Joe Smith: All right. We're here at the Beaufort Lab. It's Tuesday, March 27, [2018] in the morning, and we'll be doing interviews on the menhaden program at the Beaufort Lab. I'm Joe Smith. We're also interviewing with Drs. Doug Vaughan and John Merriner. And also present, Drs. [Ford] Bud Cross, Don Hoss, and Doug Wolfe. And we'll start with some questioning by Bud.

Ford Cross: Well, if each of you, to get the interview started, want to discuss briefly the circuitous route that all of us seem to have followed to end up here at the laboratory and then what you focused on, just for starters, while you were here, would be good. Joe, do you want to start?

JS: Sure. I'll start at VIMS [Virginia Institute of Marine Science] College of William and Mary. I was there. I was John's master's student up at VIMS. My first full-time real job was with the South Carolina Wildlife and Marine Resources Department. I arrived there in April of '79, was on some funding called the Coastal Fisheries Assistance Program, I think it was called, some old Carter Administration money. Then the Reagan administration came in and pulled a lot of the federal money out from underneath the state, so I had rather tenuous funding '80, '81, '82. '81, I started to feel uncomfortable, started looking around, and John had mentioned there were a couple of positions possibly opening up at the Beaufort Lab, one being menhaden. So I applied, and I got – I think it was (Rosa Hill?) who was the personnel officer down in Miami maybe, and I got the letter from her in early '83 and came up to work April 18, 1983, I guess. So I started on the bottom rung port sampling but also inherited some fishery-dependent data collection for the Gulf menhaden fishery then. As the program, through attrition – people retiring or leaving – [I] inherited more and more duties on the fishery-dependent side – data collection, the landings, the effort data, overseeing the port samplers, and the logbook program, which I'd like to get into a little bit later. But that was my route here. Douglas?

Douglas Vaughn: Okay, I'm Douglas Vaughn. I may be – I don't know – a little more circuitous. I started out in math and statistics at New Hampshire and Penn State, went and worked for EPA [Environmental Protection Agency] for a couple of years as a statistician in Virginia. Then I decided to go back to graduate school in oceanography and particularly with Saul Saila in Fisheries, where I actually did part of my dissertation on menhaden, so that introduced me to menhaden. It was funded by the Northeast Utilities in Connecticut. They had a big fish kill in, I think, '70. – in the early '70s, '72 maybe. I was at [the University of] Rhode Island from '73 to '77. So when I finished up my doctorate on menhaden, a dissertation on menhaden, I initially applied both here to Beaufort Lab and to Oak Ridge National Lab [ORNL], where I got the better offer at the time, and I went there and worked for five years. But they were going through a period there at Oak Ridge when they were getting funding cuts on a lot of the power plant work. So there was a chance of a RIF [reduction in force], and I got nervous, and I called around, including to Bill Schaaf, who I had met five years earlier at a conference in Gatlinburg, Tennessee. I've actually had an interview with Bill and Jim Sykes. Dave called me, and I think at least one or two others. So, Ted Rice was interested in not letting me escape a second time and pretty quickly got an offer to come to Beaufort, and I took it. I think Norm Cutshall told my wife before Ted had a chance to pass the word along because my wife worked for Norm. So I came to Beaufort to work on menhaden. There were, at that time, two groups under John Merriner that worked on menhaden. I was going to head up the assessment program,

or population dynamics, I think it was called, along with Bob Chapoton, and that was in December of ’82. And that brought me here.

John Merriner: And he stayed. And Joe stayed.

Douglas Vaughan: And I stayed.

FC: Doug, how long were you at ORNL?

DV: Five years.

FC: Five years. From ’77 to ’82. Yeah. Okay.

JM: Well, I’m John. My route is – I wouldn’t say a circle. It’s a north-south scenario, my familiarity or experience with Beaufort Laboratory dated to grad school at NC [North Carolina] State for my master’s and PhD. I came by virtue of meeting some of the staff here in classes at NC State during graduate school, having a familiarity with them as it was explained to me the work ethic, if you will, at Beaufort Lab and the topics that were being pursued. Subsequently, I did site visits by bringing fishery science classes, which I tutored – or not tutored, but which I was lab advisor for, a TA [teaching assistant], and we came down here every year as part of the dog and pony show that Beaufort Lab put on for the graduate students. At that time, my first exposure was, I guess, ’65, I’ll say, or ’66. Ken Henry was still here as the fisheries [inaudible]. He gave the introductory speech on introductory materials on population dynamics at that time. Subsequently, after graduate – continuing a series of years, graduating from NC State, got a job at the Virginia Institute of Marine Science. At Virginia Institute of Marine Science, I continued – not a direct experience with Beaufort Lab as a site, but as an experience with some of the staff and those that were involved in the menhaden program. Because in Virginia, menhaden is a very large fishery. It is one that the Virginia Institute of Marine Science was very much involved in, in terms of, if you would, liaison between the management entity in the Virginia Marine Resources Commission and the legislature which had the control of the fishery management (part of it?). So as a biologist in fisheries in Virginia, we had a tripartite function of research, advisory, and education. So that wrapped me into the menhaden fishery and an interesting experience. There I gathered an understanding of the resource, of the fishery, the personalities of people involved in both the fishery and the management of it. When a job came open here – it was at that point Jim Sykes’s position – I took an IPA [Intergovernmental Personnel Act], bounced out here for two years on an IPA, and a position became – finally was accepted in as the – I got the job of fishery division chief. At that point, it included menhaden reef fish activities, the whole menhaden program. From there, I was a division chief. Subsequently, the history is [inaudible] as Joe and Doug have related, we proceeded. The interesting part, though, was, I think, at that time, the transition of menhaden fishery from more of a governmental entity in a strong industry tie – because this lab put together data programs and biennial reports actually to the National Fish Meal and Oil Association. That transitioned with the passage of the Atlantic Coastal Fisheries Management Act, which I think is important for a lot of fisheries. Menhaden was a model for that following that. So therein lies my familiarity with Beaufort and how I got here, not circuitous, but a little bit – interesting routes, if you would.

Don Hoss: John, you and Nancy spent a summer here. Two summers?

JM: Yes. No, one. One. Excuse me.

DH: Yeah, I remember we went down to a meeting in Charleston together.

JM: I do remember that.

DH: Or Bears Bluff. But what were you here for the summer for? Just research?

JM: Research. Getting weakfish information from pound nets, haul seines, trawls – life history study, which was my pursuit at that point. I'm basically interested in the biology of fish. That's my interest – and people who go along with it. That's been part of the fun. It's what happens when you graduate in psychology as an undergrad; you're interested in people.

FC: I think in discussing this fish, the species, and this fishery, I think it would be good to just give a summary of the life history and what we're dealing with. I would suggest that we just talk on the North Atlantic, or the Atlantic fishery, in terms of its life history.

JS: Yeah. I guess, go back a step even further, Bud. The program started here at the Beaufort Lab. There were some early investigations in 1952 through '54. The original investigations got their start from – the impetus was from the menhaden industry. The industry wanted some explanations for why there was an abundance of fish one year in one given area and then scarcity of fish in the same area a year or two down the line – these periodic abundances, super abundances, and then dearth of fish. There wasn't a great deal known about the biology, so that '52 through '54 period was investigations on early biology. I think, by then, the scientists at Beaufort realized no one area or state could monitor the fishery or discern the biology because this critter was widespread from Northeast Florida to Maine. So beginning in the latter half of the '50s, the investigation started in earnest and into the biology of the animal.

DH: Who was in charge then, Joe? Do you know?

JS: It would have been Fred June, probably, who was the program manager. Fred hired Charlie Roithmayr. I think Charlie was in charge of collecting the fishery-dependent data on the fishery, the port samples, the landings, and they actually had a logbook program back then. But from those early years, they discern the biology of the animal that these fish migrate north and south; they're stratified by size and age. In the spring and summer, the larger and older fish tend to go farther north. There's a fall migration down the coast. A lot – not all of the fish tend to aggregate off the Virginia-North Carolina capes in the wintertime, hence that North Carolina fall fishery. Then there's a northward move in the spring again. Found out that wherever you find the adults during the years, a certain percentage of those females will be ripe; almost spawn in twelve months of the year – ten to twelve months of the year, but the major spawn probably being in the wintertime when the fish are down in the southern part of the range. However, there's spawning that goes on in the summertime in the Gulf of Maine. The aging – had to work out the aging, decided that the scales were the way to go with a big industrial fishery, where you had to take many, many samples on the order of thousands. So they verified and validated the

scales as good aging parts – the fish. I think, Doug, in the database, we found maybe a dozen or so that were age nine or ten, I think.

DV: There were a few [age] tens. I don't know. At most, half a dozen. Maybe not that many. There were a few [age] nines, and they were all back. Actually, I think in the early '60s, from that big year class. What was that?

JS: '58 or maybe the '52-year class.

DV: Well, I would have been the '52 year class.

DH: That's ten out of how many fish?

JS: Oh, gosh. I'm trying to think of the figures I did for Ethel, who was our ager. She aged three-quarters of a million fish in her forty-plus-year career. So it'd probably be four hundred thousand, maybe five hundred thousand.

JM: That sample size wasn't arrived at just by how many you can hold in both hands either. They did the complete exercise and coming up with the –

JS: They did the statistics early on. The early, I think, *modus operandi* for a sample with dockside from the vessel was: take a hundred fish into a bucket, lay them out in rows of ten, and pick every fifth fish, and the sample was twenty-fish samples. In the early '70s, the statisticians found that there was less variance within a sample versus among the various boats that came in. So the statisticians advised: shrink the sample size down to ten in favor of getting more samples from various boats because the variation among boats was greater than within a vessel sample.

DV: Yeah. There was a two-stage sample.

JS: The fish tend to school by size and age. So that had happened in '71, I think. Then it was, take the bucket of fish from the top of the fish hold and take a random draw from that bucket of ten fish, and then work those up for size and age. Then I'd be remiss if I didn't mention the tagging program, which was used to discern migration routes and get a handle on natural mortality, early estimates of natural mortality. I think between '68 and '74 – they were the real earnest years of heavy-duty tagging. There were over a million fish tagged on the East Coast of the US. These were internal ferromagnetic tags. The juvenile tags were about half an inch long; the adult tags were about an inch long. Again, they weren't external tags; they'd be inserted with a stainless-steel gun magazine of a hundred tags in the gun. The tags were inserted right in the pelvic area, right above the pelvic fin, lie between the body parts and the body wall. Fish would be released. You wouldn't get the actual fish back. But in the fish factory, in the true industrial process, the fish would be reduced to fish meal and oil, and strategically throughout the fish factory were these magnets that would collect everything that was ferrous. So you'd get spent welding rods, pieces, parts of the whole of the fish, but you'd also get the tags. There was this process where every couple of days, the port sampler would go clean the magnets and sift through all the ferrous material, pick out the tags. You didn't get the fish back, but you knew where the fleet was fishing for that given couple of days. So you could discern about where the

fish was recovered. That was maybe one of the largest tagging programs in the United States, I think fisheries-wise, ever. Again, juveniles and adults tagged and so discerned all the migratory routes from there. There were various attempts to look at juvenile abundance surveys, the industry wanting to know a look ahead for the next couple years, what could they look forward to – a robust stock, lean years. So there were some attempts to look at abundance of age zero fish in the estuaries and think there was a brief aerial survey to count schools of juveniles. Then Dean Ahrenholz did a lot with collecting juveniles in the estuaries. He found the most effective gear was that midwater trawl or surface trawl that he used that would fish the top meter of water. So the early efforts were indeed to work out the life history.

DV: I was just going to make one comment about – in the sampling of the fish for age and size, as Joe said, it was taken from the top of the hold. That was to represent the final set made of that trip, which we could then relate back geographically to where it was taken.

JM: That's right. It would be the final set. Yeah.

DV: So, of the two-stage sampling, it wasn't the vessel that was the second stage; it was the set.

FC: I'll ask a question. Didn't that tagging program have an extraordinary high recovery rate compared to most tagging operations that are done, fish tagging in general? Am I remembering that right?

JS: I forget the rates of returns. I wasn't around during that program, but what I remember, which was neat, was we would send – Dean was in charge when I got here of the tagging, and the tagging had dropped back to tagging the juveniles, again, with this emphasis on juvenile abundance. There would be a tagging crew that would leave the Beaufort Lab about late September, October, and they'd start in Riverhead, New York, and they would cast net – Jim Guthrie and Ron Clayton and others would cast net the juveniles, and they would tag them in places like Riverhead, New York, West Creek, New Jersey, numerous creeks in the Chesapeake Bay drainage, and then on down in North Carolina, and then also South Carolina, Georgia, and Fernandina, Florida, they'd wind up in late November. But it was neat. I was sampling the fish factory here in Beaufort. And, of course, we had the magnets in the Beaufort factory. In the fall fishery, usually that the last fish to come down the coast – the adults would come first, and the juveniles would be last around Christmas time. But you could start seeing – through the tag returns at the fish factory, you'd see the fish from Long Island are now. Oh, here we go. Here's the West Creek, New Jersey fish, and then the Chesapeake Bay fish would come out. So you could see it as those juveniles came into the area.

JM: But not part of – specifically at the modern menhaden program. I think there were earlier – ichthyoplankton surveys were done, I think, before I ever got down here, trying to find out where spawning was, where larval eggs and larvae occurred, and that predated the '70s anyway. In the '60, I guess, they were doing – and there were people from here involved in that end, as well. [inaudible] as a kid sampler, they used bongos; they used – what else? – Miller High-Speed. A variety of plankton gear was used to collect eggs and larvae, again, trying to find out where spawning areas were.

DH: John Reintjes had a cruise on the ship out of New Jersey that was doing exactly what you're saying, John. When I came, I got associated with the larval menhaden sampling with Bob Lewis – I think it was – sampling off the old railroad trestle because I was interested in larval fish. And I was just going to ask you guys if you remember that. That, I think, was trying to use larval fish abundance as an indicator of next year's –

JM: Recruitment strength.

DV: Recruitment.

DH: – recruitment thing. Does anybody remember anything? I know you all weren't here.

JM: Well, that was the way it was intended to be used as part of that, and the timing varied. And actually, there's still ongoing work up and down the coast, trying to get samples representative of recruitment pattern and timing and magnitude. Ken –

JS: Ken Able.

JM: Ken Able in Jersey is coordinating with our South Carolina connection down in –

DH: Dennis Allen.

JM: – Dennis down there.

JS: The North Inlet.

JM: At North Inlet.

DH: They're still doing it here, too.

JM: They're still sampling here. So there's still ongoing monitoring, if you would, of larval recruitment, both getting temporal and numeric, if you would, abundance because sampling gear, I think, is – if you want a better word, I'll say – standardized, back to (303?) and standard set times, etc. and times of tide. So, in the sense of the menhaden, trying to get a handle on the R-word, recruitment. There had been egg and larval sampling in defined spawning areas and then larval sampling inshore, trying to find out – does it correlate anything with the abundance then of juveniles in the estuary. Those estuarine collections went for years. Then you can see that in the recruit – we tagged these studies and seen recruitment back into the fishery, all of them geared for a forecasting and a mathematical relationship to forecasting what your class strength would be, thereby forecasting what the fishery might support the following years in and analytically, plugging it into Doug and the analysts – analysts *de jour*, if you would, who were in the system here and in the states that were all participating in part of these studies.

DV: Yeah, in the course of doing the assessments over the years, we were trying to develop recruitment indices from the juvenile sampling, starting with principally the Maryland data and a

few other states, and that got added to over the years up and down the coast. They have a pretty well developed –

JM: Beach seine indices.

DV: – Juvenile index.

JM: Back to Joe – I want to say Pond again. I'm sorry.

JS: Joe (Boone?).

JM: (Boone?). Joe (Boone?) in Maryland. That was developed for striped bass. And then striped bass and menhaden were there. So the indices of a series of fixed stations, multi-year series, and we had it going in Virginia, as well, when I was there.

DV: Yeah, I was trying to – started trying to incorporate it into the assessments. I can't remember if it was the late '80s, early '90s. That just grew over the years. Initially, I was using it as a side assessment, but not a fundamental to the assessment.

JM: That's one of the interesting things, in talking about it – there's where I think a – I'll call it a unique feature, but I think it's one that is a good teaching tool for anyone in the science side of it, to say the menhaden program represents the evolution of a government or a research program that will enable you to try to understand the biology and fishery together. Because I don't think there's a stone left unturned having to do with menhaden that hadn't been turned and many of those stones looking for the magic pearl or lump of gold was turned by staff at Beaufort or spun off of staff at Beaufort, and people doing research spawned the ideas that were mentioned or developed out of the program here. And to me, it's a classic. That's what I loved about it – that end of the piece.

DV: We had to turn some of those stones a couple of times before they produced anything.

FC: So there never was a reliable forecast developed for the fishery in terms of incoming year classes with any statistical validity?

DV: Statistically, they were somewhat weak. There was a lot of uncertainty then, but the more modern assessment techniques and models that take advantage of that uncertainty to produce the assessment results with the uncertainty captured.

JW: There's a signal there, but I'm not sure we've found a bullseye.

DV: Yeah, the noise to signal ratio is not what you would like.

FC: What's the status of the fishery now as compared to back in the '50s when I get the feeling that we were pretty much a service to the industry and trying to help industry, and then it's gone more into management over the years. But how has the fishery changed? And what are some of the causes for it?

JS: The standing joke was, for a while – probably in the ’90s – was that this might be the first fishery stock of Clupeid fish to outlive the fishery. The fishery has just been a story of contraction. Right now, 2018, we’re down to one factory on the East Coast, one company, and three factories on the Gulf Coast – two companies: Omega Protein on the Atlantic and Omega Protein and Daybreak Fisheries on the Gulf Coast. As somebody in industry said, the box gets smaller and smaller. His reference was to the areas in which the menhaden vessels are allowed to fish due to regulation. On the East Coast of the United States, the only state that you can purse seine in for reduction is Virginia. Once the vessels from Reedville, Virginia, leave Virginia waters, they have to fish in the EEZ [exclusive economic zone], beyond three miles.

DW: In what?

JS: In the exclusive economic zone, EEZ.

DW: Thank you. Got it.

JS: There, that narrows down to a three by twelve-mile corridor because the Coast Guard has said these menhaden vessels can’t fish beyond twelve miles because of – I think it had something to do with some separators that they don’t have in their bilge to separate out water from any bilge oil. So the Coast Guard says they’ve got to stay inside of twelve miles so that that box gets smaller.

JM: International waters issue.

JS: But the stock itself is – there was a 2017 stock assessment on the Atlantic. The stock’s not overfished. Overfishing is not occurring. In probably the recent seven or eight years, we see an expansion of the stock in the northern half of its range up into the New England waters, which is kind of the story of the stock since the ’50s. The program here at Beaufort has watched the heyday of the stock when it was really robust in the ’50s, lots of fish up in New England, older fish. The stock contracted in the ’60s. Most of the factories up in the New England states went out of business or closed down. That northernmost factory was in Port Monmouth, New Jersey; that stayed open until ’81. The stock rebounded in the ’70s and ’80s and rebuilt, fish showing up rather abundant in New England again. But in the ’80s, a lot of the factories up in New England, the three or four that were left or reopened, were one by one closed down because they smelled pretty bad and they were located in the downtown waterfront area. They were starting to undergo what I think the sociologists called waterfront gentrification. Stinky old fish factories didn’t mesh with marinas, boutiques, and upscale boatyards.

JM: They didn’t want to eat outside. People didn’t want to eat on the waterfront next to the plant.

DV: Not when you can smell cooking menhaden.

JS: Yes. There was an instance in Maine in the late ’80s, where Maine’s closes its last shoreside factory, I think, in ’88, and they’re faced with a superabundance of menhaden. So they enter into

an internal waters processing agreement through the US State Department with then Soviets to bring in Soviet factory ships inside of state waters inside of three miles. American ships would fish for the – purse seiners would fish for the fish and then offload either onto a run boat or directly onto the Russian factory ship, and the meal and oil were sent back to Mother Russia. So we went through that and then another stock contraction in 2000 or so, late '90s. We may be seeing another stock expansion again. We're seeing a lot of fish up in New England. Some of the bait operations that exist up there have been catching good numbers of fish in recent years.

JW: That was the age of *Riga*, the factory ship, *Riga*.

DV: *Riga*. Yes, that was [inaudible].

FC: Are they both still catching fish and sending them to factory ships?

JS: No, that was a one-time deal, that Russian deal. First, the Soviets, and [after] the fall of the Soviet Union, the Russians continued it; the Russian government continued it to – '93 was the last year they processed. There were two companies up in Maine, Resource Trading – and I forget the name of the other company, Portland Fish or something like that. But they sponsored those. I think there were up to three Russian vessels that came over. The big processors were the *Riga*, the *Johannes Vares*, and the *Duariya*. The American vessels were mostly herring purse seiners from Maine, small vessels, but they would offload onto what they called run boats, some of them, and they'd run the fish out to the Russian factory ship.

DV: That was about when the Connor Brothers up in New Brunswick or Nova Scotia.

JS: Yes. Connors Brothers in New Brunswick got into the action there. They contracted with a couple of American menhaden steamers, actually, that were privately owned. The American vessels would fish in Southern Maine and then run the fish up into the Bay of Fundy to New Brunswick. I think in '92, the Comeau Seafood Company got into that processing fish over in Nova Scotia. So it really was an international fishery there for several years.

DH: Poland was involved in that – not necessarily the menhaden, but they were involved, and they had their research vessels. That's when you could fish – that's before they extended in our waters out to twelve. The research vessel came in here a couple of times.

JM: [inaudible]

JS: All that was probably fueled by the '88 year class. I think we had the feeling that the '88-year class was the best since '58. That fueled those older fish that showed up in Maine through the late '80s. By about '83, that Russian venture was all –

DV: '93.

JS: – '93, that Russian venture was over. The fish kind of petered out. The stock contracted again.

DH: Do you remember in ’58, for example, how many fish factories were here? I can think of four companies, but I think there’s [inaudible]. I know there was Wallace, Standard, Smith, and Beaufort Fisheries.

DV: Four in North Carolina?

JM: No, no. Here in Beaufort.

DH: I’m talking about [inaudible]

DV: Oh, right here in Beaufort.

FC: Carteret County.

DH: I think there’s somebody I’m missing.

JS: There was probably Standard Products in Southport, also. There were a couple of factories down there.

DV: Yes. There’s Standard Products here. There was –

JS: Smith –

DH: Smith, Beaufort Fisheries.

JS: – across Gallants Channel.

DH: Wallace? Isn’t that a –?

JS: Wallace was down at the community college down where the community college is.

JM: Yes. The numbers are detailed in what’s-his-name’s [Steve Goodwin] book and our tech memo thing, the history of the fisheries.

JS: But up and down the coast, there’s twenty-three, twenty-four –

DV: Yes, that sounds about right.

JS: – at the time, from Fernandina, Florida, all the way up to Rockland, Maine.

JM: Now there’s one.

JS: Now there’s one in Reedville, hanging on with seven boats, maybe eight.

JM: One thing I want to mention if I can has to do with the fisheries, where it occurs in the biology. We talked about the biology of the animals, primarily being in the territorial sea. Put it

in a framework of who's water is whose – distance from shore. Zero to three – state jurisdiction, still US water, state has management authority up three miles. Then there's federal from three to twelve – international law, except in certain states, it's different. But Atlantic Seaboard [it's] twelve. Then with the '76 passage of the Magnuson Act, the US claimed economic jurisdiction up to two hundred miles, from three to two hundred. So from three to twelve is still federal waters for fisheries jurisdiction management by the US government. Then outside of twelve, an international thing is still international – was still international fisheries until 1976. So there was, up to that point in time, the rationale of how we got into Beaufort – it was still a national waters jurisdiction thing that we had, and there was a role for the federal government involvement because it went from north to south, more than just one state as we've alluded to for recovery and everything else.

DW: So that means that the factory ships from foreign countries could come within twelve miles.

JM: They could come inside of twelve. Yes. That was the basis of their getting inside of twelve, and why it took a State Department GIFA [Governing International Fishery Agreements].

DW: Until the Magnuson Act passed.

JM: After the Magnuson Act passed. There's a provision in the Magnuson Act that allows foreign governments – called a GIFA, I think it was – a clause that allows them to contract for bringing vessels in to [inaudible] materials harvested by US-flag boats to be offloaded and basically sold.

JS: With State Department approval.

JM: State Department Approval. So it's all this political negotiation. That was the basis of a comment that I made that the State Department ought to consider fish a valuable national commodity, but the State Department never really did. That's part of why we got to where we were up to the Magnuson scenario.

DW: Well, the traditional products of the menhaden fishery has been oil and mainly poultry feed. Maybe you could summarize what the traditional products have been. There's been a transition in recent years over to the bait fishery. And how has that, taking into account, affecting the management of the fishery or the impact on the fishery?

DV: Yeah, when I started doing the assessments in '83, '84, taking over from Dean Ahrenholz, the bait fishery was somewhat inconsequential, maybe five percent of the landings if I vaguely remember correctly. But I'd say by the '90s, certainly by the 2000s, the big fishery – between the decline of the reduction fleet over the '60s and '70s and the increase of bait fishing, and certainly by the 2000s, thirty percent of the landings was bait.

FC: Thirty percent?

DV: Yes. So it was a significant component because I switched over doing my assessments from just doing the catch and age matrix based on the reduction fleet to trying to figure out how to deal with the bait fishery, which was not sampled as well. In fact, we had several AMAC, Atlantic Menhaden Advisory Committee meetings in the late 90s, where we were trying to get more and more states to sample their bait fisheries. I know Joe and I were involved in making recommendations in there as to how they should get samples and start out with Virginia. In fact, our sampler in Virginia was getting samples from the snapper rigs, the bait fishing in Virginia. With Peter Himchek – we worked with him from the state of New Jersey to get samples from New Jersey because those at that time – and maybe still – are the predominant bait fish landings.

JM: So the products you asked about are historically fish meal, which we talked about. We go back to the whole fish and the corncob, right? This is taking the whole fish, cooking it down, then taking the whole fish, cooking it down, drying it, pressing it. Lining up, you get a meal, get the fish meal dried. The exudate that you cooked out, pressed, whatever else – there's a lot of water, oil, and then partially digested protein – solubles. So they get the water out. They skim the oil out – separated. They've got the oil – they got the oil gone. They got the solubles and water. That's why you see a lot of steam from the rest of it. You get the solubles portion of it concentrated. Some of it – they cooked it down and sold solubles separate as a separate product; it went elsewhere usually. Then they came up with an enhanced fish meal, and they put the solubles back on the meal; it became a richer product. All of that came about, I think – primary utility at that point, and the menhaden application came in the least cost formulation and poultry feed. When the blooming of the Georgia and elsewhere – growth in the chicken industry – a need for cheap protein input in the feed mills, cheaper than soybeans. And it was a competitive thing. It couldn't put cottonseed meal because cottonseed meal was poisonous in some aspects – overdosed. So you had fishmeal, oil-enriched fishmeal, which was the solubles added back to it. Then, with the advent of people liking – I'll say people. The Oriental market for surimi – and they had made a cooked fish sausage – Ted Miller at North Carolina Seafood Lab, I'll say, tinkered with – but he was exploring different products. This largely came out of Ted Miller and a liaison of Ted's, who was down in Mississippi who was working the same way in seafood, was a seafood technologist, but he's a chemist. So they developed other products, trying to get sausage to mimic a menhaden fish sausage that they could extrude into tubes, and it would go to the Oriental market.

DV: Yummy,

JM: Number two, they used the oil that was there, and they tried to peddle that as the magic fish oil thing. The use of the oil was in your lip balm, lipstick, lip paint. That was the basic thing for a lot of oil-based paint – (Rust-O-leum) specials. Into other uses of Menhaden from refining fish oil, separating fish oil to get the Omega−3 fatty acid fractions isolated. Then it became a medicinal potential. In the '90s or '80s, they had been petitioning – they [being the] industry. The National Fishermen and Oil Association had been lobbying Congress to get it into FDA [Food and Drug Administration] approval for uses of food. That rationale was required because, say, hey, it's a fish; you ought to be able to eat. Oh, it wasn't considered an agricultural product, so it couldn't be [made] into foods because foods had to be agricultural. They were able to get finally a "generally regarded as safe" consumption of fish oil and some of the Omega products that went into cooking. So you could put them into foods that way, oil (fractions?). And then

they refined again locally through Tyre Lanier and NC State Seafood lab; they developed the surimi ends of extracting menhaden flesh from bone – separating, bleaching, whatever else. Again, they go into the, if you would, what is now Van Camp crab legs and this kind of stuff. It can be extruded with a red stripe down under; it becomes king crab legs. This got to be a problem, however, because it always retained a slightly gray cast. So they didn't get it into crab leg, didn't get it into pseudo shrimp, didn't get it into pseudo scallops. But that's a product [inaudible]. So today, they still put their oil in anything that can get the marketers to accept the cookers, bakers, candlestick makers to use. The meal is still there. Oil is still there. Solubles are right back on. Specialties modified for aquaculture had been the vogue for a period of years. Specialties modified for the home gardener [inaudible] it's a super elixir that goes on your houseplants.

DH: I can attest to its quality in my home gardening all through the '80s, '90s.

DW: Oh, you can, huh?

JM: Any number of things. But there is one interesting quip relative to product development that was relayed to me in the '70s and '80s. I guess I was here in the '80s. And that came [inaudible] the Fernandina plant, and there's a (cute?) book on Fernandina plant by Earl Conrad – [Gulfstream North]. And that's a (cute?) book about menhaden fishing and sociology, and that's when [inaudible] is the fish – is the pig ready yet? But had to do with Fernandina. It had one or two boats was all the fishing – little tiny plant located just down the hill from a large pulp and paper plant, sulfite process. You know what the sulfite process smells like when you went through New Bern all the time. The local people said – I was there to see the owner of the company on a southern leg trip and asked people where the menhaden plant was. "Oh, the stink plant?" "How can you tell?" "Well, you go until you come to the pulp plant, and the smell is even stronger. So you go down here until you find the stink plant." That is back to the gentrification of the coast scenario that Joe was alluding. There are all kinds of stories like that that have happened. You used it for – again, back to the agricultural and home gardener, lawn application, this type of thing for enhancing meals and stuff.

JS: Probably, the meal now – I'll bet ninety percent of the meal now goes into fish feeds, salmonids feeds, for these –

DV: Aquaculture.

JS: For aquaculture – these pen-reared ranch salmon farms – Pacific Northwest, Canadian Maritimes. In fact, Omega Protein was just bought out this winter by Cooke Seafood, who's out of New Brunswick, Canada, that has a lot of pen-rearing operations up in the Canadian Maritimes. So they're probably looking to vertically integrate to catch the fish meal – catch their fish, produce their meal, and mill their own feeds.

JM: If we get into offshore aquaculture in the South Atlantic, the Gulf meal will probably come around and be active in that [inaudible].

FC: One of the things – there's been both fishery-dependent and fishery-independent work done here, menhaden and other estuarine-dependent fish. But there's also an aspect of it that involves the laboratory and spawning and rearing. Don, do you want to summarize what you guys, over the years, have done in that respect? What you've learned?

DH: I got an interesting little side point I'll throw in here, [which] is that early in my career, I was holding some menhaden and battery charge, they use to call it – some larvae, real small. I was holding them in there. I forgot about one or two charge. At that time, there was one train of thought that menhaden had to be in the estuary to juveniles. In other words, they couldn't do it and pull the saltwater. Well, I forgot about these jars. I don't know what [inaudible] got to. You could look it up. But it may have gotten as high as forty. My larvae transformed into juveniles. But Jim Sykes took that and put it in a publication he was doing with somebody at that point. It mentions in there that this little accident – it mentions it like it had been planned. Well, it hadn't been planned. It was one of those accidental science –

FC: Did he give you credit?

DH: Yes, yes.

FC: Good.

JM: Serendipitous.

DH: Credit or discredit because I don't know how people took that.

DW: Limits. We always were looking for limits, then.

DH: Yes. I'm not part of that program, but menhaden was a big part of my life here, and juvenile studies and SABRE [South Atlantic Bight Recruitment Experiment] program and all those. We did find out a lot about the eggs. Bill Hettler was a leader. I think he was the first to spawn eggs in the lab. I spawned two hatch eggs in the lab. I think it was actually Gulf menhaden. Anyway, we got all that early life history development, and more and more work was done on approximately where they spawned offshore. My work and several other people's ended up working on the oceanography. How do these things get from where they spawn inside? Because they certainly don't swim all the way right at first. That was a big part of SABRE. I don't think the question was necessarily answered, but we certainly had some ideas. The physical oceanographers came up with an idea. Of course, water is coming onshore. Well, it's got to get back, or else we'd be way underwater right now. So they developed, some of them, a three-layer system, where top water came in, middle water went off, and that created a pattern. Well, then you'd say, well, why weren't they carried back? So we had to have a third layer. If they dropped down to the – they could stay in. None of that, I don't think, is written as really the absolute answer. But I haven't kept up with it recently.

DV: Yes, Bill Schaaf, in a paper of his back in, I think, '76, made an attempt to look at the relationship between menhaden recruitment and Ekman transport, an index that he had developed of that.

DW: Walter Nelson. It was his thesis. [inaudible]

DV: Walter might have been [inaudible] –

FC: [inaudible] Nelson, [Merton] Ingham, and Schaaf.

DV: Yes, I think it was actually Nelson.

FC: I think it was mostly Walter's dissertation.

DV: Unfortunately, Bill took a later look at it while I was here before he retired. With more years of data, the statistical significance fell apart.

DH: I think the Ekman fell down. But there's still the guy – Len Petrafesa. (Len's) the last one that I dealt with because that's when I was still working. He had this three-layer – but they're just rough models of this. There has to be a way they're getting in. It's important because if you decide to jetty an inlet, you could prevent them from coming in. There's only three or four inlets that are still working in the state. So it was an interesting thing. We got food, growth – a lot of larval work was done on the menhaden in conjunction with the menhaden program early on.

DV: Actually, in connection with SABRE, Stan Warlen and I –

DH: SABRE was – we aged them. The chief fish in SABRE was picked to be menhaden. The reason it was picked to be menhaden – we knew we could always collect them. You didn't want to pick some fish you can't find half the time.

FC: Excuse me. What did SABRE stand for?

DH: South Atlantic Bight Recruitment Experiment.

FC: It was interagency?

DH: Yes, it was NOAA [National Oceanic and Atmospheric Administration] led. I got the honor of being the NOAA lead, but it had about five or more universities involved.

DV: At least Duke.

DH: It had NC State, Duke, Miami, and Chapel Hill. I know it had that many. I believe there was one in –?

JM: Was Georgia involved?

DH: What?

JM: Was Georgia involved or not? [inaudible]

DH: Yes, a little bit. What's his name? Your friend, your oceanographer friend.

FC: Jack Blanton.

JM: Blanton, yes.

DH: Yes. But also, Chesapeake Bay had a touch, too. Somebody out there.

M: Could have been [inaudible].

DH: It was a program that used menhaden as a tool because it was so easily found. You can find larval menhaden. You won't always find larval tuna. Even though that was a big, exciting one for the press, menhaden was much better for the scientists.

DV: Yes.

JM: [inaudible]

FC: It has always been where do they spawn? We never sit on spawning fish. I remember John Reintjes talking about that back in the '60s. You guys did sit on some spawning fish, didn't you? Or get some very early larvae or eggs?

DH: The main thing is we learned how fast the eggs hatch. So if we caught an egg, we knew it hadn't been there more than a day almost, maybe two. So we knew – or yes, the people doing it knew that –

JM: That led to the daily [inaudible] application of daily agents.

DH: Just having the eggs and having larvae, you knew you were in the right place.

JM: Actually, you got Beaufort Lab and Bill Hettler's production of larval menhaden or menhaden eggs, and larvae became my source for distribution of them to other research programs.

M: Yes, that's right.

DH: Once he [inaudible] spawn, then we didn't necessarily have to go collect larvae or eggs. We could tell him on this date we want some larvae, and he would give us larvae on that date. That was very handy.

DW: So I think you could summarize that this lab has had a major impact on both fishery-dependent management activities relative to menhaden and fishery-independent to understand their role ecologically in the system, too. The other thing that came out of the lab was the, actually, feeding of menhaden in terms of what they feed on. There was [inaudible] and the student in –

DV: Kevin Friedland –

DW: Friedland, yes.

DV: – working with Dean Ahrenholz.

DW: They published in some – major strides with that fishery and that fish have really been made. Its ecological focus in the Chesapeake Bay is pretty interesting because they're trying, I guess, to keep the population high enough to feed striped bass and other predators in the bay, but I'm not sure they know that much about the system yet.

DH: I can't think of – I'm sure salmon and a couple of others. But I doubt if there's any fishery better than one, really.

FC: There's a fellow out from Texas that was really active in fisheries management, and I can't remember his name. You guys would know. He said there's two animals in this world that we already know too much about – white-tailed deer and menhaden.

JM: First name is Gary.

FC: No, it wasn't him.

DV: Not Gary?

JS: A different Texan.

FC: I can't remember his name now. You'd remember him.

DH: There was really pioneering stuff done in the way, developing nets for sampling, developing how to sample, where to sample, the statistics people would – or numbers crunchers. I think it's been a leader in a lot of ways, not just for the industry, but for science in general because there were a lot of them to work on.

JM: Menhaden program, and if you went back to ICES [International Council for the Exploration of the Sea] – ICES was going on as some of the other monitoring things began going. New England had some other things going on because they had the drag it and bag it survey for juvenile abundance forever.

(DW?): How about MARMAP [Marine Resources Monitoring, Assessment and Prediction]?

JM: Yes, MARMAP came along. It wasn't predating stuff. But ICES, MARMAP – MARMAP was somewhat tied to ICES and US role in ICES, trying to get recruitment indices for demersal fish stocks. They weren't looking at pelagic fish stocks. But that planted the seeds in the rest of the fish folk. They did have larval collections, ichthyoplankton collections, under MARMAP.

DV: Some of that data was used –

JM: Under ICES, they had that – ichthyoplankton. That got into plugging them into analytical tools, again, looking at multi-stage VPA [Virtual Population Analysis], and they had Dr. (Matrix?), and here we go, we have this [inaudible].

DV: Right. We did have our multi-species VPA that was developed through ASMFC [Atlantic States Marine Fisheries Commission].

DW: My impression is that the Bureau of Commercial Fisheries [BCF] had a disjunct effort that was scattered around on the East Coast, looking at various aspects of fisheries life history and distribution. Sometime around the late '50s, or the beginning of the '60s, they realized how disjunct that was and decided they really ought to have a menhaden program. That really led to the establishment of the menhaden program here at Beaufort, I think. Was it a lot of effort going on up in the Northeast?

JM: I think a lot of effort that's going on in any federal laboratory. They were studying local – doing their local farming. What's the water body near me? Because they didn't have an offshore boat. They didn't have an oceanographic program related. They were sampling nearby, and their interests of BCF were at that time: what are the fisheries of our area in the Southeast? You had Brunswick here. Then you got into the Chesapeake Bay.

JS: Indian River, Delaware.

JM: Indian River, Delaware.

JS: (Tony Pacheco?)

JM: You had a variety of federal labs, but they specialized in what it was they were working on. Here, it goes back to blue crab, turtles –

FC: When did John Reintjes come to the laboratory? Why did John Reintjes come?

JM: Good question. I thought he was larval fish.

DH: You should have asked me that yesterday [inaudible].

JS: Was he in the –?

JM: [inaudible] up here.

DW: I think he came before the establishment of the menhaden program.

JS: Yes, because he –

DH: I think it started in about '52.

JS: Because he and Fred June had hired Charlie Roithmayr, who came in ’55. So they were here before ’55.

DH: He was there before ’58 for sure.

DW: I don’t think their focus was on menhaden, though.

JM: Well, he came out of the TABL [Tropical Atlantic Biological Laboratory] lab. He came out of the Tropical Atlantic tuna lab. Did he come out of Miami? Hawaii?

DW: I think part of our striped bass program.

JM: Hawaii is where he came out of, right?

DW: Yes.

DH: John’s getting there. He may have come from Hawaii.

JM: Yes, he did. He was in Hawaii.

DH: Because he came out of the Navy – ended up in Hawaii because he always wore Hawaiian shirts the first few years.

JM: Well, anytime he felt like wearing them, he would – Hawaiian print.

JS: I interviewed Charlie Roithmayr a number of years ago. Charlie passed away last year. But he told me that '52 to '54 era, when they were feeling around, trying to figure out what was going on with the menhaden population. There was going to be a menhaden program somewhere. It was initially going to be put up in Reedville, Virginia; that's where the industry wanted it. But Charlie told me that our very own [W.H.] “Piggy” Potter here in Beaufort put his foot down, went to the whoever the Congressman was at the time –

JM: Sam.

JS: – and said, “We want it here in Beaufort,” and that’s how it wound up in Beaufort.

DH: [inaudible]

JS: Was Piggy Potter.

DV: Our formal database for menhaden starts in ’55.

JS: Yes.

FC: In the Atlantic.

DV: Preliminary, mostly regional sampling, ’52 to ’54.

FC: Really?

DV: So there was something on.

JM: When was Sam Ervin in office? Our younger Republican House member now.

DH: Certainly something going on ’58. The reason you mentioned the spot – Bud, I think it was you [who] mentioned haphazard sampling as seen in some cases offshore. Well, that’s because those were exploratory fishing vessels; the *Oregon II* was built to look for new fisheries.

DW: That’s right.

DH: They were off Africa, South America. That’s where the director collected all the tropical fish, and he brought it back for his home. They were built for that. So it was spotty. It was somebody saying, “There might be fish over there.”

DW: That’s what Harvey Bullis did. He was one of them.

DH: Yes, Harvey Bullis – Miami.

JM: Finding the underutilized resources of the world, so we’re able to send our fleet there.

FC: Wasn’t the first stock assessment of menhaden done by Schaaf and [Gene] Huntsman in the early ’70s? Was that the first one?

DV: I saw that when I was a graduate student at Rhode Island, which is what I was looking at when I started on my dissertation.

FC: I remember when they tried to publish it because the menhaden industry – I was in Washington, DC, doing the mercury issues in the early ’70s – in ’71, early ’71. There were menhaden people there all the time coming by to talk. They were very powerful. I remember that people in NMFS [National Marine Fisheries Service] – yes, by NMFS by then – were very, very reticent about allowing us to use the term “overfishing” in the publication. I remember there was a back and forth between here and there about what’s going to – and I can’t remember what was resolved in it, but the assessments have gone a long way since then. But I think that was the first assessment.

DV: I think you’re right. Of course, overfishing at that time was a pretty ill-defined term.

FC: Well, it [inaudible] but menhaden didn’t want it associated with their industry, either. They were really pushing back hard on that paper.

JS: They were years when the stock had contracted, and landings were down. They were coming off the '50s, the boom years. One word about assessments – Doug and I used to joke. When I got here, Doug was doing the VPAs, the virtual population analyses. We'd joke that the fishery was over about early February, certainly by late January. I'd get all the data, the fishery-dependent data, straight. I'd hand it to Doug about March 1st; it was nice and clean. He would go into his office during the month of March. April 1st, he'd come out with a VPA. It took a total of twenty-eight days or so, twenty-nine days. Where we've come is – one of the most recent assessments I was associated with was SEDAR 40 [Southeast Data, Assessment & Review], it's called, where they've used a forward projection model. Amy Schueller has inherited Doug's tasks of doing the assessment. We started, and it was an eighteen-month process to do the most recent assessment. This next one is coming up for 2019, the benchmark assessment they've started now. So it will be a two-year process.

DV: There's a lot more data that goes into the assessments now. When I did those first few, I was following on the path of Dean Ahrenholz. As I say, we were doing a simple virtual population analysis with just the reduction and life history data, growth, size, and age information. It had a lot of simplifying assumptions in it, but that could be done in a month. Actually, it could be done in a week, and then three weeks to check over and make sure you haven't screwed up. That was done [by] running a bunch of Fortran programs at that time in the early '80s or mid-'80s. Then, as time went by, we were including the bait data. We were including fishery-independent data. Then you get into these forward projection models. There's a lot more to consider, a lot more cleaning up of the data.

JM: Where were stock assessments in the '70s? What were the tools being used as stock assessment?

DV: In the '70s, and that was before I came here, that was primarily VPAs, and there were a couple of – there was a separable VPA that had been developed in the mid-'70s that brought a little bit of statistical analysis to it. But it's still basically working with the catch and age matrix.

JM: Menhaden was at – in a sense, the analyses for assessing the stock status were at the level of modeling technology that was widely used in the US fisheries assessments.

DV: At that time, yes. Then, during the '80s and '90s, there was a huge development in the complexity of the models to combine both the fishery-dependent and the fishery-independent data into a single model.

JM: The IBM 360 went away. Computing power came down to desk and [inaudible] capacity. [laughter]

DV: Yes, in the mid-'80s, we went from using the IBM 360 or equivalent. Actually, we were using whatever it was that they had out in Seattle there in the mid-'80s to run Fortran programs. By '86, '87, we actually had personal computers here. Within a year or two, it had SAS [Statistical Analysis System] programs and other things that we could run on the laptops that, in some respects, were far more powerful than what we could do on those mainframes.

JM: It's like the number girls sending the – the movie [*Hidden Figures*] that was out about the ladies up at Langley, who did the calculations on their slipsticks and the moonshots.

DV: Back in the '40s, computers were women who did the calculations on the old Monroe and Marchant desk calculators.

JM: There was one other data type we haven't mentioned, and I think it's figured largely in and maintains a close tie between Beaufort and the industry, and that is the confidential data of captains' daily fishing reports. They were developed on the Atlantic Seaboard and the Gulf so that you had set by set estimates of what the catches were because the sets are pooled from wherever the boat was that day or three days or whatever it was for them to get a load. You have each set [inaudible] –

DV: That relates, again, back to that sampling of the top set of the hold. You're assuming that the sets are random. They're not. You could correct for that with this captain's daily fishing report data.

FC: Are they still being collected?

JS: Yes. That was one of the datasets I was most proud of being associated with. I think, back in the '50s, they actually tried logbook programs. Charlie Roithmayr has a technical report on it, but they could only get them on about half of the vessels. So they made some assumptions about the rest of the fleet and where they were fishing and fishing effort. But it went by the wayside. Then, in the late '70s, the old AMAC [Atlantic Menhaden Advisory Committee] committee wanted a better handle on catch and effort. So each individual boat would get this daily form, and they'd enumerate where they caught the fish, a line item for each set, how many fish, [and] where they caught them. But they laid in file cabinets, pretty much, until about 1992. At John's prodding and cajoling, we wrote a proposal to get some money to get a PC [personal computer] or two and some time for key entry – to go back and key enter the historical logbooks, and then keep up with the incoming ones.

DV: I made a brief attempt in the mid-'80s with Mitch Landen to get some of them, but we could never get in enough of it.

JS: I think it was Pioneer Fund money we got. In the person of Sharon Sechler, she was one of the main persons that did the key entry for us. As the new ones would come in, she'd key them, and then we went back as far as '85. So at least for the Virginia and North Carolina fleets, we have just about every purse seine set made – '85 right through 2017. I forget which year we got the optical scanner, but now that we worked with the industry and we both agreed on a new scanning form, we just run them through the optical scanner now.

DV: That's beautiful.

JS: Got away from the key entry probably about ten years ago. I'm told that the captains don't get paid unless they go up to the office on Friday and hand in five of those captain daily reports to the office person, and then they're sent down to Beaufort.

FC: Are they being used?

JS: Yes. Like Doug said, we use them on the Atlantic Coast to adjust for some of the vessels topping off. For instance, a vessel would go up to Cape May, New Jersey, and catch larger and older fish. On the way back, they might make a set in Chesapeake Bay. So your sample goes to the boat. On the top of the fish hold, the last set are these smaller, younger fish. But we know about 90% of the fish were older from New Jersey. So we use the captain's dailys to adjust for that mismatch of fish on top.

DV: In some years, it could make a fairly big difference. I don't think it ever much of an issue on the Gulf, though.

JS: They were good for managerial issues because there's a distance from shore. The old forms had an estimate of miles from shore since probably 2004, so we got GPS [Global Positioning System] numbers. So when a local municipality or state wants to move menhaden fishing X-number of miles offshore, they were very helpful in finding out how many fish were caught in this corridor, by distance from shore – that kind of thing. Very helpful managerial-wise.

FC: What do you think about the future of menhaden? I would assume that the fishery-dependent work will continue here. Is that the plan and that the assessments will continue to be done? That's essentially what will be done, except for any independent fishery or independent research that might come along. Is that your view?

JS: I think one of the former administrators for the National Marine Fisheries Service went on record as saying the menhaden program shall stay here. It's now in the personage of Amy Schueller, who inherited Doug's task of leading the program here and being the lead stock assessment person. Funding has always been an issue, though.

DV: Even for as small as the program is?

JS: Yes.

FC: You have states –? Well, you only average – your samples are only coming on the Atlantic out of Virginia now, aren't they?

JS: We have a full-time port sampler up there, Bradley Obier. We've been fortunate up there to have good long-term samplers. Before him, it was Bert Jett. Bert was there for years, sampling in Reedville. Then we had Rosalie Coultrip. Then hired Bradley Obier in 1990 or '91, and he's been up there ever since.

JM: Local boy.

JS: Local guy.

JM: That's important.

DH: How far do those boats work out of? Do they come off our coast now?

JS: They don't. Because in 2012, North Carolina prohibited menhaden purse seining for reduction within three miles in their state waters. So if they come down in the fall to fish, they've got to stay beyond three miles. In the fall, most of those fish hug the coast.

DH: They're refrigerated now.

JS: Yes, everything's refrigerated. Part of the fishery we didn't talk about was the Gulf fisheries. Refrigeration evolved in the '60s. That Gulf fishery developed. In '64, the early '60s, [we] realized that fishery was growing, and the program here got into sampling the Gulf fishery. So the dataset for the Gulf fishery starts in '64 and is continuous ever since.

FC: Are you getting samples of the bait fishery?

JS: Yes. Like Doug mentioned earlier, in some of those assessments in the '90s, we realized we were missing this facet of the fishery landings and samples-wise, so we made a concerted effort in the early '90s to go after samples from the bait fishery. Most of those came from state biologists, state port samplers. However, Bradley up in Reedville was uniquely located to also sample. There were several Virginia operations that were a major part of the bait fishery on the East Coast. That's a whole different topic, that big fishery and where the bait goes. I tell the story – I was ready to cross that little canal in Cameron, Louisiana, to get to the Cameron fish factory. I'm waiting there, and off of the ferry that you have to take is an eighteen-wheeler from Virginia with "Bevans Seafood. Kinsale, Virginia." I know exactly what he was doing. He was hauling bait down there to the crawfish fishermen and blue crabbers on the Gulf Coast, and he was hauling shrimp back to Virginia. But that's how far the bait goes.

DV: And yet, the bait fishery in the Gulf was never – at least while I was still doing it – never much more than one percent of the total landings, compared to the reduction fishery. It may just be that the reduction fishery was so much bigger on the Gulf than the Atlantic.

FC: Don, I've been through the list. If you or Doug have any questions.

JM: You said, were the menhadens going to continue here. I'd say yes, as long as positions and Beaufort Lab and the federal funders would be there, in that it has a historical recognition. Politically, I think it has the support of this state. Particularly, I think it has the support of the Virginia House and Senate members, I'm pretty sure.

DW: Ever since the Magnuson was passed, the pressure's been on to deemphasize menhaden.

DV: Certainly, a certain center director that I sat down with in his office in Miami at the time said, "Are you guys still doing menhaden work?" This was in the mid-'80s.

JM: Bill Fox worked me over.

DV: That was the person I had in mind.

FC: I think Barry and – never mind. I can't remember – the last guy after Barry.

JM: Brad.

FC: Who?

JM: Brad.

JS: Brad Brown.

FC: Brad Brown. But what has brought the menhaden back in terms of as a priority fishery again for management is the ASMFC regulations because now menhaden is under ASMFC, and the regulations that are passed have to be obeyed. They can't do that without at least fishery-dependent data. So I think the creation of the regulatory power in ASMFC is going to really continue to require this program to continue.

DV: That leaves the Gulf, though, on somewhat more tenuous grounds.

FC: Well, the Fisheries Management Council –

JM: [inaudible] the Gulf States menhaden plan exists as well is the question. It's cheaper for them to contribute up here unless the Gulf people – council and/or governmental entities get a wild burr [inaudible] Beaufort Lab or about NMFS in general or NOAA in general, and want to be on the high horse and be stomping on the table with a shoe.

JS: In recent years, the Gulf states – Louisiana and Mississippi – have stepped up to the plate and have either partially or fully funded port sampling efforts down there at the three ports on the Gulf Coast.

FC: Then ship them up here?

JS: The data gets shipped up here. It gets processed –

FC: They're actually reading them?

JS: Well, they're processing the fish for size and age and shipping the scales up here.

DH: You guys used to go – the menhaden barons would have a meeting all the time.

JM: National Fish Meal and Oil.

DH: You guys would go and make presentations. I was drug in once, and I have no idea why, but I didn't enjoy it. What kind of things were you presenting to the Fish Meal & Oil? Were you listeners or presenters?

JM: Presenters is the standard thing. Biannual reports to the National Fish Meal & Oil Association were done. It was basically the status of catch, age comp.

DV: Have we done that since the ’80s?

JS: Well, Fish Meal and Oil is no more. There’s so few entities –

JM: No, it’s gone away.

DH: Has it been that long?

JS: Yes. They’ve dissolved. They were under the umbrella of the National Fisheries Institute, NFI, and they’re just so few entities; it just went away. But the big thing that used to come out in that meeting – it was a spring meeting – was the forecast. We talked about forecasting earlier from fishery-independent data. But our forecasts – and I inherited it from Bob Chapoton and Bill Nicholson. It started in ’74 at the behest of the industry. They wanted to know what their landings might be in the upcoming year. It was a simple multiple regression based on historical catch and effort of the fishery. Then we’d pole the industry in January or February – how many vessels were going to be in the fleet this coming year? We’d look at the track record of those vessels in recent years, and we’d come up with an estimate for the upcoming year of effort, plug that into the multiple regression. It would spit out an estimate with some confidence intervals of landings for the upcoming year. On any given year, there could be a wide error, but on average, over that – my last year producing it was 2015. I think that forty-year stretch, on average, there was about a thirteen percent difference. I was told the industry would take our forecast and go to the bank for their loans for that upcoming fishing year, show that to their banker, and say, “Here, this is what we’re going to catch, plus or minus something.”

DV: Peter Hanson and I did – I’m trying to think of the guy from NC State.

JS: You worked with those neural networks.

DV: Our friend from NC State did the neural network. We also did the multiple regression technique that has been used here for millennia – also time series analysis. Actually, the simple model we were using did it at least as well as the other.

JM: Reminds me of the KISS [keep it simple, stupid] topic.

DV: Yeah, the KISS principle suggests we’re doing just fine the way we were.

DH: I just have one last question. Is there any way to look up to see what was the maximum number of boats fishing out of Beaufort at a given year? Is there any –?

JS: It’s in one of the –

DH: It’s hard to know that because –

JM: It's in the Tech Memo.

DH: – I tell these stories. I'm sure I'm lying.

JS: Yes, it's in one of our tech reports, the one I did.

JM: [inaudible]

DV: We had a historical tech –

JS: By port, number of vessels. I can dig it out for you.

DH: I'd like to know what the max was. I remember them in 3D, but I don't know how far [inaudible].

JM: Fishing out of Beaufort?

DH: How many boats fished out of Beaufort at the maximum.

DW: Fall fishery.

JM: In the fall fishery?

JS: We'd be fall fishery because –

JM: Be fall fishery, yeah.

JS: – they'd come from all over, even the Gulf Coast.

FC: I think it's good to get on record, too, that the fisheries division put together a whole book –

DV: *Marine Fisheries Review* [MFR].

FC: *Marine Fisheries Review* – the entire publication is dedicated to menhaden. A lot of that information will never change. So it's good for people to realize that that is out there.

DV: Joe and I did a couple of papers, manuscripts that weren't published formally, the grey literature for the stock assessments. The last couple that I was involved with before I retired. They were the history of the landings and a couple of other topics which elude me right now.

JM: The MFR came out in the '90s, right?

JS: 1991, yes.

DW: What was the approximate date of that MFR issue?

JS: 1991, *Marine Fisheries Review*. The whole thing was dedicated to menhaden.

DW: Is that on the publication's list, I assume?

M: Yes.

M: Yes.

JS: Should be.

M: It is.

DV: It is. I had a couple of papers in there. I think I had one with John and one with Joe.

JM: There's some good photos in there [inaudible].

DV: One with myself.

JS: One comment –

DW: Has to be on my list already. [laughter]

DV: It should be.

JS: One comment about the program at Beaufort's relationship with the industry. We've always had a pretty good relationship. I tell people the industry realized a long time ago, before a lot of these fisheries – they realized that they were going to be managed, and they wanted to be managed by good data versus no data or bad data. So they were always very forthcoming to me with their landings, the catch and effort information, always provided access to the vessels for our port samplers, and religiously gave us those captain daily fishing reports, the logbooks. I tell this one little story about our port sampler in Reedsville is actually housed on the ground of the fish factory at Reedsville in their old office building, right at the foot of the property there. If Brad – he's on the second floor – looks out one window, he can see the boats coming down Cockrell's Creek as they make their turn into the creek. The other window, he looks right at the dock to see the boats unloading. He's got a little wet lab there, and they give it to us *gratis* – Omega Protein does. I got wind of a plan by Omega; they were going to bulldoze that building about three or four years ago. I was scratching my head, saying, "What are we going to do for accommodations now?" I talked to the plant manager, and he says, "Don't worry, we've got the blueprints for the new building. It's going to be on the old footprint. We've already written in the plans a wet lab for your sampling."

DV: Yes, I think back to when I first came here with Bob Chapoton. I know Bob had expressed that – I guess there had been some tense moments there in the late '70s, beginning of the '80s with the industry. I know he worked very hard, working with the industry to gain their trust. But it made me also think of another incident when I came here, in December of '82, he wanted me

to go visit the Standard Products lab. He said, "It'll help give you credibility." He was absolutely correct because a couple of months later, I went down to a meeting that included some Standard Products people from the Gulf and Atlantic. I don't remember what the topic was. But the first thing I was asked was by one of the statisticians with Standard Products. I can't remember his name now.

JM: Jim Nelson?

DV: The guy that went to Notre Dame. I don't think it was Jim. I may be wrong. It may be Jim Nelson. But the first question I was asked was, "Have you ever been in a menhaden plant?"

JS: "Young man."

DV: I said, "As a matter of fact, I was in the Standard Products facility in Beaufort." I never had any problem after that.

JM: They couldn't get you –

DV: Bob Chapoton set me up perfectly. He wanted me to do that before we went on that [inaudible].

JM: If you do another chapter sometime, that gets into the fisheries management side of it. Since they are now managed both at the state level and at the Atlantic Coast-wide management level, there's a menhaden plan by ASMFC. There's still state management plans and state activities that will occur that may affect specifically – to take actions specifically that are within or in addition to whatever it's called [inaudible] management plan. So the fishery is still going on, as long as it does. If it goes away, then I think there will still be some need if the fishery ever went away, period, commercially. There's still going to be a coast-wide bait fishery. There will still have to be a collection of catch statistics, aging – that whole end of it. There will still be a federal role because it's a multi-state fishery management fisheries for management of inter-jurisdictional fisheries under the act, [inaudible] Atlantic Interjurisdictional Fisheries Management Act, the federal role was still there. There will always be a federal role. I honestly think menhaden will still be a program within the federal entity because I don't think any of the individual states will be able to persuade their political system to say, "We will be the collector and manager of all the data on menhaden on the Atlantic [inaudible]." So I think Beaufort menhaden program – there will be an analytical need and probably other facets of the biology, history, and ins and outs of menhaden. Bear in mind, one of the things menhaden fishery and the industry associated with it – I'll say through the body of Andy Kemmerer was – and Andy is an engineer, and in Pascagoula – was always the applications of technology. Because Andy was the fishery explorer man, right? He's the one – he tried the LIDAR [Light Detection and Ranging]. He wanted to know aerial surveillance and aerial survey, school size, photography, LIDAR – anything you can skin a cat at that got to be into an engineering sense and applying it to fisheries. He wasn't all – "find the herring, find the underutilized resource," but rather to apply technology because, in all honesty, his facility was always under the hammer of producing whatever because he was in the underutilized species and fishery technology side of things. So he was looking at other tools to apply in fish and fishing in the industry. And the menhaden industry provided the

platform and had aerial machines up there that could do the flying. So he had a very close tie-in with the menhaden industry as well. As far as I know, our relationships had always been good with Andy Kemmerer and good with trying to technology. The industry on the Atlantic seaboard, because you can see further in the water than you can in the Gulf of Mexico, was interested in applying some of those tools in the Atlantic seaboard, too. That's another tie into another federal lab beyond Beaufort, but the tie was from a technology one that Andy wanted to get tools into it and whether it had any opportunity in aerial survey, school size, etc., for assessment purposes, too.

DH: I have a question about the bait fishery. Can someone tell me what is the market for the bait fishery? What happens to the fish that the bait fishery catches? Where do they go?

DV: [inaudible] among others.

JS: Most of it –

DH: Who are they baiting?

JS: The two big players on the East Coast are Virginia and New Jersey. Maryland to a smaller extent. But Virginia has got a long history, probably going back into the '70s of smaller menhaden vessels fishing purse seines for bait. They also have pound nets. Then, Jersey got into it back in the '80s, mostly out of Cape May and Point Pleasant, same thing there; smaller menhaden steamers, if you will, and one or two purse boats for purse seines. My last numbers – they caught 80% of the menhaden for bait on the East Coast. The rest would come from pound nets – Virginia, Maryland. Then a minor portion from up in New England. There was a bait operation in Fall River, Massachusetts, Rhode Island – they would fish Narragansett Bay.

DW: You're telling me how they're caught. What happens to the fish? How are they distributed and marketed?

JS: Most of the fish from the Chesapeake Bay would go for crab bait, blue crab traps, pots in Virginia, in the Carolinas. My comment about that eighteen-wheeler in Cameron – they'd ship a lot to the Gulf Coast. Boy, a big boost for that bait coming out of Virginia was in 1994, '95. The state of Florida prohibited all nets –

JM: Net ban.

JS: It was their, quote, "net ban" that they passed. It put a lot of then-bait fisheries, gillnet fisheries, out of business, mostly on the Florida Panhandle. I had a couple of Virginia bait fishermen telling me then that eighteen-wheelers started heading down I-95 for the Gulf Coast. For recreational bait of chum, blue crab fisheries on the Gulf, and then crawfish. They use menhaden in crawfish pots. Then the bait landed in New Jersey. They're a bigger class of fish. They're the [age] threes and fours. They're almost a foot-long fish. Most of those go up to New England for lobster bait. The premiere lobster bait is Atlantic herring, but Atlantic herring quotas have been reduced over the past decades. A good second is menhaden. The lobster guys like menhaden because they're big. All you got to do is grab one or two of those to put in the pot

– those big [New] Jersey fish, versus the Chesapeake Bay fish, again, which are a little bit smaller, and you might have to add three or four or five or six of those into a baitwell. So that's where it goes on the East Coast. The bigger fish are generally north. The Chesapeake Bay bait stay in there, the Carolinas, and the Gulf Coast.

DW: How do the fish get from the eighteen-wheeler to crab fishermen?

JS: They get sold to a wholesaler or fish house. Then the crabber goes with his pickup truck to the fish house.

DW: Local bait stores?

JS: Yes.

JM: Yes. Forty-pound flats.

DW: Or the guys who's operating a thousand crab pots [inaudible].

JS: Forty-pound flats usually.

FC: Are they frozen?

JS: Frozen. Yes, frozen. Individual quick freeze or brined and frozen – brine tanks. Some sixty-pound flats. Up in New England, they may sell fifty-pound boxes, I think.

JM: The interesting story about driving south when I get down the road here – the old bacon plant.

JS: James Styron, here in Davis, North Carolina, down east, had a very successful bait operation down there. He had an old shrimp boat that he outfitted with the purse seine and a couple of purse boats. He'd land the fish right there in Davis Canal. Dean Ahrenholz used to live at the end of the canal. James was quite creative like most Downeasters. I mean, they can create anything. I would give him a welding torch and some metal, and they'll build anything. James had a brine tank that was the old raw box from Sea and Sound Processing, where Town Creek Marina is, and he used that as the brine tank. It would have liquid brine; the fish would go in there. It would be like twenty-eight, twenty-nine degrees. The fish would come out frozen. But you would go down to visit Dean in the early morning before the wind picked up, and you'd smell this bacony smell. I said, "What the heck is that bacony smell, Dean?" James Styron, always the opportunist, would go down to (Hempstead, NC), where the (Thorn Apple Valley Pork Co.) pork products factory was, and he would get spent pork brine down there, bring it back, and use it in his brine tank for free. He had a big tank truck. He would use that angle to sell it because that bacon smell – the crabs really go after that bacon smell. He was a local guy. James got ill and passed away. The sons and the grandsons didn't continue the operation. You can still see the freezer operation in the brine tank down there.

FC: Is commercial baiting allowed in North Carolina now?

JS: It is. In that 2012 regulation that pushed the reduction boats offshore, there's wiggle room in there that says you can have a steamer vessel of a certain size with one purse boat. That was written to allow for homegrown bait operations to regrow. By then, James Styron's operation had become defunct. So you could, but the startup costs are pretty high, I would think.

DH: Okay. Thank you, guys.

JS: Thank you.

DH: I really enjoy these.

M: It sure is interesting.

M: It was fun.

DH: If nobody else does, we're going to sit around, enjoy it, and play it again.

FC: Future generations will.

JS: Thank you.

----------END OF INTERVIEW----------

Reviewed by Molly Graham 3/21/2022
Reviewed by Joseph W. Smith 4/17/2022
Reviewed by Molly Graham 4/19/2022