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Boggs, Christofer ~ Oral History Interview

Edward Glazier

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

Interview with Christofer Boggs by Edward Glazier

Summary Sheet and Transcript

Interviewee

Boggs, Christopher

Interviewer

Glazier, Edward

Date

July 27, 2016

Place

Honolulu, Hawaii

ID Number

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Use Restrictions

Biographical Note:

Chris Boggs is a Supervisory Fisheries Research Biologist and the Director of the Fisheries Research and Monitoring Division at the Pacific Islands Fisheries Science Center [PIFSC] in Honolulu, Hawaii. He received his B.S. in Biology at the University of Hawaii Manoa. He received his Master's in Oceanography and Limnology as well as his Ph.D. in Zoology from the University of Wisconsin Madison. He began working at the Honolulu Laboratory in 1985 before it became the PIFSC. He has spent the early part of his career studying tuna.

Scope and Content Note

Interview contains discussion of: limonology, tuna physioecology, Aku fishing, sea turtles, tuna, cetaceans, tagging, marine protected areas

Dr. Chris Boggs discusses his education and how he came to work with the Fisheries Research and Monitoring Division at the Pacific Islands Fisheries Science Center. He recounts the history of the Honolulu lab which became the Pacific Island Fisheries Science Center. He describes the various tools and methods employed over the years, along with the bureaucracy that he believes slows down and even stifles their work. He speaks in detail about tuna physiology, exploration,

stock assessments and population, along with fisheries development. He provides a history of the tuna industry from Aku fishing to longlining. He also reads a “legend” story that he composed based on his experiences.

Indexed Names

Alverson, Dr. Dayton "Lee"
Barrett, Dr. Izadore
Boehlert, Dr. George
Brill, Dr. Richard
Chang, Dr. Randolph
Chipman, Gerald
DiNardo, Gerard
Dizon, Dr. Andrew
Humphrey, Robert
Ito, Russell
Jefferts, Dr. Keith
Kikawa, Bert
Kitchell, James
Laurs, Michael
Magnuson, John
Masuta, Paul
Pooley, Sam
Seki, Dr. Michael
Shomura, Richard
Uchiyama, J.H.

Transcript

Edward Glazier: This interview is being conducted as part of the Voices from the Science Center's project, funded by the Northeast Fisheries Science Center. It is also part of the Voices From the Fisheries Project. It is supported by the National Marine Fisheries Service Office of Science and Technology. I'm Edward Glazier, and today I'm speaking with Christofer Boggs at the Pacific Island Fisheries Science Center. Chris is Chief of the Fisheries Research and Monitoring Division. It's July 27th, 2016. Chris, we'll start with a little discussion on this background, and we'll proceed from there. Chris?

Christofer Boggs: I'm Christofer, or Chris Boggs, and I'm the Director of the Fisheries Research and Monitoring Division at the Pacific Islands Fisheries Science Center. I'm also a Supervisory Fisheries Research Biologist. And I'm here to talk about some of the early days of and some of the changes over time that have happened at the what was formerly the Honolulu

Laboratory of the Southwest Fisheries Science Center, where I came to work formally in 1985. And then after it became the Pacific Islands Fisheries Science Center. But many of the things that happened, especially early in my career, are the subject of a legend that I wrote for a retirement ceremony, for one of my favorite and longtime employees, Russell Ito. So although it may be a bit obscure, I'm going to read that, uh, that legend, and um, maybe fill in some details about who is what later on in my, in my talk. This, this is, this legend is called The Tale of Chris Bogg and Russell Ito and The Demise of Tuna Physioecology:

Listen closely my dears, to the tale of Chris Bogg and Russell Ito and their federal service. Once upon a time, long long ago, 1978 actually, in a parking lot far, far away at Kewalo Basin, there were fish tanks full of live tunas and mahi mahi, and algae that had to be scrubbed all the time. The philosopher named Dizzy Andy, from the Lake Lab of Mad City in the faraway kingdom of Wisconsin, had come to Kewalo Basin to study there the physiological ecology of tunas, and there also dwelt a wise old fish wizard named Kazam Osama, who studied how to raise tuna and mahi mahi from eggs. Dizzy Andy and Kazam Osama had the most powerful wizardry in all the world when it came to the physiological and the raising from eggs of the tunas and the mahi mahis. And Dizzy Andy had ordained an acolyte named Brill Rich who tortured the tunas, and together they apprenticed a sorcerer in training from the Lake Lab named Chriz Bogg, who wanted to torture tunas and become a philosopher too and was willing to work for plate lunches and scrub tanks. And Kazam Osama apprenticed a young Kawaii man named Russell Ito, who wanted to learn to raise fish and was also willing to scrub tanks for plate lunch. And both apprentices wanted to become nymphs (NMFS).

Now my dears, they did not want to become forest NMFS nor fairy NMFS, but strong and bold and manly NOAA NMFS, for such was real employment. Russell Ito and Chris Bogg were so helpful to Kasam Osama and Dizzy Andy that 30 years ago, the great and powerful Shomora Shogun hired Russell Ito and Chriz Bogg, and this seemly pair both became NOAA NMFS. And they remained NOAA NMFS happily ever after, eventually becoming not just nymphs but actual piffzies [PIFSCz].

In those days, everything was fair and bright and good and scientific. And in all of Kewalo Basin, no one had ever heard of NEPA [the National Environmental Policy Act] or IACUC [Institutional Animal Care and Use Committee] or fork lift training or even time sheets. They crashed the forklifts themselves, and they built the fish tanks themselves. And built observation buildings themselves, and strung power lines and installed fuse boxes themselves. And browned out Kewalo Basin by themselves and brought things with--bought things with cash from the Imprest Fund and took fish home from work to eat and give to friends, without ever a permit or training of any kind.

But the physiocology and the egg rearing did not fare so well. The Barrett of La Jolla was not sure the physioecology and the egg rearing were useful. And he called upon another wise old philosopher descended from the Mad City Lake Lab in the kingdom of Wisconsin, named Hunter John to decide. And lo and behold, Hunter John found that the physiological ecology and the egg rearing was not useful and should cease and desist. But the wizardry of Dizzy Andy and Brill Rich was so strong and fine, and their publications were so extensive and famous, that the physioecological and the egg rearing continued anon. And Russell Ito and ChrizBogg were content at Kewalo Basin for a time.

Now, in the parking lot at Kewalo Basin, there were also lobster traps for the Northwestern Hawaiian island survey, and always mending the traps were other NOAA NMFS, some of whom are still at NMFS today, such as Seki Sama and Tagami San and Humphrey the Jr. and Clark Deray and Eversenau. Others have passed away, and we honor the memories of the brave and bold NOAA NMFS Randy Chang and Bert Kikawa who were our colleagues there. But then the Barrett of La Jolla demanded again. And summoned another philosopher from the Mad City. He summoned the Kitchell, the right arm of the oldest Lake Lab philosopher of them all, the Magnuson, who had founded the Kewalo Basin long long ago. And lo and behold, the Kitchell, the right arm of the Magnuson also found the physiological and the egg rearing were not useful and should cease and desist. And so it came to pass that Dizzy Andy moved to La Jolla to study whales, and everyone else had to move to Dole Street, and Kewalo Basin became the fief of CRED. And the Bill Brillrich had to work on turtles. Russell Ito and Chriz Bogg had to stop the study of the fish and start the study of the fishery, which was hardly known. Moreover, and foremost, the Kitty queen of the council had demanded that the fishery be known. And so Russell Ito had to leave the Kewalo Basin, and he joined with the Kurdiff Kawamoto to monitor fishery landings at the auction. For in those days my dears there were no log books, nor federal fishery monitoring of any kind whatsoever. Not since the long-ago days of the aku boats, which no one knows of anymore. And Chriz Bogg left Kewalo Basin to study the new longline fishery and become a boss man.

And so it came to pass that Russell Ito counted fish for the lord enumerator Pooley of Dole Street. And Russell Ito counted long and well and became a great credit to the NOAA NMFS and a Kupuna among those that remain. And Russell Ito was beloved by the NOAA NMFS for his poke and his tours of the auction and for his solid service, and for the friendly goodness of his large and generous heart. And he and Chriz Bogg became wise in the ways of the long line and its management. And at long last today we all here greatly appreciate the quality, regularity, enthusiasm and insightfulness of our many reports on the fishery, of which we and the Kitty queen and the tuna RFMOs [regional fishery management organization] are so grateful to receive.

EG: Mmm (laughs) That was terrific. Where was that read?

CB: Uh, that was read at an awards ceremony, the 30-year awards ceremony for Russell Ito--

EG: For Russ, oh.

CB: --probably a year or two ago.

EG: Okay, yeah.

CB: I think it's maybe been, I think it was in, sometime in 2015--well it was before Sam Pooley retired.

EG: Ok, yeah. Mm hmm

CB: Which was maybe October of '14, '14?

EG: It'll be 2 years, this, year and a half or two years. Yeah, yeah.

CB: So this would've been -- yeah.

EG: Terrific.

CB: So just uh

EG: There's a lot of embedded history there.

CB: There's a lot of embedded history, there's a lot of acronyms and references in this story um, but some of the things that were really true about the old days was stuff was much less formal.

EG: Mmm.

CB: So when I refer to uh being able to have, take fish home, we used to be able to keep fish that was not needed, after it had been sampled for research. We used to be able to take that home or use it in parties.

EG: Mm hmm

CB: And uh, it was called 'home pack.'

EG: Mm

CB: And it was a real perk in the old days, and uh that was ended at sometime early in my career because some abuse somewhere in some other science center.

EG: Ah.

CB: Um, when I refer to not having any NEPA, NEPA's that National Environmental Policy Act, it's a, it's a, analysis that has to be made of anything you use government money to do.

EG: Mm hmm

CB: And of course we'd never heard of anything like that.

EG: Right.

CB: Uh, it's very formal process, takes a lot of time, and it kind of drags us down these days, slows down our work. IACUC is another thing, that's the, the other thing we didn't have is the animal care committee? Every time you do anything with a live animal, including catch a fish, if you're doing it under the auspices of the University of Hawaii and now the National Marine Fisheries Services adopted their format. If you're going to do anything with a live animal, you have to have a permit.

EG: Which goes through some sort of review body I would think.

CB: Yeah. And if you want to drive a forklift you need training.

EG: Yeah

CB: And you certainly don't build buildings and string power lines and do any of that kind of thing. It was a, it was a different world when I came to work here. I came from the faraway Lake Lab in Mad City. I was a graduate, I got my Ph.D. at the Limnology Laboratory, affectionately known as the Lake Lab in Madison, Wisconsin.

EG: Gotcha, but you grew up in the islands.

CB: Grew up here. I moved here when I was 12.

EG: Ok.

CB: And I went, I got my undergraduate work at UH Manoa [University of Hawaii], in biology.

EG: Biology -- Ok

CB: Biology, yeah. Bachelor of science in biology.

EG: Uh huh.

CB: And then I went off to Mad City, Wisconsin to get a master's degree in oceanography and limnology and a Ph.D. in uh zoology. Um.

EG: What was the inspiration there? To --

CB: Well um

EG: To head over to --

CB: John Magnuson who is referred to in the legend--

EG: Right

CB: --had started Kewalo Basin, and he was very --he was in the National Marine Fisheries Service at the time that I went to grad school there, but formerly he had run this Kewalo Basin tuna physiology research lab.

EG: Mm hmm

CB: He actually founded it. So there was a connection between University of Wisconsin and University of Hawaii that centered around this affiliation with the, with the National Marine Fisheries Service Kewalo Basin Laboratory.

EG: Got it.

CB: Um, I had my graduate advisor here at UH recommend that I apply to University of Wisconsin Madison, even though I was interested in oceanography, because she knew that John Magnuson, who is the senior professor there and Jim Kitchell would welcome having someone from Hawaii, which they have, viited regularly to do -

EG: Yeah

CB: -to do research on tunas. And when I had written my application to graduate school, I had talked about wanting to come back to Hawaii and do something useful for the Hawaii fishing industry. What I specifically described was maybe I could help develop a fishing station out at Midway. At that time there were visions that the albacore fleet would somehow set up a base to help support its' operations in uh the North Pacific out at Midway and have a place where they could freeze and ship fish from.

EG: There was sort of a fisheries development demeanor at the time, correct?

CB: Well, when I started working at fisheries, there wasn't fishery management.

EG: Yeah, mm hmm

CB: It was all doing fish, studying the fish, and the legend makes reference to having to quit studying fish and start studying the fishery.

EG: Fishery, right.

CB: The Magnuson Act was passed in 1976, and I think I came to work here as a graduate student on my Ph.D., working on a project under Jim Kitchell and John Magnuson to study tunas. Tuna physiology in fact. And that was in '78 or '79, so before the Magnuson Act it was strictly fish research and fishery development research.

EG: Development, right.

CB: So the science center, what was then the Honolulu Laboratory, and before that it had another name, the Hawaii Biological Laboratory, where it was actually part of the Department of Interior, and before that it was the Pacific Oceans Fisheries Investigations. That was the first name it had. The Pacific Oceans Fisheries Investigations was started in the late 1940s.

EG: The '40s, ok. So post-war.

CB: Um, I think maybe '49 it got, really got going in the '50s. And it was looking for where you could have tuna fisheries and where you had bait fish resources, because many of the tuna fisheries in those days were pole and line bait boat fishing.

EG: Mm hmm.

CB: So, the history before I got here had been in the far past, before my arrival had been on tuna fisheries exploration and development.

EG: Right, right.

CB: A lot of work on how to raise baitfish or bring baitfish from other places.

EG: Even gear use, I've read a lot of descriptions of different types of gear – ika-shibi and what not.

CB: Yup. Um, ika shibi is ancient, ancient handline fishing technique. But the king fishery in those days, the absolute dominant fishery, was aku boat.

EG: Ok

CB: For aku or skipjack tuna.

EG: Mm hmm.

CB: And uh the only fishery monitoring of any kind that was going on then was, we'd send people down to the cannery every time the fleet came in to get size frequencies, to take sub-samples of the size frequency distribution of the skipjack, because there had been a huge decline in the abundance, in the large fish in the catch. Which was causing some distress for that fishery, which when the cannery closed in 1984, they no longer had a place to sell at a marginal profit their excess fish, so that they made their main money off of sashimi and poke sales for fresh raw tuna. But they needed this other marginally profitable place to sell all their bulk of their catch. When the cannery closed, the fishery shrank dramatically. It had already been suffering from issues of access to bait, and um, fish size reduction, which reduced the price.

EG: So there was, so it wasn't necessarily the stock. It was partly the stock it sounds like.

CB: We don't, we don't really know whether there was a reduction in the larger sized fish in that stock, but it would make a great deal of sense that there was.

EG: Was that targeted on sea mounts? Or or --

CB: No. It um

EG: Open ocean?

CB: Open ocean fishing, that used birds - followed bird flocks--

EG: Ok

CB: --that would aggregate with the schools of fish, um

EG: How far from the islands?

CB: They did not have to go far.

EG: Yeah, they didn't have to go far.

CB: You used to be able to see and so the question about stocks diminished, I mean, the only argument against the stocks having diminished is that maybe it's the near-coastal environment is no longer as thrilling and productive and attractive to tuna schools. Because you used to be able to sit at Kewalo Basin and see big breezing schools of tuna from shore.

EG: Right off the beach yeah.

CB: Yeah, and that doesn't happen anymore. Um, and it could be because the stocks are depleted or because the wetlands have been filled in to build houses and there's just not a huge attractive bait resource right around the island like there used to be.

EG: Which you don't, I don't see much bait these days. Yeah.

CB: Yeah, yeah. But it was always complicated. A lot of the, a lot of the time I spent after having been just a tuna physiologist was devoted to understanding the aku fleet. But to get to the, just to cover the physiological or the physiological ecology for the Kewalo Basin was famous for, it at the time it was absolutely unique as a place in the world where there were live tunas in captivity that could be used for research. And so that was a huge focus of the Honolulu laboratory, was that prestige. Of course, it's commonplace now to see tunas in aquaria. But there were none anywhere in the world at the time, and it was because of the aku fleet, the boats that would come in and bring the fish to, to the cannery right there by Kewalo Basin where we had our laboratory, that we could get the live fish. So it was a synergy, a symbiosis of the aku fishery and that laboratory.

EG: It occurs to me that we might want to describe the aku, the aku fishery a little bit. Aku is skipjack.

CB: Yup, aku is skipjack tuna, it's the, one of the smallest of the true tunas, not the smallest, there's also frigate and bullet tunas that are even smaller. It's a dark blue fish with a silvery belly, and uh striped, dark stripes on the belly. It looks a lot like a bonito, and the Japanese name for it,

katsuwonus, means bonito and in the old cultural classification system, it's not a tuna. It's a bonito. But we know now that it's warm bodied like the other tunas. It generates heat that is retained through a countercurrent heat exchanger in the vascular network. So all tunas are warm-bodied.

EG: It's a very red meat. Oily.

CB: And they have very red meat with myoglobin, that helps oxygenate the muscle. And they have ability for remarkably high levels of metabolism which can be maintained even in anoxic conditions when they're diving deep. And they can dive very deep because they have either very strongly strengthened gas bladders, or else none at all, so that they can go down and up through the water very easily. And that's a predation strategy for them. But the fact that they are warm-bodied, unique in fishes at the time, and have such a high metabolic rate, made them of great interest to physiologists. And so, you know, when I was in graduate school, I met professors who were interested in that, and they, they and Andy Dizon, the Dizzy Andy referred to is Andrew Dizon, who was a Ph.D. scientist from the Lake Lab in Wisconsin.

We're trying to understand why they were warm, what the point of being warm bodied was, what the point of having such high metabolic rate was, whether they had some sort of unique efficiency of locomotion. So, I came out here to study their bioenergetics. To understand the cost of transportation in those animals and what the advantages might be. We never did solve the mystery of why an animal that was so incredibly streamlined would have such a high metabolic rate, and what the point of being warm-bodied was if it wasn't to be more efficient. But later work, much of it by Richard Brill, Dr. Richard Brill who's the Brill Rich in this story, helped figure out from the blood chemistry what some of the advantages were, including better abilities to remove oxygen from very, very low oxygen water. And then have that same oxygen be able to be delivered, in, in a tuna's muscles, in a situation where the binding affinity of the blood had to be changed between the gills and the muscles. So, it showed that there was a real advantage to being warm-bodied.

EG: Interesting

CB: It would change the chemistry of the affinity of binding of oxygen molecules in the circulatory system. I'm going to take a break here.

EG: Sure, sure.

CB: I'm going to have a sip of coffee just to clear my throat.

CB: Just to recap, a couple of my professors who did a lot for the early work at the Honolulu laboratory were John Magnuson and James Kitchell, professors at the Limnology Laboratory at the University of Wisconsin Madison. Other people who were important early in my career were Richard Shomura, he was the laboratory director who hired me, and Izadore Barrett at the time was the director of the science center in La Jolla, of which the Honolulu laboratory was a satellite.

EG: Richard has passed, is that correct?

CB: I don't know!

EG: I may be wrong.

CB: He hasn't been around at events for some time but I'm not sure he's passed away. Sam Pooley's also referred to in here. He was a director for much of my career. In between Sam Pooley and Richard Shomura, George Boehlert was a scientist here. And there, in Shomura's day, the lab focused on, on pretty much [pure] science. Or fishery development or fishery description. And that was during the early '80s. The Magnuson Act had been passed in '76 and fishery management plans needed to be developed, and although fishery management plans were developed there really still wasn't any management *per se*. The plans were just set up to monitor the fisheries. It wasn't seen as there being any particular need to control them. But there was an interest, and the Magnuson Act provided an interest in getting foreign fishing out of the U.S. EEZ [Exclusive Economic Zone]. And so some of the earliest studies were to understand the dynamics between distant water foreign fishing, which occurred inside the EEZ in those days, back in the '70s, and the local fish, fish abundance. And so we had to use, you know, even though we didn't have fishery management, or stock assessments, or catch limits, we did have fishery data from the states and the territories, who had been collecting it for the state for a long, long time, State of Hawaii, for a long, long time, since the late '40s. And the territories were being, were having data collection systems initiated during this time. Those data were analyzed to try and decide whether big, foreign boats could have an effect on pelagic fisheries like the aku fishery or the trawl and hand line fisheries around the main islands.

EG: I believe that that was a big North Pacific issue in fact, wasn't it?

CB: It was, and what's interesting the whole thing of had to evolve without really bringing up tunas, because at the time, tunas were not considered fish under the Magnuson Act. It wasn't until the Magnuson Act was amended in 1990 that tunas were considered fish. And that's kind of a joke. Everyone knows they were fish, but they weren't fish under the Magnuson Act. The Magnuson Act defined fish as not including what it called highly migratory species, which were the tunas. There was some politics behind that. U.S. had not joined the international law of the

sea. We hadn't signed onto it. We had a big purse seine industry that wanted to be able to purse seine for tunas inside other countries' 200 mile zones. And so we had, legally in the United States, defined tunas specifically as having no country, as not recognizing any boundary. And therefore the Magnuson Act which was set up to manage EEZs, excluded them from its' management. So all this work we did to try and understand the effects of foreign longlining on local fish availability was done on marlins and mahi-mahi, fish that were fish and not on tunas because they couldn't be considered and you couldn't provide justification.

EG: Very interesting.

CB: Well, the fishery management council, was very, very interested in changing that. Because the bread and butter - the main point of these fisheries was tunas. And to not be able to have management plans which would manage tuna fishing, greatly limited the influence that the federal fishery management had over the federal fisheries. So this was largely due to the efforts of the Council-- of our Council and other councils that tunas were included under the Magnuson Act of 1990.

So you had the demise of the skipjack tuna aku fishery during and after that the closure of the cannery in 1984. You had the pelagics fisheries management plan actually established in 1987 and right about that time and through 1989 and the early '90s, the huge expansion of the Hawaii longline fleet. As fishermen from the Gulf states primarily, and also New England, who were suffering from the radical decline in the swordfish stocks, and a lot of management measures being implemented through the same process, FMP's [fishery management plan] coming on line, fishery management getting more active, and they moved out to Hawaii in large numbers.

EG: The Black Boats were part of that?

CB: Yeah, they were part of that migration

EG: - There were other vessels, too?

CB: Yeah, a huge number of vessels from the Gulf of Mexico that fished shallow gear for yellowfin tuna. And so it was Atlantic, Northeast Atlantic boats for swordfish, the Gulf boats for swordfish and yellowfin tuna, all came to Hawaii from about 1989 through '91, '92, and there was this huge increase in the number of longliners, up to a hundred and fifty or so. We got tuna, at that time tuna were under the Magnuson Act, and in quick order, the Council passed a moratorium limiting the increase of that fleet saying there can't be any more boats. And then it became a limited entry program in 1991, and that's been continued to this day.

EG: 175 or something like -

CB: There were about 175, now I think their limit is 156.

EG: Ok. Mm hmm

CB: We don't, we've never had that number of boats active in a year since that was passed. So in terms of limiting the number of participants that never, that didn't work. Well . . Well, I don't know, maybe we would have a lot more participants now. But it definitely didn't limit the amount of fishing effort, because those boats have continued to exert more and more fishing effort year after year ever since. But when I came here to study tuna physiology and then started moving on to try and work on, on fisheries and understand fisheries, the data that were there to work with, were very, very little. The state had its' data system, and we had copies of their data, but they weren't reporting it in any routine way, except as an annual catch summary, a printed annual summary of catch. The territories were learning how to do creel surveys and generate fish statistics. The whole, the whole culmination of that each year was just a, was a printed book of everybody's total catch. Just catch.

EG: Total catch.

CB: Not catch effort or any kind of fisheries analysis or stock assessment. It was just catches.

EG: How about biological parameters? Were they measuring...?

CB: We, our, we had a long history or studying fish age and growth, studying otoliths.

EG: In Hawaii.

CB: Yeah, in Hawaii. Yeah. Our lab um, well, the limnology lab at the University of Wisconsin had first figured out how to track fish using pingers. They had a radio - Rayovac battery plant there that made hearing aid batteries, and Gerald Chipman who was the technician at the Lake Lab, where I worked, had figured out how to take one of these hearing aid batteries and make a really teeny, tiny pinger that you could put on a carp. And they tracked carp around Lake Mendota. Um, and then Andy Dizon came here from there and John Magnuson came, was also associated, and they brought this idea of tracking fish with pingers, and the first tuna acoustic tracking was done in Hawaii.

EG: In Hawaii? Wow.

CB: Yeah. By the Honolulu laboratory. So we studied fish behavior, we studied fish growth rates, we studied fish diets, their distribution, um, lots and lots of science. When George Boehlert

came out and took over um the directorship from Richard Shomura, he was the next director, he started a whole program of ichthyoplankton surveys. Um, you know, even that late in the game, and I'm not sure exactly what year that was, but it would've been in the 1990s. We were embarked in huge programs that were pretty much pure basic science to understand distribution of fish larvae in the Pacific. We had a ship that that was, we, everyone organized every year to make sure we used all 243 days of ship time on the research ship, the *Townsend Cromwell*.

EG: The *Cromwell*.

CB: We were down to one ship in earlier years, Pacific Oceanic Fisheries Investigations had up to 4 ships that were surveying tuna resources and bait fish resources in the Pacific. We were down to one, but boy, we had to use every one of those 243 days, and we don't get 243 days of ship time on a ship anymore, that was, that's something, that's from the past. It was an incredibly efficient use, at 365 days a year, and you're going to be at sea 243 of them. But very little of it was what you'd expect to have done. Every time we'd have an external review of our scientists, of our science, external reviewers would say, "well, why aren't you actually surveying the resources?" Because we would be out doing things like studying what depth fish are caught at, our collecting specimens to do age and growth, or, we were doing one kind of survey in those days, we were surveying the Northwestern Hawaiian Islands lobster abundance and for assessment of that stock.

EG: With the Cromwell?

CB: Yeah. When I, when I started work here and moved into fish, into fishing and away from fish. The fishing that was of concern was the bottom fishing and lobster fishing in federal waters in the Northwestern Hawaiian Islands because that was federal territory. Um, so in addition to the pelagic high sea stuff, which was all federal, there was that. But management was long in coming.

EG: Mm hmm.

CB: The first management that I'm aware of was a limited entry program for the Northwestern Hawaiian Islands Bottomfish fishery in 1988. And that was just who could fish. It was trying to keep the size of the fishery small.

EG: Yeah, that was to be a limited entry program.

CB: And the other zone, the Mau zone, was still open to everyone.

EG: Mau zone, right, mmm hmm.

CB: Bottomfish fishery management didn't migrate into the Main Hawaiian Islands until much later. I think it was 2007 when we first had catch limits for Main Hawaiian Islands bottomfish.

EG: We might mention the main species there. Just a couple of them.

CB: Yeah, bottom fish are the, are the deep slope snappers, so things like opakapaka and onaga.

EG: Onaga.

CB: Yeah.

EG: Very valuable fish in the islands.

CB: You know, we might cut back a paragraph here about what aku fishing was, we really never described what it was. Aku pole and line bait fishing is a style of fishing that came to Hawaii from Japan very early in the 1900s. And it's a fishery which has to catch live bait, and usually does that at night, but there's all different kinds of ways around the Pacific to catch the live bait. A lot of it was caught in the harbors, and even in Pearl Harbor on Oahu.

EG: Nehu?

CB: Nehu.

EG: Nehu. Which is the...?

CB: Or -- that was a main, main baitfish was Nehu, which is an engraulidae, like an anchovy, it's an anchoveta.

EG: Right, Ok. Mm hmm.

CB: So related to herring, things like that. Smelt. Then they keep that alive in a bait well, which as the bait was used up and fish caught became an ice hole, and they would drive the boat out and look for bird flocks. They'd drive the boat out at dawn with this live bait. So they baited - they'd go out, start in the middle of the night to catch the bait, drive out at dawn, fish all day long and often not head back until after dark. It was incredibly hard working type of fishing. But there were up to 40 boats doing this at one point. And -

EG: The method itself is worth mentioning I think.

CB: Yeah, the uh, the pole and line refers to a simple fishing pole, not a rod and reel but just a pole with a fishing line attached to the far end of it. And a barbless hook with a lure made from shiny fish skin of the lai fish, a scale-eating fish that has bright shiny skin. And they would scatter bait on the water to create a feeding frenzy amongst the aku who would school at the surface. It's a tuna, surface schooling kind of tuna.

EG: Mm hmm.

CB: And when the feeding frenzy was started, they'd enhance that by a spray of water around the skirt of the boat that would make it look like the frenzy was even more frenzied, and also kind of hide the fishermen from the fish. And they'd slap this silvery lure, unbaited hook down in the water and fish bite it instantly when they're in their frenzy. And for about 30 minutes, they could just pull fish in and easily slip the hook out and slap the hook back into the water and catch another fish. One fish after another.

EG: Right, sort of leveraging it over their shoulder and releasing it behind them.

CB: Yeah, over their shoulder yeah. And in Hawaii this was one pole per person. But this was the primary, at this time and earlier, especially earlier, that was the main way of catching tuna all over the Pacific, not just aku, but yellowfin off the West Coast, in Japan and they would, they would catch fish up to 200 or 300 pounds the same way, but you'd have to put more poles on the hook. So they would have a baited hook on one line with 2 or 3 poles. And there'd be 2 or 3 fisherman, coordinating, flipping these big 200 pound, 300 pound yellowfin up into the boat, or bluefin, or whatever they were fishing for.

And when they invented the purse seine, they invented the power, what was it called? Power block. So it was a hydraulically powered lock that was used to pull in a purse seine net that could be a mile long and hundreds of meters deep. That's when this new kind of, of fishing for scooping up big schools of fish started to take over around the world from pole and line fishing.

EG: Made the pole and line somewhat obsolete. Almost.

CB: Made the pole and line somewhat obsolete in that it never - never had the heyday that it, that it had had before purse seine fishing. But that also brought in one of the biggest issues for fishery management when I began my career which was by-catch. In that case of pole and line fishing for tunas, not in Hawaii, but in the West Coast where our mother science center was, it was an issue for the purse seine fisheries that would surround dolphins. And having the dolphins get caught and die in the nets, was a big issue. So, by-catch was actually an issue before fish management itself.

EG: That's right, it started with the dolphin, didn't it?

CB: Yeah. But the council had an interest in having active controls, once it had fisheries management plans. And so we did a lot more monitoring of the fish, starting in that time period. And the focus of this, of the laboratory went more and more towards fishery monitoring from what had been more science of exploration. Now became the science of fishery monitoring and trying to explain fishery statistics and trying to understand the dynamics of the fishery. Maybe not directly to limit it, but to understand things like foreign impacts on local stocks. And when this longline fishery took off, in a huge way, it really upset the small vessel fishermen. So around 1990, my career starts to focus on whether large industrial scale fleets can have a depleting influence on the amount of tuna locally available to smaller fleets and participants.

EG: Primarily in the Hawaiian Islands -- yeah, uh huh.

CB: And this is in Hawaii, and the big fleet in this case would be the longline fishery, and the small vessels would be the trollers and handliners, and the questions at stake are, To continue this moratorium into a limited entry program, to limit the longline fleet, to keep them further from shore, so by closing areas to longline fishing --

EG: Right, right, so it's an early spatial form of management.

CB: Right, close to the islands. And the question to be answered was whether this was justified based on an actual understanding of the dynamics of depletion. And we never actually found much strong evidence for that. All those things were, went ahead and were done and around all the isl-- not just Hawaii but on the territories too there were areas set up that were closed to purse seine fishing, closed to long-lining. And the sizes of the fleets were limited by regulations. And I was involved in doing, helping with the data analysis to support all of that . . that was the focus of my work at the time. So I went from, you know, being at a place that had almost no focus on fishery management to an almost complete focus on it. And so once we got tuna under Magnuson, the longline fishery started to be managed in terms of its size and the issue had been interaction with other fisheries . . . Then, the next big development was sea turtles.

EG: Mmm. With the longline.

CB: And yup, the long, lo and behold the long line fishery was catching sea turtles which were endangered. And -

EG: How did that come to light?

CB: Um,

EG: Let's see what year would that have been? It's all significant because of the ascendance of endangered species at a certain point in time.

CB: Well we had an an observer program initiated in 1994.

EG: '94, hmm.

CB: And I --

EG: --And I mention this because Hawaiians and other Pacific island groups have always eaten turtles, so this was a departure.

CB: Yeah.

EG: At some point.

CB: But turtles had been protected since what was it, uh, '72? I think, we can check that date, but I believe the law said you can't, you can't eat sea turtles, was in '72. I've actually been here long enough that I have legally eaten sea turtle.

EG: Is that right?

CB: Yeah. Um. I had a friend Paul Matsuda, who invented the sport of surfboard fishing out on Waianae. I lived in Waianae when I was a kid. I moved to Hawaii in 19 - uh - 66. And my parents were doing ethnographies on a Hawaiian community in Waianae.

EG: No kidding!

CB: And so I lived every summer, the hottest time of year to live in Waianae, I lived on Puhano Street in Waianae.

EG: Ok.

CB: And my next door neighbor was Paul Matsuda, a math teacher at Waianae high school, who was a friend with Hobie [Alter] and had Hobie make him a special surfboard, which had a hole in front of the skeg. It was larger, more like a tandem-sized board, and it had a little, he had a little wooden block there that he mounted a small two-horsepower outboard motor on that would stick down through the board, and he'd power this thing up, get through the surf, power this thing up, and go out and fish with a mask and snorkel and poles, so that he could actually see what he

was fishing. He didn't, he didn't wait around for fish to come to his hook and bait, he found a fish and lowered the hook and bait in front of it.

EG: Mm hmm

CB: So he caught a turtle that way once when I was out with him. He used to wake me up, a little 13-year-old kid living next door, and he'd wake me up early in the morning at dawn, take me out on this surfboard, show me how he would fish, and he caught this sea turtle, and he had this sack in front of, on the front of the surfboard there was some tie downs for a fishing box and a sack, and that's where I was also supposed to sit, was up there in front next, basically on top of or next to the fish sack. He put this sea turtle in it, and it bit me! So I've actually been bitten by a sea turtle, and bit it back [laughs]

EG: [laughs] Later in the day?

CB: Later in the day yeah. So that's a little aside fishing story.

EG: Yes, yes indeed. Interesting. So uh, right, then um, there was a, some years of trying to understand turtle long line interactions, and that's carried through for quite a while.

CB: Yeah, yeah, and the fishery was actually um, we put it on observers in 1994, we must've, I think we had a pilot observer program.

EG: Ok.

CB: Somehow we knew that there was bycatch. But we actually started a program in '94, and we did, Gerard DiNardo, who was head of stock assessment for a while, but at that point was just a researcher, did some, little bit of modeling, decided well we should have at least about a 5% coverage. So, from the early years of that fishery, we had 5% observer coverage, and it revealed that there was a significant bycatch of sea turtles especially in the shallow . . wait a minute.

EG: Shallow set?

CB: Yeah, there were larger numbers of sea turtles caught in the shallow set fishery, but also very high survival rate.

EG: Ah.

CB: And much lower number of sea turtles caught in deep set fishing but a higher mortality rate.

EG: Higher mortality – yeah.

CB: So it was a problem in both. And that fishery was actually closed in 1999 through part of 2004. Because of the tur-- parts of the fishery were closed and certain areas were closed because of the sea turtle take.

So, there were also seabirds caught in that fishery, and more recently we've been really worried about the cetaceans. But when I came to work here, the protected species work was monk seals and sea turtles. Green sea turtles, the recovery of green sea turtles, and the recovery of the Hawaiian monk seal, and it wasn't until one of the first times I took a research vessel out on longline cruise that anyone even tried to survey the mammals here. They took the first leg, spent some time on my trip out toward the Big Island surveying whales though the channels between the islands, the main islands, between Oahu and the Big Island [for instance]. So, yeah, we have a huge presence here doing cetacean [research] now, and maybe you talked to somebody else about that since it's not my field, but that's all a modern development.

EG: Yeah, really recently, actually. Yeah, with the pilot whales and the melon-heads and puka heads and whatnot.

CB: So, let's see I'm trying to figure out the order of some of the big shifts in research emphasis here. I think, before we actually got into sea turtle problems, right when tunas got under Magnuson and the longline fishery greatly expanded around 1990, it not only expanded, these boats that came in from the mainland fished shallow for swordfish, and this big expansion here was largely swordfish directed. And we had a new director about that time also, Mike Laurs.

EG: Mike Laurs, yeah.

CB: And Mike was convinced that the issues with swordfish and swordfish stocks which had been such a huge issue on the East Coast, and on the West Coast, was going to be a huge issue in Hawaii. So, we diverted almost the entire research effort of the Science Center to understanding swordfish. Swordfish diets. Swordfish life history. Swordfish stock assessment. And I really disagreed with that direction, I was pretty convinced that that was a flash in the pan, that it would not persist. I wasn't exactly wrong about - I wasn't right about why. One of the big problems that came up was this bycatch was so much worse. Sea turtle bycatch was so much worse in the swordfish fishery, and it was that, and not the assessment of the status of swordfish stocks, which never looked bad, that caused the shallow set fishery to be much more rigorously limited than the deep-set fishery.

EG: Mm hmm

CB: And that resulted in lots and lots of people moving from swordfish fishing either away or back --

EG: Back to tuna, yeah

CB: Not back, but into tuna fishing. I'm going to need a drink of water.

EG: Sure.

CB: One of the things I wanted to mention relevant to how simple it was in the old days, as in the legend of Russell Ito, when we didn't have training and permits. One of your questions to respondents is whether there've been big technological changes. More important to me has been that there's been a huge change in the degree of administrative overhead that's required to do science for the science center in current times. There's been a - just a huge increase in the number of things that we have to do that are not directly related to the mission. So, for example, the National Environmental Policy Act. You're very familiar with, with, because you've done that sort of thing.

EG: Yup. Yes.

CB: Um. You can't, you can't conceive of doing anything in the natural world now without writing an analysis of what the effect would be, and there was nothing like that whatsoever in the old days.

EG: The turtle long-line interaction business is one of those where NEPA was, you know, absolutely essential in a legal sense, but . .

CB: Yeah. We, we had, we had designed a bunch of research to try and look at the turtle interaction, as you do well know. And it was halted because of a lack of the proper documentation. Eventually, we gave it, gave it up. Let it, let it uh, had a lawsuit filed against us, and let the permit that we had lapse as moot. Because a lot of progress had been made on turtle bycatch mitigation elsewhere, and we ended up applying results of that research in Hawaii quite successfully.

EG: Mm hmm. Deeper sets and…

CB: Um, yeah, a different kind of hook and bait was a very successful combination, circle hooks and fish bait that hugely reduced the take of large loggerhead and leatherback sea turtles in the shallow set fishery.

EG: So the deeper sets weren't as important?

CB: They um -

EG: - I remember that was a part of the experiment at the time.

CB: They did not end up, you know, the major reduction from like 400 turtles a year to dozens a year, was achieved just by controlling the shallow set take with new methods. And by making the deeper set - the other thing that was done was the deep, was defined and regulated, so that when you were deep fishing, you really had to be deep--

EG: Yeah.

CB: --and that actually cut down on the amount of turtle take in the deep fishery too, because it was really deep, not just nominally deep.

EG: And observer coverage increased dramatically.

CB: Observer coverage was important to making that work. And knowing what was going on.

EG: So that's part of that overhead you're talking about, all the observer coverage and -

CB: Yeah, all the NEPA work, and, you know, when I came to work here there were no time cards. It was an honor system. You didn't need to be trained to ask to buy things and get, take, and go down and buy something and get reimbursed. You didn't have to be trained for hardly anything. And now we have to be trained for everything we do. And so there is a lot less, well between environmental policy, and just modern, what's considered modern government administrative procedures, it's a huge, huge additional workload that's cut into our abilities to do science.

EG: To do the mission, yeah.

CB: And I see that as one of the strongest influences and when I look to what can be done in the future to make things better, I hope that we can somehow get a handle on that. And another thing that I have worries about the future is, as you hear my story, you hear that we kept, we always keep changing what it is we're doing. So, I haven't even finished but more recently those federal waters that used to have those federal fisheries lobster and bottomfish in the Northwestern Hawaiian islands, those were closed in 2000. Those waters in the Northwest Hawaiian islands were closed and became reserves, and the federal fisheries there took a little longer to end, they were permitted for a while and then closed. But that's meant that the, you know, that whole focus

was over, and we had to have a whole new focus. And now we're geared up to do coral reef fish stock assessments and management. It never stops changing.

EG: Yeah, mm hmm.

CB: And the administrative procedures never stop, or changing or being added. And, if I had hope for the future, it was that somehow our mission could stabilize a little bit so that we could get more efficient at it. It doesn't, it doesn't get efficient when you're always changing what it is you're trying to address. And I guess it could always change. But, my imagination is limited in thinking of how, what those changes would be, and I've some hope that for the future we could get a little bit more control over the administrative burden, or at least more used to doing it, so that we become more efficient. NEPA's not nearly the problem it first was. Because when we first got it, we didn't know how to handle it. And now we have experts and professionals who know how to address it, and it's a little more smooth. But you can only sort of pull yourself out of the overhead if you've got some time and stability to do things the same way. So, that's my hope for the future.

EG: Well, how about this movement towards more protected areas, I mean that seems to call for consistent assessment of stocks and movement across artificial bounds and that sort of thing. Does that provide [laughs], even though it's not the favorite topic for a management council, does it provide some, a stable platform for research?

CB: Well..

EG: Since it seems to be a persistent trend, I don't…at least in the Pacific.

CB: It is a persistent trend. It has removed areas of work from us, so we don't study the Northwestern Hawaiian Islands lobster or bottom fisheries anymore.

EG: Not at all. Yeah.

CB: And we can't even follow up. So we don't know what the stocks are doing in the meanwhile, because we can't go fish them.

EG: Right. Interesting.

CB: Um. So that cuts down the workload.

EG: Yeah

CB: I think it's, it's pretty well established that for limited range animals, animals that stay in an area, that those reserves help them. But there's a lot of talk about reserves that there's no evidence help things, like reserves - big expanses of deep blue ocean, hundreds of miles from shore, as a way of protecting tunas doesn't. That goes back to the question I referred to earlier, when, can you, can you locally deplete the population of a species like tuna, so that the local fishing is worsened by the presence of the big industrial fleet? Never did find strong evidence for it but that doesn't mean it doesn't occur. And that's the issue when it comes to closing big chunks of ocean to highly migratory species like tunas and billfish. Whether it would do any good or not, we still don't know!

EG: Still don't know.

CB: Yeah. But longline fishing. One of the most fun things I ever got to do was to take a research vessel out to do longline fishing. Longline fishing had traditionally, before my time, been done with piles and piles of ropes tied up in little bundles that you would untie and tie end to end and spread across the ocean for dozens of miles, 60, 100 miles of this stuff out in the ocean. So, you'd end up with a main line that was strung together in segments that was maybe 60, 60 miles long with a couple thousand individual hooks in the water, buoyed up by floats at intervals so it makes this parabola of uh, it's not a parabola, what is it, a catenary curve of rope with hooks on it between floats. At my time, they had switched that off to one big reel holding 4 millimeter thick monofilament main line that you would clip, snap with, snap the lines and floats onto with clips. But the same idea. Except that with this, with this monofilament, you'd put many, many more hooks between the floats, and if you wanted to, you could get the line to fish deep that way. The practice came from the Gulf of Mexico and the Atlantic. Those boats that came over from there brought fishing gear from a company in Florida that had developed this monofilament gear for fishing for yellowfin and swordfish, so it was a surface fishing operation. They managed to modify it out here to get it to fish deep for tunas. And I got to have one of the first such monofilament rigs in 1989, when they were first starting to be imported by a local company. I got to take that out and on a research vessel and put out not 60 miles, but 10, 15, sometimes 20 miles of line with maybe 800 hooks at the most, and you would, you know, when you go longlining, you catch lots of great big fish. I mean, it's not sport fishing, but you have all the excitement of seeing the catch and bringing it onto the boat or letting it go, and sometimes we would actually catch and track fish.

EG: That's one thing we haven't hit on is tagging.

CB: Yup. Well, we, I talked about the invention of sonic tagging--

EG: Yeah, mm hmm.

CB: --which was a development of the Lake Lab in Wisconsin and the Honolulu laboratory here.

EG: And that gradually evolved into pop ups and all…

CB: It went from following fish based with hydrophones, listening to that little pinger that Gerry Chipman first designed to creating a smart tag, and I was actually present at the sort of evolution of that idea. One of our tuna conferences um, oh what was his name? Keith Jefferts was a scientist at a company called Northwestern Marine Technologies, who'd had this concept of having a chip record temperature and depth. He had heard a renowned fisheries biologist, I think it was Lee Alverson, say that if you knew what water temperature and what depth a fish was, you could probably figure out where it had gone. And so he had said that to, at some meeting, earlier meeting with Keith Jefferts and Keith came to, flew his plane down from Shaw Island, Washington to Lake Arrowhead for a meeting of the tuna conference, and said, "Hey, you know. Alverson says we can take this -I'm not sure I have the first name for Alverson right, Alverson says we can, if I can, if you had this data logger that told you what the temperature and depth was, you could tell where a fish went." And that was probably a little too optimistic. But we had some meetings following that trip to the tuna conference where we discussed the idea. And came up with the notion at these meetings of a bunch of scientists thinking together that, well, if you could also record light, not just temperature and depth, if you could record light you could basically celestially navigate.

EG: Mmm!

CB: Because if you know when the sun comes up and when the sun comes down, you know how long the day is.

EG: Right.

CB: And if you take the exact halfway point, that's noon.

EG: Gotchya.

CB: And if the chip in the tag has a clock in it, you know what Greenwich noon is, and you know what local noon is. And as all old sailors know, if you know local noon and Greenwich noon, you know where you are in the world in terms of longitude. So that's, that's the easy part. Then the hard part is the, is the latitude which was, of course in the old days, just figuring out how to navigate, that was the easy part and longitude was the hard part because they didn't have clocks. Now with a clock, longitude is the easy part and latitude was the . .

EG: Hard part.

CB: Because the fish can't look at the stars. And they can't see the altitude of the pole star. But they do know how long the day is and the date. And day length is a function of latitude, if you at least know whether you're north or south of the equator.

EG: Mmm hmm, mm hmm.

CB: You know how long the day is, and you know the date.

EG: The date.

CB: You know, you know what time of year it is.

EG: Mm hmm, interesting.

CB: So that was the trick. We said, "Yes! We can, you build us tags that will record all those things, and we can figure out where a fish goes."

EG: Interesting.

CB: And with various fits and starts they worked on that. Much more successful are the tags that are carried by animals that come to the surface often enough that the satellite can actually get a hit on the tag. Because this scheme for analyzing the light hasn't been all that successful. It's got a pretty wide variation. But the other remarkable development was the tags that would not have to be recovered by fishermen, electronic tags like this, that would not have to be recov-- first ones you had to get them back.

EG: Right.

CB: And they designed ones that would fall off and upload all that data to satellite.

EG: Right. That's where we are now, I think.

CB: Yeah. But yeah, I tried I was one of the first people to try implanting those kinds of tags in big eye tuna to get a record of movement, and I worked with the people at CSIRO [Commonwealth Scientific and Industrial Research Organization] to develop that technology for Southern Bluefin Tuna which was one of the biggest, first big projects that used smart tags. And that was fun. That felt like being on the front edge of technology. That was the time in my career where I felt I was part, helping to push technological development forward in a way that would help. We thought it was going to revolutionize fishery management. When we figured out, oh

now we can tell where fish really go, not just where they appear to go when you tag one and they get the tag back. But actually it hasn't revolutionized the science.

EG: Um, not enough data, or?

CB: It turns out that the picture we had from conventional tag returns isn't that far off from the one that we get with these -

EG: Interesting.

CB: - You know once we follow the fish movements, more - with more detail, looks like many, many highly migratory fish like tunas tend to stay not that far from where you tag them, and some of them go a whole long way, and that's what you see with the archival ones, too. We thought maybe all the ones that look like that never went anywhere, were unbeknownst to us making big loop, big, big loops and just getting caught again where they got caught the first time because that's where they were vulnerable to being caught, but they didn't really stay there all the time. But there hasn't turned out to be a whole lot of huge secret un, un- I shouldn't say secret, but a whole lot of unobserved looping amongst those fish that don't go very far. Yeah, a lot of fish don't go very far, and then a bunch of them do.

EG: Do. Hmm. [laughs] Sounds like the natural world.

CB: Yeah. But they're, we're getting more clever about how to use that kind of information. How often fish return to a spot, what kinds of water they use, what's important habitat to them, what depths they're at, all kinds of very useful information that it was much harder to gather one fish at a time using a ping, trying to follow a ping with a hydrophone.

EG: That's fairly significant in Hawaii with the notion of a, a, I don't want to say a sub-population, but a behavioral population that hangs around the islands.

CB: Mm hmm

EG: You know, from a management perspective that seems to be an important finding.

CB: It, it's a, it's a huge issue whether that's true or not. There's a bunch of evidence that it may be true. It's --

EG: Increasingly it seems, yeah? Ok.

CB: Yeah. Increasingly. Um. There's still a question of whether it is true for the whole life cycle or just the smaller fish since the, there's a lot less information from big fish.

EG: Ah. Right.

CB: And there are a lot fewer big fish. But I'm not going to talk a whole lot about that issue. I have, if you want to you can go to the Council and get about an hour and a half on video of me describing the pros and cons of that information and what it means for size regulation of local fish and, I'm going to bypass that topic for today.

EG: Sure, sure.

CB: Hmm.

EG: We've hit quite a bit, we've done well.

CB: Quite a few things.

EG: The lead-in story really helped organize the discussion [laughs].

CB: Yeah, we covered a lot of this stuff.

EG: Well, how about an assessment of, you gave us an assessment of the future.

CB: Yup.

EG: Uh, where would you like to see things go - here - at the Center, in terms of priorities?

CB: I'm never very good at that, that question. My bosses would tell you that.

EG: Scientists [laughs].

CB: I mean, I just feel so, that so much of the time we end up responding to very clearly outlined needs of others that come, you know, I don't, I don't feel like we drive our course much. We're constantly having to face a new problem. And that's, that's not bad except that I think, as I said before, it makes it hard to get efficient. One of the biggest challenges is how quantitative the science has become. How much more quantitative computers allows us to be. And the difficulty of finding people that are really skilled in fish stock assessment, modeling, quantitative modeling of any kind, and what a, what a big um, how competitive the market for people with those skills are. So that it's hard to get them to work in fisheries. Um. And even when it just comes to down

to database managing, which is a real important thing for fisheries, too, the market for people who can do that well is also hugely competitive. So, we struggle to be as professional as we need to be about this business.

EG: There's a human resource element here, yeah.

CB: We're particularly shorthanded in the stock assessment field in the Pacific, Pacific islands and in Hawaii. We don't, we are trying to develop a program at UH that will train more people to be skilled in this area. We don't have a hinterland like they do on the mainland with lots of universities in commuting and easy moving distance, training people in quantitative sciences. And so, I would love to have this organization become better staffed and more professionally staffed to do this kind of work.

EG: Well, how did the demise of PFRP [Pelagic Fisheries Research Program] factor into that? Are those folks - ?

CB: Hmmm. It had never really created a faculty program at UH, which we are now doing, as a

EG: So these were visitors, basically.

CB: - Yeah.

EG: And they're probably still available to, well, or some of them are, I guess people are aging out of that, as well. But you envision a, an actual program that would boost stock assessment capacity.

CB: Yeah, if we could, I would like the University of Hawaii to build up its' program of producing academics in the field of fishery science and fishery stock assessment. That would really help us a lot. We are, it took a while to convince me, but we're very much trying to develop a fishery independent survey technique which does not actually require catching fish. So, I would love to see that succeed and become a very powerful tool. Among other things, it would be amazing to be able to use a technology like that that uses cameras to look at fish and uses automated and artificial intelligence to try and count and measure fish, so that that process becomes efficient. We could go back and look at things like the Northwestern Hawaiian Islands bottomfish fishery. We could have a hugely powerful tool to find out what, what the effect of having reserve up there has been. So, that was Mike Seki, my boss's vision for the future, and I, it took me a while to become convinced of how useful it could be. But I'm, I'm a convert. We have a devil of a time trying to produce credible stock assessments for bottomfish as it is now. Many, many problems with the fisheries statistics we have available to us, and an ability to develop a scientific fishery independent tool to, to measure fish abundance would be fantastic.

EG: Right on.

CB: Kind of running out of steam. How long have I been at it?

EG: Um. An hour and 10 minutes.

CB: Ok, well there's plenty more time, and I thought I wouldn't, wouldn't be able to finish. But um. I got everything down on my list. If you find parts of this when you review it that that seem the most interesting or that you'd like to expand on, I'd be happy to do it again. And I'd be happy to redub any parts of it that you think need doing.

EG: Terrific. Great. Well, thank you so much Chris. It's been really helpful and -

CB: Here's a copy of the legend.

EG: [laughs] okay, thank you.

CB: And this might be useful, too, it's a timeline.

EG: Ok, yeah, good.