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# Goldberg, Ron ~ Oral History Interview

Fred Calabretta



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Voices from the Fisheries
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# Interview with Ron Goldberg by Fred Calabretta
*Summary Sheet and Transcript*

## Interviewee
Goldberg, Ron

## Interviewer
Calabretta, Fred

## Date
July 8, 2016

## Place
Cheshire, Connecticut

## ID Number
WFF_MF_RG_001

## Use Restrictions


## Biographical Note
Ron Goldberg was born in Boston, Massachusetts on July 2, 1952. He moved to New Jersey at the age of 11 where his love of the ocean and its' mysteries developed. He credits inspirational teachers in high school and college with cultivating his interest in marine science . He returned to Boston to study at Northeastern University. Through the University's co-op program, he worked for the EPA, the Northeastern Lab, and the Milford Laboratory. He was hired at Milford in 1975 and retired after 40 years in 2015. He now lives in Cheshire, Connecticut.

## Scope and Content Note
Interview contains discussions of: laboratory work on aquaculture, shellfish, hard shell clams, climate change, and collaboration with other scientists.

Ron Goldberg explains how he became involved in marine research at the Milford Laboratory and talks about his research with hard shell clams, aquaculture, climate change, and other observations in the scientific field.

## Indexed Names
Brousseau, Dr. Diane
Cousteau, Jacques
Glowka, Art
Hanks, James

Landers, Warren
Loosanoff, Victor
Rhodes, Ed
Turner, Dr. Ruth
Wikfors, Gary

**Fred Calabretta:** This is an oral history interview being conducted as part of the Voices from the Science Center project funded by the Northeast Fisheries Science Center. It is also part of the Voices from the Fisheries project that is supported by the NMFS Office of Science and Technology. The narrator is Ronald Goldberg. The interviewer is Fred Calabretta. We're located at Mr. Goldberg's home in Cheshire, Connecticut, and the date is July 8th, 2016.Well, just to start if you could give your full name?

**Ron Goldberg:** My name is Ron Goldberg.

**FC:** And your date of birth and where you were born?

**RG:** I was born on July 2nd, 1952 in Boston, Massachusetts.

**FC:** And so you grew up in the Boston area?

**RG:**I did. I lived in a post-war housing development outside of Boston, in Natick, and spent my first 10 or 11 years there, and sadly, my dad died and we moved to New Jersey after that. So, I spent my junior high school and high school years in New Jersey, and then chose to go back to Boston for college at Northeastern University.

**FC:** And how did you first get interested in marine science. How did that interest that became a career, evolve?

**RG:** Well, I certainly had some encouragement at an early age. My dad was a meteorologist and he found a lot of teachable moments as I was just growing up. I had a chemistry set, and I remember building a radio with my dad, and I think those kinds of things got me interested initially, they kind of sparked my interest.

**FC:** And then what about the water specifically, and how are you drawn to that field specifically?

**RG:** Well, like so many millions of others, I think Jacques Cousteau had an influence on me. I lived on the coast in New Jersey and spent a lot of time working in beach clubs and would always go to the ocean to swim every day, and I think the mysteries of the ocean were sort of always on my mind.

**FC:** And then if you could just summarize your education and then your entry into the profession and a little bit about that?

**RG:** Sure. In high school I had the obligatory biology course, but then I was fortunate that I could take a second year of an advanced biology course, and had a very inspirational teacher and the course was a very small group of eight students, and we were given a lot of latitude about the

kinds of things we studied and were interested in and I think that really fully charged my interest in biology, and I think I knew in high school that's what I wanted to pursue in college.

**FC:** Did you realize you had an aptitude for it, that you could grasp the concepts?

**RG:** Yeah, I mean it wasn't a struggle for me, and I think like anything else, if you enjoy it, you tend to gravitate towards it and expand your horizons with it. I remember one of the projects was working with cultured algae, and coincidentally that turned out to be something that was important later in my career, in that single celled algae are the primary food of bivalve larvae, but I had no idea at the time that that connection would ever come to be.

**FC:** And then you said you went to college in Boston?

**RG:** Yeah, I went to Northeastern University and had a number of great professors there, and they were very inspirational as well. I think my invertebrate zoology professor really continued to kindle my interest in marine science, and I became especially interested in creatures without backbones. At Northeastern, I participated in a co-op program where it was an extended five-year period, and over the five years you would alternate between school and work experiences, or co-op jobs. And a number of those jobs also kept me leading in the marine science direction. As an undergrad I worked for Ruth Turner at Harvard, who was studying shipworms, and that was a fascinating experience. I worked for the Environmental Protection Agency in Edison, New Jersey. And that was at the early days of the Clean Water Act, and EPA really had kind of a strong mission to clean up America's water ways, and it was exciting to be part of that environment. I worked at Northeastern's marine lab in Nahant, an island just north of Boston, and I learned some skills there, tissue histology, and learned little bit more about ichthyology while I was there, and that was a great experience as well. But after those jobs, one of them fell through, and I ended up taking a job at the laboratory in Milford, and that was very fortuitous because I ended up starting a career there.

**FC:** What year was that, that you started?

**RG:**I graduated in 1975 in June and I had one interim job in New Hampshire that summer, and the reason I had that job was because of my co-op experience at Milford. I was tasked with raising a couple species of bivalves to sharpen the identification skills of some of the analysts there that were working on a project related to the Seabrook nuclear plant, so I was there in the summer of 1975 and then I was hired full time at Milford in the fall of 1975.

**FC:** And what was the focus of the Milford branch at that time?

**RG:** The lab had its' deep roots in shellfish aquaculture, and a number of the founding scientists at the lab had either left or were very late in their career, and I consider myself fortunate to have met some of those folks or at least rubbed elbows a little bit. And the feeling at the time was that much of the work could be done with oyster culture had already been done, and our particular branch, the branch I worked in, the program was looking at a couple of new species that might have a potential for commercial aquaculture. My particular project, I was assigned to work with the surf clams, spisula solidissima, and most people know the surf clam as a very large shelled clam that winds up in clam chowders and clam strips, but the idea at the time was that…

We asked whether we could apply some of the methods of larval culture that had been developed from oysters to that species, and the question was whether we could raise it to a smaller two inch size, economically, in a reasonable amount of time so that that might be a new shellfish species, sort of a two inch surf clam that would be competitive with a small hard clam, and at the time, there was a NOAA food technology lab in Gloucester, Massachusetts, and they were able to take some the animals that we raised, and did taste testing with citizen panels, and they seemed to be pretty well accepted at a small size.

So my research started with just trying to do experiments in laboratory to see how we could modify the oyster culture techniques for this particular species and the goal was to raise the larvae to metamorphosis and then raise them on a little further until they're about the size of a dime, and we would have what we were considering a seed clam that could be grown out to that last spurt to two inches, and that part of it turned out to be pretty easy. There really didn't have to be drastic modifications of the standard culture techniques, but what became challenging was that last stage where we would go from the size of a dime to a two inch sized clam that could potentially be marketable. At first we started working in, what we called our tank farm at the lab, which were rows of 10 meter long black fiber glass tanks, and because the surf clam is a burrowing animal, we filled the tanks with sand and put these small seed clams in the tanks and pumped water on them continually, and they grew quite well, and we saw that by the end of the summer season to the fall they had gone from about 18mm seed to about a 50mm two inch clam, so we really knew that it was possible to do this.

When I looked at the economics though, the cost of pumping water for that amount of time, made it all less feasible, in terms of a commercial enterprise, and that really pointed us to growing them out in a field environment. At that time, I became a scuba diver, and the lab had a research vessel at the time called the Shang Wheeler. W e did a number of experiments in Long Island Sound, looking at ways to grow these small clams in one season and after coming out of the hatchery. The method that we devised was to take a wire mesh cage and partially bury it into the sea beds, so it was buried about half way. Then we would introduce cultured clams from the hatchery into the cage from a hinged top and basically the clams were protected from predators, and could grow throughout that whole summer season, and again that worked. We did produce two inch surf clams.

What every scientist would like to see is that there were, immediately becomes kind of a commercial success, and picked up by industry, and that really was kind of very slow in coming. A lot of the established shellfish companies, and there weren't many at that time, were really involved with raising hard clams and were not too encouraged to start working with a different species which might dilute their cash crop. But over the years, a number of people picked it up. They were grown successfully with similar methods in Delaware and sold through a family business. The grower down there decided to call them butter clams and was selling them for premium prices, but that was not really a sustained effort over time, that kind of petered out. They were raised in Maine the same way, and successfully sold in seafood markets. But again, this just didn't seem to last. But the interest hasn't really gone away even though that was 35 years ago. Recently I was on a Sea Grant review panel and people are still interested in trying to develop techniques to raise these to market size.

I think the basic idea that the industry needs to diversify is still there and if they can find other products, they're still worth pursuing, and I know surf clams, along with razor clams, and some other species have come up on the radar even as recently as the last couple of years.

**FC:** Interesting and it sounds as though it was an interesting sort of first major project for you, and what about the atmosphere at Milford and did you feel as though there was a good spirit of cooperation, and you had good support for the project you were working on, that sort of thing?

**RG:** There was. Warren Landers was my first supervisor, and he was quite a bit older than I was, and I'm really indebted to him for teaching me the techniques of research and also how to . write well so you could publish your results. Warren was very influential in that regard, and there were a number of other people there. Ed Rhodes was in my program and we worked together, he helped on the surf clam project. I helped him with some of the work he did with bay scallops and we had a number of other staff that helped support the effort, and there were students that came in during the summer, the co-op program was still viable at that time, so it was a very supportive atmosphere.

**FC:** And beginning then and continuing through the years. Have most of the projects you've been involved with tended to be collaborative projects where there really, it's not one person kind of working independently, but rather a group effort or?

**RG:**I think marine science really demands that. When I first started at the lab, James Hanks was the first Laboratory Director that I knew - he was the one that hired me- and the way the lab was set up, they had specific investigations where a lead scientist would have a small staff and pursue research. I guess you would call that more of an individual effort where the investigation chief was leading the work. But throughout my career, especially moving into the field, you become reliant on a lot more people to support what you're doing, whether that's boat time or diving or even just preparing the kinds of experiments that you hope to conduct, and then also from a scientific interdisciplinary standpoint, especially later in my career, we wouldn't just look at one aspect of a problem, but there may be somebody that would contribute insights into the physiological changes within an animal. Somebody that would look at the chemistry of the environment or the habitat that the animals were living in. And people became specialized in certain types of instrumentation, so collaborative efforts are definitely very important.

**FC:** So, people with differing areas of specialization, their work becomes relevant to what you're doing in the course of the project?

**RG:** That's right, and for any particular scientific question, there might be three or four topical scientific interests. There's room for people to do their work and hopefully publish those results in their own discrete areas as well as synthesizing all the results for the overall initial questions.

**FC:** And one thing that you mentioned, that in some ways is a step away from marine science, but you mentioned early in that initial project that you referred to the commercial viability of it and it strikes me that that's sort of an interesting factor if one of your end goals is to create an idea that is commercially viable, like so many other things, it comes down to the financial aspects. That's sort of the bottom line in some ways. Is that true?

**RG:** Yeah, I think from the very beginnings of the Milford lab, in the early 1930s, there was always a strong interest in working with industry and supporting the oyster industry. At that time, a lot of the beds that had been very productive in Long Island Sound were starting to sort of peter out and I think throughout Victor Loosanoff's career, the first Lab Director, he tried to devise ways that could enhance the productivity of the commercial industry, and that certainly carried through, through the years. Some of the work, I guess you would call pure science, but I think there was always kind of a theme of trying to help industry in one way or another. So it would be more of an applied science than a pure science.

**FC:** And another thing that you referred to, that I find interesting is that the timing of your entry into the field, the fact that, we're pretty much the same age, and the early '70s, the environmental movement is really kind of taking hold, and the EPA, it does seem like, in a lot of ways, a pretty sort of dynamic time to be getting into this. Did that make it even more interesting and exciting for you?

**RG:** Yeah, I think there was a strong environmental sensibility in the public at that time. It certainly was a clean kind of industry trying to farm shellfish or eventually fin fish in the marine environment. So there was kind of an inspiration as well.

**FC:** And one of the questions that we had here also was sort of the general state of the science at that time, and I think you've addressed that, but if you could comment maybe a little bit more on that, and sort of the dominant paradigms that governed your research, and the Milford Lab's research at that time.

**RG:** Sure, well Victor Loosanoff and his staff are largely credited with pioneering many of the bivalve culture methods that are still in practice today. In fact, you still see reference to the Milford methods of shellfish culture. The number of shellfish enterprises or hatcheries grew pretty steadily through the years of my career and today I would say it's really at a peak. It's become actually a very big sector of seafood production, not just in the U.S., but in some ways other countries have led the charge ahead of the United States.

But especially now with shellfish, there are a lot of smaller operations, they're not huge mega businesses, like Purina, or any of the big food production companies, but basically entrepreneurs that want to have their own business and will either raise shellfish themselves, or buy them from a hatchery and then grow them out. It's become pretty common now to go into restaurants along the East Coast and see a whole selection of different kinds of oysters and clams that are available. Each grower seems to have their niche, and claim that there is some sort of terroir or merroir associated with their product, so it's good to see that.

There are some much larger operations as well, especially on the West Coast where the environment is a little different, because they have sort of vast intertidal flats, a lot of the shellfish culture happens in some of these areas that are only exposed at low tide, where growers can either put animals right out on the flats themselves or protect them in some way. There are some companies out there that produce quite a large crop of shellfish, and they're again popular throughout the Northwest and they ship all over the world. There are growers out there that cashed in on the interest in the geoducks, the large clams that bury very, very deeply, and those

same intertidal flats they can grow the clams, and then sell them, especially to Asian markets in Asia, for very, very high prices, so that's been another success of that shellfish industry.

And this was always more oriented towards shellfish, but fin fish culture has also taken off over the years of my career. There are large offshore fish cages that are very productive of a number of species, especially in Hawaii. Unfortunately, some of the regulatory stipulations that are put in place in our country have kind of slowed down the progress of that. I know of one situation out in California where Hub Sea World has a hatchery and technology pretty much worked out to raise white sea bass and a number of other species in ocean cages, but it's been a very large struggle to get permitting through to do this on the California coast. As a result some of those efforts have turned to Mexico and Central America where it's being done successfully.

**FC:** Interesting, and we've touched on it already a little bit, but if you could sort of summarize your primary research interests and interests and focus over the years, and sort of maybe a chronological summary.

**RG:** Sure, I really would have to say that I kind of jumped around a lot and I think that was a good thing. My career started in the laboratory working with the surf clam, as I mentioned, but I think as time passed, I developed sort of a strong interest in ecology and what was going in the natural environment. The idea of stock enhancement was something that's always intrigued me, where you could kind of hybridize production from a hatchery in aquaculture and then introduce those animals to nature and let them reestablish themselves. I was involved in a bay scallop restoration project here in Connecticut in the Niantic River. A group of very dedicated men who were mostly retirees were very interested in reintroducing the bay scallop into the Niantic system. They worked with our lab and we made a number of efforts just to introduce small seed scallops into the river, but because of the enormous predation pressure, none of those efforts were ever terribly successfully, but what the group was motivated to do, is to over winter small seed and grow them to a large size, and then maintain them in the river in floating trays and let those animals spawn so that nature could take over again and introduce larvae into the water. That project wasn't an overwhelming success, but it did demonstrate a way that you could possibly bring back bay scallops. Those efforts have been more successful over on the eastern end of Long Island, where there's been a concerted effort to do that for the last couple decades.

**FC:** I'm gonna interrupt for one second, I want to make sure this is ok...[pause] ok, I'm sorry we're all set.

**RG:** And then, over time, I also developed an interest in fin fish as well. I was involved in a project that involved our laboratory in Milford and our sister laboratory in Sandy Hook, New Jersey, the James Howard Laboratory, and Rutgers laboratory in southern New Jersey. We were interested in the habitats of young winter flounder, where the nursery areas were for young flounder to spend their early first years of life. Across the three major estuaries in our three regions, we looked at what habitats the flounder used at these different estuaries. We compared eelgrass beds to microalgae areas to tidal creeks, (I think I'm going to have to drink some water) [pause]

So one project I became interested in, was looking at the early nursery areas for commercially valuable fin fish, and we were involved in a project that focused on winter flounder, and we worked with our sister laboratory in Sandy Hook, New Jersey, the Howard laboratory, and also Rutgers laboratory in southern New Jersey, and we looked at what habitats these small fish were using during their early years of life. We also did an aspect of that project where we were measuring the growth rate of small flounder in particular habitats, and those habitats were eelgrass beds and macro algae areas and tidal creeks. We were able to compare across three estuaries that were geographically separated, what the best, our most important habitats were.

As it turned it out, the eelgrass beds were very important for the small fish in terms of helping them get off to a good start through their early life history. One of the things that was apparent in our work was that when winter flounder stocks were sparse, you would see more fish gravitating to these optimal habitats, but when there was a great abundance of small fish, they would tend to live in more marginal habitats. So all habitats were fair game to these small fish, but if there was a way to try to enhance the fishery, it probably would be to propagate eelgrass beds which have always been known to be a very valuable ecological habitat.

I also did quite a bit of work with looking at some of the ecological effects of aquaculture. In the early 1990s, I guess the lab was encouraged to focus some of these. I think some of the preconceived notions were that aquaculture might be always a negative, a kind of a harmful effect, and being a regulatory agency, I think, NOAA needed to know more about what to permit and what not to permit, but I think it became very clear that aquaculture can also have very many positive benefits to the marine environment just by their nature. Bivalves tend to filter out excess nutrients, which is a big problem in coastal areas eutrophication. The work I did specifically was when some of the practices here in Connecticut with the effects of shellfish dredging came into question.

In Connecticut, the oyster industry was really dominant for most of the 1900s, but there were several oyster die-offs in the late 1900s and the clam industry became very important. But years and years ago, Milford - not Milford, but Connecticut had established a system of lease beds, where shell fishermen would actually purchase the lease rights to a fairly large tract of land in Long Island Sound. There were thousands of these parcels that were all accounted for by the lease holders.

The clam industry would use basically an agricultural or a farming technique where they would use dredges, hydraulic dredges, that pumped water from the surface down to the dredge itself, stirred up the bottom, and then scraped up the clams. It actually is a pretty benign piece of gear, it only roils up the top inch or so of surface of the bottom, and it doesn't really tear up the bottom like you might think of a huge, heavy, scallop dredge. So once the harvest is done on the lease, the grounds are left fallow for quite a few years usually, and in the interim time, new clams settle out on those beds and grow, and then eventually they can be harvested. So throughout the entire map of Long Island Sound on the Connecticut side, you have all these little patches of leased beds, and even though the fishermen, the clammers, really believe that they were not causing any ecological harm, some of their practices came into question.

So the project I was involved in was to look at the effects of dredging on these leased beds. And what we did was to look at it from a biological standpoint, and also a chemical standpoint. When you take a big scoop of mud from the bottom of Long Island Sound and you sieve it through some fine mesh screens, what you would find is that the mud is not just a barren, azoic medium, but it's just teaming with benthic organisms. And what we were able to do, is to set up experiments where we would work with the industry, do cooperative experiments, and they would graciously dredge certain areas for us. We'd leave certain areas undredged, and then we'd go and take biological benthic samples and look at the organisms that were living in the benthos.

And through our work we found that what really happens is, I can't say that there's no impact of the dredging, because naturally any disturbance is going to cause some changes, but what the dredging does is trigger an ecological succession where you get new pioneer species moving in shortly after the dredging and then in relatively short time, more established species show up and eventually you get to a climax community, in a relatively short time. So, our conclusion was that the dredging didn't have a long lasting permanently harmful effect and the same was true for the chemistry. The chemistry was altered, but only for a period of a month or two, and then things seemed to come back to some sort of state of equilibrium. So, we couldn't say that anything the clammers were doing was really harmful in an overt way, and in fact in one of the experiments, we found a much larger statistically significant number of new hard clam set in the area that was dredged, compared to some of the areas that weren't dredged. So in a way, the dredging is kind of a sustaining process, it keeps the industry sustainable.

**FC:** Interesting, so are there some additional projects that you'd like to mention?

**RG:** Yeah, I'll mention two more. One was, I was fortunate to be able to work with Dr. Diane Brousseau at Fairfield University. Her area of interest was invasive species and at that time, in the late 1980s or early 1990s and even a little later than that, the Asian shore crab was showing up in great numbers here in Connecticut. The Asian shore crab is an invasive species that is found initially in Asia, of course, and it's believed that it came over in the ballast water of commercial ships. The larvae came over. And it was first identified in New Jersey in the mid 1980s, and within a very short time frame after that, the species had spread up and down most of the East Coast of the Atlantic. The animals are very prolific and they seem to occupy almost every little rocky habitat that you could find, all up and down the coast. If you just go out to a rocky area and turn over a few big rocks, there's an excellent chance that you'll see a dozen of these little shore crabs scurrying out.

So, initially there was a great concern about what this meant ecologically. Is this going to disrupt the entire ecosystem as we know it? So working with Diane, we asked that question and we tried to narrow our focus to something specific that we could actually study and actually measure. What we decided to do was to look at the impact on newly settled barnacles, which could certainly be a prey of these small shore crabs, and also small blue mussels which are both important species ecologically, in terms of the marine community. We were able to take tiles and set, let small barnacles set on those tiles, and then we brought them to field sites which were shallow sub tidal shoreline areas. We set up an array of cages so that we could manipulate the situation from a quasi-ecological position. Like, in some cages we would have no predators, we

would have no shore crabs, some we would actually introduce shore crabs into, some we would have a partial cage so the native crabs could go in and out at will which would sort of account for the effect that we were doing a caging experiment. And some tiles were just left exposed.

Over the course of about two months, we looked at the impact of the shore crabs under these different situations. We found that the shore crabs were definitely preying on the small barnacles, but not to the extent where they were completely devastating that year's crop of barnacles. So, to us, it somewhat allayed the fears of the doom and gloom scenarios that the shore crabs were going to upset the apple cart completely. And we really had pretty much the same results with the small mussels. The shore crabs had a measurable impact, but it wasn't so significant that we felt that they were completely wiping out the mussels population.

That particular question with mussels was very interesting to us, because there was a wonderful person who is no longer with us, Art Glowka, who was very much an environmental activist. Mussels in general, go through these large cycles, boom or bust cycles, and for about eight or ten years, they pretty much were not evident in Long Island Sound, and Art Glowka asked the question: what happened to all these mussels? He was wondering whether it was the shore crab that was wiping them out. So, I guess we kind of answered that question for Art that it wasn't totally the shore crabs to blame.

Then, another project, the last one I'll mention, is that we were interested, as I said earlier I was interested in stock enhancement as a way of kind of hybridizing aquaculture and introducing these animals into nature, so that they may take off on their own and become reproductive in sustained population. The lobster industry in Long Island Sound also collapsed along with the oyster industry in the 1990s for a variety of reasons, some of them are still kind of controversial. Albeit, there are very few lobsters in the Sound today, and the idea that if you could enhance the population of lobsters seemed like a worthwhile thing to explore.

So kind of as a side project we were very interested in what a scientist in Maine had done, where he took lobsters that were hatched in a laboratory environment, which is actually a very old technique. There were lobster stock enhancement efforts that started back in the 1800s, history of the Woods Hole Lab was very much involved with stock enhancement. And Martha's Vineyard had a lobster hatchery that the State of Massachusetts ran up until I believe, the 1980s. So, it was fairly easy to take female lobsters in captivity and hold them in a condition so that their larvae would hatch and then rear the larvae and then release those larvae. But, as with the base scallops in Niantic, you're really feeding fish initially. So, another scientist had determined, which made a lot of sense, that if you could grow these lobsters to a larger size and then release them, they have a much better chance of surviving in the wild. And coincidentally we had also done a project tagging some small lobsters, and we found that they really were home bodies. They didn't move around a great deal. So we felt that if we could introduce larger lobsters into some of these preferable rocky habitats, they would eventually grow up and wander off and be caught by the fishery. So, the scientist in Maine, getting back to that, was taking these hatchery lobsters and holding them in containers in the field in the ocean, and because the containers become fouled with all sorts of organisms, the lobsters can actually graze on those fouling organisms, and all the

little amphipods, copepods that pass through these open containers. You don't have to provide food to these young lobsters that are sitting in their cages in the ocean.

And we were interested in seeing if this would work in Long Island Sound, and we devised, I'd say a more innovative way maybe of holding them, and we deployed several test cages with lobsters that some of the students at the Sound School in New Haven had hatched. Because the water temperatures are just so much warmer here in Connecticut, Long Island Sound compared to Maine, we really got some pretty phenomenal growth and we were able to go from little small fingernail sized lobsters up to, I'll say, an inch and a half or so over a course of about a year. They really didn't require any maintenance so it's not a big expenditure to set up these lobster nurseries.

So, this is again something that is not really part of a full-fledged stock enhancement program, but we feel we contributed a stage or step that could be useful if that's to be put into place at some point. Certainly the lobster industry is very concerned about some of these big global changes of climate change, ocean acidification, and overall lobster populations along with many fin fish populations have been migrating northward in the last few decades because of some of those global effects.

**FC:** Did you, a couple of follow up points, one is: you talked about both working with bivalves and fin fish. How is the research or the approach or the science different between the two, or is it not very different? If it's a fin fish project versus a clam project for example.

**RG:** Yeah. I think the basic husbandry techniques whether you're raising fin fish or bivalves in a hatchery. The overall principles are very similar. You're trying to make sure that the animals you're rearing are well fed, and the environmental conditions are suitable to their needs. So, I think as a scientist you can move fairly easily across phyla to get to raise different species or have an understanding of what's important to them.

**FC:** And speaking of sort of moving freely, another question that came to mind was, roughly how much time over the course of your career have you spent in the field or outdoors versus in the lab or using a computer or doing research. I mean just a ballpark figure, I'm not going to hold you to an exact...

**RG:**I mean it changed over the course of my career. As I mentioned, I started out pretty much in the laboratory and then around 1980 or so I got my NOAA SCUBA certification, and started doing these experiments out on Long Island Sound. And then, for a lot of the dredging projects, I spent a lot of time on boats and in the field as well. With the winter flounder project, we did a lot of beach seining and sampling from small boats. So I guess I would have to say about a third or so of the time at least over the years, you know, my career changed a bit as I got more involved in the management of things, my time out on the field diminished quite a bit.

**FC:** And when you weren't spending as much time out in the field, did you miss it?

**RG:**I did, and that's…as a retiree, that's something I still look fondly back upon. I think there's nothing you can compare to actually being out there, either SCUBA diving or sampling

something, and really seeing what the animals are seeing directly. I think it just connect you with what you're studying, it's not just an abstract academic exercise.

**FC:** Yeah, and that sort of leads to another question I was going to ask later, but it seems like a good time, and that is: do you enjoy being out on the water as a place of recreation? Have you had much time for that, whether it's boating, or walking on the beach, or has that been..?

**RG:** Yeah, I think there's always been a natural attraction to shoreline or coastal areas for me. My wife and I just bought kayaks so we're hoping to spend more time doing that in retirement. I enjoy swimming in the ocean, it has great appeal for me to be close to the ocean. I enjoy fishing. I haven't done a lot of salt-water fishing but I've done a lot of fly fishing in later years.

**FC:** So you just naturally enjoy the outdoors.

**RG:** Yeah, I do. I think that kind of goes with the territory for biologists in general. You have to have an appreciation of nature, look at the big picture as well as your narrow focus.

**FC:** You have to be comfortable outdoors to do your work.

**RG:** Yeah.

**FC:** What do you see as your most important single contribution in the field, or if there's more than one that's fine.

**RG:** You know I'd have to say that I would feel that some of those things I mentioned were equally rewarding. Looking at the ecology of winter flounder, trying to better understand the impacts of the invasive crab species, working with the shellfish industry cooperatively to determine the level of the impacts that their farming practices have on their fishery. I guess I'm glad in that I had that diversity, I think. In some cases, if I had overspecialized and just stayed with one particular area, it might not have been quite as rewarding or enjoyable. I got to use some different approaches and methods for all those different projects.

**FC:** And has your work over the years informed the fisheries management process to some degree, or in terms of regulation and things like that?

**RG:** Yeah, I think that in the way that regulatory process looks at the impacts of the dredging, you know, it provided a new insight that should certainly be considered, that it's not like the recommendation would be to shut down the hard clam fishery in Long Island Sound because of the dredging practices. I think some of our evidence shows that it can be relatively benign. You know all farming is disruptive in one way or another. You know, you don't see oak trees growing in corn fields.

I think aquaculture in general is serving a greater role in the world. It's a hungry world, and the world needs more food and high quality food. The United States has been running a very huge trade deficit for decades, importing more seafood than we're exporting. I think it can be done properly as a very clean industry. I know some aquaculture has come under a lot of criticism for some of the cruder practices that might have been done initially. But, the industry has become well aware of that and things can be managed in a way that the aquaculture industry is sustainable. If best practices are followed, I think it's as clean an industry as any other. I mean,

certainly the cattle production industry and poultry cause a lot of environmental harm in their own ways, and there are also quality issues, and hopefully the aquaculturists can learn from some of those lessons and produce a high quality product. The food conversion ratios for marine species tend to be much, much better. In the case of bivalves, you're not really feeding them, they're feeding on natural phytoplankton in nature, and the food conversion ratios feed to product flesh in fishes much, much better than in comparison to cattle or poultry and other land based agricultural products. So there are a lot of reasons why I think aquaculture is important, and is going to become part of our future.

**FC:** So you see growth?

**RG:** I do see growth, yeah. And also in the back drop of fisheries, which in general are in decline, the trend within NOAA Fisheries over the years has been the emphasis of managing the commercial harvest fisheries, and I think in more recent years NOAA has become a lot more cognizant of the role that aquaculture is playing and can play in the future in terms of food provisioning. It's really going to be more and more important niche as time goes on.

**FC:** What's the greatest threat to aquaculture?

**RG:**I think some of these global effects, like climate change. Although one advantage that aquaculture has over managing a protected fin fish stock is that you can move your operation to other areas if necessary. Although that happens in the fisheries too, I was just reading that surf clammers who traditionally were based in New Jersey are now coming up and running their boats off of Massachusetts. They're following their crop too.But you know you have that versatility with aquaculture, you would want to raise species that are appropriate for the particular area, where they're going to do best.

**FC:** What are the greatest challenges you've faced in your career?

**RG:** I think over my career and at Milford, I think the Lab always had kind of an underdog mentality, the agency was not always as supportive of aquaculture. In fact, there were several attempts to close the lab in the 1970s and 1980s. I think the reasoning behind it was that the agency had a limited budget, and the prime focus of the agency in the eyes of some in leadership positions was that the main purpose was to support Magnuson Stevens, the fishing act, and aquaculture was kind of something that should be left in industry or the private sector. But, I think because the Lab has had such a talented and creative and resilient staff over the years, even though we've had sort of funding roller coasters of good years and bad years or groups of years, the Lab's always managed to remain relevant and has garnered the respect of industry and academia. I guess the bottom line is that if you can do good science that answers important questions, then that's something that should be continued.

**FC:** And you've done a considerable amount of writing and publishing, could you kind of summarize the role of that aspect of your career, and the work in general, how the publications fit in?

**RG:** Sure, I think that's just a crucial part of being a scientist. You can do all sorts of wonderful work in laboratory or the field. If you don't write that work up, analyze it and write it and have it

go through peer review and get it out there to the public, no one will ever know of it, so it's really a crucial step in the whole process. That's something that I've always recognized and it has been important to me that for any research project, if you can't publish something to describe it, it's kind of a lost cause.

**FC:** A lost effort.

**RG:** Lost effort, yes.

**FC:** It's like doing research in a vacuum.

**RG:** Yeah, and you also never know. With the internet now, papers that I might have published back in the 1980s, somebody might come across it and say, "Hey! This could work now, in our area." And people get renewed interest in particular topics, and that's what science is all about, building on the work of others, and trying to advance the field and make progress.

**FC:** What have been the most satisfying and rewarding aspects of your career?

**RG:** I think, I'm really unusual in that I've had basically a one-job career. I mean, once I got started at Milford, I stayed there for over 40 years. I take some pride in that I started as a co-op student, and over the time there I spent half a dozen years as Acting Director of the lab too, so I got to grow as a scientist and as an individual and see a lot of the changes at the lab, work with others, and feel that at least I was able to shepherd the lab along its' way for many years.

**FC:** How has technology revolutionized research in general, scientific research?

**RG:** Oh in tremendous ways. You know when I started in the 1970s, aquaculture was kind of still in its' early stages. I mean even some simple things like materials, like plastic piping and fiberglass tanks made a huge difference in terms of what you could do in a shellfish hatchery. And then, with the advent of electronic sensors and instrumentation, you could measure the oxygen levels within tanks. Then as computers came into the scene, you could set up very complicated experiments where instead of a scientist running around and dumping 10 mls of algae in a particular tank, the computer would do that for you, and would record how rapidly the shellfish were filtering out the algae. So a lot of new possibilities, you know, from that aspect, and then just in terms of science in general, one of the comments that a coworker made at the lab was that, you know we really have capabilities of looking at what's going on inside the shell bivalves instead of just growing them and measuring them and counting them. Some of the biochemical analytical techniques, some of the techniques to measure physiological changes, and some of the very sophisticated medical technology can be applied or misapplied, as Gary Wikfors likes to say from the lab, to better understanding ways to raise shellfish.

**FC:**Is there a downside to the technology and the computer revolution as far as marine science is concerned?

**RG:** I don't really see it, I think the field has gotten very sophisticated using the technology wisely and greater and greater insights are gained by special disciplines being applied to understanding some of these aquaculture situations.

**FC:** And we've talked about specifics and specific projects and things, but maybe if you could talk a little bit more about the key events and trends throughout the time of your career and right to the present, the key events or trends affecting marine science or the marine environment.

**RG:** Well, from the Milford Lab standpoint, I think the early pioneers laid the groundwork for this concept of aquaculture of shellfish. I think over the years, all the scientists at Milford tried to follow in their footsteps and add their own contributions to advance that field. I think during my career, the growth of aquaculture has been phenomenal. I think it really accelerated in the last 20 years. I think within our agency, NOAA established an Office of Aquaculture at a very high level within the agency probably about 15 years ago, and I think that's been important to come to terms with the policies and regulations that are important to govern aquaculture in the U.S. I guess the growth of the industry is something that's been rewarding for me to see it grow. I would say that it kind of got off to a slower start, but now looking at what's going on around the world, it's pretty impressive, and it's pretty clear that aquaculture is here to stay, and it's something that will continue to grow in the future.

**FC:** You've been so closely connected to Long Island Sound. How do you see the state of the marine environment in the Sound now and how has it changed since your earliest connection to it in the '70s?

**RG:** Well going back to my pre-Milford days, with the Clean Water Act, I think there are tremendous changes. I mean, there were some pretty horrific chemicals being dumped into the sound through outfalls, prior to the 1960s or so. In general when people would come to the lab just as interested citizens, that was probably the most asked question: "How is Long Island Sound doing, is it getting cleaner?" I always responded that it really had improved markedly from the bad, old days and that it's really teaming with life, and I think that the marine life tends to renew quality of the Sound in general, all the filter feeders, and the cycle's going on there. You know, low oxygen has always been a problem in Long Island Sound and some of those problems have been ameliorated by better treatment of sewage from coastal sewage treatment plants, less nitrogen load being put into the system. he waters of Long Island Sound are certainly fit for recreational use. There are many tracts that are open for recreational shellfish, although, some are not, you have to be aware of those regulations. So, in general as an urban sea, Long Island Sound is a pretty healthy body of water.

**FC:** What impact do storms have, and even in the local paper for us, the New London Day, very often after a heavy rain storm or a rain event, the town shellfish beds are closed or whatever, and then on a much larger scale you get something like Storm Sandy. What is the impact of those events, large and small?

**RG:** Well, starting with the small, that's really critical. The amount of rainfall is very critical to the shellfish industry here in Connecticut. The State of Connecticut has a laboratory on the same property as Milford Laboratory and they're charged with sampling the water quality and looking at bacterial levels in the water, particularly after some of these local or smaller storm events. If the coliform counts are too high, then shell fishing harvesting is shut down until the bacterial levels come back down again. The reason they're doing this is to be in compliance with the Food and Drug Administration that in order for the shell fishermen to sell their product, they have to

meet these standards. So, shell fishermen have been very much in tune to what's going on with the weather situations in general. Then large scale storms, hurricanes that have hit us in recent years can have a devastating effect on particular aquaculture operations. There was a small farm off Branford that I think lost most of all their gear and stock during Hurricane Sandy. I think the nature of farming, that you don't know whether it's going to be an insect plague or a drought or a hurricane that is going to affect you, but you're going to have some of these cataclysmic events. I think among the small scale growers, crop insurance is always an important product for them to purchase if it's available, and there have been many new opportunities I think in the last 10 or 15 years, where a small grower can basically insure their crop to try and ride out some of those disasters.

**FC:** What about, close to us, Hurricane Sandy, just across the line from us in Rhode Island, the Misquamicut area really took a pounding, and one thing that was really striking were the volumes of sand that were pushed up and over the road, I mean, quite a distance. That must have a dramatic effect on the sea floor and the life in it?

**RG:** In some ways I think it can actually end up with positive outcomes. Sometimes you get these accumulations of organic materials that are pretty much stagnant and they rob the waters of oxygen as they decompose. Some of these big waves and winds can stir up the bottom to a point where system gets flushed out again, and then because the marine biological community is so resilient, as I was describing with the dredging, in a very short order, you get pioneer species that move in and the process of recolonization starts all over again.

**FC:** So it's not necessarily a bad thing or a catastrophe it may appear to be, I mean as far as the sea life is concerned.

**RG:** Yeah I think it'll always, the marine community will always rejuvenate itself over time. It's just not as devastating as losing your home, I guess, so that kind of serious storm.

**FC:** What do you see as the future of research and marine science in general? What do you see you see in the future in terms of research trends or whatever it may be?

**RG:** Well, I think, I alluded to this earlier, but I think climate change is a very important issue. We've already seen shellfish stocks and fin fish stock sort of migrating within their range to more, to cooler waters that are more suitable. I think a lot of what happens there is not up to the marine scientists, but it's up to the political will. Are we going to reduce carbon emissions? Shellfish actually remove nutrients from water and have a very low carbon footprint and in some ways they're a partial solution to some of the problems reducing these nutrients.

As far as ocean acidification goes, which is kind of hand in hand with the climate change, that can be a real threat to shellfish. There's been some good work done at the lab, and some shellfish actually can protect themselves by regulating their internal pH, but there are others, I just read an article about mussels that byssus threads tend to deteriorate in acidic waters, and a study from Washington State was projecting that this was going to be really bad for the mussel industry, both harvesting wild mussels and culturing mussels as well. Whether we can actually intervene and do anything about some of these things is the big question. I mean, I would hope that we

could get a better handle on man's impacts on environment and what that means to the oceans worldwide.

**FC:** And you've, talking about your work, you prefer a lot the tidal flats and tidal marshes, and how does sea level rise potentially impact that? Does it eliminate some of it or just move it inland more, theoretically I guess?

**RG:** Yeah, I mean theoretically, it could really shake things up in terms of coastal living, of course. Then where maybe some marine habitats that were valuable as intertidal flats become no longer intertidal, you know, you've lost that habitat. So, I would guess in that regard, you could have some nursery areas that are threatened by sea level rise.

**FC:** One thing that I think should have been my first question, but I wanted to ask you when you retired, and after how many years, I think you've mentioned that?

**RG:** Yeah, I retired May 29th of 2015. So I just passed my one year anniversary very recently.

**FC:** And when you first started working in Milford, you weren't familiar with this area, yet you had done some work there at the time that you were hired?

**RG:** Through the co-op job, I came to Connecticut from Boston. That was my first introduction to Connecticut. I basically I'd never really lived here, but now having been in Connecticut so long, I've lived here longer than any other place during my lifetime.

**FC:** Well, is there anything else you'd like to add or any topics that we should have touched on that we didn't, anything you can think of?

**RG:** Yeah, I think we covered a lot of territory. I hope I captured the highlights of my career, and how I feel that maybe this made some kind of contribution to the field. I know you'll be interviewing others from the laboratory, and I hope collectively a lot of us tell different aspects of our perspectives, and it makes sense to capture that history.

**FC:** Yeah, I think it's really useful to add it to the record and interesting.

**RG:** Someday it would be fun to just capture the actual history of the laboratory as a project. That's always been something that has come to mind, but as I mentioned when we first met, the lab has a long, storied history starting from the 1930s and still managing to survive and be productive and do good science now in 2016, and hopefully will continue.

**FC:**Is there a good paper record there, or files, or inter office memos, or things from the early years and that sort of thing? Sort of a record of...

**RG:** Yeah, it's a little haphazard, but I know during my career, I tried to collect and save things that I felt were archivable materials. There are still some older documents from the 1940s and 50s letters that Doctor Loosanoff had written. During my career, it may sound trivial, but when I started we would write letters to people and make requests or inform people and provide information, so there was a long history or tradition of writing things down that way, and then as technology moved along, it all became much more transient with e-mails, so some of the more recent information is not as well documented as the past. There was always a good photographic

log at the lab, a lot of the experiments were documented through photography and there's a good archive of photos at the lab, too.

**FC:** That's a good record too. Great. Well, I think that's good.