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Rust, Michael ~ Oral History Interview

Maggie Allen

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

Interview with Michael Rust by Maggie Allen
Summary Sheet and Transcript

Interviewee
Rust, Michael

Interviewer
Allen, Maggie

Date
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Place
Northwest Fisheries Science Center
Seattle, Washington

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Use Restrictions

Biographical Note
Michael Rust is an aquaculture science advisor for NOAA in Silver Spring, Maryland and has spent the last two decades conducting aquaculture research at the Northwest Fisheries Science Center. He received his undergraduate degree in biology from the University of Colorado. He then served two years in the Peace Corps in the Philippines before returning to the United States. Rust pursued two Master's degrees at the University ofCalifornia, one in International Agricultural Development and one in Animal Sciences. He also has a Ph.D. from the University of Washington. Rust completed his post-doc in Norway and has done aquaculture work in Haiti, Florida, the Bahamas, and Quebec. At NOAA, his research has focused on feeds, nutrition and hatchery development of marine fish.

Scope and Content Note
Interview contains discussions of:NOAA, National Marine Fisheries Service, Northwest Fisheries Science Center, aquaculture, hatcheries, marine fish, nutrition, world hunger, sustainability and climate change.

In this interview, Mike Rust discusses the state of aquaculture in the United States and his career working for NOAA.

Indexed Names

Cousteau,Jacques
Hardy, Ron
Stickney, Robert

Transcript

Maggie Allen (MA): This interview is being conducted as part of the Voices from the Science Centers project funded by the Northeast Fisheries Science Center. It is also a part of the Voices from the Fisheries project that is supported by the NMFS Office of Science and Technology. I am Maggie Allen and today I'm speaking with Michael Rust at the Northwest Fisheries Science Center in Seattle, Washington. It is August 24, 2016 at 10:00 am. Mike Rust is NOAA's aquaculture science advisor in Silver Spring, Maryland, and he's spent the last two decades conducting aquaculture research here in Seattle. He has two Master's degrees from UC Davis in International Agricultural Development and Animal Sciences. He served in the Peace Corps in the Philippines and has a Ph.D. from the University of Washington studying nutrition. At NOAA, Mike's research has focused on feeds, nutrition, and hatchery development of marine fish. As science advisor, he's interested in communication of science to non-scientist and how science can inform policy and decision-making. So Mike, why don't you start telling me what inspired you to pursue a career in aquaculture and nutrition and how you got to where you are today.

Michael Rust (MR): Okay. Well, it's been a long and winding road that, I guess, if we go back, I came of age in the '60s and '70s, and it was a very different time then. There was a Cold War on, we were worried about nuclear annihilation. There was a lot of countries around the world that had huge problems with poverty and starvation. We still have those, but it was at a higher degree back in those days.

Culturally, there was a lot of interest in the oceans. People like Jacques Cousteauhad programs that everybody watched every week. There were other things—as a kid growing up in the rural part of the central part of the country, I was very interested in the ocean, but I was also interested in food and I was also worried about some of these global things going on. I guess I kind of got the idea that if anybody was to set off a nuclear weapon, it would be over food and it would be over hunger. Putting those things together when I graduated from college, I went into the Peace Corps, spent two years in the Philippines in Southeast Asia which had a very active aquaculture and then decided to just continue with that.

When I got back, I did my master's degree in International Development and my first career was really in Third World countries doing aquaculture. Spent a year in Haiti. Started then, as one does, having a family, and decided that maybe rural Haiti was not a great place to bring up kids as well as my wife had career ambitions of her own, so we came back to the U.S., worked a little bit in Canada but then eventually came back for my Ph.D. here at the University of Washington. My advisor was here at the Northwest Fisheries Science Center, so that's kind of where it all got started.

MA: Okay. But then after you got your Ph.D., you went to Norway, is that correct?

MR: Yeah, I did a post-doc in Norway. So again, my master's degree at Davis was on larval fish physiology and when I came and did my Ph.D. here at the University of Washington, I combined nutrition and larval physiology and did a project on the digestive system of larval fish. At the time, Norway was very interested in that topic for halibut culture and cod culture, so I spent six months in Norway at the Austevall Lab near Bergen.

MA: Did your family come with you?

MR: They did not. They stayed here, yeah, so it was one of those long-distance type things. Something you can do for six months for your career.

MA: Sure, yeah. And you also spent time in Florida and the Bahamas for aquaculture?

MR: Yeah. So, after I finished my Master's degree, I got a job in Haiti but it was working for a laboratory located in the Bahamas, and also co-located in Florida. About halfway through the project, there was a coup in Haiti and we had to leave relatively quickly, and so we evacuated it to a laboratory in the panhandle of Florida, in Sopchoppy, Florida there was part of Florida State University. It turned out the political situation in Haiti did not make it conducive to go back and so we ended up moving to Quebec, Canada and working for a consulting company up there for a while. Got kicked out of a lot of nice places.
MA: Yeah [laughter]. And so when you got here then, who was your immediate supervisor and what kind of research was going on when you first got here?

MR: So, I came here and my supervisor was Ron Hardy, who was a fish nutritionist here in the old Utilization Research Division. He was also one of my committee members, but the chair of my committee was Bob Stickney at the University of Washington. So, I did all my graduate work here at the Center as a UW [University of Washington] graduate student, like a lot of people do, and then got hired here to build the water recirculation systems that are still functioning down here for fish research.

MA: Okay. And then how did you end up being the advisor for the Headquarters?

MR: So, after 20 years or so of doing aquaculture research here, there was—and to kind of go back a little bit, aquaculture at the agency did not have a presence in Headquarters when I first started. The only aquaculture program really, and it was loosely defined, was in the science centers. There was activity in the Northeast [Fisheries] Science Center at the Milford lab, there was activity in Galveston on shrimp and turtles, and there was activity here largely because of the salmon hatchery. I was hired really to look at marine fish, so to expand beyond salmon. It was only in the last about eight or ten years that an actual aquaculture program was developed at Headquarters. That program began to mature—it really did not have a science, while it spend a lot of money on science, it didn't really have any science coordination.

So, when the position came up, I thought that maybe it was an opportunity to do some good in a

different way. There were people inthis program that needed to move up, there was a lot of things going on. Originally, I thought I would do it for maybe one or two years and then come back—I'm still thinking of coming back at some point in time, but it would be in a different capacity than I left. Also, there was a lot of pressure after twenty years because aquaculture really was not funded very well by the agency, so every year I would have to get external funds to bring in to support the people that were here. Year after year…that takes a toll on you, having to bring in a million dollars a year for supporting your crew.

So, it just seemed like a good choice. I also was interested a little bit in the science of doing science and strategy behind how we decide what to fund and what to do. I was also interested in the communication of science, especially in the aquaculture area, there's a tremendous amount of misinformation in the public. I thought science could potentially address some of that. Also, I was just—after 20 years of really being in tight budgets and really a lack of support by our agency, I was hoping that maybe I could help to change that a little bit and integrate aquaculture as a mission in the agency a little bit stronger.

MA: And so do you feel like you were successful in doing those things?

MR: Partly. Partly—not on the budget, we certainly have not had any movement on the budget…maybe a million bucks, but it's a drop in the bucket. But in other areas in terms of strategic spending on aquaculture, I think we have. I think we've daylighted a lot of funding decisions and we are making smarter decisions now than we did before. I think that's paying dividends in terms of how we spend our money on science and aquaculture. I think it is extremely strategic and extremely value-driven. So, I think there's been some changes. We certainly have a higher presence, we're beginning to get the words out a little bit more. I can't take credit for anything. The country is increasing its marine aquaculture production and its' doing it in a way that is sustainable and really environmentally the best anywhere in the world is doing it. I think we've been partially successful. We have a ways to go.

MA: What about communicating with the public? How has that been, trying to right those misconceptions?

MR: It's been a challenge. I think we have made progress. One of the things that kind of prepared me for going into kind of more of the national scene was several years ago we did a feeds initiative and this came out of this idea that aquaculture was unsustainable because of its dependence on fish meal. We did an initiative, we brought some people in, we did some documents and some outreach, and I think we were able to decouple that notion that fish meal is a limit to finfish aquaculture development, because really it's not—I mean, there's plenty of things that you can feed them. So, I think that that was partially successful, though I still see articles coming up saying that we can't continue to grow aquaculture because of the fish meal issue. But it's becoming less and less. I think we did push that down. Now, there's a number of other things out there. We're working hard on some of these big questions in the public's mind, and I think we are seeing the pendulum shift—certainly it's not just due to us, but it's due to a lot of people in the area of genetics and benthic impacts and disease transfer and feeds and ecosystem services and resiliency to climate change, all those messages are beginning to

resonate.

MA: I saw that you did a kind of Twitter Q&A once?

MR: Oh, yeah.

MA: Do you feel like that's a good mean to do that, kind of communicating through social media?

MR: I think the tweet chat didn't probably work as well as hoped and Twitter is kind of a two-edged sword, I think, for scientists because really science doesn't fit well in 160 characters or whatever it is. The nuances are too important to the conclusion. But, some of the other social media, certainly YouTube videos, we've done a story map now that you can find all of our research on. I think that's a great thing. We're redoing our website and it should be a lot more information rich and user friendly than it currently is. So, there are aspects of the social media that I think are excellent. The tweeting, hmm, maybe not the top of my list.

MA: Yeah. How else has technology change helped you with your work and how have you seen that evolve over time?

MR: So, it's been tremendous for me, actually. So, I started my college career with a manual typewriter and I did my master's degree on a PC Junior, which was 256k of memory, it was quite a machine, and did my Ph.D. on a Mac SE, which had maybe a megabyte of memory. So, that part of the transition was tremendous for me, largely because I'm dyslexic and I can't spell my way out of a paper bag. So, having spellchecker in modern word processors totally changed me form being that kid in class that got a D in English because he couldn't spell his name to somebody who could write and articulate his thoughts and put them out on paper without that distraction of every other word being misspelled. So, that part of technology has been tremendous.

The next step into the ability to mass communicate is an area that I think technology is ahead of society—especially in science. So, we have now a lot of effort to create communicators out of scientists, which I think is good for the most part. The bad part I see is that it tends to circumvent the checks and balances that science has developed for information quality So, right now to publish papers it first goes through a peer review process, but then peer review process is only an invitation to a scientific conversation. It doesn't mean that the information in a peer-reviewed paper is correct, doesn't mean that even most scientists agree with that. It just means that here is a sentence in a large conversation that as a scientist you need to take into consideration. What we're finding, though, is people are ending at the peer review or even sub-peer review level and just going straight to the media and saying all fish are going to be extinct by 2030, when the reality is that that published paper or many, many other like it, was just the very first step the very first, coarsest filter of information quality. Beyond that then, there needs to be a review process, there needs to be trysts, there needs to be groups of people in the field coming together to develop a paradigm. Oftentimes the science which is most exciting to people and is easiest to communicate is that which questions a dominant paradigm, right—it's like the Earth is round,

instead of the Earth is flat. Nobody's going to quote you to say the Earth is flat, well, they might now, but in the old days the Earth is round, it's a radical idea, let's publicize that. But the problem is that nowadays most of the dominant paradigms are dominant for a good reason. There's a lot of support for them. So, one paper that questions that, while it might get a lot of press, is most often wrong. So, this is an area where technology has kind of overtaken science's ability to make sure it maintains those checks and balances on information quality. Does that make sense? I'm kind of rambling…

MA: Yeah, I was wondering how you think that, as a scientist, you can help right those wrongs and make sure people are getting the right information?

MR: It's not easy, but it's actually a big part of my job now, is to sift through a lot of research and separate the wheat from the chaff, actually. And it's not something that the general public can do. There needs to be a reliance on experts, unfortunately, to do that. I think that we address it now through what we would call an initiative process, where we will go through and summarize a body of literature around a topic, subject that to expert opinion, distill it down to some paradigms which are meaningful, and then use that for decision-making rather than the latest the sky is falling report that comes out on the television, and that's the danger is that a lot of times the poor quality of information is the easiest and most exciting to communicate.

MA: Right, yeah. So just trying to keep up with that and kind of counter it when it does happen. Watching for when that stuff appears.
MR: But it is, from a public perception standpoint, it's a losing battle. It's really hard because most good science is kind of boring, you know, and most bad science is kind of exciting.

MA: Right. So it's just going to…

MR: By the time you see it on television, 99% of the time you can guarantee it's wrong.

MA: Right, because they're not going to report good science because there's nothing really new to say or nothing media—

MR: Well, it's incremental.

MA: Incremental.

MR: Yeah. If I say that all the fisheries are going extinct, that will be on the nightly news, but if I say that we're getting a good handle on managing fisheries, that'll never make the news.

MA: Right, right.

MR: Aquaculture is the same thing. If I say that salmon farms are killing wild kind of salmon, that gets on the news, but if I say salmon farms are providing us with a healthy, sustainable supply of protein, that's never going to go anywhere.

MA: Right. So, do you see aquaculture—you believe aquaculture will help with food security and hunger issues around the world?

MR: Yeah. Yeah, absolutely. In fact, I just got back from Thailand from a conference on climate change and fisheries and aquaculture and I'm working with a group at UC [University of California] Santa Barbara on a paper that looks at vulnerability and resiliency of different food production systems. And if you line them up, you line up agriculture, you line up fisheries, you line up aquaculture, various kinds of aquaculture, various kinds of agriculture or whatever, you find that the resiliencies and the vulnerabilities are in different places.

Right now, we get 98 plus percent of our food, fiber, and biofuel from agriculture—less than 2% from the ocean. We do that using about 40% of our land and 70% of our freshwater. The upside ability in a world of nine, ten billion people for agriculture is—I mean, there is some upside, but it's maybe not as great as if you look at the ocean. Now, if you were to look at the ocean and extrapolate that…I mean, now we have 70% of the Earth's surface producing 1.86% or less than 2% of the world's food, fiber, and biofuel. If we were to take and extrapolate a seaweed farm in China, let's say, and figure out how much of the ocean's surface area we would need to double agriculture, to equal agriculture worldwide, it'd be less than a half a percent of the ocean's surface.

So, there's tremendous upside potential in the ocean. In addition, we can do it in ways which add ecosystem services rather than cause ecosystem degradation. Fish, especially in the ocean environment, don't require freshwater, they don't require land, they don't require fertilizer inputs for things like seaweeds, shellfish. We have a dead zone right now in the Gulf of Mexico the size of the state of Connecticut. What if we had an algae and a shellfish farm the size of Connecticut instead? We could eliminate the dead zone and provide literally tons and tons and tons of products for human consumption. Well, there's dead zones all around the world, so even if those were the only things we exploited, we could greatly increase our sustainability and our food security at the same time for marine aquaculture.

MA: Yeah. And you think the U.S. is leading the way in sustainable aquaculture production?

MR: Oh no no no no. We are a third-world country in aquaculture production. Our techniques are good. Our science is good. But we don't have an industry here. So, really we are far, far behind the Chinese, the Vietnamese, the Koreans, Japanese. They are coming about these things because they have gone through the problems, but really the final approaches of what we would suggest to do right now, not having an industry but wanting to design one up front and what they are doing, having had an industry for the last—modern industry for the last 40 or 50 years, are the same. They're looking at an ecosystem approach to aquaculture is what we would be starting as well. But no, no. We don't have any world-class aquaculture research stations in the United States. We're maybe…our best facility at NOAA is the Manchester research lab, USDA [United States Department of Agriculture] has a couple of pretty nice ones, but on a world stage they would be considered second-class.

MA: And is that because of the public, a lack of people wanting to invest in it?

MR: Yeah. We have some very difficult regulatory hurdles here that were designed for different reasons and it's kind of a catch-22 in that nobody's father or grandfather was an aquaculturist in this country, but a lot of our grandfathers and fathers might have been farmers. Nobody has a fish pond in their backyard, but a lot of us have a garden in our backyard. So, we have a much greater familiarity with terrestrial agriculture, of which the U.S. is a powerhouse, than we do of aquatic agriculture. Likewise with fisheries—some of our fathers, uncles were fishermen or are fishermen, so we have a familiarity with that. In Asia, a lot of people's fathers and grandfathers were raising fish in ponds, and so they see that as a natural and normal part of the economy and the food production system. There's also a lot more poverty and hunger over there, so there's a lot more motivation to do that. We're not a food insecure nation. There's plenty of food—too much food. We're a nutritional insecure nation, because a lot of what we have is crap compared to seafood, but we have plenty of food and we have a lot of jobs and we're rich, so there's not a lot of motivation.

MA: And so what about challenges you see environmentally, like out here, climate changes and acidification? Do you see those as a challenge for aquaculture to continue?

MR: They are a challenge, but they're a challenge that we're up to. It's not going to be the end of aquaculture because of climate change, and in fact even in third-world developing countries that have much less capacity to react than we do, climate change is not seen as the major threat—there are many other threats that are above that.
MA: What are the major threats that are above that?

MR: Well, a lot of them are driven by population increase. Poverty, damming of rivers for hydroelectric projects, changes in governance, political instability, inundation or some of the island states as well as places like Bangladesh and parts of India and also the Mekong Delta region. And so it's not climate change per se—in fact, we have this ocean acidification problem here, but the shellfish industry has very quickly adapted to that and is in the process of getting ahead of that. So, I would see if anything that the U.S. is advantages and also because of what I said before about how vulnerabilities versus resiliencies—I think marine aquaculture has more resiliencies than it has vulnerabilities.

MA: More so than other agriculture or open-water, off shore fishing?

MR: Yeah. I mean, fishing is subject to whatever nature provides. The only lever we have on fishing is how much we catch. We can protect habitat—I'm sure I'm going to make my colleagues unhappy—but really our major lever is how many fish we catch. Aquaculture you have all kinds of levers: what you inputs you, where you put it, what animals you use, you can selectively breed animals, you can protect them from diseases, you can protect them from predators, you can do many, many different manipulations to make them more resilient. Likewise, if you go out in the ocean and you go down just 20 or 30 feet under the water and a hurricane goes by, you hardly even feel it. But if you're on land and you're trying to raise crops, look what's happening with flooding and droughts and tornados and hurricanes. Freshwater is a big part of the equation. So, it's something that we need to start looking at in terms of food

security, but it's fairly low, I think, on the U.S.'s importance scale to be food secure at this point.

MA: Because of what you were saying, how we're not food insecure…

MR: We just buy it. We just buy it. And in the seafood area, we kind of are a good market for other countries because we like or we buy cheap stuff. Most countries where it's produced, they like to keep the good stuff. Which is strange, we're fairly low-quality seafood consumers.

MA: Tilapia.

MR: Yeah, we love tilapia, catfish, low-end things for the most part.

MA: And what other challenges have you faced working in the government or for science throughout your career?

MR: Well, government and science are almost—to put those together is almost an oxymoron because government is extremely reactive, it's extremely prescriptive…I mean, everything is a form, right, and you've got to fill in the form. Science is creative, it should be proactive, it should be eclectic, it should have a diversity of views and opinions and so I think the clash between science and the government system has always been an interesting one for me. I've never done that well in the government side. So the more laissez-faire, the better I've been able to survive. For most of my career, that occurred because aquaculture was not even on the radar screen—there was no national program. I was pretty much left alone to do what I wanted. But now as we do have a little more visibility, it's actually become more constraining and I'm part of the problem now because I'm one of the constrainers. But I guess that's just the way it is.

MA: And so what's that like working across the country but living here? What's that like?

MR: It's kind of nice. I guess one of the things I've enjoyed most is tasting oysters all around the country learning about shellfish. All kidding aside, it's been very interesting. I don't really relish spending all that time on an airplane, but it's been interesting to see a lot of the issues and problems on the East Coast, on the Gulf Coast, Pacific Islands, Alaska, here, are similar. They may have—what's limiting may be slightly different in each area, but they all have the same list, just the order is different. So, it's been interesting to try to put people in contact from different parts of the country that may have solved one problem and have another one that somebody else has solved and to try to bring that together has been interesting.

MA: And how often do you think you travel for your job?

MR: I travel probably at least once a month.

MA: Mostly nationally? Sometimes you go into international…

MR: Yeah, mostly nationally. So, Washington D.C. obviously. Silver Spring, I go there a few times a year. Milford, the sister lab to Manchester, I try to get there a couple times a year. We

have developing programs in La Jolla, so California. And then kind of as the science ambassador for the agency in aquaculture, there has been a lot of international travel, so we have a trilateral with EU [European Union] and Canada, so I was in Brussels earlier this summer. [Unintelligible] meeting in Thailand, I chaired the U.S./Japan bilateral, so I'm there. I've been on the U.S./Korea panel so there has been a lot of international travel and then domestically one area that we're trying to get started in collaboration with the Department of Energy is seaweed aquaculture. So, there's an algal biomass meeting that we've been trying to say all algae is not microalgae, but there's seaweed out there, too, which has been an interesting process. The shellfish industry has a different meeting than the finfish industry, aquaculture meetings, and I'm kind of expected to be at all of those to show the flag and learn the latest and make sure I bring that information back to policy.

MA: That's a lot of traveling. So where's been your favorite oyster—what do you think is the best-tasting one?

MR: It's wherever I happen to be at the moment [laughter]. For political as well as cultural reasons. But if I'm honest, Washington State has got the best oysters, by far. Maine comes close, but for whatever reason, that cold water just makes a really, really good oyster.

MA: That's true and so what's that like, collaborating with different federal agencies and different academic institutions, international partners? What's that like collaborating with so many different groups?

MR: Kind of like juggling a chainsaw, a hatchet, a wiffle ball, and a wet sponge. They're all kind of different, but you've kind of got to keep them all in the air at the same time. It's been interesting, kind of, to look at how other countries fund science and do a little benchmarking. There's a lot of money that goes into different parts of science that doesn't seem to bring back a lot of return. I think we're a little bit better in the U.S. than other countries. It's also—there's a lot of issues that are the same. Especially with Canada and the EU we seem to have a lot of similar issues. So, things that they're spending money on, I'm happy not to be. It's a very good leveraging opportunity. And then there are things that we've developed which we can't maybe test here, models, for example, because we don't have a big enough industry that we can test in Korea or we can test in China or Japan. So, there's been a lot of good back and forth.

Some of the modern genomics and genetics we just recently put together an exchange with Japan, USDA, and our La Jolla lab to do some work on yellowtail genomics, which none of the three groups could have done on their own, so that was kind of rewarding. There's some work with EU and Canada on public perception, which I don't think any of us would have been able to do by ourselves. So, it's been a good experience. I think that our public is a little wary of international collaboration. They look at it as being a stream of our technology going overseas, products being developed and bringing back, but that's really not the case. We get more than we give.

MA: So do you have a lot of public/private partnerships where private companies will help build aquaculture?

MR: We're just getting into that. So, in the last four or five years we've been trying to streamline and just make people aware of the mechanism to do that. There's something called a Cooperative Research and Development Agreement. Places like Department of Energy and USDA use these all the time to work with private/public partnerships. We're just now getting to those, so I think in my five years now at Headquarters, we've maybe gone from one or two to five or six of those. I think even though with those small numbers, I think aquaculture probably has more than any other part of the agency. Maybe the Weather Service.

MA: Yeah, because you kind of need those to function.

MR: Well, we're still growing. We're still an industry that's growing. The fisheries industry is consolidating—they're not growing. They can't catch any more fish. They do a really good job of catching them right now, maybe too good of a job. So, it's a different kind of technology transfer, it's a different kind of collaboration with industry on the fishery side. Aquaculture doesn't exist yet, very much. I mean, very small. They have problems that people haven't figured out solutions to yet, so it's a very different kind of science as well. Much more experimental, much more technology-driven. Regulatory things on the fishery side are pretty well established. I mean, we kind of know, the models kind of work. There's tweaking and improvements to be made, but it's kind of working. It's in the hands of management science now. Aquaculture - we're still developing new systems. We don't have a lot of the science embedded in the management yet, things we're calling "tools for rules" don't exist. So, how do we get science embedded into the management side so that regulators and managers are making intelligent decisions? That's an area of science that's kind of still developing.

MA: And how do you see that playing out in the future? Where do you see the future of your field going then?

MR: Well, I see it in a number of ways. I see it expanding. Already with shellfish, we're seeing in some places 30% growth annually—in the Chesapeake, for example. Nationally with shellfish and finfish in seawater, you're still seeing 7-8% increases. So, it is expanding. I think we will expand offshore more into deeper water, and I think we'll see expansion of seaweed—last five years we've gone from zero seaweed farms to maybe twelve, thirteen, fourteen around the country. We'll see expanded finfish offshore. I don't know if that's going to happen in this country. It may happen elsewhere and we may just import the fish. Certainly it's happening in Mexico, it's happening to a certain extent in other countries, but we'll see. We're getting sued, so we'll see how the lawsuit goes.

MA: Oh really? Oh, okay.

MR: We get sued about everything.

MA: [Laughter] Yeah. Is there seaweed farming—I know seaweed farming's been going on for a while in other countries like East Africa and so are you working at all with that, trying to expand the market or anything? I know they've been doing them for a while, so…

MR: So, we're not really working overseas that much to try to expand production overseas other than an occasional project with World Bank or FAO [Food and Agriculture Organization of the United Nations] or something. For the most part, we're more concentrated on looking at growing domestic production.

MA: Right.

MR: A lot of the seaweed stuff, for us, is driven by the potential for ecosystem services and to clean up water bodies.

MA: Right, yeah. And I know the public seems to be getting on board with that because they've seen videos of oysters cleaning up dirty water. Although some people say that they're afraid that the oysters are sucking up all that dirty water and then they're eating that stuff, so. Trying to correct things like that, that people think.

MR: Right. That's part of the job, is to assure them that we have very tight food safety laws and that they don't need to worry about that.

MA: So, out of everything you've done, what's been the project you've worked on that you've most enjoyed or you're most proud of?

MR: You know, I've had that question before and I never, ever come up with a good answer for it. I guess I have to reject the paradigm that there's a favorite or there's a best. My whole career, I've really enjoyed stuff that I've been doing and whatever project I've been working on at the time had been extremely rewarding, and that's the nice thing about science, is that you pretty much drive the boat where you want it to go and you might as well stop at nice places. So, it's been—I think the seaweed stuff is very interesting right now, the whole adaptation to climate change is something that I'm working on that's exciting. It's also fun to just go down and weight fish and feed fish and do things that don't have anything to do with people [laughter].

MA: So would you say your work now is mostly desk work, but then you still get to go out and do that kind of stuff?

MR: I don't get into the lab very often anymore, and I think that people get nervous when I step into the lab. I'm just going to break something or mess something up. What I'm working on now, though, are more research that is perhaps thought-oriented. The science of doing science, how do you look at issues that society has and apply spending on science in a strategic way to where you get to an outcome that has both benefits to whatever mandates that you're under. For us, how do I fund aquaculture so that on the other side, we're going to have a system which is both an environmental benefit and an economic benefit? I think that's part of the key to getting around these regulatory hurdles, is just the fewer impacts you have, the more positives you have, the easier it is with regulators—though it does always come down to somebody objects because they don't want to have the viewscape messed up in front of their house.

MA: Right, yeah. That's always going to be there. And so what advice would you give to aspiring scientists, or someone who wants to work in aquaculture, I guess?

MR: I think that passion is extremely important in whatever you do. You've got to really love it, and oftentimes we're good at what we're passionate about, and we're passionate about what we're good at. So, I think that's the main thing, is first to identify what lights your fire, and try to do that. When I have interns or I have grad students, I try to give them a menu of things that these are things that we need done, pick something that you're really excited about because they do a better job at it. They're willing to read papers in the evening not because they have to, but because they're interesting, because they want to. When you get into that sort of situation, you'll be successful.

MA: That's pretty much the takeaway point for…

MR: Yeah.

MA: Yeah, okay. I guess one last question that's kind of not really related to anything we've talked about, but since you've been here for 20 years, what's been the—how has the office itself changed and how have you seen the office environment evolve? Just at NOAA, at NMFS.

MR: You mean from like a political standpoint, or from a physical standpoint?

MA: People usually talk about physical or different—more women coming in, more people, less people kind of things.

MR: I think there's less people. Probably the same relative proportion of men to women. I started working for a woman here, and the Center Director shortly after that was a woman, she was here for a long time. It hasn't changed a lot, to be honest. The facilities we built, and that was early in my career. Certainly there's more facilities now at Manchester, but it's not necessarily because of the organization, but because of the research changed. I think I've gotten older.

MA: [Laughter] That's changed, yeah.

MR: That's changed. Now the pictures of my kids are out of date.

MA: So do you have plans in the future to retire or change any position? You said you were thinking about maybe moving more of your work back here.

MR: Yeah, I don't know what to do. I'm not ready to retire, I'm not interested in retiring, but I could potentially change jobs. I think going back to my early career in international development holds some appeal, to go back and do something like that with FAO or UN or our own USAID [United States Agency for International Development] or an NGO [non-government organization]. But at this point in time I'm just kind of taking it one year at a time. I like what I'm doing, I like what I did and I have unfinished business. So, maybe as I run out of those

things that I have on my list I'll start looking at something new.

MA: Yeah, just play it by ear. Cool. Well, if you have anything else to add about your life or your career here or anything like that, but that's pretty much most of the questions.

MR: Okay, well hopefully it wasn't too rambling.

MA: No [laughter].