Loren Haury Oral History

PETER BRUEGGEMAN: Today is July 13, 2012, and I'm Peter Brueggeman with the Scripps Institution of Oceanography Archives. I am with Loren Haury, who is being interviewed, and also Paul Dayton is present.

LOREN HAURY: I'm Loren Haury. I was a researcher at Scripps for 21 years, and before that I got my PhD here and retired in 1999 to Arizona. It is a pleasure to be back.

PAUL DAYTON: I'm Paul Dayton, I have retired also, but I'm hanging on at Scripps for a while.

PETER BRUEGGEMAN: How did you get into your career? People have interesting stories, and oftentimes do not have a master plan from an early age.

LOREN HAURY: Well, when I try to understand how I got into oceanography, I have to look back to even before I was born and the family I was born into and the predecessors, particularly my grandparents. My grandfathers on both sides were involved in colleges. They both contributed to the founding of Bethel College, in Newton, Kansas. My paternal grandfather was a professor of classics and Latin, and my maternal grandfather was a Mennonite minister. My parents grew up in this family associated with college life on Bethel campus. Both my mother and my father were associated with Bethel College.

My father, when he was young, would wander around the Kansas countryside. He became interested in archaeology, and in 1924 he was invited to go to Mexico, and he worked with a University of Arizona archaeologist in Mexico, south of Mexico City. He became an archaeologist. He went to the University of Arizona in 1924, leaving Bethel College, and never left Arizona basically.

PETER BRUEGGEMAN: He got his PhD there?

LOREN HAURY: He got his Masters at Arizona and then went to Harvard for a PhD in 1937. Then he went back and became the director of the Arizona State Museum and head of the department of anthropology at the University of Arizona. That is the environment into which I was born in 1939… an anthropological family with a broad outlook on all of the disciplines that go into anthropology.

In growing up, as I got old enough -- which was five years old -- I would go into the field in the summers with my parents where my father was doing field archaeology and running field schools teaching students archaeology. I spent 12 summers of my life in the field in San Carlos Apache Indian reservation.

PETER BRUEGGEMAN: It must've been warm.

LOREN HAURY: It was 6,000 feet in Ponderosa forest and prairie. Paul Dayton was there washing dishes one summer, and that is where I got to know Paul. When he was in high school, was it, Paul?

PAUL DAYTON: Yes.

LOREN HAURY: This allowed me to do whatever I wanted to in basically what was a wilderness area, or should have been a wilderness area. I was doing archaeology from about 10 years old, and I became interested in natural history. I loved birds. I had huge passion with snakes, and astronomy, because the skies of Arizona are fantastic.

As an aside with reference to snakes relevant to what is coming up in talking about my Scripps career, my passion for snakes led me to propose as my first thesis project when I became a graduate student at Scripps that I study sea snakes. I talked to Dick Rosenblatt about that. He discouraged me, because there is only one species of sea snake that lives in the eastern Pacific. He said it is very difficult to do field work on it. I did not want to do lab work, I wanted to do field work. He said, "I don't think it would be a very successful project because of the difficult logistical problems associated with it." I had to totally revise my ideas of what I was interested in and would like to do.

That is an aside relative to my childhood interest in snakes.

PAUL DAYTON: But your childhood interest in snakes went way beyond snakes, because you knew all the birds and the lizards and all the geology and all the plants. You picked up a heck of a lot.

LOREN HAURY: Well, I think it was in part because in my family, in the summers there were geologists at the field school, and I would just be hanging around them all of the time. There were geologists, there were dendrochronologists studying the tree rings, and I learned about climate change and the association of

plant growth with seasonality and with the annual changes. Biologists would come through, and just huge variety of incredibly interesting people. It all whetted my interest.

My first association with the oceans -- my first look at an ocean was in 1948 when my family came to Coronado. I have pictures of myself and my future wife on the beach in Coronado in 1948.

PETER BRUEGGEMAN: You met her at that young an age?

LOREN HAURY: Her father was a student of my father way back when. I was nine years old, and she was four or five years old. So that is when we first got to know each other.

Then in 1949, my father took a sabbatical leave to go do some archaeology in South America, in Colombia. We took a United Fruit Company freighter from New York City to Cartagena, Colombia, and that was my first cruise on a ship. We stopped at the Panama Canal, Havana, Cuba, and Puerto Limon, Costa Rica. Coming back from South America, the sea was incredibly rough, and everybody on the ship got seasick except me. I knew I had sea legs.

PAUL DAYTON: So you went to Tucson High, and you went to grade school in central Tucson, you lived on the north side?

LOREN HAURY: Central Tucson, the eastern side of Tucson, went to Tucson High School from 1954 to 1958, and this gets into what I did in high school, where my interests went in high school, because I had a strong interest in astronomy, and I was in the astronomy club. Sputnik went up, and the U.S. was having a satellite project as well -- and the tracking systems were very poor, and they started a project called Moon Watch, which was enlisting volunteer observers to use some very simple instrumentation -- binoculars and sight wires and sight lines -- to observe satellites, take the exact times, and then the scientists could calculate the orbits. I volunteered for that, and I was on Moon Watch. That was my astronomy end of things, and I got fascinated with that.

That got me really interested in engineering and how you get a satellite up and things like that. I was interested in everything, not just natural history and astronomy and physics. Everything.

My brother went into mechanical engineering, and he went to work for Convair on the Atlas missile in San Diego. I became fascinated with engineering, and that's when I decided that engineering was what I was going to do.

I would go to San Diego and visit my brother, and I got familiar with the ocean that way too. I think I probably went to the Vaughan Aquarium on one of those visits to see Scripps when I was still in high school, visiting my brother.

I applied to several universities. I was accepted at Yale University and their School of Engineering, and I started there in the fall of 1958 in engineering.

PAUL DAYTON: The engineering came in and the rest of the things you had done were sort of hypothesis-based science. Engineering is a little bit different, but you came into that from Sputnik and from the interest in the space program. So you just followed your interest to Yale and got your degree in engineering?

LOREN HAURY: Yes.

PAUL DAYTON: During any of that time, did you look back and wonder about whether you were really more interested in archaeology or other types of science as opposed to solving engineering problems?

LOREN HAURY: Very definitely. Throughout the whole of college, I was able to deal with engineering, and I enjoyed it very much. But during my years there, every summer I would have -- still do a job in archaeology. Two summers I worked at Mesa Verde on the Wetherill Mesa project -- one whole summer was surveying the mesas, which gave me the opportunity to ramble all over Mesa Verde and see all of these incredible places and do all of these incredible things and work with an ecologist who was studying the plant and animal resources and weather impacts on what the environment must've been like when the cliff dwellers were living there in Mesa Verde. I was interested in that, and we were doing fascinating work.

One summer at Mesa Verde I did stabilization in the ruins, which is reconstructing the ruins so they would not fall apart when visitors came to walk all over them and see them. They were opening up one of the mesas for visitation.

Then one summer I spent in Europe working for General Electric getting experience in engineering. That was fun, but it did not have any relevance to the other things.

Then my senior year I started thinking about what I really wanted to do. I had a job lined up at Boeing to work in their engineering design of landing gear, of all things. I started thinking about it, did I really want to do that. Ever since I had been young, since being in South America at least, I had been building model airplanes and I loved flying, and I decided no, I'm not going to do engineering, I am going to do what I want to do and that is to fly. To make a long story short, I joined the Navy and flew in the Navy for five years.

PAUL DAYTON: Before we leave the early part of your life, let me fill in some more details, because I have family pictures of you visiting with my family when I was in diapers. I know that you were spending time just enjoying nature very early. Do you remember any fascinations with the aquatic systems or the birds and things in the area or anything like that? You are one of the best naturalists I know, and you learned it on your own completely. I think that is impressive, and it must add to your curiosity of the world that will permeate the rest of your life.

LOREN HAURY: Well, we would go out often. Besides being in the field every summer at the archaeological field school and being associated with natural history in that way, my mother was interested and she always had the field guides. I would use her field guides, and that is how I learned a lot of it.

I would get associating with geologists. Some of my brother's friends were interested in natural history, and they were studying herpetology. I was fascinated by what they were doing, and I would learn from them.

In aquatic systems, I just loved everything that was associated with being outdoors.

PAUL DAYTON: So you learned your natural history from your mother's field guides?

LOREN HAURY: More or less, and reading books like Konrad Lorenz, reading and picking it up on my own, and looking at exhibits in museums. The Arizona State Museum had little bit of everything in it in terms of geology and anthropology and some natural history. Then we would always go to museums and other places because my father always was associated with visiting

professors and other institutions, and we would go to the museums there and pick things up that way.

PAUL DAYTON: You picked up a lot because you can walk around the desert and name lizards and birds and plants better than most, better than I can.

PETER BRUEGGEMAN: You joined the Navy because you wanted to fly and they accepted you?

LOREN HAURY: I joined the Navy because I wanted to fly, and this gave me the opportunity. This was before Vietnam, this was before the Cuban missile crisis. I was in training command in the fall of 1962. I graduated from Yale, I went into the Navy in -- I think it was October or November of 1962 to become a pilot. Fortunately I was selected to fly jet fighters. I went through the flight training program in Mississippi and Texas, and I got my wings and was assigned a squadron in 1963. I went to the West Coast to Miramar here in San Diego where my brother was. That is a real key element in this whole story of how I got here.

My brother was also interested in natural things, and it was in the fall of 1965, I believe it was, that he asked me, "Would you like to take a UCSD extension class, an introduction to oceanography?"

I said sure, so we took a class that fall. It was taught in the classroom of the old Scripps building by Joe Reid using the Sverdrup, Johnson, and Fleming book “The Oceans, Their Physics, Chemistry, and General Biology,” and I still have the book that I bought for the class. I really enjoyed it too. I mean, it was everything. It was a broad overview from Sverdrup, Johnson, and Fleming of all of oceanography, and we took that class and decided well, let's take another one.

PAUL DAYTON: This is with your brother?

LOREN HAURY: With my brother.

PAUL DAYTON: While you are on active duty in the Navy, flying your jets around, you were coming in and taking Joe's class.

LOREN HAURY: In the spring of 1965 we took Sam Hinton's shoreline ecology class that he taught, and I cannot remember where it was taught here at Scripps. We would go on field trips just like Paul does now to the intertidal all along the coast

here. We had to do projects for Sam Hinton. I did one project on the commensals of sandcastle building worms, *Phragmatopoma californica*, did one on the tidal migrations of *Donax*, the beach clam.

PETER BRUEGGEMAN: On the beach right here?

LOREN HAURY: Right here, yes.

PAUL DAYTON: That was while you're flying your plane?

LOREN HAURY: You had very strange hours and very strange times off, and they would work around what your schedule was. They were pretty cooperative as long as you put in the other hours, which were sometimes incredible.

PAUL DAYTON: But by this time Vietnam was gearing up, and they were probably planning to send you there.

LOREN HAURY: I went into a squadron that was changing from an old jet fighter, an old single seat jet fighter, into the Phantom II, the F4B, it was a two-seat all-weather high-performance radar interceptor. We had a long training period here at Miramar because we were shifting type of airplane and relearning a whole new system. Vietnam had started, and their ultimate assignment was to go to Vietnam. That is what happened in 1966.

PAUL DAYTON: Meanwhile you were on the beach with Sam.

LOREN HAURY: Yes, and meanwhile I was taking these classes and on the beach with Sam and skin diving out here and really enjoying being on the coast.

PETER BRUEGGEMAN: What were your impressions of Sam Hinton as a teacher?

LOREN HAURY: Oh, we both absolutely loved Sam.

PAUL DAYTON: I loved him too.

LOREN HAURY: Yeah, he was so great. He was such a people person. I mean, his singing was part of it, but he was also the administrator and he was also the teacher and he was also the illustrator. He did the column in the newspaper. Once a week he had a shoreline critter drawn in this column.

PETER BRUEGGEMAN: Back then when you are taking the class, were you aware of him as a folk singer? Did you enjoy his teaching style in the class?

LOREN HAURY: Yes, he was really hands-on, and he would be out in the field with you, just like Paul. He knew how to get people enthusiastic about all of these neat things that you can find out there that were in the sand, hidden in the sand. The sandcastle building worms, he would get you excited about what was there. That is what I really enjoyed about that.

Joe Reid too, in the introductory oceanography class. He was very professorial, he was Joe Reid. But you know, that's the kind of thing that really interested me, and he made it interesting. It was a very formal class. Midterms and all of that stuff, and you got a grade.

PETER BRUEGGEMAN: Whereas Sam's was less formal?

LOREN HAURY: Sam's class was what people wanted to do for fun. Joe's class was what people wanted to do for preparation for something. That got me interested in the oceanography side of the ocean. Being on an aircraft carrier many times and for long periods of time, it got me thinking about the ocean, and I would sit there in my airplane for various reasons for hours looking at the ocean and how the ocean changes and the moods of the ocean. Watching what you could see of the life in the ocean, and then flying over the ocean all of the time too. Looking down on it and looking at wind streaks and internal wave slicks and all of the things that I later studied. I think that is what set my mind to go into oceanography.

I went to Vietnam for six months in 1966. When I finished that cruise, I did not have enough time in the Navy left to do another cruise to Vietnam. They transferred me to the East Coast, and I went to the Mediterranean, and I flew in the Mediterranean. That was a great opportunity as well, because the Mediterranean is a very different place from the Pacific. I had the opportunity to go ashore there and see the aquariums at various places, especially the one at Monaco. I looked at the collections of the Prince of Monaco, and I was very impressed with those.

PETER BRUEGGEMAN: Did you get to Naples and see the zoological station?

LOREN HAURY: Yes, I went to Naples and saw the zoological station there too.

The other thing that the Navy opportunity gave me was in the Philippines. I was able to dive on the reefs, and that blew me away. Absolutely blew me away. In the Mediterranean I also dived.

PETER BRUEGGEMAN: Snorkeling?

LOREN HAURY: Snorkeling, yes.

PAUL DAYTON: But there is an interesting parallel, because that is what got McGowan too, was being in the military and diving in the Solomons in World War II.

LOREN HAURY: Also in Palau when he was there.

PAUL DAYTON: Yeah, but it was when he was young in the Navy, 18 or something, he made himself a mask out of a paint mask and was diving in the Solomons and got interested in marine biology. You were there in the Philippines also thanks to the military.

LOREN HAURY: That experience really helped cement it -- ice the cake.

PAUL DAYTON: You know we've others interviewed who have spent some time in the military in World War II. I think it is sort of interesting to compare your military experience. Are you comfortable talking about your experience flying off the carrier in Vietnam?

LOREN HAURY: I can talk about it, but the easiest thing and the most expeditious way to tell people, if they are interested in what it is like to fly in Vietnam and fly off an aircraft carrier, is to read Tom Wolf's essay, a story that was in Esquire in October of 1975 called *The Truest Sport: Jousting with Sam and Charlie*. It talks about a mission that a squadron mate of mine flew on the cruise I would have gone on if I had not gone on to the Mediterranean. Their life aboard the ship and the mission they flew over North Vietnam, and it describes exactly what it is like to fly -- a beautiful description, one of the best -- what it is like to fly off an aircraft carrier, what it is like to fly into combat, and have to make decisions about how you're going to try to stay alive when you are getting shot at by anti-aircraft fire and anti-aircraft missiles.

They did get shot down. They fortunately made it back out over water and were picked up. That is basically where the story ends, but it is this whole account of life on an aircraft carrier and flying in this surreal environment in a fighter aircraft over an enemy country. The analogy with jousting is that it is like being a knight living in a castle. We were on an aircraft carrier, we had stewards that would clean our room, make our beds, we would eat in the wardroom with silver and linen tablecloths. Then we would climb into our airplane and go out and get shot at, and a number of my squadron mates were shot down. Some were captured, some were killed. Then you fly back to the aircraft carrier after all this experience and you are back in this castle getting treated like a knight. It is an incredibly surreal experience.

PAUL DAYTON: Did you start to think about a career at Scripps before you were discharged?

LOREN HAURY: When I left Vietnam and I went to the East Coast, I had fallen in love with my future wife. I was thinking about my future and what I was going to do, and I realized I had a degree in mechanical engineering. I loved the ocean, so what was the logical thing to do? Go into ocean engineering. Where do you go to do ocean engineering? The University of Arizona had a school of engineering, and I had started graduate school there before I was accepted in the Navy, just as an insurance if I did not get accepted in pilot training.

I applied to U. of A., and they accepted me. I applied to UCSD in ocean engineering, and they accepted me while I was in the Navy. Because classes started in September and I was not scheduled to get out until October, the Navy had a deal where you could get an early out. I was so fortunate in that I got out of the Navy two months early just so I could make class registration.

PETER BRUEGGEMAN: Did you apply at other places as well?

LOREN HAURY: Just University of Arizona and UCSD. That's all I can remember having applied to. But it was a real struggle, because I was trying to get all of the references and everything to get people to accept me. So I was accepted in the Department of Aerospace and Mechanical Engineering Sciences at UCSD, in ocean engineering.

PETER BRUEGGEMAN: That would be the UCSD engineering department, not Scripps?

LOREN HAURY: It was UCSD, it was not Scripps. That fall two days after I got married I started classes here at UCSD and at Scripps.

PAUL DAYTON: What year was that?

LOREN HAURY: That was September of 1967. The two classes I remember vividly were Hugh Bradner's mechanics class and John McGowan's and Mike Mullins' biological oceanography class. They were in that first fall quarter of 1967.

That quarter taught me that I loved the oceanography and I hated the engineering. So for the next two quarters, I took every oceanography class I possibly could and I took as few engineering classes as I possibly could take.

That spring -- I don't remember if it was before classes were out -- I went to talk to McGowan, and I might've talked to Mike Mullin as well about the possibility of transferring from the engineering school to Scripps. John, bless his soul, encouraged me to apply. He said, "There's no reason why you couldn't." I applied for the transfer into -- and John knew this -- biological oceanography. He also knew that the only biology class I had ever had was high school biology. I had never had any biology as an undergraduate at all. He said, "You did okay, you can learn enough to become a biological oceanographer."

I applied, and I was accepted in the transfer, and I started that fall as a full student in biological oceanography.

PAUL DAYTON: That would be the fall of 1968?

LOREN HAURY: That would have been the fall of '68, yes.

PETER BRUEGGEMAN: As a side thing -- you had that class that Hugh Bradner taught. Did he mention anything about his development of neoprene wetsuits at that time?

LOREN HAURY: He may have, but I don't remember.

But in relation to that and diving, there were two things that happened as this whole transfer process was underway. In September of that year, I went on my first cruise with John on Climax I, and that was September of 1968. That was for a month to the North Pacific gyre. That was his first cruise in his Climax studies of central gyre community structure. That was a

wonderful experience. It was great to be back at sea again, and also it gave me John's viewpoint of the big view of oceanography. You've got to look at everything. That's where I really got my indoctrination on doing fieldwork with a big overview, a system study.

PAUL DAYTON: While we are at this chronological time point -- when you came in in the late '60s, I think of those years as the heyday or golden age of oceanography and the heyday of Scripps in so many ways. You want to try to recapture the spirit of the place? Sverdrup Hall was full of the food web people, food chain people. McGowan and Isaacs and Mullin, everybody were sort of at their peak. It must've been a heady time to be a student of oceanography.

LOREN HAURY: It was a wonderful time, it was an inspiring time, it was a time where there were so many opportunities to interact with all of these great people. What absolutely amazed me about what was going on then, and when I think back on it and I wonder -- it can't possibly be the same -- is that I would go on these cruises with John, and he would give us all of these responsibilities. Then as well, when I was doing my thesis work -- he had the money and the opportunity and the willingness to let his graduate students take a cruise and run the cruise. We were the chief scientists, and he was not along. We were able to take a ship and go down into the Gulf of California. John Wormuth, Elizabeth Venrick, and I went down into the Gulf of California and did research.

PAUL DAYTON: This would've been when?

LOREN HAURY: This was Bios, and that was 1970. I did Climax II in 1969. That was a two month cruise to the North and South Pacific, the North and South Central gyres.

PAUL DAYTON: You guys did your own cruise then in the Gulf in 1970?

LOREN HAURY: Elizabeth Venrick had her PhD, and I think she was either a researcher or an assistant researcher, doing her phytoplankton work. John was doing his squid thesis work, and I was doing my vertical distribution studies of zooplankton.

PAUL DAYTON: Which would've been pretty interesting in the Midriff area of the Gulf of California.

LOREN HAURY: I did my studies off of Guadalupe Island, and John did his squid studies everywhere at night. And Venrick was doing her water bottle samples for phytoplankton everywhere. We got into the Gulf and went to Mazatlan and Los Frailes Bay and had a great time.

PAUL DAYTON: You didn't get into the Midriff then?

LOREN HAURY: We didn't get into the Midriff, no.

PAUL DAYTON: It would have been pretty interesting for vertical distribution.

LOREN HAURY: Yeah, I always wanted to do something like that in the Gulf but never had the opportunity.

PAUL DAYTON: So back to what was going on at Scripps, and Strickland and the food web people. John Beers.

LOREN HAURY: Well, I was in my office which was with John McGowan's down in a building, separated from Sverdrup Hall and all of the food chain group.

PETER BRUEGGEMAN: You were in one of the cottages?

LOREN HAURY: It wasn't even a cottage, it was on the north side of the parking lot, it was that barracks building. That was John's old building, and he had one, two, three, about four graduate students. Pat Walker --

PAUL DAYTON: It was T6.

LOREN HAURY: Yeah, it was T6.

PAUL DAYTON: Yes, so you were in T6 the whole time you were a graduate student. John was in the current Scripps director's office building.

LOREN HAURY: He started in the director's office. That is how I first met him. Peter Wiebe and Charlie Miller and Bruce Frost were all graduate students then when I started. They finished up a number of years ahead of me, and they were in there. But then John moved over to T6. Then when I came my first year there, I shared an office with Roger Larson, who was in geology. Why he was in McGowan's office I don't know.

PAUL DAYTON: So you didn't really interact with the food chain people.

LOREN HAURY: I didn't interact much with the food chain people. A lot of them would come on John's cruises, though, doing the phytoplankton work, and primary productivity and stuff that he wanted done and that he was not doing. We had all these aspects of central gyre function that he would bring all of these resources from Scripps.

The other exciting thing I remember about being a graduate student then too was having at least one class with John Isaacs where you just sit around and brainstorm and shoot the breeze and go where you are interested. Everybody really liked that.

PETER BRUEGGEMAN: What was John Isaacs like in that class? How would you characterize his style or thoughts?

LOREN HAURY: Well, he would always expound on his ideas and then draw you out on what you thought, and you would have some idea that you would pursue and try to fill out in terms of a concept of a project or the way a system would work or whatever, and how would you study it. Then he would expound on all of his sometimes harebrained ideas that would fascinate you and make you think out of the box.

PETER BRUEGGEMAN: Did he talk about the floating island plans?

LOREN HAURY: He would talk about floating islands, he would talk about -- the stories I remember are extracting wave power, his concept of extracting wave power. We would talk about his deep-sea monster cameras attracting things. He would talk about flying around the world backwards with a glider, unpowered. He would talk about tornadoes being generated by traffic on freeways. He would talk about everything.

PETER BRUEGGEMAN: Did you see Isaacs monster cam footage back then? What did you think? People had not seen things like that before.

LOREN HAURY: No, it was mind boggling. A natural concept of what was going on in the deep sea. But on the cruises we went on with John in the central gyre -- I don't think that Climax I had it, but on the second one Bob Hessler came along and did bottom coring. We were looking at all of the samples that would come up from 3,000, 4,000 meters. We knew about the monster cameras and what was probably down there.

PETER BRUEGGEMAN: When you look at the monster cam footage now, we are all so used to Bob Ballard and the Titanic and all of this excellent high-def video footage shot deep. Could you say something about that monster cam footage in the context of the times -- because people did not really know visually what it was like down deep. There were just samples and drags and nets…so what did you think when you saw it? You were seeing life like you were actually down there down deep seeing it.

LOREN HAURY: Well, the first photographs I remember were not movies; they were just single snaps that would get triggered under a strobe light. You would see the head of the shark or you would see the hagfish or something. Most of the time you would just be looking at a bait can.

PAUL DAYTON: That's what I remember too.

LOREN HAURY: Just looking at the bait can, and the field of view was very small. You were probably only three meters away from the subject. That was also part of the beginning of the concept of free vehicles too. Everything up to that time was always attached to a wire because you had to get power down to whatever instruments you had. But his were free vehicles where you could drop them down, and they would sit there for a long time, and then they would pop the release. That impressed you with what was going on, and that was just the beginning of doing that kind of work in the deep sea.

Another thing that I have to mention about my experience that first year after transferring to Scripps… when talking about the deep sea and the bottom is that I got a scholarship support job to help pay my tuition working on John Isaac's North Pacific buoy program, the Bumblebee buoy. John had invented the Bumblebee buoy to put out weather stations on the surface of the North Pacific, and he had a design and engineering group that was next to the old machine shop that was run by Meredith Sessions. I worked for Meredith Sessions as a mechanical engineer that second year at Scripps designing equipment for the bumblebee buoy. That got me familiar with moorings, how you moor something in 4,000 meters of water and not lose it. How to survive shark bites on instrumentation and mooring lines. How to run an automatic profiling bathythermograph to do temperature profiles.

That was another exciting time to be around, because there were these really large-scale projects being funded and going on, putting instruments like that out in very hostile environments.

PETER BRUEGGEMAN: So you went into biological oceanography, but your engineering background obviously brought something to your experience.

LOREN HAURY: Well, yes, and I have not talked a lot about it yet because that's what my thesis project was. Peter Wiebe was John McGowan's student. I knew Peter and I knew what work he was doing. Very shortly after I transferred over, maybe within a year or two, he got his PhD and went to Monterey, I believe it was. His thesis was on the horizontal patchiness of plankton, how plankton was unevenly distributed on small scales, on an order of tens of meters. He had used a device called the Longhurst-Hardy Plankton Recorder that was developed by Alan Longhurst from a concept of Sir Alistair Hardy on looking at large-scale distributions of plankton with a recording device that would sample over long, long distances. You would count the plankton on these long strips of silk gauze.

PETER BRUEGGEMAN: Towed along and the silk scrolled by.

LOREN HAURY: The silk scrolled by, and the plankton gets filtered out by that. Then you would go and you would count sections of this linen tape to look at the changes in distribution as the ship traveled through space. John had always been interested in sampling variability and why the numbers of animals caught from net tow to net tow changed. That was called patchiness because the plankton was distributed unevenly. Peter Wiebe used a Longhurst-Hardy plankton recorder to look at the horizontal distribution of plankton on a scale of tens of meters, and that was his thesis.

I got interested in the question of how these animals were distributed and why they were patchy. Was it the environment that was doing it or was it behavior that was doing it. Or was it predation that was changing distributions, things like that. I said well, you know, when you are looking at things in a horizontal sense as Peter was doing, towing a constant depth -- the ocean is going up and down, so there was a vertical problem aliasing the results. I wanted to look at vertical distributions and fine scale distributions in the vertical sense to learn how that would interact with horizontal distributions.

PETER BRUEGGEMAN: Over tens of meters?

LOREN HAURY: Tens of meters. I wanted to sample on five meter intervals vertically from, say, 300 meters to the surface to see how an animal's distribution with respect to light, temperature, oxygen changed on a very fine scale in a vertical sense. Peter had looked at it, how it would change in the horizontal. I wanted to look at the steeper gradients that were in the vertical. I had to make my own instrument to do this. I had to modify this filtering system, the plankton recorder, and I used my engineering to design and build this vertical device.

PETER BRUEGGEMAN: That would be free dropped?

LOREN HAURY: No, it was off a cable. It would go off the end of the ship or the side of the ship, be lowered down -- not operating -- down to 200 meters, 300 meters. Then you would pull it up and on the way up it would operate, and you would get a sample that would represent every five meters or so, dependent on when/how often the gauze mesh tape was advanced.

PETER BRUEGGEMAN: So it must've been a fun engineering challenge.

LOREN HAURY: Oh, it was, and the other thing I should say is because I was designing this underwater device that had to work well, I wanted to be able to dive on it and to observe it and see how it was functioning. I learned to scuba diving from Jimmy Stewart, and that was a great experience. I got my certification in scuba diving that way.

PETER BRUEGGEMAN: Were you testing that equipment off the end of the Scripps pier, and scuba diving next to it and watching it come up?

LOREN HAURY: I would test it off the end of the pier, and then we would take it out to sea. We had test cruises out of Scripps Marine Facilities to make sure that it worked. That was the device that I had when we went down Guadalupe Island, the graduate student cruise into the Gulf of California. That's what I used for my studies.

PETER BRUEGGEMAN: You weren’t yet studying seamounts yet in terms of zooplankton abundance and migration -- you were more open ocean?

LOREN HAURY: I was. The Longhurst-Hardy plankton recorder was being used for lots and lots of studies of distributions of

plankton. I said the plankton recorder has problems. We have to find out what its biases are. How does it change the data at which we are looking. I did a study of how the sampling bias of the recorder distorted real distributions in space in the ocean. I developed a device that would inject particles into the system that were fake plankton, and I knew when I put them in -- I put them in at this instant, where did they appear on the tape and how smeared out were they, and how much delay was it. It is all under the general rubric of sampling problems. Sampling biases. So I studied that so I could get a handle on how good was my data, how reliable was my data.

When I was here at Scripps I was thinking of distributions. The first one was sampling bias. The second one was the study of California current vertical structure -- of the sampling using this vertical plankton recorder off the coast of Guadalupe Island. Then I did an identical study in the central gyre on Cato cruise, and Cato was 1972. I did the same study there to compare vertical structure and vertical patchiness in the central gyre to a California current system. That was the basis of an interest that carried through all the way through my career at Scripps, looking at how animals were distributed all the way from Hawaii to the California coast, and I would use plankton recorders and net tows and the like to look at that in detail.

That is what I did when I was a graduate student. I went to Woods Hole as a postdoc, and that would've been 1974 when I went to Woods Hole after I got my PhD.

PAUL DAYTON: You got your Scripps PhD degree in '73?

LOREN HAURY: Yes, I started in '67 and got my degree in '73.

LOREN HAURY: I postdoc'ed with Peter Wiebe at Woods Hole, and he was doing a study of Gulf Stream eddies. I would go to sea with Peter using the plankton recorder to look at vertical distributions in the eddies, these big, circular bodies of water that would oxbow off of Gulf Stream fluctuations, meanders.

PETER BRUEGGEMAN: Were you the only one at that time in biological oceanography looking at sampling vertically?

LOREN HAURY: No, John McGowan had invented the bongo net, and he was using bongo nets. However that would sample on scales of 50 meters, 100 meters in vertical. I wanted to look at the real

fine scale and see what was distorting even the bongo net results.

Then at the same time, Charlie Miller developed what came to be called the MOCNESS, the multiple opening closing net and environmental sensing system, which looked at vertical distributions too. And they also have the Isaacs Kidd mid-water trawl, and some of those you could open and close at depth.

PETER BRUEGGEMAN: But nothing fine scale like you are talking about?

LOREN HAURY: Nothing fine. Nowadays they have the really fine scale cameras and video systems that Jules Jaffe and some of the other people here developed to send down and look at it in real time with video systems. That's the way to get the real answer. I always consider what I was doing remote sensing science. You go down and sample it and bring it up on board and you had to look at it, a pickled sample.

PAUL DAYTON: After leaving Scripps in 1973, was it a one-year postdoc or was it going to turn into a research science position?

LOREN HAURY: It was a one-year postdoc paid for by a grant that Peter had gotten to study these Gulf Stream rings, they are called. At the end of that, I applied for and got a research position at Woods Hole. I was at Woods Hole for four more years as a researcher working with Peter and writing my own proposals and getting grants.

PETER BRUEGGEMAN: What was your first proposal? It would be at Woods Hole, do you remember?

LOREN HAURY: I don't think I can answer that. Maybe it was all joint proposals with Peter because we always went to sea together. Oh, there was one. I was on one proposal that Peter was not a part of, and that was a proposal I wrote with Mel Briscoe, who was on the physical oceanography staff at Woods Hole. Using the Longhurst-Hardy plankton recorder to look at vertical and horizontal distributions, through internal waves in Massachusetts Bay. We knew that there were these big tidally driven internal waves, big oscillating structures of temperature and salinity that were visible on the surface in slicks, and the whales would feed in them. They would come into the Massachusetts Bay and feed on these slicks because it aggregated plankton. So I was interested in the physical mechanisms and

biological response to these incredibly big physical signals in the marine environment.

Mel Briscoe and I went out on one of the smaller ships and did all of this plankton recorder work. He did endless CTDs looking at physical structure. We married his physics, physical oceanography, with my biology in understanding --

PAUL DAYTON: Was that way offshore?

LOREN HAURY: No, it was in Massachusetts Bay. It's called Stellwagen Bank.

PAUL DAYTON: My recollection was that's where Jesus Pineda got information on breaking internal waves and educated me. I remember Jesus introducing me to bores, and going back to your work -- I thought that was kind of neat at the time.

LOREN HAURY: Yeah, that was -- that must've been in 1977. We published that work in *Nature*. It was the only big-name science journal that I ever got a paper into, doing that. That was really exciting and interesting. The graphics were beautiful. We had high-frequency acoustic images of the internal waves. It would go along with the temperature profiles, and you could see the plankton being carried up and down and aggregated and changed by all of the internal waves. The signal is so huge that it made a very interesting picture to somebody that was not really familiar with it. It is surprising to see that kind of thing going on underwater.

PAUL DAYTON: I think that you really broke a paradigm with that, that it is not just the waves washing in, and it is much more complicated. It is -- with some of Hamner's work in the early 1980s in Australia, the sticky water stuff, it is the foundation of our coastal ecology. And it is still. Jesus Pineda really brought that to bear, and your paper had laid the groundwork so beautifully that all he had to do was go back and look at your paper. It is still the most important component with the sticky water, all of which has been ignored by the blue water oceanographers.

LOREN HAURY: Yeah, and it is going on out there too in a much more subtle signal.

PAUL DAYTON: Of course it is. I just wanted to emphasize for the record how important that work really was.

LOREN HAURY: Well, it was a lot of fun doing it.

PAUL DAYTON: You and Peter were sort of a natural combination, because he had looked at the horizontal transport and you looked at the vertical structures. It just seemed sort of obvious that you would get into that. It might be time for you to talk about your recollection of your most famous paper and figure, the Stommel diagram by Haury, et al.

LOREN HAURY: We did that in '78. I think we wrote that when I was back with Peter at Woods Hole, and John was here at Scripps. Peter Wiebe, John McGowan, and I wrote a paper that was for a meeting that John Steele from England put together on plankton patchiness. I think the whole book was dedicated to distributions of plankton varying on all scales, because he was interested in that whole idea too.

We wrote a paper summarizing what we felt were the distribution of plankton biomass over space and time on scales from practically millimeters up to ocean wide scale. We plotted on a logarithm on one axis the time scale, the orthogonal axis, the space scale, and the vertical was our understanding of the way plankton variability -- what you would measure if you measured changes of plankton abundance on that timescale and that space scale.

PAUL DAYTON: It is one of the most important figures in oceanography, in my mind.

LOREN HAURY: Yes, it has manifested itself in really surprising ways. This paper was published in 1978. It drew some attention, particularly among people that looked at community structure in the ocean, oceanic community structure on larger scales. It told you how sampling variability affected what you are looking at and where you were -- and what the mechanisms were controlling distributions.

In the course of the next 10 or 20 years, it found its way into a couple of textbooks and was cited a fair number of times in peoples' work. It forced them to look at what the results meant in terms of the conclusions they would draw from community structure and space and time variations in a community.

About eight months ago -- I went Googling to look for Stommel diagram references. There was a paper that came out that reviewed the history of the Stommel diagram from the very beginning to the present and how it has now become a way to look

at a system. That concept has gone into urban ecology and building communities, on terrestrial building communities, and how looking at how physical features interact on different scales to control what kind of community you get. It boggled my mind.

I sent a message to John McGowan, and he just said, "I can't believe it, that what we did would go into such an unimagined to us field of human endeavor." How do you design a livable community? Well, you've got to understand all of these different forces, and you can conceptualize it by looking at a Stommel diagram.

I must say, first of all, that the Stommel diagram was based on a diagram by Henry Stommel that was just physical oceanography. He was looking at how temperature and salinity varies in space. And Patricio Bernal got the idea that you could do this with biology too. He mentioned it in his thesis. So we took that concept from Stommel to Patricio Bernal to what we were working on, which was plankton variability in response to John Steele's request to contribute a paper on the patchiness of plankton. The consequence has gone far beyond anything that we ever imagined at that time.

PAUL DAYTON: It really was a big conceptual leap in oceanography, and maybe in all of biology, to marry those two log scales and look at the where patterns fallout. It was a huge conceptual leap.

PETER BRUEGGEMAN: So you were at Woods Hole starting in 1973?

LOREN HAURY: To 1978, approximately. I came back to Scripps. I don't remember when John McGowan let me know that an opening occurred in the CalCOFI program for a researcher. He encouraged me to apply for it.

PETER BRUEGGEMAN: With the funding for the position coming from where?

LOREN HAURY: State money. MLR, Marine Life Research Group.

PAUL DAYTON: Isakson.

PETER BRUEGGEMAN: Not a faculty position?

LOREN HAURY: Not faculty, it was research. The research was CalCOFI funded, which is State of California research funds, coming to UC.

I flew out West, and I had an interview with Joe Reid sitting in his office.

PETER BRUEGGEMAN: Did Joe Reid remember you from the class?

LOREN HAURY: Yes, I think he remembered me; I certainly remembered him. I was accepted, and we moved back in 1978 to Scripps, and Joe Reid became my boss.

PETER BRUEGGEMAN: So why did you leave Woods Hole?

LOREN HAURY: I was ready for a change. It was going from a soft money position, which was always dicey -- I was always writing proposals -- to a hard money position. I loved San Diego; I'd been here for four years in the Navy. I grew up in Arizona, so I was closer to home. Both of us were tired of New England winters, and so we moved here, and I took this research position in CalCOFI. It was a blessing, in that I was almost free to do whatever I pleased so long as it concerned the California Current. They didn't specify -- "You've got to study this particular problem."

I moved into an office in Sverdrup Hall, right next to Mike Mullin. Strickland was over on the other side. The Food Chain Research Group was on the same floor on the other side. It was an exciting place too, because [Adrianus J.] Kalmijn was there, his office was on the same floor, and he was doing electro-sensing in fish, and he had his lab up on the hillside. There were lots of things going on.

I started going on cruises right away. My first cruise was with a physical oceanographer, Jim Simpson, who was also in MLR doing physical oceanography. We started studying fronts in the California Current. I was doing the same thing as before, looking at vertical distribution of plankton, and he was looking at the physical structure, the physical variability in the California Current.

PETER BRUEGGEMAN: Is that the James Simpson who did the satellite oceanography later?

LOREN HAURY: James Simpson, yes, he went totally into satellite oceanography. I did a couple of cruises with Simpson, and then started going on CalCOFI cruises.

To carry on with what you mentioning about getting into other areas and seamounts -- I was working with the fronts in the California Current and working with eddies in the California Current, because that's what I had been doing at Woods Hole. John was getting money, I believe, from ONR to study the central gyre. ONR started having an interest in seamounts because they would send their ballistic missile submarines out to perch on top of seamounts so they would not have to keep moving around all the time. Subs could sit on top of seamounts, and the Navy was interested in what submarines could see acoustically from the top of a seamount and whether they could be detected on top of a seamount. To understand their vulnerabilities and their capabilities, the Navy wanted to understand how temperature, salinity, how the physics around a seamount varied and how the plankton varied around it. Plankton and marine life scatter acoustics and distorts acoustic signals which the Navy was absolutely dependent on for anti-submarine warfare.

I got interested and applied and received ONR grants for a fair number of cruises to seamounts off the California coast, studying the vertical distribution of plankton around seamounts.

PETER BRUEGGEMAN: Not just above them, but how plankton moved off?

LOREN HAURY: How they moved off, how they were affected by the current that would sweep past and the eddies. Seamounts create eddy chains behind, von Karmen vortices that stream out behind them.

PETER BRUEGGEMAN: You would not have gotten this opportunity without the Navy?

LOREN HAURY: Oh, I never would've been able to do that without Navy funding, and the Navy poured money into that research. It was a big program, and I went on three or four cruises doing that.

PAUL DAYTON: Did you interface with my student Amatzia Genin during any of the seamount work, because that's what his thesis was about too. He was being helped by Fred Spiess at the time.

LOREN HAURY: Yes, Amatzia Genin and I became very close, and I actually went to Israel twice to work with Amatzia just doing some simple things, visiting with him and talking with his people.

Then Tom Hayward and I became interested in large-scale changes in vertical distribution… large-scale meaning Eastern Pacific wide changes in vertical distribution. We did two cruises from Hawaii to San Diego doing frequent sampling all along the way of vertical distributions of zooplankton. This was larger scale than I had been doing before. It was not fine scale, it was 1,000 meters to the surface, looking at how a species distribution would change from Hawaii through the whole transition zone into the California Current. The target was to see the same species that occurred in both places would change when the physical environment would change.

We did two cruises looking at that. Those were interesting and took a lot of time because there were lots of samples, lots of species to look at.

We were doing a lot of work on the phytoplankton distributions too, and how the plants, which were the resources for the plankton in which I was interested, responded to the same changes. There were all these factors worked in; how the plants responded to the physics, and how the animals respond to both plants and the physics.

PAUL DAYTON: Tom Hayward was really helpful for many of my students by encouraging us to use CalCOFI platforms, David Hyrenbach with his birds. Tom was an important player in his CalCOFI niche as well.

LOREN HAURY: All of the people in CalCOFI had a wonderful approach to the problems that CalCOFI was designed to address in terms of encouraging every possible resource to participate.

Since we are talking about cruises and what I focused my attention on, the plankton recorder offered another opportunity in connection with the Navy and the Navy's problems with submarines and acoustics. Tom Osborn got his PhD here at Scripps. When I was a graduate student, I was living in an apartment under Tom Osborn when he was a graduate student. He got his PhD with Chip Cox in probably 1968 or 1969, and he went to the University of British Columbia. Osborn was interested in -- because Chip Cox was interested --physical microstructure. Physical microstructure is basically on the scale of what I was

interested in… plankton distribution on the order of meters or smaller. How physical distribution changed -- that was Tom's interest. My interest was how plankton changed on scales of meters.

Towards 1990 or sometime around there, Tom Osborn had a postdoc named Hidekatsu Yamazaki, who was interested in the same problems. Yamazaki was studying physical microstructure. The Navy was interested in studying physical microstructure from a submarine. The Navy had a research submarine called the Dolphin, a diesel/battery powered submarine, strictly designed for research. It had no torpedoes or anything like that.

We put together a proposal to the Navy, and it was a simple thing because they wanted it done. The Navy paid to have my plankton recorder put on the side of the conning tower of this research submarine that had been outfitted specially to measure physical microstructure. As they measured physical microstructure, they wanted to record the plankton at the same time, so they put my plankton recorder on it.

We did one extended cruise of several days on the submarine, and that is the only time I've ever been on a submarine, outside of Monterey Bay. We weren't supposed to say what depth it was; it was on the order of hundreds of meters -- looking at physical microstructure and plankton distribution.

I collected the plankton and Hide analyzed the physical data, and we wrote a paper on this -- this is the finest scale work that I think I had ever done with the best acoustics, the best physical structure, and the like. And that was very, very interesting.

This might bring up a point about how oceanography had changed, because my bunk on the submarine was over batteries. And my first bunk on my first cruise with John McGowan in 1968 was on the old Horizon. Not the New Horizon, the old Horizon, where my bunk hung on chains over the toilet paper locker. I had gotten out of the Navy from a stateroom with stewards taking care of it, and I went to a ship that had --

PETER BRUEGGEMAN: You were on a downward trajectory.

LOREN HAURY: I was on a very downward trajectory in terms of quality of shipboard life, so that was a unique experience.

My last research at Scripps that I got excited about and had received Navy support for doing was totally different, absolutely totally different. It had nothing to do with plankton, and looked at how the vertical distribution of nutrients changed near the surface of the ocean in real detail. There were nutrient profilers, and then there were the bottle samples that sampled every number of meters. Eric Shulenberger and I were looking at all of the old data and observed that there were two features that nobody ever talked about in vertical distribution of nutrients in the ocean, particularly in the California Current. Right near the surface, within a meter or two of the surface, the nutrient level would go up, and we could not explain that, because that is where there's the most mixing. Why was the nutrient level high right at the surface, and then it would decrease as you go down?

In a number of cases, you would go down and you would expect -- because it is a mixing zone -- consistent nutrient distributions, uniform, and they don't change until you get to the thermocline. Then they increase. We observed in a fair number of cases, that you would go down, and there would be a section of uniform nutrient distribution, and then there would be a reduction. There would be a decrease, a narrow decrease -- it would only be a few meters or tens of meters wide.

I had at least one big cruise looking at that with Tom Hayward, doing detailed bottle samples, detailed nutrient profiling. These are very, very small, and the changes were so small that the automated sensors that would profile nutrients could not detect them. Their accuracy and precision was not enough. We had to do bottle casts every meter or two to resolve these features, and the differences were down in the .005 level of micromoles. I can't even remember what the units are that you use for silicate, nitrate, phosphates, and things like that. Then they would manifest themselves in most of the nutrients.

I was trying to determine, along with the physics -- we would do lots of physical profiles -- what was going on. ONR was excited about it, and I was excited about it. We published a paper on it, and we had some hypotheses. When I retired I always wanted to work more on it, and I haven't. I don't understand it, and it has not received attention.

PAUL DAYTON: People haven't looked at it? Do you think it is aerosols?

LOREN HAURY: Surface aerosols are a possibility for the top one, but not the bottom -- We call the features SNE and SSNR. Surface nutrient enrichment is the surface enrichment that goes down centimeters to maybe a meter. SSNR is the subsurface nutrient reduction.

PETER BRUEGGEMAN: That would be above the thermocline or below it?

LOREN HAURY: It's right at the thermocline where you get that reduction. That part has to have something to do with biology, and I never understood it.

PAUL DAYTON: I agree, and I don't understand it either. The terrestrial ecologists looking at fog have lots of data on the nitrogen in the air.

LOREN HAURY: In the air, right. I thought about that. Where I first saw it, it was in the California Current, and we did all of the studies in the California Current. You go to the Hawaii ocean time series, the HOT station there, and you can see it sometimes out there. All of the sampling that John McGowan did in the central gyre was not fine enough to really detect it. I don't think they were looking at it with high enough precision. We would go out and look at this, using special chemistry. Which is great, because the Food Chain -- the MLRG and the CalCOFI group -- Arnold Mantyla and those people, they could do wonders with auto-analyzers and such for determining high precision. Technology allowed this.

PAUL DAYTON: Do you want to stand back and talk about how Scripps changed in your time?

LOREN HAURY: I think we alluded to it a little bit in the sense that when I first came back to Scripps as a researcher in 1978, particularly even more so when I was a graduate student, funds were easy to get. There was an open-mindedness about what you wanted to work on, about what to do. Everything was fair game in terms of understanding. There were so many things that we needed to know about various aspects of the ocean that you could discover things by just doing what interested you.

As time went by, it became harder and harder to get funding. You had to be more and more specific on what you wanted to do. It had to be more and more convincing to the funding agencies. It had to have a mission purpose like the Navy and acoustics and anti-submarine warfare. You had to have more of a -- I don't

know whether you would call it 'applied' or ‘somebody's idea what was important’ to get funded at NSF.

When I was here in those days of CalCOFI and state funding, there always seemed to be some money if you had an idea. If John Isaacs got a harebrained idea, he could go and give it a shot.

PETER BRUEGGEMAN: Speaking of that, the UC reduced research funds to Scripps. Did that affect you? You came to Scripps on research designated funds, and my understanding was that UC reduced that at some point over the years.

LOREN HAURY: Yeah, but I retired in 1999. It was after that that the real crunches hit. I never felt any pressure from when I came back in 1978.

PETER BRUEGGEMAN: Did you mostly go after NSF funds, or just occasionally you got Navy funding?

LOREN HAURY: After I got here, it was State funding for a lot of the work. Then to do all of these other things that were divergent, it was Navy funding. John was doing the Navy funding because I think the Navy wanted to understand central gyre.

PETER BRUEGGEMAN: So it came through John?

LOREN HAURY: A lot of the encouragement came through John, and then when I was a researcher, I could write my own grants to ONR. That's where I think it began with the seamounts, and carried over into the Navy funded nutrient distribution work.

PAUL DAYTON: I have always thought that the Mansfield Act was a good thing not to have all of this classified research in science, at the universities anyway. Yet when I got to Scripps, I realized just how important the Scripps science is to the nation's security, and that there is a need for our scientists to do classified research in a sense, and you were on the submarine where you could not tell us the depth. So you must've had a security clearance, and you must have some thoughts on the interface between academe and classified research.

LOREN HAURY: Honestly, I did not think about it that much. The consideration I had was that the work I did for the Navy could be published, and it was.

PAUL DAYTON: But not the depth of the submarine?

LOREN HAURY: We made sure when we did our published part of the study, that it would not reveal anything they did not want anybody to know about.

PAUL DAYTON: Yes, but basically, you were dancing -- you were complying with the Mansfield Act -- but sort of dancing along the surface of it.

LOREN HAURY: In that sense, yes, but I never felt like what I was doing had any classified aspect whatsoever.

PAUL DAYTON: Nor I, but I still see now in hindsight -- and I saw it all along -- that a lot of the things that the people do for submarine warfare is classified; it should have been at the time, anyway, and it is pretty valuable.

LOREN HAURY: Yes, looking at the particular kind of data I gave the Navy, it was not classified. What they did with it, I'm sure it was classified, because they knew it fed into the acoustic devices they had, frequencies and all of that which I do not understand, and how that worked.

PETER BRUEGGEMAN: Your career sort of encapsulates the whole profound period of technological change. How did the improvements and changes in technology and the miniaturization affect your research or impact your research? It certainly must have.

LOREN HAURY: Well, it certainly facilitated a lot of it in terms of observing the physical environment in which I was interested, the environment for the plankton that I was working with. During my time up to 1999, the technological advances in studying the distribution of planktons on a small-scale had not advanced that far.

I did work at Woods Hole a little bit with a fellow who was observing plankton behavior with a camera, and we did some laboratory studies together. We used it in the field maybe once or twice in Massachusetts Bay just off the wharf. He was trying to develop a camera that could look at small-scale distributions, but it never became a usable tool for me up until the time that I retired. I was dependent on my old-fashioned techniques.

PETER BRUEGGEMAN: But then you could analyze the data more effectively?

LOREN HAURY: The particular problem was that to really understand the system, you have to understand the plankton community. You had to understand what species it was. The more I learned about community structure and the differences in species -- the species identification became very important. Some species are so similar that no imaging technology could tell you even whether it was two different species of the same genus or whether it was the same genus or not, or two different genera. I needed to know that, because that was the question I was really interested in,… how individual species respond to the environment.

It is pretty nitpicking. I could not use these more general sensors. They are just now starting to know how to use acoustics to separate whether it is a Euphausiid, or a big Euphausiid or a small Euphausiid, much less tell you what species it is. I needed to know what the species was. With video techniques, laser imaging techniques, they are getting to that point. They are really getting good now, and it is exciting.

PAUL DAYTON: Just for the record on Loren, his early youth in Arizona and his natural history has stayed with him, and he actually taught my field course when I was away. He often came to my field course and was always the leading intellectual on the natural history of whatever we were seeing at the time. I was just thinking while he was talking about the natural history and species specific patterns that Loren is a naturalist. In the ocean it is almost unique to find somebody with his level of natural history and his physical, chemical, large-scale sophistication. I think we are finished.