s happened in the last ten years or so, we know see, because population growth is enormous everywhere in the U.S., it’s outstripping water resources, and because of climate change, and by the way, I don’t mean global warming when I say climate change, what I really mean global weirding. I think the most important thing about climate change is that the extremes have gotten more extreme. Our droughts are droughtier, our floods or floodier, I mean, look at California, how it has flip flopped from that horrible drought, a drought of record to a flood of record, we see the same thing with hurricanes getting more intense, where we don’t get one for 20 years, and when you get one, it’s just completely devastating. It’s just this global weirding, the variability seems to have increased. We can get colder colds, hotter hots, it’s just amazing. The point is because of this, places that never used to have these kinds of problems are having them dramatically now throughout the entire Southeast, parts of the Northeast. In fact, the place where I did my master’s degree in Boston. That spring, that river, now goes completely dry every summer. That was never true in the early seventies when I was working there. We see it throughout the East and West Coasts, even in the Northwest, where there’s huge amounts of rainfall, and we have salmon and stuff like that, we see problems where there’s not enough river flow to maintain the salmon populations. My point is that this has now become a national issue, and over the last few years, we’ve had a lot more success by saying we’re going to compare the results in Texas with what they’re finding in Florida, or California, or Massachusetts, or Rhode Island, or even the Seattle area. That’s what we’ve been able to do over the last few years, and that’s been a huge change. You know, the reality is that when it comes to research, the research industry in the United States is enormous, it’s, I don’t remember the exact number right now, but it’s well over a hundred billion dollars, and if we can’t tap into those federal resources to solve our problems, it’s just going to be slower because state and local resources are not designed to support research for the sake of supporting research. The local resources are to build the infrastructure, to manage the infrastructure. That’s been the biggest change over time is that we’ve finally caught the attention, I think, of the national audience of scientists who realized that’s not just a local Texas issue anymore, it’s an

issue that has implications for what Ohio is going to look like, when it gets drier there, for example, or Florida or California.

JB: That's interesting. Well, those are all the questions I had about freshwater inflow.

PM: Great.

JB: Did you want to continue or did you want to set up a different time? What would work for you?

PM: I think that, um, this is a hard one. Why don't we just keep rolling?

JB: Okay. Do you want to talk a little bit about, um, your involvement in the Mission Aransas National Estuarine Research Reserve?

PM: Yeah (Montagna laughs).

JB: I guess, I mean, to start, why did you want to create the reserve?

PM: Well, it's interesting. When I was a graduate student at the University of South Carolina we had a research reserve surrounding the marine lab there and so I naively thought that all marine labs had national estuarine research reserves that helped support research in the marine lab. and I discovered that wasn't true at all (Montagna laughs). So I moved to Texas in 1986, and I found out right away, that wow, not only that we do not have a research reserve that Texas doesn't even have a Coastal Zone Management Plan. It turns out the Coastal Zone Management Act authorized things like these research reserves, but they also created a program where the federal government would help the states manage their coastal areas, but only if you have an approved Coastal Zone Management Plan. Texas didn't actually develop and pass a Coastal Zone Management Plan until 1995, and once we did that, than the General Land Office, for example, who manages coastal lands from the state was eligible for federal funds from NOAA to do management activities along the coast, and then Texas became eligible for a research reserve because we now had a Coastal Zone Management Plan for the state. So I called up my friends at NOAA, and said hey we want to do this, and they told me I was crazy, the program was already oversubscribed and they couldn't add new reserves, and, anyway, you can't initiate it, only a governor of a state can initiate creating a reserve. Soon after that, I don't remember exactly how we did this, but because I was working at the University of Texas at the time, I couldn't start approaching the governor on my own, so working through the channels of the UT system, the president and the legislative liaisons between the groups, we were able to make contact with staff members at the governor's office and start bringing up the idea of shouldn't Texas have a national research reserve? At the time, George Bush was the governor, and they said oh sure, we'll think about it, but we need to know a couple things. One, do the people of Texas really want this? Two, we can't do anything for UT alone because then A&M will be mad at us so you've got to tell us that other people want you to be the guy who does this thing, and that set up me off on a seven-year journey (both laugh), and for the next seven years, I spent running around the state trying to build a consensus that yes people who live in the coastal zone in Texas wouldn't mind having a research reserve at all, and sure they wouldn't mind if UT went ahead

and designed it, built it, and managed it. As I said, it took me about seven years to pull all that paperwork together. Of course, before that happened, you know George Bush became president and Rick Perry became governor, and the funny thing about the Bush administration was that they were really great at doing the political thing by putting me off by never saying no. So every time I thought I had done everything they wanted me to do for the governor to write a letter requesting a reserve, they would always say to me, yeah, but did you fill in the blank? I must have went back five or six times and every time it was, yeah, but did you fill in the blank? So that's why it took so long, and then of course we had that huge hiatus once that presidential campaign started, and then 2001 Rick Perry is now newly appointed governor succeeding Bush, who had become president, and he's got a legislative session so he couldn't deal with it so it was way into the spring of 2001 before I even got a chance to talk to Governor Perry's staff. I'll tell you, my first initial conversation with him was great because I walked into their office, and I think I had two or three big legal boxes full of documents and said this is what I've been doing for the last seven years and what the Bush administration asked me to do, and I've answered all the questions and they were just about to approve it when this whole presidential thing came up, and we'd really like you to help us move this process along, and they were a little overwhelmed at first, but after a while they got back to me and said well, good news, Governor Perry believes that the state of Texas doesn't get its fair share back from Washington so if we can get a program to get some federal resources in the state we think that's a good thing. Within a short period of time, he signed a letter requesting a NERR site for the state of Texas, and that was in 2002, I think, and then it took me another four years before we actually had a dedication ceremony, and in that four years, we had to 1) pick a place, and boy oh boy, once we started drawing lines on a map, things got different. All the people who I thought were my great friends and allies quickly abandoned me or didn't like what we were doing so there was a huge political battle. I'm calling it a political battle, but it was a socio-political battle. I had to figure out, how do I make friends and influence people. A funny thing is that I spent nine years as a school board member on the Port Aransas School Board, and I think I learned an awful lot of political skills during those times, of how to listen, how to react to people, how to work with people, how to comprise, how to get things done, and I think those skills, which had nothing to do with being a professor, served me very, very well during this whole period. And, believe me, there were times during those four years where I thought I give up, this will never happen, there's no way I can continue along this path, and then there were other times where I just was very optimistic. There was a lot of up and downs in those four years where we actually had to put it together, and then of course it had to all culminate in writing an Environmental Impact Statement, which was a very large document, and believe me I had help from a lot of people, it wasn't something I did all by myself, and that last couple of weeks, when we were running right up to the point where, all right, everything's done, it's time to sign the memo, the memorandum of understanding from all the different parties involved, and we were all on the same page, we all agreed to do this, and the funniest thing was, literally weeks prior to us having to get the University of Texas to sign the memo with NOAA, and the GLO, and I think the Texas Department of Transportation, altogether there were 11 signatories on this because we were using a conglomeration of public and private lands of various kinds and different entities had different authorities and jurisdictions. The crazy thing was, when we got right up to the end, UT had just gotten a new president, who turns out was a lawyer, so I held off UT's signature for last, thinking that was the only one I wouldn't have a problem with, and we were greeted very rudely by a new staff member who said, well, what's this? We don't know what this is, we've got to study it, come

back in six months and we'll tell you if we think it's okay. This was like one or two weeks before we were going to do our big signing ceremony with senators and the Undersecretary of Commerce coming here, and you know, the governor's staff. I thought I was going to die (both laugh). Eventually I was able to reach a few friends of influence who were able to speak on our behalf and the President's Office signed the paper (Montagna laughs), committing UT to running the program. The funny thing is, it was such a—I don't know how to describe it, but when all this was done and we finally had the designation ceremony, and the reserve was up and running, I just remember this huge let down. It was just a remarkable feeling. I've often thought, maybe this is what post-partum depression is like. It was so hard to gestate this baby and push it out, it's just like, I don't want to have anything to do with it now (Montagna laughs). It was an incredible experience. We created the second-largest research reserve in the country, 186,000 acres, the only state that had a bigger one was Alaska. It's still a remarkable program, even though I'm no longer associated with it. The people who took it up and ran it and managed it have done an incredible job. It's one of the most successful NERR sites in the whole country by far, and I really believe it's because it's run by the university. There are now 28 or 29 reserves in the country, and only seven of them are run by universities, most of them are run by state agencies. They're all very diverse. The one in Texas focuses primarily on research. There are some in Florida that are essentially just parks that host visitors every day, and there's everything in between. It was a great experience, I learned a lot. I'm very proud of having been the person to put that together, and I can tell you that it took two important skills. One is perseverance, if you can call that a skill. That's a skill you learn in doing a Ph.D., I think. You've probably said this or heard this before when people ask you, what's a Ph.D. really? I always say it's a measure of perseverance (both laugh). Can you actually finish something big and daunting? And then the second thing was the remarkable time I spent as a school board member. You don't realize what you're learning, you think you're doing a community service when in fact you're getting a lot back. I received tremendous benefits from the school district and the peers who worked with me, and the administrators I worked with those days, teaching me how to be a better person, be a better manager, and certainly teaching me some political skills that I didn't know I was going to need in the future. The bottom line is two things I'd done a long time ago got me to the point where maybe I was uniquely able to do something like this. It was hard.

JB: How did you originally get support from people around the state?

PM: Talking to people. Asking. It's amazing, if you don't ask, you don't get something. It was just learning how to just—and thank goodness it was before Internet was ruling the world, and the kind of multimedia stuff you have going on today was ruling the world because what it meant is that I had to go and sit in someone's office, face to face, and talk to them. It was just a lot of meetings. It was literally a second full-time job. I spent a lot of time traveling, just meeting with people individually. We held a lot of public meetings. Most of them were pretty good, only once in a while did they get a little testy (Montagna laughs). It was primarily when we started putting lines on a map, the meetings got a little testy. What? We don't want it there, move it there! Luckily, we had enough allies and friends who helped allay fears.

JB: What did you tell people when you would meet with them?

PM: Well, I would try and tell them that it would be a benefit to the state, and it would be a huge benefit to the environment as well. Also, had to tell them that we wouldn't take anything away from you. The research reserves, that word reserve, frightened a lot of people. When you say reserve, people hear take away so fishermen were worried about will I able to go out fishing in Aransas Bay and the oilmen were worried about will I be able to drill my oil wells in the bay? The Texas Department of Transportation was very concerned about the Intracoastal Waterway, and maintaining the Intracoastal Waterway. It turned out that wasn't going to be a problem, but we did wind up excluding the entire Intracoastal Waterway from the reserve boundaries. I never thought that was really necessary, but it was what they really wanted to be a partner, to be on board with the whole program so we compromised and said yes, we will draw around. A lot of private landowners were worried about the boundary coming right up to their land. In some places, we have the boundary offshore a certain setback limits. We had all kinds of issues that came up, but primarily related to will I still be able to use what I use today? Those were the main issues. That was on the state side. On the federal side, the feds wanted to get as many restrictions as possible (Montagna laughs). I was the ping pong ball in between the General Land Office, and the Governor's Office who was representing the interests of the people in the state, and NOAA who was trying to make it as much of a reservy kind of thing as possible. At the end of the day, the National Estuarine Research Reserve is a management program, not a protection program, at the end of the day. That's true in the federal statutes. Even though the NOAA people were pushing me, get some rules, get some regulations, they really couldn't require it because it's not in the federal statute to begin with. They could ask for something that was never there, but I certainly was obligated to give it (Montagna laughs). And the state certainly wasn't going to give up something they already had a right to either.

JB: You mentioned the problems with deciding what lands would be included, how did you make those decisions?

PM: Believe it or not, huge committees and huge public meetings. Our very first meeting, we had people literally draw circles on a map of places that you think are special or great, that are a unique resource in the state of Texas that really need some attention and some focus on. We just kept narrowing things down, and the other thing was public-private partnerships. I was surprised how many private individuals approached me, saying I'd like to be part of this. And one of the things we can offer are conservation easements so we could pay someone for the right for them not to do anything on their land (Montana laughs). We had a lot of people who were conservation minded and they wanted to see the area protected for whooping cranes. For them to get a benefit out of doing nothing on their land and having these benefits was a tremendous win-win situation for both the reserve itself and for the private individuals. There was just a lot of little tiny back and forth. Some things fell through. There were a couple of deals I thought would be great and they fell through, but the biggest one that went through was putting the [Fennessy?] Ranch into the reserve, which is about 3,000 acres of private land. We did that by purchasing a conservation easement on the land, and it's an interesting place because they operate it not for cows, but they operate it for tourism, private ecotourism, and it was a great partnership because we can supply lots of tourists now (Montagna laughs), which helps them run it day to day. We were able to give the a down payment by purchasing the conservation easement.

JB: What—what do you think are the main benefits of having the reserve now?

PM: Well, it's a focal point. What it does, is it puts the state of Texas on the map as a national significant coast, and it puts a very large part of the coastal system of the state on the map and in the federal view as being a nationally significant part of the country so that means we have resources available to us to run programs, and the programs are educational programs, research programs. We try and do management programs, what I mean by management is, for example, if there's a problem, we have resources to try and figure out what's the root of the problem and what are the potential solutions. It's not like the reserve is going to come in and do something. It's not, we're from the federal government, we're here to help you. It's not that kind of a program. It's more of a grassroots, bottom-up program, and to me, those are always the best kind anyway. As issues—I think it's benefitted Rockport tremendously because Rockport has had a lot of problems with water quality issues and I know the reserve has helped them several times. It's benefitted Aransas County and San Patricio County quite a bit as well. Nueces County is where the seat of the reserve is because that's where UTMSI is and we were able to obtain money to build a new facility for the reserve, both a visitors center, we built a huge visitors center there and we built a small visitors center in Rockport, too. All that happened after I left, but those were all things that were in the original plans and documents I wrote. They were all things that were part of the original fundraising I did. The original fundraising I set in place between 2004, -5, and -6, and eventually it all got built out. It stunned me that everything happened. I actually I didn't expect at all to happen, and it did. There was a lot of hard work after I left, obviously.

JB: What sources of funding did you have to seek?

PM: Well, originally, that period between 2000 and 2004, NOAA gave me just a $100,000 to do the entire design and designation process, and then the university, the University of Texas, matched that with a $100,000. I actually had $200,000 to work with over that four year period, and it was just barely enough to get everything done, and then of course it's your own blood, sweat, and tears. I can guarantee you that I probably worked a lot more than forty hours a week (both laugh). Particularly those times when I was driving back and forth from Austin to College Station to Houston to the Valley to you name it.

JB: How many hours a week would you say you worked on average during those years?

PM: Ah, probably the same as now, who knows. I never am not working, so it's easily probably 60. If I'm not sleeping, mowing the lawn, or surfing, I'm probably working (both laugh). Or eating or cooking or working, that's all I ever do, but you know, the funny thing is that it's not work anymore. It's who I am, what I do, it's fun. Some people knit, some people do the Sunday crossword puzzles. If I'm sitting at home and I need recreation, I open up a book or my computer and play with it. For me, it's play, it's not work anymore. It wasn't always like that, believe me, but it's right about that time it started becoming so easy. I always draw the analogy of hitting a baseball. It's a ridiculously hard thing to do when you first start, but at some point, it becomes easy and you don't really know how that change occurred. It's almost like a muscle memory that happens, it just becomes something you can do, you learn how to do it and it becomes a skill you have. It becomes a part of you and it's not something you have to think or work at anymore, you just do it. I'm very fortunate to have a job that's not work (Montagna laughs).

JB: Uh, what sort of work have you done personally at the reserve, after it was created?

PM: So we still have two or three things. We did a lot of our oyster research there. We did oyster restoration programs there as well. Another program I created was something called Shellbank. This was done here at HRI. I wanted to start this shellfish initiative and start looking at shellfish in general, because I realized that shellfish were important indicators of freshwater inflow effects (Montagna laughs). Oysters, shrimp, blue crab. Okay? And we started out with oysters, and when we started looking at oysters, we discovered a whole bunch of disturbing things. Number one is that it's the most degraded habitat in the world. Everyone's worried about mangroves and coral reefs, and it's true, we've lost about 30 percent of our mangroves and coral reefs worldwide. But we've lost 85 percent of our oysters worldwide, and in the U.S., it's been particularly devastating. We knew there was going to be a need for restoration, and one of the problems with the oyster industry is when they remove the meat, they take the shell with it, and the problem is, the oyster shell has to go back in the environment or oyster babies can't grow (Montagna laughs) because they need a place to land, and also, when you remove oyster reefs, you remove those important habitats that other organisms like redfish depend on, by the way. Oyster reefs are important habitats for redfish. What we realized is we needed a way to put oyster shells back in the environment and we started a program with Brad Lomax who runs Water Street, and he started giving us all his oyster shells, and what we realized was that he was helping us and we were helping him because he was going to have to pay to have that oyster shell go into the city landfills, where it would do no good at all. Gosh, I can't even remember when that program started, at least five or six years ago, maybe longer, maybe seven, I can't even remember. My postdoc at the time, Jenny Pollack, who is now a professor here at A&M-Corpus is one who really got the program started, I was just the cheerleader, so to speak, and some others helped me get it going, and once it got going, I just stepped back and Jenny runs the program today. That was another important little conservation program I was able to start and get going. We do a lot of research now on what does it take to restore oyster reefs, how do you do it, what's the science behind it, what kind of configuration should a reef be in, what benefit should the reef have in terms of ecosystem services, cleaning up water, providing habitat? We still look at freshwater inflow issues in that area, we also are looking at the nutrient chemistry in the area. We still have some projects in and around the area, but mostly focused on the oyster reefs.

JB: Okay. Is there anything else important about MANERR that you wanted to talk about?

PM: The last thing would be to reemphasize how many people were involved in doing that. Again, I have the tendency to play the role of head cheerleader (Montagna laughs), and rely on a lot of others to help and do a lot of things, but in particular at the time, the entire administration, university, and staff was just incredibly important because without them, I would have had no access to the governor and the state agencies. They made that happen, and I was very lucky my director, dean, and president at the time of that university was supportive of the idea because they had to put up with me talking about it for a really long time before it actually happened. It took nine years altogether, and they all stuck behind me along the entire way. A lot of other students, staff, over the years who all contributed tiny little bits here and there. It's amazing how every master's thesis or Ph.D. dissertation is like a brick in a wall. It's really easy to step back today, and say, oh look at all these accomplishments. But you know what the reality is? It's like

a brick wall, every single brick had to be laid piece by piece individually, and I think the difference is that every piece was put there by an individual bricklayer rather than by a master bricklayer. I was more like the guy supervising thousands of little bricklayers. What's funny is that a lot of times the students don't see how their part fits into the big picture in the grand scheme of things so that's one of the things as a professor I always try and explain to students how important their individual little bit is in the big picture. I think the reason why that's important is they're going to leave, they're going to go forth, they're going to go do something someday, and I would like them to carry on that same conservation-minded attitude, that same idea that, yeah, it's just a brick at a time, and don't worry and don't get frustrated and persevere, because eventually you will have that big beautiful wall.

JB: How many graduate students would you say you've supervised for theses and dissertations?

PM: I think something like 80ish, like 60 masters students and 20 Ph.D.s. It's been a large crowd.

JB: Yeah.

PM: And I've had about thirty postdocs. I've had a lot of people. At one point I've had about fifteen technicians with me. The total number of technicians of worked over the years is probably about thirty or forty. I've had a lot of people cycle in and out of the labs. And again, that's the thing I love about being at the university, all the young people who are constantly coming in and out. On one hand, there's this repetitive exercise of always starting from zero and bringing them up to some level and training each one individually, but on the other hand, each one brings their own unique stamp and mark to bear on every single little bit on all these projects in this whole enterprise, and it's impossible to really understand those influences, I think, until you step back and look at the total picture and realize that each one is like a little pixel or a little brick in the picture.

JB: Well, is there anything else you want to add?

PM: That's it for now, I guess.

JB: Um, do you want to wrap this up today, and set up another time to talk about oil and gas issues?

PM: Sure, let's do that. Yeah

JB: Okay, great. I'm going to stop the recording then.

[End: 1:39:14]