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Rago, Paul ~ Oral History Interview

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Voices from the Fisheries
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Interview with Paul Rago by Joshua K. Wrigley
Summary Sheet and Transcript

Interviewee
Rago, Paul

Interviewer
Wrigley, Joshua K.

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Use Restrictions

Biographical Note
Paul Rago is a National Marine Fisheries Service biologist. He was born in 1952 in Pittsburg, Pennsylvania and later studied at University of Michigan as well as Colorado State University where he received his master's degree. Later, he earned his Ph.D. and dedicated much of his life to fishery science.

Scope and Content Note
Interview contains discussions of: power plants, striped bass, preservation of fish species in the Great Lakes, nuclear energy, fishing yield

Paul Rago's interview reviews his career path and his work.

Indexed Names

Goodyear, Phil
Murawski, Steve
Studds, Gerry

Josh K. Wrigley: okay so now it is running which is good I see the numbers moving there and-- so this is an interview with Paul Rago, former Branch Chief of Population Dynamics here at the NEFSC and I'm Josh Wrigley, Project Manager at Voices from the Fisheries and this is an interview for the Voices From the Science Centers Oral History Initiative taking place in 2016. It is June 20th in the morning, and the time right now is just shortly after nine o'clock and we're sitting here at the Carlson Lang office on Social Sciences Branch in room 206 upstairs. So I guess the first question could be when were you born? We'll go back to the very beginning.

Paul Rago: [chuckles] I was born in 1952 in Pittsburg, Pennsylvania, long known as a hot bed for fishery scientists from around the world so [more chucking].

JKW: And where did you go to school?

PR: Um, I went to, well, I did my graduate degree at the University of Michigan and then I decided to go to graduate school-- well, I worked for a while after that at a place called Great Lakes Research Division at the University of Michigan where we did-- worked on power plant impacts on fish populations around a nuclear plant in Lake Michigan... from there I decided to go to graduate school at Colorado State University where I got a Masters in Fisheries Biology. And then I was intending to pursue a degree in wildlife and range sciences and ecosystem modeling and so forth. And then an opportunity came up within Fish and Wildlife Service back in Ann Arbor where my wife was from and so I decided okay, well, I'll pursue my degree in fisheries at the University of Michigan and so I simultaneously enrolled in a Ph.D. program and began my work with US Fish and Wildlife Service... and there I was on a group called the National Power Plant Team which was kind of a... special group among six or seven different teams so to speak that the Fish and Wildlife Service had sort of put together to sort of address concerns of national interest. And--

JKW: What year was this?

PR: This was 1978.

JKW: Okay

PR: Yeah, and then... it... so one of the tasks was to... evaluate power plant impacts from a variety of different standpoints. One was a temperature induced problems, you know, thermal loading due to discharges and the second was entrainment and impingement that is the... animals that were pulled within the cooling waters and subsequently they're boiled through the cooling process or stuck on traveling screens which are then removed them as trash.

JKW: What species were most affected by entrainment and impingement?

PR: Uh, there were a variety of them... alewife were one of the, one of the big ones, these were introduced species in Lake Michigan. Yellow perch was another big species... some miscellaneous... species like spottail shiners... minor species and a number of iconic species such as... a whole suite of introduced salmonids into the Great Lakes, um lake trout was native but then there was also... you know, coho and chinook salmon which were also, you know, entrained and so these became... major concerns of the regulatory process, the EPA regulatory process for licensing.

JKW: So was the research you were conducting there being used in a regulatory capacity for... nuclear power plant expansion--construction?

PR: Right, right exactly nuclear and cold fired plants but it was... it was designed to sort of facilitate the licensing process or at least ensure that it adequately addressed... a lot of the... environmental concerns and this was you know, coincident with the development of the Magnuson-Stevens Act, you know, about the same time period

JKW: 1976--

PR: '76 through '78, you know, this whole period was one of a huge expansion in, sort of, employment opportunity for fishery scientists and you know a lot of people sort of got their start doing power plant impact work, you know. And ultimately it was very difficult work because the idea of... of monitoring individual impacts of a single source on a large system and dissecting that or isolating those affects relative to... the whole suite of factors that influence stock--

JKW: --Right--

PR: --the dynamics was really quite challenging, probably in retrospect more, almost impossible... But you usually had a small spatial area, a limited time domain, a modest affect size in terms of the actual impact of the plant, of the single plant itself--

JKW: --yeah

PR: --was relatively modest compared to the whole suite of things that might ultimately affect the trajectory of stocks before and after one of these plants went online

JKW: You mentioned when we met earlier that the Three Mile incident had a fairly profound effect on

PR: -- yeah

JKW: the national discussion about nuclear energy.

PR: It certainly did and that was consequential in a number of ways. Of course, first it was-- it put a chill on a lot of the licensing process so I think since then there's only been one nuclear plant that actually got licensed. There were a number in play at the time and many of those went through, most of those went through but you know, of course, at that point the utility companies said, you know we can no longer make that investment in... in electric generation and I think they went to either coal fire plants or energy conservation measures and things of that sort and, ironically I think, the current nuclear capacity is like 20%, remains about 20% of the US and electricity budget so, there's a huge legacy and also a need to-- many of those plants are certainly at the age of their design, are at the limits of their design capac- longevity and there are some-- some of those are being relicensed in some areas but, that will be an important transition--

JKW: In the present day--

PR: --In the present day, toward an alternative energy sources or different ways of generating power, meeting demand, I guess.

JKW: Um... so as you made the transition eventually to the National Marine Fisheries Service in 1993, how did your work with US Fish and Wildlife on power plants inform what you began doing with Population Dynamics? Which is the branch you joined, right?

PR: Exactly, right, I think that's a great question, it -- I think the primary one was-- that there was an emphasis on quantification of impacts, and so many of the aspects that you would do in an attempt to try to quantify the impacts of power plant were sort of a good basis for evaluating the effects of fisheries... anthropogenic effects on stock dynamics, climate change, and the like. So this sort of structuring of data basis to quantify...

JKW: --The same types of data

PR: --Right, right so it was a lot of the same kind of process, you know, quantitative science, probably more of a hypothesis testing framework in environmental studies in the sense that you had multiple factors, you had a number a ways in which you could deduce or infer the effects of the impacts. I think that split between deduction and inference is an important one because in the deductive process you postulate axioms and then everything kind of flows in a logical fashion as the deductive process whereas in inferential works, you're trying to infer the underlying cause based on properties of the data and then trying to say, okay can we make that epistemological leap to--

JKW: --yeah

PR: --to a new understanding of factors that might be underlying the changes that you see so, I think both of those were useful for sort of understanding how mathematical modeling of fish populations can help you mostly on the deductive side of things, but you know it's like the inferential side and trying to say okay, well you know, if this is true then we have to say-- we should find some evidence over here as here's this missing dark matter

JKW: -- right to validate.

PR: to validate that kind of process.

JKW: And um, when you came over in 1993 then, you were, you mentioned before that you were working with Atlantic salmon mostly and striped bass.

PR: Right, right. My job at Fish and Wildlife Services so after Three Mile Island, power plants became less important, I was briefly with a group called the Eastern Energy and Land Use Team which was looking at broader questions of land use such as disposable coal fly ash and impacts of acid rain on populations so I was involved in a couple surveys, uh, national surveys, number of modeling exercises to try to say, okay, what does modest acidification What are the consequences at the population level for stocks and, so collection of populations of multiple lake systems and stream systems and things of that sort.

JKW: What was the thinking on that at the time?

PR: Well--there was a, uh, huge interest in this as a potential consequence of fossil fuel consumption and the acidification much more so than the carbon loading was considered one of the primary impacts and you know that there were a lot of prognostications of large scale depletion of forestry resources, fishery populations and some streams…

JKW: --yeah

PR: -- and natural stock and so forth, um most of those turn out to be a little bit overdrawn I think the... ability of systems to respond to loading was probably stronger than you would get when you do a titration in a closed system.

JKW: So it wasn't quite as dire as…

PR: It wasn't quite as--

JKW: -- as previously thought…

PR: --exactly, yeah... yeah so there were still some areas where the acid loading was... had some consequences but most of these were in fairly... unbuffered systems.

JKW: Mhm

PR: And even in those systems often times there's a lot of weak acids that... tannic acid, humic acid, folic acid, that'd allow for sort of buffering of systems so the responses--

JKW: What's the definition of buffering?

PR: Buffering is, well, buffering just means that...

JKW: -- the resilience?

PR: ..the chemical reactions in response to a stressory, you put a stress on one side, additional protons acid then the-- a system of weak acids donate hydroxyl

JKW: Okay so now we're getting into chemistry.

PR: Basically right right

JKW: [laughter]

PR: It increases the resiliency, I think is probably the best way of describing it so that such that the change in PH is less than what you would have expected based on the input itself.

JKW: Okay, I'm from upstate New York originally so, I have often heard about effects of acid rain on the population.

PR: The Adirondacks, right, right. Okay, so right right, the guy I worked with, the name escapes me but the Cornell University had a number of kind of prominent people involved in these studies, and in upper Wisconsin there was similar kinds of work where we had... poorly buffered systems with…

JKW: Was it a fairly new area of study in response to the environmental movement or was this something that had sort of been an ongoing conversation within the sciences for a while?

PR: Yeah, I think it was a bit of both, certainly it became a cause because it was tied to air quality issues and the air quality issues were--

JKW: -- public issues that were coming to head at the time.

PR: Exactly, right right, so the air quality act you know, you solved one problem by eliminating local pollution by putting in a tall stack you created a…downstream

JKW: set somewhere else [chuckle]

PR: Right right right, so it's sort of highlighted the connectivity between regions and sort of isolated solutions were going to be insufficient for many kinds of problems.

JKW: Right when something is that systemic

PR: Right right you can't just transport your problems to another area, zone or whatever as a solution to your local problem. But that work allowed me to migrate to... I had an opportunity with Phil Goodyear.

JKW: Who is he? You'd brought up his name before.

PR: Phil Goodyear is a scientist within Fish and Wildlife Service, just tremendous respect for him, you know he's served as a mentor to me in my career... and was instrumental in terms of sort of introducing me and giving me the opportunity to work on other types of problems so one of these was salmon and we were representative along with National Marine Fisheries Service in the... a newly developed treaty called the North Atlantic Salmon Conservation Organization that was designed to sort of manage or help address the issues of Atlantic salmon conservation wild stocks.

JKW: Was that a bilateral organization?

PR: It was a multilateral. It was U.S., Canadian and then all the countries along the northern Atlantic, so I went to Iceland and the EU and Norway and Faroe Islands, Greenland, and Russia, Finland. The whole arc…

JKW: So everywhere [laughter]

PR: Everywhere that the Atlantic salmon either currently or historically inhabited, you know was part of this fabric of this group. And then there was some work through the International Council for Exploration of the Sea, ICES, which was another component where the sort of scientific issues were addressed, where NASCO was sort of treaty related so it was... it took information from the science but also melded the political dimension on top of management concerns and you know it was instructive in terms of seeing how the stocks were, well, how management actually occurs because you don't normally get to see that part or understand it that very well--

JKW: --right

PR: --until you actually get to do it and then, you know, I guess one other thing about that was that Phil was really instrumental in terms of what was called the Emergency Striped Bass Study which was the... also developed and in response to a collapse of the coastal populations of striped bass and it was authorized by Congress.

JKW:-- this was during the early 1980s?

PR: Yes--

JKW: --the midyear of their population

PR: -- yes, right right, and so you know a number of measures were introduced to sort of stem the tides so to speak and uh, Phil who had been kind of a key person in terms of the Hudson River power case which was a huge

JKW: The Storm King Mountain controversy

PR: The Storm King Mountain and Indian Point and all of the-- there were seven power plant facilities on the Hudson, which were part of Storm King plus the

JKW: --they were-- where they all Con Edison

PR: Yes.

JKW: Okay.

PR: Yeah so it was all Bowline, Roseton, Indian Point 1 and 2 and then there couple other, three other, minor power plants

JKW: I have to go back to Robert Boyle's *The Unnatural History of the Hudson River*.

PR: Yeah that was a good book, and Boyle's you know they, you know they... and there again, because, uh I think... the striped bass were east coast fish, species, you know the impacts of stock decline were immediately evident within the Washington metro area and because the Hudson, there are so many powerful interests, you know, could witness the decline I think there was a concomitant... urge or desire or intent to get to the bottom of this and so there was a whole suite of studies that were funded jointly between Fish and Wildlife Service and National Marine Fisheries Service so that was kind of a big-- another nexus with Fish and Wildlife and National Marine Fisheries Service.

JKW: I guess it was sort of geographically or strategically positioned geographically to be a cause celebre in some respects.

PR: Exactly! Absolutely right, right, right, and um, you know one of the... key people involved in terms of you know initiating and continuing the funding for that was Gerry Studds who was a Congressman who represented Cape Cod at the time and so that... was another way in which I started to establish a linkage with National Marine Fisheries Service as part of this.

JKW: Was Studd's instrumental in pushing forward the legislation that led to striped bass conservation efforts?

PR: Um, the, yes. The Striped Bass Conservation Act was also, which was a follow up to the emergency striped bass study you know was a way of sort of developing a... a cohesive way of handling the inter-jurisdictional stocks that, um, didn't exist under the framework of the Magnuson–Stevens Act because these were inside the territorial waters so within a twelve mile limit in which, you know the federal jurisdiction didn't exist, yet the same kinds of problems existed and probably manifest more acutely because these were also primary recreational species that so, striped bass, blue fish... herring... other…

JKW: -- Charismatic in shore species

PR: Charis-- right right right right right exactly. The ones that show up in ...at regular intervals and you know when they stop doing so then,

JKW: People get worried.

PR: People get worried.

JKW: So was that in, is something in addition to what the ASMFC was doing at that time?

PR: -- Exactly, it was it

JKW: --was it more of an advisory body

PR: It gave the ASMFC some teeth, so they had a regulatory process and so there was no... you couldn't evergate... I think that's the proper word, federal authority but the ASMFC could advise and say, you know advise the Secretaries of Commerce and Interior jointly, that state "X" was out of compliance with regulations that they had commonly agreed to so at that point the uh, federal government could take under consideration their advice and impose a moratorium on a state's fishery for lack of compliance with it so it was

JKW: --which they wounded up doing eventually, right?

PR: They did it... and they applied. I think the threat was more important than the reality of it. Instances where they did apply it, it was generally sort of a, it was an instance where they had a regulatory issue with the state, New Jersey for example, New Jersey had a state... regulations that were... had to be, had to be authorized by the legislature. The executive branch couldn't change their bagging limits. They had to have the legislators convene and say your bag limit should be X and stuff. Well, that didn't occur until, you know, like, February or January or February or whatever like that, but the deadline was December 31st. So they imposed the moratorium but it was inconsequential because it was in process, but the mere exercising of that authority was sufficient to say this wasn't a live round but, you know, had it been, you know, this could have been …

JKW: Could have gone... a disaster

PR: effected your fishery so other states generally... brought into-- so ASMFC brings together a mix of the science and the management arena in a way that, you know, I think both uncommon and ultimately useful you know. You might argue that sometimes it contaminates both processes to some extent but you know I think... in most... most fisheries issues are kind of... simplistic. Okay, you need to cut fishing mortality you know, but, the reality of that is in the… actual details of that process, how it occurs, and who it effects and the allocation consequences of those decisions are, are

JKW: Much more systemic

PR: Much more systemic, much more interesting and you know bring together not only the mathematical and statistical aspects of it but also the policy concerns that you know, ultimately dictate... what allocation redistribution is a-- occurs as a result of these kinds of things, and that's what makes it both challenging and interesting and fascinating.

JKW: Well, as you're talking about the crisis of the striped bass it seems that there is a... a real sort of historical noteworthiness to it, you know is this really kind of the first time that the uh... decline of the species you have-- of fish in northeast have mobilized such a public response but also such resources as well.

PR: Yeah, I think it did have a number of... really longer term consequences I mean...you know... there is often times a tendency and this is documented in a number of you know, seminal papers and so forth but I mean it's sort of these shifting base lines you know forgetting what fishing was like, you know..

JKW: Yep, of interpreting your world as you see it as being--

PR: --exactly, right

JKW: --the norm throughout

PR: Right right right, or sort of right right, or that you know you start to view well, what we have here is a pygmies species here, that uh, you know it's not going to ever get to that size again, you know they're stunted or..

JKW: Yup

PR: Or you sort of say okay, there's no market demand for those big fish because they're way too big for a plate, you know, and or, the product quality is low because you know

JKW: --and now one of the lines that was used during this time period, right>

PR: Exactly, right right--

JKW: there were no desirables, market size--

PR: -- the small market size, you know if you take these fish then... you know you're depriving this market from or this group of people who harvest them so, and again it gets to those allocation issues you know, and I often times would refer to the allocation as sort of the preservation of historical inequity however--

JKW: [laughter]

PR: However it arose you know

JKW: [more laughter]

PR: Because it's, because you know there was always this sort of historical inertia that says, Massachusetts gets 22%, Rhode Island gets 17%, New York gets 18% and that was based on the balance of fishery usage over some period and then that became redefined as a target as to what should be.

JKW: Do you know when the landings data is from that the, those allegations were based off of initially?

PR: Well, yeah, well actually it was-- right, it was... for striped bass I think it was '82 to '88, 1982 to 1988 and so, again--

JKW: How are those dates picked?

PR: Uh, it was a combination of... probably...I don't know... somebody probably... I can't say for sure but I'm sure somebody gamed it, a little bit, to say what does it mean; was this an acceptable balance--

JKW:-- right-- for their own state

PR: -- but for the second part of it, probably the more consequential one was that it was a period where they had reasonable data, you know, comprehensive removal data of not only the commercial data which historically has been... relatively well monitored but the more important

one was the recreational data you know, hadn't been available before that on a consistent basis so um, again um. The historical conditions were free for speculation in the memory banks of the individuals who were at the table at the time you know, so, now this was a period where okay we did have some, some reasonably concrete data for making inferences.

JKW: And I guess the uh, trend is continuing still since I... isn't New York state at war with New Jersey so to speak over fluke allocations? [chuckling]

PR: Oh yeah! right right, I mean and so, yeah these things are nuts, I mean because, once they may have preferable prices or landing conditions or... or some other economic factor which leads say fish caught in one state to be landed in another and if those conditions existed historically but don't exist now then they'll seek retribution or grievance and say you know I'm sorry, you know, these allocations are, are incorrect because, you know our fishermen from New Bedford were landing in Point Judith during this period in order to get a better price for something, or... yeah... things, you know, people will say okay we don't know what went through full market at that time, you know the books are a bit shaky.

JKW: obscure

PR: -- obscure right right

JKW: [laughter]

PR: New Jersey, Mattawan, Cape May and so forth are actually much higher, you know but that hope whatever the specifics of that argument are there, sort of the generality is always there, there's some underlying sort of... economic benefit or societal-- perceived societal benefit or allocation to a set of individuals that drive the dynamics and so all of that was sort of you know exceptionally good training for me to sort of-- for you know the sort of broader issues of management of... species under the Magnuson Stevens Act created in the Northeast I guess. Where there were long term historical fisheries for these resources.

JKW: Right a long, long lineage of--

PR: Exactly right, right you know so, ostensibly 400 years or so.

JKW: Well going back for a second to when you were talking about Phil Goodyear's work on Atlantic salmon... what was the state of Atlantic salmon's spawning populations in the U.S. at that time?

PR: Uh it--

JKW: I know it precipitously declined over the course of over hundreds of years but…

PR: Right right yeah, they were... actually better than they are now in-- for many of the stocks they were still returning fish to the Connecticut River--

JKW: Really? Wow.

PR: You know on the order of... I think upwards of a hundred, there was this sort of peak runs there. There were still fish in the Merrimack River... and so... the--

JKW: --and are those populations now completely extinct?

PR: Well, yeah, they were pretty much on life support through a variety of stocking programs and... and so stocking has a strong appeal in the sense that you directly see the input to the water, so there's a perception that you are doing great dramatic things for restoring populations--

JKW: [laughter]

PR: -- even though many of these things are like piscatorial chickens, I mean they are not terribly street wise... and so they... if they see a looming object overhead, they think it's the hatchery feeder as opposed to a bird of prey, so you know. So they often times are... ill adapted to survival in the wild and so, but you know that became... a... a very strong... driver within U.S. Fish and Wildlife Services because they were, the fish part of Fish and Wildlife Service was really oriented towards hatcheries, you know. Everything designed from their nutrition to their disease regulation to their pollution control to their growth, dynamics, breeding stocks and genetic depletion, you know all these kinds of things that you take...that you recognize within a... a closed system environment there.

JKW: Almost sort of a holdover from the progressive era emphasis on environmental management through programs like stocking and---

PR: --yes, right right

JKW: the ability to--

PR: --right, I worked for the national, one of the national labs for Fish and Wildlife Service in Leetown in West Virginia and they had a model of their-- the railroad car that they-- that allowed them to transport carp, across the country--

JKW:--interesting

PR: --yeah yeah but you know that was you know, in the early... the late 1800s, you know, that became a preferred way of sort of providing both recreational opportunities and I'm not sure exactly what other noble goals they had for restocking carp.

Both: [laughter]

JKW: I'm sure people would question it now it's completely considering carps--

PR: Right and it's always easier than--

JKW:--reputation [laughter]--

PR: --right right, it's always easier in retrospect to sort of say, well, okay did you really want to introduce those pigeons or you know the starlings or those carp?

JKW: Right right, cane toad…

PR: Right, right so they pushed you know, they pushed striped bass far out west you know and induced them into the Pacific--

JKW: --Yeah--

PR: -- and so forth and salmonids were, of course, hugely popular, brown trout from Europe sort of became a dominant species within small streams.

JKW: While the number of them in the different colonial areas

PR: Right right, so like all introduced species they either go extinct right away or they find that there's no predators for them and they explode... so those kinds of things were sort of... sort of consistent patterns across. I mean man as an agent of biogeography is, is a huge...probably the biggest agent of... change in species mixtures in compositions across the world.

JKW: So our era really could be... could deserve the term the Anthropocene now, as we uh, as we move forward.

PR: Right yeah yeah, when you think of... you know like a, you know I always would say to people. Well, now let's assume that you had to do an environmental impact assessment on Welland Canal which you know connected Lake Erie and Lake Ontario and allowed for passage of sea lampreys and alewife, you know smelt and all these other species into the upper Great Lakes in where they've never existed before... and also allowed for you know... when barged traffic and overseas ship traffic became you know when we sold to Russia you know wheat, they brought in Baltic sea, you know... species of zooplankton and introduced them into the Great Lakes and clams and things of that sort.

JKW: Who could have foreseen the environmental ramifications of seemingly innocuous acts?

PR: Exactly, right, right, so those kinds of things are...sort of give you some humility I think in terms of... and uh temper the hubris of many--

JKW: -- one hopes [laughter]

PR: You hope they would maybe, maybe, I guess if you don't read up on it then you're going to be you know, sort of unaware of it; those are the kinds of consequences so, of somebody's actions.

JKW: So who is the branch Chief in Population Dynamics when uh-- in 1993 when you first arrived?

PR: Steve Murawski he was my first supervisor, he was a great boss. He did a lot of-- very high energy person you know and sort of... made for a... both a collegial and an intense working environment there but I really, I felt at home you know, I felt where this is really where I can sort of blossom and I mean I ... consciously made a decision to sort of, you know, readdress my, my scientific... credentials, perspectives or whatever because you know, through my work in Fish and Wildlife Service I was increasingly on a, sort of a Washington office trajectory--

JKW: --Towards management?

PR: Towards management issues, I had been, you know, involved in a number of congressional hearings and briefings with State Department and things of that sort, you know although I found that, interesting, I thought okay, you know, there's... I really should try to address the science, I mean I am probably better at that then I am at the political game. And so, you know I thought this was a little opportunity to sort of work, you know, provide some of the skills I may have had that were useful to other groups and you know, I had a... a slightly different perspective than those who had sort of come through more traditionally fisheries programs and so it was, it was a huge opportunity to sort of work on, on a variety of species and get involved and... you know everything from ground fish to invertebrate species and things of that sort.

JKW: What was the office environment like at that time?

PR: It was good. I mean it was, yeah there were--

JKW: --right above the aquarium, right?

PR: Right above the aquarium, yes. Same, same place it is now

Both: [chuckling]

PR: Yeah, I think it was in some ways, it was kind of ahead of its' time you know... physically the plant was a dump... and not much better now, the carpeting is better. We got new windows, things of that sort--

JKW: --minor upgrades

PR: Minor upgrades, right, right. But, you know it had sort of a mixture of, of you know, permanent offices, cubicals, and then some more open space and it was kind of a bowling alley design that... because of the placement of the common printer and the, you know, the coffee area, the life source--

JKW: [chuckling]

PR: --You could, you know, you sort of had a regular mixing of people.

JKW: So people weren't too sequestered away--

PR: -- Right right, they had, you know--

JKW: --in offices without interaction--

PR: Right, it wasn't like a labyrinth where you could be, you know, you could hide away, you know, people wondered if you were still alive or not.

JKW: [chuckling]

PR: So, but most people kept their doors open which was, which was good, you know there was a regular exchange of ideas there were, you know, sort of not too many, like big meetings, but a lot of meetings of convenience, you know. Like here I am working on this or, you know could you help me with this? It was a good spirit of exchange you know, a lot of sharing of, of resources and code and things that, that people facing a common challenge often do.

JKW: What was the technology situation at that time? You had mentioned --

PR: Um there was--

JKW: --model 29 I think punch cards

PR: Oh yeah, the key punch and the... the nine track tapes and the reliance on the... the Hoey, computing environment was actually going away at the time when I started there, there were you know the... Intel 386... the chip had just been introduced this was a 16 bit chip--

JKW: --top of the line of its day--

PR: -- top of the line you know, probably capacity of, you know, one one hundredth of a cell phone--

JKW: [laughter]

PR:--in terms of its computing horsepower and capabilities--

JKW: -- of a bag phone maybe to be era appropriate

Both: [laughter]

PR: So you know, and internet and e-mail was just starting. So, you know, there was, a shift towards PC oriented work, there was less, you know, when I was with Fish and Wildlife Service we had more work stations, you know, Hewlett Packard, you know digital work stations and so forth. These official... these were more like individual scientists' tools whereas you know... at National Marine Fisheries Service was more of a network environment then, you know there was a number of… there was a central computing facility as well as individual capacity on the PCs. The thing that was interesting was... it was fundamentally different was at National Marine Fisheries Service was sort of this... dedication to collection of long term data that... that was very appealing to me in the sense that... that recognizing that it's only through maintenance of long term record that you're able to interpret the past as well as... attempt to forecast the future. That whatever factors lead to... the current state of the population are off, can be deduced or inferred from these long time series of information and sort of... there's... a lot of... basically deadly dull work in science, you know, in order to do the exciting broad sweeping work... you know, breakthroughs and so forth are usually the product of lots and lots of people doing relatively mundane kinds of things. We're doing a survey consistently year after year, takes a huge amount of discipline and attention to detail and deferred gratification in the sense that... the individual on 1974 is probably not going to see the full benefit of their, the fruits of their labor for 10, 20 years

JKW: Much longer trajectories

PR: Right right, and it's sort of asymmetric too because the consequences of failure are immediately evident as well as propagate long term over time, so things were... you know, something was changed but not accounted for, tested or... there were not ways of say, linking the two time series. It could be incredibly damaging to long term research and I think, there was that sort of, attention to that aspect of science which I found appealing mainly because I, myself, am deadly dull.

Both: [laughter]

JKW: Hardly [continued laughter]

PR: Yeah the, you know sort of, that... it, it's somewhat boring for a lot of scientists, it can be, it can feel constraining you know that, that you, your scope for innovation within any given series is constrained tightly by money and time and so forth.

JKW: Was there a lot of cross over with the academic community?

PR: Um... at that time... not...--

JKW: --exchanges of ideas and?

PR: -- yeah... there was some--

JKW: -- collaboration

PR: Yeah, yeah there was some but, typically not within the context of the, of the...long term surveys or, or data collection systems for... for management purposes. And, it's a really tough balancing act because you have the issues of, sort of innovation and improvement, which you know, at its core it's very hard to deny you look like a stick in the mud if you're saying, oh we can't do that because we never did that before. That alone is a pretty weak justification it's, is consistent inference... possibly bias, better than... improved inference but... with a distinct shift in the ability to sort of link the two series together, you know is the... is the historical data relevant to this? And I think, you know this is not an uncommon problem--

JKW: --Is that changing now in your view or?

PR: Um...I think to some extent some of it out of necessity. For example, the transition from the Albatross to the Bigelow was a tectonic shift in sort of the sampling properties of the two vessels and so there was this huge recognition of a challenge and a pretty sizable investment in the... ability to sort of... pretty sizable in terms of undoing the underlying science that'll allow you to sort of interpret these two time series and so. But at this point even, what's going on is we're... it's just changing now, not necessarily when I was there. But, it's changing to the extent that... you know we still take the Bigelow data and in the fishermen's perspective we degrade them back to Albatross units because we take the improved information but, use conversion factors which allow us to make them consistent with the metrics that we had in the past. And so for some, that's sort of a math to science, how can you--

JKW: -- And they feel you should be moving in the right direction--

PR; Right, right, they feel that you should be moving in the other direction, but it's sort of... you sort of-- the explicit recognition is that, you know in order to look at the projectory of populations over longer time periods, you still need to have a common measure of trend that you simply can't get away from that issue and you know, it's common in economic time series too, you know, they have conversion metrics for various things, you know, even say unemployment statistics they'll take the June unemployment and they'll see a spike every year and it's related to high school kids getting out of school and looking for work. So, they apply the adjustment factor that says, this is the typical aberration, we'll take that into account. Here, we have a more systemic issue with stocks and... you know, the fact that the net is not only more efficient, the new net system, so to speak, is more efficient in capturing fish but also catches different species and different size classes of the same species you know, than the older net did. Those kinds of things are, are very... uh, you know... they may change over time, not only with respect to the mix of species but the abundance of species, so, very large catches. And so it, in a long way of saying it, it has very profound impacts on your stock assessments and so, you know that kind of... was kind of... some... major trauma within the context of... of um... the stock assessment process within, you know, I mean... stock assessment science is basically an observational science, sort of like astronomy, you're waiting for a supernova to blow--

JKW: --So observational zoology of--

PR: --Rrrr, exactly right right, so right right, so because real experiments are very difficult to sort of... impose, you know because of over societal consequences um, in you know so but I think

there were a couple of these big experiments that, that sort of were... were consequence of management issues that provided a huge amount of insight into the stock assessment process.

JKW: What were some of those?

PR; Well, I guess, the primary one was probably in 1994 when... the stocks were... the ground fish stocks were declared depleted so, cod, haddock, and yellowtail in particular... so it was clear that there was a crisis of these stocks and that there had been a number of areas on Georges Bank and... and in Southern New England that, that were... closed seasonally in response to the sort of notion that you don't want to fish on spawning aggregations and so that sort of... those were a number of areas that were agreed upon as primary ground fish areas and so... the first measure that was taken, very controversial, of course, was to simply close those areas permanently year round to fishing activity. So, that decision, was... you know... not... not terribly challenged because there wasn't a whole lot to catch anyhow and you'd have to burn a lot of fuel to get out there, to not catch anything so we'll say, okay this... this became the norm.

JKW: Was that for ground fish and scallops?

PR: Well, it was for any gear that caught ground fish, and so at the time, the scallop industry was highly dependent on yellowtail flounder and monkfish and so... they-- each scallop vessel you know would often times bring in a mix of... you know... scallop meat and uh and monkfish tails and... and yellowtail and other flatfish species. So you know, they were excluded from there and the Georges Bank population was low at the time for... sea scallops and so they-- it wasn't terribly controversial so... you know and we continue to monitor the resource there and then sort by 1996, we had, you know, an assessment that, that was demonstrating that over period of three years, the closure had resulted in a threefold increase in the biomass of the scallops there. By 1998 it was, you know, projected to be like 10 times more and so forth and this was all in our stock assessments documents but you know, fishermen had also been sampling these areas somewhat surreptitiously and were aware of the very high abundances in these areas and so... it led to a series of... cooperative research, you know, surveys which you know, we played a part in, and I was involved with. It was... pretty exciting work because it was, it became a demonstration of the, or an unequivocal demonstration of the power of the fishing mortality and that if you--

JKW: --and limiting pressure on fish stocks--

PR: --and limiting pressure, right, right and so, if you were to... back off from fishing you could, and do it effectively, as opposed to ineffectively through half-hearted measures or one's easily... you know, circumvented that you could in fact get much larger yield out of the population, but you know, the challenge was that, you know, how do we... allocate this resource, so it's sort of like stop me before I kill again syndrome.

JKW: [laughter]

PR: You need to figure out a way of using this, and I think here--

JKW: -- is that scallops now or?

PR: With scallops yeah, so scallops was the demonstration because, scallops don't move a lot. They do move a little but they disperse and so forth, but in general terms they're not doing any longer term migrations and so... so the full benefit of closure would accrue to those populations

much more so than those species that were regularly traversing the boundaries of these areas and so... there were lots of opportunities to monitor the behavior of the ground fish stocks and in fact, I think Closed Area 1 which is just east of the Great South Channel, a very large and pretty successful fishery were occurring right on the perimeter of the boundary area and so they were like ants around the picnic table, and sort of harvesting fish as they moved in and out of the closed area that became... for haddock for example, it became very big, specialized fishery for these things-- but it...---

JKW: --So was it essentially a message of biodiversity that-- or I guess a lesson of biodiversity that came out of the success of the closed area?

PR: Yeah, and I think it was, right right, I mean I think that you know, it was-- it might be a low... I think that the books are still being written as to whether the biodiversity was a primary benefit and in terms of, okay, you're allowing an alternative set of species that typically don't do well with the sheer force of... a net... kind of lopping them off regularly and things of that sort. So now with that type of... new biotic community that you could support different mix of species but what was clear was that for, rather more simplistic system with scallops and... a sequence of populations that were interconnected... that were the larvae, eggs and larvae could flow between these systems and colonize other areas that you were gaining some benefit from, longer term benefit from that, diversity of habitats that one crew... it was a more complicated issue than simply, for a given set let them grow and then harvesting them at an appropriate time, this was saying that these patches of real estate that were linked by currents were providing the seed that allowed these areas that were not as well protected could have relatively abundant sets and therefore, ultimately made a more stable kind of production system and ---

JKW: --was it very difficult to deliver that message to the fishing community at the time?

PR: Uh, at some point it was um--

JKW:-- what were the challenges inherent in that?

PR: Um, well I think uh, the one was that it was...actual abundance was high but it wasn't quite as high as the fishermen thought so, in one sense people thought wow there there are scallops waist deep on the bottom, we're just skimming the tops off these things but had we... had the opportunity to really harvest them, then we could show a much different overall yield and I think the work that SMAST did with putting the cameras down there and their link with the fishing industry was really an instrumental part of the process they were, you know, by showing them what's on the bottom and then we could-- we had been saying okay look, the densities are... not nearly as great as you think but they're high and certainly harvestable and profitable and all those kinds of things but you can't simply revert to your historic patterns of fishing. You're going to ultimately-- that will crush the resource, kill the golden goose here that you have the opportunity now to work on, so that was one. The management measures and so forth were challenging because we're trying to sort of operate under the radar of sort of the Magnuson-Stevens Act that just said over fishing in and of itself is the primary metric of success. Or not doing that is a success, so... this was kind of saying it matters where you fish and when you fish and that this heterogeneity of fishing mortality across space and across H glasses and all that kind of stuff is an important aspect of management and, certainly an important aspect of yield to fishermen that their, that their pockets will have more money in them if they can figure out a way to share this

resource and so, they developed, largely through an interactive process, the concept of trip limits that were--

JKW: --oh, days at sea?

PR: Well, more so in the sense of within these closed areas it was very easy to basically fill your boat.. ten minute tow could give you 200 bushels... at certain points and areas and these were highly valuable scallops and so they sort of recognized even over short time periods in some of these reopening that those yields were high enough in June but by September they were half as--

JKW: -- tended to depleted

PR: Right and so the depletion was also evident and so, I think because of the act of involvement of fishermen and seeing the cause and the effect that... they sort of said okay, look, we're willing to share, and you had all these issues and the guy with the hundred and twenty foot boat versus the guy that had the sixty foot boat, you know, why should they get the same fraction, obviously this one had paid more for its' investment then the other. So, there were those kinds of conflicts that were... that they ultimately worked out and so essentially they worked out a system where areas that had been closed and subsequently reopened had trip limits where, everybody, sort of like a fairness thing, where everybody gets a shot and then in areas that weren't closed, the so called open areas, they used the days at sea so that the bigger boats could get more than the smaller boats because of their capacity but then we always... a lot of the throttles that... management had put in place were retained so, crew limits were retained. The mesh size or the ring size actually increased as they saw the benefit of leaving a larger population of fish on the -- or scallops on the bottom. So, that was really, I think one of the transformative aspects of management because it involved the fishermen. There was this demonstration that you could generate more abundant resource and certainly more abundant yields by doing it. And it didn't hurt that fact that they had a... a huge... price increase as they were able to increase the product availability and timeliness and all that stuff--

JKW:-- what did the price go up to?

PR: Oh it's a, right now I think it's like 18 or something for U10s at the dock. So the fishermen price was that and so, it's 24, 25 at the supermarkets now versus back in the day a U10 back in 1998, that's a 10 per pound weight scallop was fetching 5.50, 5.60 something like that--

JKW: --really?

PR: Yeah, yeah yeah, yeah, and it's dramatic so you can't do consumer price index or anything like that to explain away those differences. I mean, current dollars it's probably like $7 vs. $18 now a pound so, it became a bit of a highly valued product but I think it was kind of a similar to the striped bass situation in a sense that you know during the period of sort of, low yields and hardship, people's perspective on resource changed, that you recognized that you could get a lot more out of this resource that you couldn't have otherwise and I think... that's kind of a long term lesson that hopefully has some... utility across this species. Now unfortunately, it wasn't realized kind of across the board--

JKW: --yeah I was going to ask you if it bled at all into the ground fish fishery

PR: Yeah no, there were some nascent recoveries that occurred with a number of species, the yellowtail flounder for example, on closed area two, Georges Bank kind of skyrocketed and by...

sorry, I'm trying to think when was it... 19...99? I have to check the dates I can't remember but as a result of the closed areas, they also shot up, because they're a little more sessile then... some of the other stocks. So they--

JKW: --and that didn't last I guess?

PR: It didn't last and so there was a reopening of the fishery, it didn't have nearly as many controls and... the scallop fleet is attend (?) to the two fisheries, you know it's hundreds of vessels whereas the ground fish was near to a thousand or more. So we attend the fishery, and the...the ability to achieve more homogeneity within that group was, it was much more diverse, greater numbers of ports, greater numbers of diversity of vessels, economic concerns and so forth, so it wasn't quite as easy but anyhow the populations went down very quickly and have sort of just bounced around since then and often times at very low levels and so there wasn't any real--

JKW: -- didn't provide the second model... that the scallops did

PR: -- didn't provide the same model. In contrast... the haddock population did respond very well, the Closed Area one was historically a haddock spawning area and because of the aggregation because, probably factors we still don't understand, a series of strong year classes began, 1998 and those allowed for the development of a very strong 2003 year class and then subsequently a number of other strong year classes after that which have led to an explosion of haddock in terms of their overall abundance. Now, the ability to harvest haddock was... was compromised by the fact that they hang out with the wrong crowd and namely cod, and so cod didn't experience this, this increase... for a variety of reasons, one was that their spawning behavior, you know, fidelity to sight, things we now understand about cod reproductive dynamics that were critical as well as they're the ultimate bed hedgers. They stay in bed. They do batch spawning where they don't release their full clutch of eggs. They might mate with multiple males, they extend... the larger fish can extend their breeding period over several months so they're all designed to sort of capture the prime conditions for larval success, early feeding behaviors and all this kind of stuff, early growth by spreading it out over... you know, the environment is unpredictable and you hedge your bets by spreading that risk over a larger period of time and that was-- a lot of that was coupled to large fish and having a sustained population of mature multiple years spawners and so forth. So, that wasn't impossible and certainly was compromised by the fact that if you wanted to allow high fishing mortality rates or commence harvesting on an abundant haddock species, you're going to sort of incure equivalent or higher mortality on the depleted cod population so... the sort of conflict there was one that was not easily resolved with management issues or gear technology--

JKW: --how do you exclude one... without the other

PR: Right, right, exactly and so do you... forego the opportunity to harvest an abundance resource in order to protect a...what has become a more minor species but of course it has the same iconic value as the striped bass in the sense of, of being an important national resource.

JKW: So how is the data? And um the process of data collection sort of evolved from 1993 onto now in the various sources of data?

PR: Oh well... it's... from the data sets that have been, under sort of, for better or worse is called scientific purview in terms of... data collected on research vessels with research scientists and--

JKW: --you mean non NMFS data?

PR: No, our-- the NMFS data collection systems on the Bigelow, on the Albatross, on the Delaware, other platforms that were used. That has continued and improved vastly. I'm sure others that you've interviewed can document the nature and scope of the changes that these, that have occurred over time as you have dedicated acquisition systems on vessels that they improved the quality assurance and ability to link data sets from multiple sensors and things of that sort. All of that stuff has improved greatly... could it have done better? Sure, I mean anything with more resources could probably be better but I think it's a good model for how data needs to be linked and the people involved in that thing have a very strong appreciation for the power of interconnected databases and so forth and that sort of... and at the same time maintaining that attention to detail along the way.

JKW: What about the ways that the data is analyzed? Have those... evolved or?

PR: Oh yeah yeah definitely, I, well, I mean I think the data really do drive the models, the feasible set of models and for much of the history of the ground fish, they swim, say, the mid 70s through the 90s and so forth. These were very intense fisheries that were sort of like whack-a-mole, you know, year--

JKW: [laughter]

PR: -- year class come in, its' abundance becomes evident and across the board fishing intensity increases and they're gone and the next year's class comes in, of a different species perhaps or whatever, but there's a pulsing of, over time I see it riding this rollercoaster of... of, you know, recruits and depletion. The use of A structured data allows you to sort of chronicle this demise of the resources and this was-- the models that were typically used were called virtual population analysis or VPAs and they were valuable in the sense that they... the whole concept was that if you look backward and were able to record the history of removals of a particular species by age group, you could see how many there have had to have been, at least at the start. It was a population that you never really saw, that it was virtual in the same sense of a virtual population in physics. You knew, you saw the decay rates of protons from a... an alpha wave, alpha... particles or whatever Geiger counter or whatever. So you knew how much was there originally by the rate of decay.

JKW: So that was where the otoliths came in for aging and…aging fish--

PR: -- right, otoliths and scales and so forth has-- became a way of doing this. The virtual population analysis was sort of modeled was used in ICES in the... analysis of ground fish populations in Europe and so we had a lot of environment, a lot of, sort of exchange of science and ideas with them, and, because of the data... similar data structures and so forth that this became a primary source of information--

JKW: --for how long have they been in use?

PR: Uh, I guess probably, and since the... mid 60s. They started to develop and underlying theory and elaborate on various ways... the--- you did need to do some special treatments... data analysis for what we call the unconverged part of the population so if you look back from say the... period of 1978 to 1988, for example, that's a 10 to 11 year period, you could see what was caught of a particular cohort and, you didn't see them much after 1989 at all so you pretty much

could say okay, this group of fish was extinguished so to speak-- so we call that a completed cohort. For fish that were in a contemporary population, there might be a mix of say 2005 to 2010 or... recruits to the population and even some of the younger fish were say from 2011 to 2015 or something, as an example... you don't get-- have as nearly as much information about their size because you haven't seen them very much so you have to sort of condition that information based on some other source of data and that primary source of that data was the surveys because that allows you to see the trajectory of the population was overall... and then you could calibrate that so to speak against the information that you were seeing from the removals from the fishery. So, you get some indicator of okay, what's coming down the pipeline? How likely is that to be you know a reliable source of fish in the future. So…

JKW: Sure! We'll pause it for a second.

PR: Okay.

* brief pause *

JKW: Okay, now it's back on so--

PR: Okay, recording? Okay.

JKW: --so we had left off talking about data and stocks assessments and--

PR:-- and various modeling approaches, um so this sort of paradigm of-- or reality of very high fishing mortality rate in retrospect sort of made population assessment process somewhat easier because the models relied very-- a lot less on the assumptions related to unobserved sources of mortality, namely natural mortality and discarding. And so it-- because of... those... data conditions, these... the... untuned or moderately tuned so to speak-- tuned to external data kinds of things, the VPA was really... a good work course for doing assessments. As fishing mortality was decreased through a variety of regulatory measures, you started to have a greater dependence on those other sources of mortality which you either had to infer from--

JKW: -- you mean natural mortality--

PR: -- natural mortality or discard mortality... and again these regulatory measures were also changing that dynamic because you were... having increased discarding of fish because of size limits or catch limits and so forth and since fish don't-- aren't uniformly distributed in time and space and the capture process is stochastic... you had these conditions where often time there would be very large losses of... of fish that were unaccounted for in the process so that's one that's attractable in some sense because you can increase your sampling intensity and so forth and I was involved fairly heavily with a lot of that work in terms of developing a systematic approach for monitoring the resource based on objective standards and... a way of sort of following through with... deployment of observers in subsequent years so there was an optimization process that was embedded in terms of reallocating, in observer coverage to, sort of, meet specific precision targets, so that was... one way of addressing the issue but the, the other issue in which the overall mortality is declining and so now that both fishing mortality and natural mortality were of equal magnitude or in some cases where fishing mortality was less than natural mortality that meant that a lot of the removals were essentially unobserved and only were taken... in some cases fairly weak kinds of... inference so that sort of... okay, population that lives to 20 years old or 30 years old must have a fishing mortality-- or a natural mortality, intrinsic

natural mortality on the order of blank, you know you couldn't get that old and if it was higher, you would last a lot longer if it was lower. So, you see 250 year old quahogs and say okay, that means that they're doing something right over that period and mortality is fairly low, otherwise you wouldn't see that many-- or you'd have to have, you know you walk on the eggs... in order to support a population of that age. So that sort of... --it's more kind of a-- evolutionary kind of argument about what the natural mortality would be and of course that's a pretty strong swallow hard assumption, a lot of stock assessments is...I would say it's like a-- a suppressed gag response because you had to make some pretty strong assumptions along the way of-- about the underlying processes, the quality of the data, you know, how long the time period you use on this stuff so it was, tough. And so it, this-- change, resulted in improvements to the models in some ways, also increased the uncertainty because getting a handle on natural mortality was-- is an extraordinarily difficult kind of thing. It's really an ecosystem kind of consideration, but in order to say--

JKW: -- oh I was going to ask if-- sorry I didn't mean to interrupt you--

PR: -- no no no, it's fine

JKW: -- um but how-- if, the new emphasis on ecosystem based fisheries management, has it all changed how natural mortality is calculated or what the effect is now

PR: --well, I think it has informed it certainly. It provides a... a conceptual paradigm in terms of how we look at the problem. At the end of the day though, if you're going to put them on the same sort of metric as the removals that we estimate from catch that landings plus the estimated discards, you know, we have to sort of try to get them on the same sort of quantification level as that, and so we've made some significant improvements in some species. Herring for example, but, in order to do that, what you need to do is-- in order to quantify the magnitude of removal, the flux if you will, you have to quantify the abundance of the predators, so... in a sense if you have the rate, if you measure the stomach contents of multiple species, you can see on a given day, where they were sampled, this size fish had this much in its' stomach of this species. So, that gives you a rate of consumption but doesn't give you the flux; the flux is the product of the rate times the quantity of fish eating that thing. In order to get the cumulative removals that might occur over a particular time period, you have to multiply those stomach rate contents consumption rates by the number of predators... so that exercise then it really just massively expands the problem of single stock assessment because now the herring assessment depends on estimating the quantities of... monkfish, of dogfish, of cod, of haddock--

JKW: -- I guess everything [chuckling]

PR: -- Everything that's-- an potential consumer as well ones that we don’t have very good quantification of the mammal populations... the large shark populations, the tunas, the-- other things that are making some significant inroads in... bird populations... in many areas. So all of these things-- in order to do that, you massively increase... the uncertainty associated with that... and although these are fascinating, scientific problems and ones that I think everybody involved in the process would just love to drop everything and work on, intensively for a decade, you know--

Both: [laughter]

PR: --at the end of the day, you're approaching November 15th and the council says hey, we need a recommendation on how much to remove here so... you can't stop the world to try to... to... figure out what's going on. You need to make a decision and go forward and so that's... sort of this... the real challenge of the stock assessment process was doing that without... becoming hopeless or feeling that this thing is--

Both: yeah

PR: --So I think... we met the challenge reasonably well, you know, succeed for some stocks but obviously some not as well and, there's always this interplay of science and management and politics and lawsuits and things that tend to make everybody look stupid--

Both: [laughter]

PR: -- sort of a... I don't know... that sort of intersection of ideas and policies and a whole mix... no one comes out smelling sweet, you know, they all kind of look like they're--

JKW: [chuckling]

PR: -- you know, what kind of numskull could-- proposed this or... why do we have such a tumultuous, contentious, system here.

JKW: What resources would really, I guess, lend themselves to the continued integration of ecosystem based stock assessments then and... the old paradigm of single species models?

PR: Yeah, I think... the obvious ones are, of course, are money... increased numbers of people and ship time and ... resources... to acquire new types of data streams... and those... could consume the gross domestic product of the country in terms of--

JKW: [chuckling]

PR:-- the needs to fully understand it and so... I don't know... if there are... conservative metrics or... principles that... organizing paradigns that would allow us to monitor system quality in a way that's a meaningful metric. I think there's a large number of people working on the conservative properties of systems that would allow us to deduce this kind of thing. Probably an explicit recognition that we can't, we don't have the ability to control the system as well as we would like and have the flexibility to...sort of pick and choose the winners which we are effectively doing under the current system and since we're not as intentional about who's the winner and who's the loser... it works in a singular fashion there. The relaxation... of... many of the principles of the Magnuson-Stevens Act are probably essential to do this, but of course that's heretical in many ways because it's like okay, from one policy perspective you need that, sort of hammer to induce--

JKW: --overarching framework--

PR: --yeah, sort of induce the behaviors and so forth. I mean, what has worked in like an unsaved West Coast example works well is the fact that most of the resources are abundant, that the complexity the fisheries are typically lower so you don't have the... all the... don't have as many states, as many senators, as many congressmen involved--

JKW:-- oh the geopolitical... complexity--

PR: -- the geopolitical landscape is simpler, the nature of the fisheries is simpler; you're fishing the North Pacific, there aren't too many classes of boats that'll allow you to fish there successfully in return to dock, so you have to have a big boat.

JKW: The fewer fleet diversity issue…

PR: --right, right, right, and again that's... antithetical to social perspectives on... resource use and so, can we... how do we-- address that issue without... that sort of... all becoming Conagra or sort of one big--

JKW: -- consolidation issues--

PR: --right, right, right, you know that sort of take-off. And those are...-- usually the consequences of societal decisions that are never fully formed, they... have... one group lobs grenades to the other and then they go back and forth for a while and some... partial resolution is determined but... it's not... it's not a synoptic one, and I guess... ultimately, maybe that's an impossible goal to achieve as well. If it's... if it's pure economics and we know what the outcome would be. If it's pure job preservation, we also know that it... ultimately will have a high failure rate... if it doesn't allow for exchange, rebuilding and so forth. I think, maybe you're... ultimately you're sort of, just kind of providing some sideboards or-- on... you got this big herd that you're trying to get from Kansas to Texas or something so [chuckling] you're hoping you're kind of hoping you're directing more or less in the right direction with the appropriate outcome.

JKW: Incremental change..

PR: Yeah, right, right, I think cataclysmic change throughout history has always been, pretty... damaging ... in a lot of different ways.

JKW: I often wonder the extent to which New England's history... going back several hundreds of years opposed to the sort of more recent history of the Pacific Northwest, really kind of effects, and colors the... debate about fisheries and... to the extent to which New England becomes a crisis situation, and meshed always in this... contentious--

PR: --right right, this cauldron

Both: [chuckling]

JKW: --crucible of sorts--

PR: --exactly yeah, so I think history does play a really massive role in terms of... this... expectations... okay... this is the last hunting economy... the--

JKW: Right. The last wild capture--

PR: --right, the free... right the... individual, free to pursue their own agenda, objectives, carry them out, challenge against the--

JKW: -- there's a mythology attached--

PR: -- yeah, yeah, exactly

JKW: --to it a noble ideal almost, that can be taken to extreme heights.

PR: And fishermen, I know a lot of them and... and work with them side by side on cooperative research vessels and... things of that sort and they're incredible, intelligent, perceptive, hard-working people. Society could use a lot more of them, of those skills. They're willing to take risks, to challenge themselves daily, to work beyond normal capacity limits and things of that sort, that you know... are all incredibly valuable traits... you want to sort of have in our population, so forth. This is a productive society but without the... process of true ownership of the resource, it becomes one where there's always this underlying tension between...--

JKW: --the competition--

PR: -- the competition, the productive capacity of the resource and the productive capacity of the fleet... you got to be an equilibrium. Otherwise you're going to have... a need for re-strength on capacity and productive capacity which... the government has spent at least 200 years perfecting measures of inefficiency to impose on the industry--

JKW: [chuckling]

PR: You know, if you can't buy it and sell it, then you've got to make it inefficient in some way. So you've got to restrict the crew limit to 7 on a scallop vessel or you've got to restrict the vessel size, you don't allow the... the Alaskan destroyer to come in and... you know harvest all the herring on the East Coast, you've got to parcel it out to smaller boats. So all those things are... are impediments that... the government imposes in various ways on ... you know, they're best imposed when they're self-imposed. Most effective, if you can have a large subset of the fleet, sort of agree on the set of conditions and agree on conditions that... are effective and fair... or perceived as fair... then you can actually accomplish those things--

JKW: -- which was the principle behind Amendment 16, I guess--

PR: --right, right, right, right, which--

JKW: --where the new output management controls--

PR: --right right, so, you know, there of course the... that was another major data challenge--

JKW: --yeah, quite a watershed moment.

PR: Exactly, right, right, and so, between the simultaneous imposition of reductions and catch with a new management system and economic system, just made--conflated both issues. And, when you brought the Bigelow into the mix, simultaneously, so you're changing the quality of the data streams, so you have kind of a, almost cargo cult mentality that it was the Bigelow--

JKW: -- oh the switch from the Albatross--

PR--the switch from the Albatross to the Bigelow... that's the reason of course... paraphrasing, that... nothing-- everything was great until that vessel came on board.

JKW: So it's easy to be publicly... vilified--

PR: Exactly, right right, right, right, and then you had... challenges of... okay, are the data collected under this system where there are lots of economic incentives to... adjust the data in some way or compromise it. Are they comparable in quality to the... historical data... so that

whole... mix of... simultaneous changes... made... made for... some pretty... challenging... environment... a lot of challenges to the science--

JKW: --well, that was one of my other questions I was going to ask earlier to about, your perspective on the relationship between policy and science and the challenges inherent to... in balancing those two things, not in the sort of... I guess... pure science so to speak--

PR: --exactly yeah yeah, I think, we've touched on those kinds of things... in earlier parts of this discussion but... it's....yeah. The most interesting problems are at that interface... between... the policy and the science because... from the... just... the pure statistical mathematical deductions from, from the models, are fairly simple. Okay, you got to move your fishing mortality from... 0.9 to 0.4, and you can... do that over a period of ... x number of years or you can do it all at once, or you can... have... some.... some risk tolerance associated with that transition and all that. Now all those are... incredibly interesting, statistical mathematical kinds of considerations and ones that you can... do... There's a lot of fun science associated with that kind of, that kind of work that dynamic programing components, optimal trajectories and that kind of stuff but, at the end of the day, you've got to take that and sell it to... often times a hostile audience that... even before you start talking about.... which ways to deal with the thing, they may say I don't believe that there's a problem or that you've characterized anything properly here and that, you know for these things so you're sort of, on your heels--

JKW: -- you're at a fundamental disadvantage there--

PR: --disadvantage there, and you really can't... I mean, you could make attempts and... try to explain the science... in as... best as you possibly can and you know... really need to be sympathetic to their plight. I mean, these aren't irrational humans that you're talking to, these are savvy, smart, intelligent, driven people... that have... a lot of legitimate questions as well as a right to challenge these types of conclusions. So you do have a responsibility as a scientist to sort of take the time to work with them in a variety of ways, and show them, the kind of step by step... path that... we use... to try to... make these conclusions but... you know, also recognize that... along the way... some decision were made and, you know that have some in consequence for these things, there are different ways of interpreting or, trying to understand the data, you know, what you have though is... I mean, somehow you have to develop that level of trust and... and I think--

JKW: --between the government and the public__

PR: --between the government and public. Government... and the fishing community and so forth. We made some progress. Certainly not as much as, you know, we would have liked and everything. And certain things... had consequences for things, I mean, so, the trawl warp issue... erroneously defined as Trawlgate--

JKW: --what was that? When--

PR: --Trawlgate was, it was... it kind of coincide with, sort of a change in... in our perspective on the biological reference points...

JKW:-- what year was this?

PR; This was ... 2000, 2001 and so forth...

JKW: Okay.

PR: It-- during that time period... we were, sort of, fresh off some of the experiences with scallops and you know saying that, these resources have a potential to be vastly more productive then otherwise thought. Striped bass is another example of being evident with haddock of how that population was responding, so that... we were... as a... as a society we were foregoing a lot of yield... by... mismanagement of... overly intense fishing. And, when you're started to look at in terms of what the potential was for these resources it became evident that many of them would be much more productive and achieve levels that were consistent with the historical record which we were fortunate enough to have, um but, so that... challenge or these new reference points that is the target biomasses to which these populations should... be managed toward... were perceived as... moving a goal post. You said we only need 10,000 tons. Now you're saying we've got to go to 30,000 tons and we're the only ones that will bear the consequences of that because we're going to have to not only we thought we were close but now we're going to have to forego additional yield and rebuild to this uncertain future that this paradise, you think you've... found in you're... you're mucking through your data...all this stuff--

JKW: [laughter]

PR: --you've defined this new world that, you know, we're going to have to wait another... few years. Of course that was... not well received but, at the same time, there was... one of the fishermen observed the docking of the Albatross and was looking at the lines associated with the trawls and... and saying that they're not symmetric. That you've got these cables, which you think are pointing out at, say, 200 meters, on each side, where in fact 220 meters on one side and 190 meters on the other side, so the net was going cock-eyed through the water as opposed to perpendicular to the flow of the trajectory of the vessel. So--

JKW: --that was the genesis of the Trawlgate--

PR: -- that was the Trawlgate so yeah, that became known as Trawlgate, I mean it wasn't a criminal activity nor was it corroborating but you know--

JKW: --how long would it take to gain back the confidence of the--

PR: [sighing] I think we probably haven't gained it back--

JKW: [chuckling]

PR: I mean, the... the lead up to the... implementation or the change to the Bigelow it took into account a lot of these factors, I mean it there was--incredible attention to detail of... what the deployment or retrieval protocols would be on the vessel. The acquisition of data, the use of an auto trawl to serve as a mechanism to adjust simultaneously, a compensate for any... changes in the wire... on the... you know, because cable stretches and... and depending on-- there's right hand and left hand threads on wired cable and because of the way it was wired and retrieved, you know, they twist on the pullies and so they can unravel or tighten... so---

JKW: I guess I should have assumed it has similar properties to regular lines, despite being made of metal-- that's interesting--

PR:--right, right, yeah, exactly right, right. I learned a lot about wired cable and its' properties--

Both: [laughter]

PR: -- you know it, how could this be but... it kind of unravels and stretches and all this kind of stuff but, I think, there was a lot in that process that was very positive... for building it but then again, it coincided with different catch rates then the challenge of comparing those two catch rates over those two years and so again, it introduced this... core belief that the government was certainly unaware of what it was doing. You had a bunch of egg-head scientists who didn't fully --

JKW: undermines credibility

PR: undermine--understand the fishing process so how could they possibly make these determinations that effect our livelihood.

JKW: Well, that's a PR nightmare.

PR: Oh, it was!

Both: [laughter]

PR: And it continues to be. And I think it... it's sort of like a...I don't know, a relationship that-- where the... you suppress the tension but it pops up in various times and places and --

JKW: It's always simmering.

PR: --it's always there and it doesn't take too much to scratch the surface to, bring it back to the front and center stage. That was again, a long period of trying to... reestablish some degree of trust with the community. I think, one of the things that the industry did that actually was beneficial was that they hired lawyers... but they also hired scientists to work with us in various ways, and so a lot of those collaborations were... they were--

JKW: --and this was post scallop

PR: -- post scallop yeah. And, we had a similar situation with the clam industry and we're getting some variations in catchability--

JKW: Was this surf clams?

PR: Surf clams and ocean quahogs, yeah. That was in 1994-97. There were some major concerns there-- actually that whole process kind of set the stage for the cooperative work that we did with the industry at-- for scallops in '98 to 2000, early 2000s.

JKW: So I guess, I only had one more real question here, which was going to be how your research interests evolved over your career but I guess, we might have, sort of have touched on that in sort of complete ways as we've moved through the conversation.

PR: Yeah I mean, I've, yeah... I've always had an interest in the mathematical modeling of populations and so, I-- I've tried to exercise that on a number of stocks or provide input collaboratively, working with others, you know, surf clams and quahogs and scallops and ground fish and... squid... and butterfish. I mean, I think I've probably worked on almost every species--

JKW: -- the whole gamut--

PR: --monkfish, and so forth. I was fortunate... either had... I was more likely to have co-responsibility but, I worked closely with someone, it was more of a species and data expert and

then we tried to improve the assessment in some way... I guess, in terms of leading to the Branch Chief position that was kind of, I think a good... set of experiences that allowed me to... do a good... hopefully a reasonable job with that task. It was fun, and I appreciated the opportunity to work with a lot of people, and was able to hire a number of people, the cohort that's there now... and tried to get-- I valued initiative and integrity-- integrity first, initiative. And then, intensity, they're willing to work hard to achieve their goals and weren't afraid to sort of fail. And to always, no matter what, maintain the integrity or work, don't let me or anybody else compromise that by some edict. So I think give them freedom... I was never a micromanager or anything and all that... so it was enjoyable... exercise... a lot of fun. I looked forward to going to work every day.

JKW: [laughter]

PR: Even despite a lot of these controversies so.

JKW: Well, thank you very much for sitting for an oral history today.

PR: Yeah, thank you, I appreciate the opportunity. Thanks a lot, Josh.