

James E. Johnson

Oral History Interview  
Interview Number 1

Interviewed by Carson G. Prichard  
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Besser Museum for Northeast Michigan  
Alpena, MI

Project—Human dimensions of the Lake Huron salmon fishery crash: Using oral histories to assess the attitudes, values, and beliefs of anglers and non-angler stakeholders in Great Lakes coastal communities

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PRICHARD: So my name is Carson Prichard. I'm here with Jim Johnson, retired fisheries biologist from the Michigan DNR [Department of Natural Resources]. It's Wednesday, May nineteenth. It's 12:31 p.m. Just before we begin—or I should say we're at the Besser Museum for Northeast Michigan in Alpena, Michigan. Before we begin, can you please just state for the recording that you do consent to being interviewed and for the interview to be recorded?

JOHNSON: I consent to the interview and for it to be recorded. Yes.

PRICHARD: Okay. And then to begin, can you just tell me about yourself, Jim?

JOHNSON: Okay. I was raised thinking I was going to be dentist, and (laughs) went to Central Michigan University for a while and discovered fisheries while I was there and switched my direction in the fisheries way at Central, and then as a junior I transferred to Michigan State University and studied fisheries there. Got my master's degree at Michigan State and then worked for seven years as a fisheries biologist in Nebraska,

where I was a district supervisor and I was the head of fisheries management in Nebraska when I left to take the head of research for the Utah Division of Wildlife. And I worked there as head of research for ten years and then the dream job that I'd been looking for for years came up in Alpena. And I applied for it and by golly they offered it to me, so I've been here ever since. This is where I did my master's research, which was comparing survival—we were looking at early mortality syndrome in salmonids and I chose coho and steelhead, and raised them from eggs from Lake Michigan and Lake Huron. And the Lake Huron ones were gathered here on the Thunder Bay River. And then I repeated it with steelhead. At that time we thought early mortality syndrome was caused by contaminants and I showed that, yeah, there's a really really close association between contamination and the survival to first feeding of salmon and steelhead. But yeah, there was a nice correlation because it turns out that's because they were eating so many alewives and alewives were a perfect way to bioaccumulate contaminants. It wasn't until much later that it was discovered that it was really the thiamin deficiency issue that was causing this early mortality syndrome. But anyway, I got to come back to where I did some of my graduate work and as a kid I used to fish in Port Sanilac where my grandparents lived on Lake Huron, and my grandfather was a commercial fisherman there, for a while anyway. So I've had a long and close association with Lake Huron and it became much closer when I got the job here. So I was head of the DNR's fishery research station in Alpena from 1989 until 2014. And that station does the research and assessment work for the waters of the St. Marys River, Lake Huron, all the way down to Port Huron. So, pretty good swath of water. And then, towards the end of my career, the station head position for Lake Erie, and Lake St. Clair, Detroit River, he retired and

rather than fill the position they gave me that, too, so for a while there I was over the research of the eastern side of the state, Great Lakes waters. Which was ridiculous but, whatever. (both laugh)

Anyway, what that did is place me in a position to witness some of the major changes of Lake Huron. And the changes were in about this order: the introduction of lake trout through stocking to try to restore lake trout, introduction of walleye through stocking to try to restore walleye, and then until about 2000 virtually no sign of success, other than it was basically put-grow-and-take stocking, and the system seemed to be quite stable, and based on alewives and stocking. Then the changes started to happen in rapid succession starting in 1998. Nineteen ninety-eight there was a decline in alewives at the same time Norine Dobiesz was doing her PhD work under Jim Bence at the Quantitative Fisheries Center [Michigan State University]—got funded to look at the total consumption of alewives by Chinook salmon in Lake Huron. And she had a population model for Chinook, and she just needed to feed the Chinook in the model and needed to know what their daily consumption rates were and I was—and for her my job was to go out and collect these salmon through the summer—you don't collect them from anglers because those are feeding fish. And she wanted to know what the ingestion rates were across the population whether they're in feeding phase or not, she wanted a cross-section of what was in their stomachs and she needed fresh food [Johnson clarification: stomach samples], too, she needed fresh fish. Fresh stomachs. So we thought this would work pretty well. We'd used deep, or, high gillnets. These were either sixteen- to twenty-foot from float line to lead line monofilament nets, larger mesh sizes. But we had a gradation of sizes because we wanted to sample two-, three-, and four-year old Chinooks, so I think

they were three- to six-inch mesh. And we'd suspend these things into the thermocline where we were marking Chinooks, and it just happened that that was the year when Norine started her work that the Chinooks didn't have anything to eat so it kind of compromised her work. (laughs) We had a hard time sampling fish. They weren't moving very much, they were just kind of hanging there and their stomachs were mostly empty and the fish were emaciated. And that's the first time the warning bells went off to us at the research station and to the agency that things weren't right in Lake Huron, and that the alewife population might not be so stable after all. So Norine somehow managed to pull off her thesis. She got enough information on diets to show that, yeah, consumption, top-down effects were pretty serious, and the Chinook population was maybe large enough to impair alewife survival. At the time we still—her model is based upon the assumption that 20 percent of the fish were wild in Lake Huron. (Prichard laughs) And then because of the concerns in 1998 with alewife abundance, I insisted that we couldn't keep stocking Chinooks and not marking them. I needed to know what the real percentage of wild was. And the management—fishery division management team agreed to this massive marking proposal. Dave Fielder really helped me with this because he's an OTC specialist, oxytetracycline marking specialist. He learned OTC in his work in South Dakota marking fish there. And so he guided the process to marking in the hatcheries and we managed to get three year-classes in a row all marked with OTC, and a subset of them marked with coded wire-tags. And then we began collecting Chinook salmon from the creel. It was very very hard to gillnet them, we kind of gave up on that. We collected most of our salmon from the creel and from weirs. We had Canadians helping us with some of the returns from their streams. We got a few samples there. What

we'd do is sample the tail sec[ti]on—tail vertebrae, right underneath the adipose fin from each fish [Johnson clarification: the caudal peduncle]. And we'd go around and sample tournaments—that was where we could really hit pay dirt. Salmon were coming in fast and furious. We'd get lengths and weights, check their stomachs, and remove the vertebrae. So we'd weigh them and take length first, give it to them to clean, then take the skeleton back and check the guts and remove the vertebrae. We collected an ample number of samples. There was no shortage there. And that was good because there was a little bit of variation north to south, and there was a lot of doubt about the OTC technology.

And I remember—the most distinct memory of that period was one afternoon I was working at the office and Steve DeWitt who was the technician at the time reading all the otoliths—or (Prichard: Vertebrae.) all the vertebrae, he was preparing the first samples from the first year of collections from the creel, and he went through, I don't know, must have gone through forty or fifty fish and hadn't seen more than one or two OTC marks. And he called me down, he said, "Jim, you've got to see this." And we looked at these things and went through some more, did another twenty or so, and I don't know if we saw even another OTC mark. They were just not marked. And Steve's immediate reaction was, It doesn't look like the mark's holding. It doesn't look it's working. But we collected Swan [River] weir fish. Swan weir is, maybe Frank [Krist] told you, it's on Swan River, which is really a creek that drains a limestone quarry, and no self-respecting salmon would try to reproduce there, and there's where we've been stocking for years and years. That's the center of Chinook stocking for Lake Huron, it always has been, because it's an egg taking facility. And we had a sample from there, so we thawed those

out. By now it's like seven o'clock and we're still thawing vertebrae but neither of us wanted to go home until we got the answer. And we put some under the scope and they all just glowed beautifully. (laughs) So, the marks worked. And it was really really scary to see the low percentage of hatchery fish that were out there. And yet we were getting good returns of stocked fish to the Swan weir, so it's not like the stocked fish weren't working. And at that time we were also getting pretty good returns at—we were doing a—we had been doing cage culture and evaluating cage culture<sup>1</sup> in Oscoda and Harbor Beach and getting good returns there, too, using—and been doing that for years using adipose clips and coded wire-tags.<sup>2</sup> And they were coming back just fine, too.

PRICHARD: Is that the same as net pen?

JOHNSON: Net pens, yeah. But in the lake you put cages (Prichard: Okay.) in the lake and hold them until they're well-smolted and trying to get out and just release them from the net pens. Yeah. But we did have raceways in—we'd built raceways on the AuSable River and they're super slick.<sup>3</sup> They worked great for salmon and they improved salmon stocking survival by about two or three hundred percent. That's published in one of the DNR research reports. "Early Life History of Chinook Salmon and the Effects of Net Pens," something like that, by Steve DeWitt and myself. (Prichard: Okay.) John Clevenger was a co-author, too. Myself, Steve DeWitt, John Clevenger.

<sup>1</sup>Johnson clarification: "doing cage culture and evaluating cage culture" meant evaluating net pen acclimation

<sup>2</sup>Johnson addition: adipose fin clips and coded wire-tags were used to identify them

<sup>3</sup>Johnson note: you could call the raceways "pens," too

*At |00:12:16| a machine turns on near the back patio of the museum where the interview is being conducted. This machine can be heard until the participants relocate inside to a classroom in the basement of the museum at |00:24:25|.*

JOHNSON: And that gave us some insight into early life history, too. We knew that smaller stocked Chinooks were not making it, and that pen culture was getting around predation to a certain extent. The fish [the pen-acclimated Chinook salmon smolts] were being stocked at a size where they were ready to move [further] offshore but Chinooks don't go offshore a lot like steelhead and Atlantics would. They [Atlantic salmon] just disappear, they go out into the wild blue yonder which makes them easier to stock around walleyes. But Chinooks want to stay on the beach for their first few weeks, and they want to stay in bays and close to shore for their first few months. Makes them real vulnerable to predation. So we were able to stock around the predation problem<sup>4</sup> as long as we had alewives. We knew that going into this marking study. So we knew that the stocked fish were surviving, we were doing a good job getting around predators. So we knew there were quite a lot of stocked fish out there and yet they were dwarfed by the number of unmarked fish. And so I worked with Ed Rutherford at University of Michigan—he's now at NOAA [National Oceanic and Atmospheric Administration]—and the two of us did a mark-and-recapture approach on our data from vertebrae and known numbers of fish stocked and we were able to—of course we're taking vertebrae, so—the vertebrae are not a perfect bony structure for aging the fish, but you can age them. And we were pretty confident in our ages on vertebrae, and some of them we had otoliths from so we could confirm the vertebrae ages. But we kind of roughly estimated how many were from

<sup>4</sup>Johnson clarification: the predation problem occurred during the Chinook salmon smolts' beach phase

each age group, and we knew how many were stocked in each of those age groups, and came up with an estimate of the percent hatchery, percent wild. We knew how many were stocked in each age group. We just did [a] mark-and-recapture estimate for each age group, and added them all up and came up with about fourteen million recruits to the lake. That's not fourteen million salmon this big,<sup>5</sup> (Prichard: Right.) but fourteen million [young-of-year] salmon this big. What happened to them after that point we weren't sure. But we knew that the wild fish must be surviving as well as the stocked fish at that time. And the stocked fish weren't surviving too badly, but we never knew for sure how well they were stocking. [Johnson clarification: "surviving," not "stocking"] Norine estimated it in her model, and I think that was probably a reasonable estimate.

At that time there were, I guess, as quantitative as I can be, is there was a shitload of salmon, (both laugh) and enough for us to, again, think that this is a serious top-down situation. And then at the same time Ji [He] was measuring reproduction of lake trout and started working on his assessment of top-down effects in bioenergetics of lake trout. And Dave Fielder who's now a damn good stock assessment biologist—he got his PhD on stock assessments of walleye and he built the walleye stock assessment models. And you put it all together with diet information and the bioenergetic knowledge of just about everybody they could scrounge up. And they estimated in Ji's paper that Lake Huron's a heavily top-down system. But that was disputed in peer review. There was a lot of controversy over that. And I have to say that, yeah, the bottom-up effect—we oversimplified it. We acknowledged there was bottom-up, but we said it was primarily top-down. And I think it was primarily bottom-up, but top-down had a serious effect. But, maybe split the difference. It was both, but we had been under-assessing what the

<sup>5</sup>Johnson clarification: of a size big enough to be caught in the recreational fishery



bottom-up effect was until we saw what was happening to whitefish, then we realized anything that is small is not going to find much to eat. And anything that's appealing to walleyes and lake trout is going to be fed on. So it's a double whammy. If they don't starve to death they're going to get eaten. It's that sort of thing going on. So they were working in—the two, bottom-up and top-down effects were working collaboratively to reduce what we were seeing. But the mussel effect, especially with the later surge of quagga mussels I think, made it mostly a bottom-up effect by maybe 2005, something like that.

But, that's my story. I think the most gratifying thing along that storyline, though, was the efforts we made to treat the St. Marys River. The Great Lakes Fishery Commission established the St. Marys River sea lamprey taskforce—I was a member of that. And the Michigan DNR established the sea lamprey funding taskforce which was a subunit of the Lake Huron advisory committee and Howard Tanner and I were chairs of that. And the two worked in tandem. The St. Marys River lamprey taskforce identified where the ammocoetes [larval sea lamprey] really were, where the hotspots were, and identified technologies for treating that were cost-effective and came up with this granular Bayer treatment using GPS [global positioning system] guided mapping and dropping of the granular form of Bayer. And the DNR came up with the money. The DNR lobbied Congress. I actually went over to Canada and lobbied Parliament there for a while, went to various hearings they were holding. And lobbied our congressional delegation. Marc Gaden maybe was cutting his teeth then, also, doing what he could. He was just starting then, I think. He might have been in college at the time. But that might have been when I first met him. And amazingly, Governor Engler—and I'm a democrat (laughs)—he made

me vote for him because he embraced this, and he took a proposal to the legislature that would rebuild Platte [River State Fish] Hatchery because he said, “We’ve got to grease this. Legislators want hatcheries, right? They think stocking’s the answer. But if we really need to treat lampreys, let’s embed the lamprey proposal in a hatchery proposal.” And I hadn’t thought of that. And the hatchery certainly needed rebuilding. So we ended up with \$4.8 million I think it was, to go towards sea lamprey control—just the St. Marys River—and then another \$5 million for Platte River Hatchery. And Oden [State Fish] Hatchery got a rebuild out of it, too. So, everybody was onboard with sea lamprey control—the feds, the state. Congress came through and restored the Great Lakes Fishery Commission’s base budget, and then added some just for the St. Marys River. And we had the funding available to do the St. Marys treatment which we did starting in 1998-’99. And that was happening at the same time as the new negotiations for the 2000 Consent Decree were taking place. And I think the thing that really made the Consent Decree work was the fact that we had lake trout being stocked with a serious federal investment in that—millions of dollars a year stocking lake trout—and this multimillion dollar treatment of the St. Marys River. And in some of the negotiations—I’ll tell you there’s a non-disclosure agreement over it, but I think I can say that the parties agreed that it would be crazy to continue treating the St. Marys River and crazy to keep stocking northern Lake Huron if something wasn’t done about the gillnet issue. So if we hadn’t had the momentum from the St. Marys River treatment I don’t think we would have gotten the gillnet conversion done. So it all snowballed into one big change. The change resulted, though, from several things—it was from the reduction in gillnet effort, from the increase in sea lamprey control, and the collapse of alewives which caused the thiamine

deficiency problem to go away. And in Saginaw Bay it meant that the predation on larval walleyes went away.<sup>6</sup> And by 2005-2006 we weren't stocking walleyes anymore. And we could see the end of the line for the lake trout stocking.<sup>7</sup> The wheels started turning while I was still working to stop stocking lake trout in Lake Huron. So that was pretty exciting to work on all those things and see it all come together and produce the result it did.

Some would say that the loss of the salmon, the DNR could have done more to prevent that by cutting back stocking more quickly, but I don't think that's politically feasible and in hindsight, now, with the bottom-upper's argument becoming more and more persuasive, I don't think the DNR could have done anything to stop the alewife collapse in Lake Huron. It was going to happen. And I think one of the proofs of that is that Saginaw Bay—in Saginaw Bay the walleye—the alewives were—that was a major spawning haven there, for alewives.<sup>8</sup> Why did they simply disappear from Saginaw Bay? They're so fecund. It doesn't take a large year-class of [spawning-age] alewives to produce—of spawning alewives—to produce a large year-class of young-of-the-year. And all I can conclude is that the young-of-the-year, starting in about 2002-2003, before the walleye recovery, before anything had changed with walleyes, the alewives had already stopped reproducing in Saginaw Bay. And they certainly stopped in Thunder Bay. We call Thunder Bay the Thunder Bay biological desert now. (Prichard laughs) It has almost nothing in it. It still has almost nothing in it. A few smallmouth bass along the shoreline. Gobies, but only where there's patchy outcroppings of rock, and mostly it's a

<sup>6</sup>Johnson clarification: predation by alewives on larval walleyes went away and walleye reproduction rose

<sup>7</sup>Johnson clarification: we could see the end of the line for lake trout stocking as they began reproducing

<sup>8</sup>Johnson clarification: One of the proofs that the DNR could not have done anything to stop the alewife collapse in Lake Huron is the Saginaw Bay walleye. Saginaw Bay was a major spawning haven for alewives.

sand bottom. It was a *Diporeia* haven.<sup>9</sup> Now that *Diporeia* are gone it's got mostly mussels and nothing much else. No plankton. So nothing recruits. Saginaw Bay was a challenge. If it was bottom-up, look at Saginaw Bay, see if it actually happened there, too. And as productive as that place is, I think there was a bottom-up effect on alewives, too, because they collapsed before the walleyes recovered. So, something else is going on, not just top-down. Salmon don't go into Saginaw Bay and eat alewives. (laughs) The alewives collapsed in Saginaw Bay before the alewives [Johnson clarification: before the *walleye*] had shown any signs of recovery, and the only change was the quagga mussels had swept the system. Just a lot more of them.

PRICHARD: I didn't—well, I didn't want to interrupt you. I guess, would it be possible to move inside? (Johnson: Mm-hm.) Because I think that's going to be—

JOHNSON: That could really mess you up.

[00:24:26]

PRICHARD: I hadn't really thought of this until now, but when you described that—I think you were talking about how there was probably nothing Michigan DNR could have done with respect to stocking. (Johnson: Right.) The bottom-up effect was there and that the outcome that played out was not really something that was influenceable or much under control. What if somebody said—take the way that Lake Michigan is being managed now—is that too different to compare to Lake Huron? But there, they have the predator-prey balance framework for trying to balance the number of—predation pressure on alewife with the amount of alewives that their understanding is of there being out

<sup>9</sup>Johnson note: prior to about 1995

there. Is that—well, maybe it's not fair to speculate, but is that not going to probably work in the long run? Or are Lake Michigan and Lake Huron not comparable enough to even try to—?

JOHNSON: Well that's the beauty of the test tube approach that I was talking about. We have different systems, but we do have a control with Lake Superior. But Lake Huron is a much less productive system than Lake Michigan. And if you look at the limnology of the two lakes, Lake Huron was always the whitefish lake. It's always had big expanses of littoral zone. And in this case let's define littoral zone as less than 110 feet. A whole big chunk of Lake Huron is less than that, especially from Alpena south, and over on the Canadian side up to Bruce Peninsula, big enormous sandflats that were once *Diporeia* heaven and therefore it made us a whitefish lake. And Lake Michigan's more trough-shaped with [a] much higher percentage of deep water. And as I was mentioning it seems that there's a gradient of dreissenid effects. The least-affected lakes are the shallowest ones that are eutrophic. And the most-affected ones are the oligotrophic lakes like Lake Huron and Lake Michigan. Lake Superior would have been just disastrous but it's too soft o'water for zebra mussel and quagga mussels' shell making, and a little too cold for the zebras. Not too—quaggas could have made it in Lake Superior but there's just not enough calcium carbonate there. [Johnson clarification: Lake Superior is not too cold for quagga mussels] So that keeps Lake Superior as a steady state and we can compare these two lakes and try to infer things from them. The conundrum is why isn't Lake Michigan collapsing? Is it because it's being driven more by its nutrient inputs like Saginaw Bay is? Saginaw Bay's doing fine, too. It's obviously nutrient driven to the point that the mussel effect isn't as pronounced there. And I think maybe there's some of that going on

with Lake Michigan, too. It's got a better nutrient feed. But there's also something to do with the morphology of the lake, I think. And we've found that in Lake Huron, in our bit of really truly offshore water where we're beyond that 110 feet, where we're beyond where the thermocline intersects the bottom, there's no opportunity for dreissenids to vacuum out the zooplankton—or the phytoplankton—of those offshore waters, except when the offshore waters, by currents, are brought into that more shallow habitat. So the offshore waters of Lake Huron have more plankton now than the nearshore which is *totally* ass-backwards. (Prichard laughs) It's never been like that. Always the nearshore waters were the plankton-rich environments. And we used to have this donut effect of overwinter survival of diatoms, and then they bloom in March and April. So satellite imagery used to show this brownish, tannish color to the water all around the shoreline. It's gone. It's absolutely gone. But that's where the production used to be is nearshore. And that's why the whitefish recruited so well in Lake Huron nearshore, there was all that plankton for the fry, and then for the older fish there was always *Diporeia* habitat everywhere. Both are gone. So I think what it tells me about Lake Michigan is that Lake Michigan, being more trough-shaped, has more of that open water that has a—it's just too deep for mussels to have much of an effect—especially after it stratifies, there's no effect of mussels in the summertime on the epilimnion over three hundred feet of water. Yeah, the nutrients have been reduced in Lake Michigan by quite a bit, but still there's some plankton in the offshore water and it must be just enough to keep alewives going.

I think there was another factor, though, that happened in Lake Huron, but I can't be sure. I do know that in the late 90s and early 2000s we had a period of dry summers, and warm winters—especially warm winters. The winter of '98-'99 was a cold winter, and had

some alewife mortality. Then it warmed up. So '99-2000, 2000-2001 were super mild winters and alewives just, bang, they recovered. So there is a certain thermal sensitivity to alewives—we're right at the northern edge of their range, anyway. And warm winters are usually good for alewives. But it's also warm and stable flows in our tributaries are good for salmonid recruitment. Paul Seelbach worked on our most stable river, the Little Manistee River that flows into Lake Michigan, looking at steelhead recruitment and those factors that affect it from year to year for his PhD work back in the early eighties I think it was. And he found that low water winters with warmer and more stable conditions without big spring snowmelt and runoff periods produced the highest crops of steelhead, as both young-of-the-year that carried over to the next winter, the egg survival was better, and fry survival was better if they didn't hatch in the middle of a flood. And then the carryover to yearling and smolt size was also better if there wasn't severe winter and spring floods. And I think we had that in Lake Huron in 2000-2001-2002. And I think there probably were bumper crops of Chinooks produced, especially in Canadian tributaries, some of which were marginal, like coming off the North Channel, some of those would normally freeze solid. They don't have much groundwater coming in. But Chinooks don't need those tributaries in the summer. The [young-of-year] Chinooks are gone in the summer. But they do need egg incubating temperatures, and they can't freeze without killing the eggs. But there might have been conditions where some of their marginal tributaries actually carried egg survival over the winter and produced some fry. But our trace element analysis, the work was done by—

PRICHARD: Stephen Marklevitz.

JOHNSON: —yes, showed that by and large the big year-classes were coming out of their big rivers out of the south. [Johnson note: i.e., the Niagara Escarpment] The Nottawasaga and others. But there might have been some marginal tributaries contributing, too. But even the Nottawasaga which is as neat of a river as the Pere Marquette, it still would benefit from mild, stable winters like the Little Manistee did. So I think that we probably did have an extra-large crop of salmon in those years. If that's true, maybe Lake Michigan's just waiting for one of those super years—and I think we just had one. (Prichard: Yeah.) This is one of those years like we had back around 2000, where the alewives recovered and the salmon just reproduced like crazy. I was fishing the Pere Marquette and the swarms of baby salmon are just everywhere. I was catching steelhead almost exclusively on salmon fry. And was catching a lot of brown trout while I was at it. But it was amazing. I hadn't seen a river so full of fry since—let's see, I was fishing the Hoh River in the Cascades in Washington—or in the Olympic Peninsula in Washington—and it was filled with fry just like that and everything was eating the fry. And I thought that was a west coast thing until I saw the Pere Marquette. Man, it's just swarming with baby Chinooks.

And, yeah, maybe there's a thiaminase issue, too. And I don't know why. I know, was it Jay Wesley or Randy Claramunt? I think it was Randy Claramunt that once said, "Thank God for thiamin deficiency," at the time he was working on Lake Michigan, "because if it weren't for thiamin deficiency the Pere Marquette River would probably produce enough salmon alone to wipe out our alewife forage base." So there's that, too. There's stochastic variation driven by weather, but there's also variation in thiamin deficiency effects. If enough fish start feeding on things like ciscoes or smelt in Lake Michigan—and that's



what Lake Huron had and Lake Michigan doesn't. Lake Michigan had a more diverse forage base composed of about 50-50 smelt and alewives. [Johnson clarification: Lake *Huron* had a more diverse forage base, as clarified at |00:36:20|] So as alewives went down they shifted more and more to eating smelt which are—there's still a thiaminase delivery system there in smelt, but not nearly as potent as with alewives. And in systems where—well like Atlantic salmon are super sensitive (Prichard: Yeah.) to thiamin deficiency but they can eat smelt. But they can't eat alewives and produce decent eggs. Not at all. And it looks like Atlantic salmon stocked in Lake Michigan actually died when they were trying to spawn—the spawning stress was enough to kill off broodstock. So you can't have Atlantic salmon and alewives in the same place. So I think what we've seen is evidence that thiamin deficiency maybe also changed during the surge in Chinook salmon reproduction in Lake Huron, and that's a lesson they might think about in Lake Michigan. That if they're not monitoring thiamin deficiency they might be missing a major factor that could produce a large wave of Chinook reproduction. Combine that with mild weather conditions and it's a double whammy.

|00:36:20|

PRICHARD: So just to be clear, in Lake Huron when there was more of a prevalence of smelt in the diets, it could have been correlated with when you're seeing, or when you might have seen greater natural reproduction of Chinook. And then in Lake Michigan, you don't have the presence of smelt so much.

JOHNSON: No, they're almost obligate (Prichard: Yeah.) alewife feeders there. But ciscoes could change that, and ciscoes are coming on. And especially the larger salmon

would select for, I don't know, probably they would be selecting for ciscoes up to three hundred-four hundred millimeters. A twenty-pound salmon would definitely rather eat a three hundred-millimeter cisco than chase down twenty-five little alewives. So, lake trout are the same way, they select for really large items. Given the choice, so when you go through lake trout stomachs and see, say you're going through stomachs from fifteen-pounders, you're very likely to see whitefish in those stomachs, and other lake trout, and steelhead, pink salmon. Even though their abundance is much much lower than gobies, they select for—they definitely select *for* and seek out large fish. And that's what I suspect Chinooks would do though we don't have very much Chinook diet information. So it's surmising, though. We never, as I mentioned earlier, were able to very adequately describe the diets of Chinooks. We tried and it didn't work very well and we certainly didn't have enough data to say for sure that they had switched—enough of them had switched to eating smelt to produce better eggs. We weren't even monitoring egg thiamin levels that well at that time. We were starting to monitor it in lake trout but not Chinooks. Only at the Swan weir. We were monitoring it at Swan weir and that was the only place we monitored egg thiamin.

[00:38:24]

PRICHARD: I wonder if you could correlate that with—because the brood stock—or, the eggs are collected from wild fish, if you could—

JOHNSON: Well they're collected from feral fish. The Chinooks are stocked and then they return to a stocking site at Swan.

PRICHARD: Yeah, I didn't—yeah, they're collected from fish that have been eating out in Lake Michigan. (Johnson: Yeah.) And you could look at, maybe in the hatchery practices, whether or not there was changes egg survival to hatching, and compare that to diet data.

JOHNSON: I think they must be doing that. (Prichard: Yeah.) They must know whether or not they have to treat with thiamin. They used to put Chinook salmon eggs in thiamin baths. Do they still have to do that? I don't know.

PRICHARD: I don't know. I know they do that for the Atlantic salmon.

JOHNSON: They're super sensitive. (Prichard: Yeah.) But, do they still do it for Chinooks?

PRICHARD: I don't know.

JOHNSON: And have they been measuring egg thiamin levels in Chinooks over the last few years? I think they should. I think that's a really important parameter. That would be a tipoff as to whether or not there could be a surge of reproduction. (Prichard: Yeah.) But the lakes are different. The factors, then, to summarize, are productivity of the two lakes are different, the morphology of the two lakes are different, and I think they can both respond to the same stochastic effects of weather and so on, it's just that we had that combination of effects when alewives were already down, they'd taken a hit in 1998 from a hard winter, and also they were more stressed because of the uniquely efficient feeding of dreissenids in Lake Huron where they were able to strip more of the lake of plankton than they have been in Lake Michigan. So there's those differences. I feel like we're at

that point now where the Lake Michigan Technical Committee should start writing their predictions down (Prichard laughs) on an envelope like we did for the Lake Huron Technical Committee and see whose prediction is right. But, yeah it's a scary thing when you're down to putting predictions on your napkin and stuffing them in an envelope to see what the answer is five years later. You have all these scientists with all these different opinions and we just don't know. I don't think there's—there's no way you could possibly know what the outcome in Lake Michigan's going to be in five years, but the lesson—the cautionary note I would take is that the bottom-up effect in Lake Huron has been demonstrated to be much more significant than we thought, so if you think you can control and manage an alewife population by managing top-down effects you could be mistaken.

[00:41:35]

PRICHARD: Well I wanted to shift to focusing a little bit more on Rogers City if we can, and so over the time that you were with the Michigan DNR, how much of a—to what extent was Rogers City something that you focused on, or had unique interactions with people there, or anything like that?

JOHNSON: Well the Hammond Bay sportfishing association [Hammond Bay Area Anglers Association] has always been an influential force. Through participation of their members on the Lake Huron advisory committee, and by their contribution of funds and people to the coalition to protect Michigan resources, the amici for the consent decrees, they've been very closely engaged with the consent decree negotiations. Their role being to advise the judge as to whether or not this agreement that's being proposed is going to

be—whether you can sell this agreement to the public. What will the backlash be like if you do this? How will the public react if you do that? And that’s been the main reason the judge wants the amici there, and the amici wouldn’t be there if it weren’t for the Hammond Bay Angler Association. They’re the ones that stepped forth in the first place. And their advice has gone beyond just public acceptability of agreements, it’s also—they’ve been really good about focusing on resource issues and keeping the parties focused on what’s good for resource sustainability. It’s weird that you have to push the resource agencies to talk about resources, but they’re sometimes so eager to get into allocation and who gets what that they forget that they haven’t yet figured out how big the pie is. And the Hammond Bay Anglers have done a really good job of that through the coalition. Of course the Hammond Bay Anglers have contributed to the Lake Huron advisory committee in a big way, especially with Frank’s leadership on the advisory committee [Frank Krist]. And I used to address—every now and then I’d be invited to talk to their annual banquet. And that was always fun. They have an annual banquet to raise funds for the coalition and other things, and just to have fun. It was always a fun banquet and good food, and lots of good stories to be told and usually some good speakers, including yours truly now and then. And I’ve been a member of the Anglers Association, and I represent the Anglers Association as an advisor to the Lake Huron advisory committee, now. Beyond that, there’s, of course, always been Swan weir. Steve Swan [retired Michigan DNR fisheries biologist] set it up, but Swan weir wasn’t named (Prichard laughs) for Steve Swan, it was already called Swan weir. But that<sup>10</sup> was at the urging of the Hammond Bay Anglers. I’m not—I’m sure Frank has that story, but it’s my understanding that the Anglers urged Steve to try something there. And it worked so well

<sup>10</sup>Johnson clarification: “that” being the stocking of Chinook salmon in Swan River

that they ended up setting up an egg taking station there. It's a very secure location where just anybody can't go in there. It's on private property, and the quarry's been super good to work with, and seems to be proud to be helping the DNR get eggs there. So that was a wonderful idea that they came up with. They've been influential in the drive to get Atlantic salmon stocked in Lake Huron and see what we can do with them. I kind of look at Lake Huron, again, as a test tube, an experiment for when Lake—if and when—if and when Lake Michigan loses its alewives, Lake Michigan would be an awesome Atlantic salmon system. But it can't have alewives. [Johnson clarification: for Atlantic salmon to survive and produce viable eggs, Lake Michigan cannot have alewives] Meanwhile [in Lake Huron] we can figure out how to stock them and make them more cost-effective. And Hammond Bay Anglers have really pushed for that, and Frank Krist in particular. He is just a force. Lake Huron would be quite different if it weren't for Frank, Frank Krist. It wouldn't be nearly as cool a place. I don't think we'd have Atlantic salmon. I don't know what the consent decree would have been like in 2000, but it wouldn't have been as good [for the resource] as what we got. So they've been very very effective.

One of the things that we didn't understand and what the DNR's office here in Alpena now is starting to get ahold of is just how much [lake trout] spawning habitat there is in the Rogers City area. (Prichard: For—?) The focus had been on Drummond Island refuge for lake trout spawning, and the thinking was Straits of Mackinac, you know, out west they call them the Mackinaw because that's where the eggs used to be collected for the federal hatchery system is under the Mackinac Bridge—or, well before the Mackinac Bridge, of course. But anyway, people had just not thought much about the spawning habitat in the Adams Point-Hammond Bay area, and Presque Isle. But Frank has been,

with all his mapping of fish, he's been fishing after the season closes, just catch-and-release of spawning fish, and pretty well demonstrated they were actually spawning on some of these reefs there, and got Ji [He] to go out and do hydroacoustics work, and set some gear and make sure they were wild lake trout. [Johnson clarification: Frank Krist *suggested* Ji He do the research] And [Ji] counted them hydroacoustically. And mapped the reefs. And yes, there's a lot of spawning going on in the Rogers City area, and it could be a major source—not just a small spawning population, but these—from Adams Point to Presque Isle those reefs could be major sources of lake trout for all of Lake Huron. Probably bigger than Drummond Island refuge. And we didn't see that coming. And Frank's just keeping his eyes open and being so perceptive. And he's a scientist. He went to Central [Michigan University], too. (laughs) And he's a real scientist. And very thoughtful and tireless. He demonstrated to Ji that he had something going there and Ji was convinced, and took the [RV] *Tanner* there, and with all their high-tech stuff they've got on the new boat that, they made ready work of proving that, yeah, it's important habitat. So things like that.

But my focus in my career has been pretty much *the lake*, and the system, not any one place. I tried not to be—to feel wedded to Alpena, especially, because I was stationed here. But any port in particular, I tried not to—you know, you can get—if you're viewed as somebody who loves this port or that, it undermines your credibility, and especially when you have to take—and when you start cutting stockings because they don't work anymore, like cutting brown trout. I had to cut the brown trout stocking in Thunder Bay which was pretty horrible, because of the Brown Trout Festival. It was a big, big deal. So I didn't have any trouble un-wedding myself to Alpena. By the time (Prichard: Yeah.) I

got done cutting brown trout in Alpena I was dirt, in Alpena. But favoritism, anything that looks like favoritism towards any one port or another, when it comes to these hard decisions like that it could lead to recriminations and things. I was really careful to try to give every location of the lake equal attention as best I could—Rogers City just being one of them. But you can't help but recognize the importance of the people of Rogers City and their interest in stewardship and the leadership that the Hammond Bay Anglers have shown. That's just their doing, that's the way it is. [I] had nothing to do with that.

|00:50:21|

PRICHARD: I wanted to ask about—because you brought up the Hammond Bay Area Anglers and the Lake Michigan Citizens Fishery Advisory Committee—and I have kind of an understanding of the framework and what goes on with respect to meetings between policymakers and stakeholders and the researchers in recent years from having gone to Sea Grant workshops and the citizens advisory [committee] meetings—but what role did the issues like the alewife crash, and the decline in the Chinook salmon fishery, and having to abandon the brown trout stocking, those issues play in—and in your having to manage the conversations about those issues and decisions with the public—how did those issues and the history of those issues shape, kind of, the current framework we have now for meetings between the agencies, the policymakers, the researchers, the stakeholders? And how did the Chinook salmon fishery contribute, especially?

JOHNSON<sup>11</sup>: Well, it's kind of changed over the years. There was like a genesis of this collaboration that happened under John Robertson's leadership when he was chief of

<sup>11</sup> Johnson clarification: My answer that follows is confined to the way these issues shaped the Michigan DNR Fishery Division's approach, not the inter-agency, inter-state, GLFC interactions.



fisheries. He set up the Lake Huron [Citizens Fishery] Advisory Committee in 1989, the same year I got here, and by 1990 we were meeting. He was a trained collaborator. He was transparent before people talked about transparency. He was a facilitator as a leader, more than an ayatollah, and he totally believed in collaborative management.

Participative management was the buzzword back then. And so that's why he set up the advisory committees is to involve people that are opinion makers and opinion leaders from all the different groups up and down the lakeshore of each lake. And Frank [Krist] was appointed as the opinion leader for the Hammond Bay Anglers Association, for example. And Ed Retherford, here, the charter boat captain, was appointed because he represented the charter boat fishery of central Lake Huron, and that sort of thing. And so early on we were doing that collaboration, but it changed when issues came up. Like the brown trout issue was the first one. We had to recognize that that was a failed program as alewife numbers went down and walleye numbers went up, we just couldn't get brown trout to survive anymore. They hung too close to shore where the walleyes were, and where the cormorants were, and very few of them survived their first year. And it cost like a dollar a fish to stock them as yearlings. And it was economically unviable. And it was—when you look at the cost of the program, we DNR people felt mandated to cut the stocking, but we couldn't do it without public support. So that's where Brandon Schroeder came in. And that's when the Sea Grant workshops changed. They used to be for charter boat captains and they'd share information and they'd learn about the latest in safety and all that stuff. And they'd be—maybe one or two speakers would come in and talk about the lake. And I'd generally go in and give an update on Lake Huron's fishery every year to the Sea Grant workshops. But there was just charter boat captains there.

When Brandon Schroeder came along, he didn't see any reason to keep that template. It was amazing. He just decided to throw that right out and make the workshops open to everybody. And he invited the DNR to bring topics du jour to those meetings and use them to inform the public and inform the press of what's up, and why, and try to get the public involved early on in these decisions. The Lake Huron biologists all up and down the lake embraced this—the managers as well as the research station. And so we started setting up these annual spring Sea Grant workshops. And one of the first things to hit was the problem with brown trout, and that this huge program that had been so successful just wasn't working anymore. And we had to cut the stocking. That was based on a lot of data. I spent years and years of my career measuring the decline, and when it happened, and who was eating them, and trying everything I could to get around the predators. For example, we'd haul these brown trout offshore on the [RV] *Chinook*—about seven or eight thousand yearlings at a time and stock them five miles offshore. And then that night while I was doing the seining for the Chinook salmon project, along the beaches there to measure Chinook salmon reproduction in the beach zone—the reproduced fish would just spread out from tributaries all along the beach—and here these brown trout are back in—the night after we stocked—that *day* we stocked them, that night they're in the beach seine catch. Right back in there with the walleyes and everything else. They just weren't meant for a lake with predators in the nearshore zone. Getting that message to the public was only possible because of Brandon's conversion of the spring workshops from a charter boat workshop to a public meeting. And now they're Zoomed, and over a hundred people attend each Zoom meeting. And we haven't had the big issues lately, but we have been working hard on Atlantic salmon lately. But that's been a good thing. The bad thing

was having to cut the brown trout stocking and then having to go through the workshop process of why we can't justify stocking Chinook salmon anymore south of Rogers City. And that was tough. But a lot of people were predicting that neither would succeed—that we'd never get out of stocking brown trout, never get out of stocking Chinooks because the public and the politics of it all will demand that we keep stocking regardless of what the science says. But we were able to convince the opinion leaders through the workshops and through the Lake Huron advisory committee, and the public was along with us. I remember we had one last year of hearings and discussion before we were going to actually cut the Chinook stocking, and we'd been doing this for like three years, telling them we had to cut it. And for three years back-to-back we had Chinook salmon presentations, and why the program doesn't work, and why it's crazy to keep stocking. And one guy stood up when it came to question time and said, "How many more of these meetings do we have to go through before you just cut the (mouths "goddamn") Chinooks?!" (both laugh) And that was really helpful. The DNR management was *very* very antsy about the cut. I mean, the Lansing administrators. That convinced them that the public had come along enough that we could actually do this. And we made the cut with no—I mean I don't remember *any* backlash. I had some backlash from the brown trout stocking. And Ed Retherford here in town, he'll never forgive me. (Prichard: Yeah.) But, it was just—the Chinook reduction from 4.3 million a year I think it was, to just a few hundred thousand in MH-1, that was just, Okay, let's do it. No backlash. Nobody's ever said, "Can't we have our Chinook back?" Haven't had that. It was just amazing. And that was because of this whole change in the way we used the advisory committee and the spring workshops. Without the public being along with us on that we couldn't have done

it. I'm worried now that that attitude isn't the same. John Robertson's been gone a long time. And I just hope the DNR doesn't lose track of how important that is: being transparent, and open, and taking your data to the public. I was amazed at how perceptive most people are if you talk to them about what your data mean in terms they can understand. They can understand it. There's some pretty complex concepts we got across, and they understood it. I think we underestimate the public too often and think, Oh, we know best. We don't need to do this. And they would never understand so let's just do it. I hope we don't go back to that way, (Prichard: Yeah.) because it was really gratifying to me to see how that worked.

[01:00:33]

PRICHARD: We kind of covered a lot of what I had written down about asking. Um—yeah. I can't think of anything else. Unless you had anything else to add that was kind of specific to Rogers City. One thing (Johnson: Yeah.) that I was thinking about was, when you started there, Rogers City was calling itself—and the local media there were using terms like “world-class”—they called themselves the “Salmon Capital” of the Great Lakes. And I was wondering, did you have any feeling about those monikers? And did you feel—you know, in that time period, from when they started stocking close to a million Chinook salmon a year in Swan River, the mid-eighties through the—1986 they had the first Rogers City Salmon Tournament, which, you know, in some years—it probably for some time period was the biggest salmon fishing tournament in the Great Lakes—was there any feelings like, [I'm] proud to be associated with that? Or was there worry, like, How good is this going to get? Were there people always advocating for, Let's just make this bigger and bigger, stock more and more? And did you ever have any

feelings like, This can't last forever—how well do we even have control over the state or the status of the Chinook salmon fishery in that time period?

JOHNSON: No—. Couple of comments. One is that the zebra and quagga mussel effects on the alewife population were totally unrecognized, unknowable during the 1980s and nineties. When they first showed up in—let's see, I saw my first one I think in '92, or '91, my first zebra mussel. And it went on for, like, six-seven-eight years and was like, What's the big deal? You know, they're a pest. They get on your stuff. They infest the beaches and all that. But the fishing just kept going great guns. I did not see an end coming. I didn't think that you could ever tap out alewives, they're so fecund. Each year-class just seemed to be bigger than the one before. The thing that concerned me was that they were younger and younger, where you didn't have as many three- and four-year old alewives. That was the warning flag we had is that we were down to ones and twos. The bigger, older alewives had disappeared. But, I don't think anybody was especially concerned about that because they seemed to compensate by just producing bigger year-classes. And there is that compensation—the older ones, obviously, feed on fry, and if you get rid of the older, bigger ones the compensation mechanism seems to be more young ones. And, no I didn't see that coming. I thought that the Chinook fishery was sustainable on the long term. In fact, I was trying to increase stocking survival using net pens to get more bang for our buck. If I had known that the alewife population was going to be limiting within a few years I would have been reducing stocking to compensate for the increased survival that we were measuring in our net pen fish. But I didn't see that. I just, no, I thought it was sustainable.

The other thing is, I thought it was really good. I wanted to hear communities screaming about the resource because that meant we had stewardship. You had partners out there, then. And oftentimes it doesn't work out just perfectly for you. It's messy. But when you really need friends, you want to have resource stewards out there. And that's where Rogers City's always been is they've been there for the resource. Yeah, they'd love to have more salmon for their tournaments and stuff like that, but they are there for the resource more than just the moniker of we're the "Salmon Capital of the World" and that sort of thing. But there was a serendipitous outcome from one of their—I was a little irritated when they insisted on not taking a salmon reduction to zero. They would only take—they only agreed to reducing their salmon stocking to a few hundred thousand. And I was surprised that the DNR management went along with that. I was thinking we were just going to cut stocking except for the consent decree requirements which is Nunns Creek up in (Prichard: Yep.) the Upper Peninsula. But they did present good evidence, and they made us look at the Swan weir data. Swan weir was still producing eggs. It was as reliable an egg resource as the Little Manistee weir, and it was good. So why cut it when it's a weir? Okay. So they kept stocking salmon there. Well, little did we know that most of those salmon were feeding in Lake Michigan, anyway. And now we know it's Lake Michigan's best stocking site in terms of—in terms of return of stocked fish, survival of stocked fish to the sportfishery is best if you stock them at Swan weir. [Johnson clarification: in terms of return of stocked fish to the sportfishery, it's best if you stock them at Swan weir]

PRICHARD: Oh, that's amazing.

JOHNSON: There's not very many walleyes there, I guess. (Prichard: Right.) And it must be that beach zone around Swan weir does have some plankton. And [young-of-year Chinook salmon] will eat a lot of insects, too, because you see them just feeding on dropping insects that are washing up in the beach zone. So if they're not getting eaten in the beach zone they [the stocked Chinook salmon smolts] probably have a good chance of surviving that [life stage]. Then they move out into Lake Huron where there's not an adult salmon population to speak of, get to a size where they can migrate to Lake Michigan and not get eaten there, and just contribute to that fishery. Something like that's working. But I didn't think that stocking site would continue to be successful the way it has. They were right.

|01:07:00|

PRICHARD: Another thing I was interested in asking you about, maybe not necessarily focused on Rogers City so much, but I hear anglers talking about this and it comes up in Lake Michigan talks still is this paradox between having more age-four Chinook salmon, but that being not an indicator of bigger fish or better fish. There seems to be a misperception among some people that when they're seeing bigger fish they're seeing more age-fours, but it's actually flipped where you have better growth, you have earlier maturation, your biggest fish are often age-threes, over the years. Because I talk with people often and they think their bigger fish are their age-fours, those are the ones that we should be collecting brood stock or eggs from because they think there's probably a genetic component to the size of the fish that they're catching in Lake Michigan. And I just wondered if something you'd ever had to navigate were those kind of conversations.

JOHNSON: No, I haven't had that. The data are clear for the Lake Huron Chinook salmon that from the mid-1990s until we stopped stocking most of the lake, the number and percent of age-fours just steadily went down. And when the alewife collapsed age-fours disappeared altogether and became mostly age-twos and almost the same number of threes. But, I think what that's telling you is that the lake isn't suitable for big salmon as well as it is for little ones. And Ji's been working on this growth trajectory model that can predict when ovulation will occur in, like, lake trout females. If the lake trout, if their growth is like this, (forearm held at a steep angle) they'll never mature. [Johnson clarification: they'll never mature early] It's like they know, Okay, I'm growing so fast. This year I produce three thousand eggs, but next year I could do *six thousand*. It's almost an exponential increase, if I live a few more years before spawning rather than spawn now. And my egg viability—they've [these female lake trout] reached a point where they're not going to get eaten. They're growing really well. And as long as the growth curve is like this, they'll spawn late, like at seven or eight, nine years old. But as soon as it starts to plateau, as soon as they reach this asymptote where, okay, now they're not going to grow very much anymore, it's like they physiologically know that now's the time to start devoting energy to eggs because I'm not going to grow much bigger, anyway. This is where my fecundity's going to be for the rest of my life. You know with Lake Huron with gobies this big (Prichard: Yeah.) you see that. It's really a sharp break in the growth curve where they grow rapidly to about 700 hundred millimeters, or a little less, 650, and, pffft, they sit there, and a 700-millimeter fish could be seven years old, it could be fifteen. So those fish, they started to mature earlier. We started to see females, instead of maturing at seven and eight, at four and five. And I think you could translate



that in terms of Chinook, the Chinook are going, Well, I'm three years old, but I'm not growing anymore. Why risk it? Let's just dump my eggs now. So if you start selecting for four-year olds I think what you'd be doing is you would be selecting for the fish that are less suited. They made the wrong decision, they should have spawned when they were three because now [at age four] they're probably skinnier than they were when they were three years old. The lakes without a large prey base, without a large-bodied prey, are tending toward smaller body sizes in their top predators. That'll be reversed if we ever get a large prey back again. We need to be more like Lake Superior and have big ciscoes and stuff for them to eat. But that's what the four-year olds are telling me is that the lake's not suited to big salmon anymore, so why try to make it suited (Prichard: Right.) to big salmon by trying to select for big salmon? [Johnson clarification: why try to force four-year olds by trying to select for big salmon?] That's not going to work. That's working against—if they want to select for successful salmon they should be selecting for fish that have the best body condition at the egg taking station which might, in a way, start selecting for fish that will feed benthically instead of pelagically. Because the food's there. Successful salmon are probably those few that are eating gobies in Lake Huron. If they live in Lake Huron, they probably are eating gobies or doing something interesting. But we keep taking eggs from Lake Michigan and fish that eat alewives. And Swan Bay fish, they're coming from Lake Michigan. So you're selecting for Lake Michigan fish, and we're not selecting for something that works in Lake Huron.

|01:12:18|

PRICHARD: Now, I hadn't thought about asking this, but do we know about the wild fish that are coming out of eastern Lake Huron? Are they going to Lake Michigan, too? Is that the working assumption?

JOHNSON: I think it's just that, just a working assumption. I spend a lot of time on Puget Sound, and just for shits and giggles I looked at—you know, we took<sup>12</sup> the eggs from a tributary to Lake Washington way back in the sixties. And they [young salmon of that stock] would migrate through Lake Washington, through the Union Canal and down into Puget Sound, and then from Puget Sound up through Straits of Juan de Fuca and then east into the Pacific. That distance is only slightly longer than the distance from Georgian Bay to the Mackinac Bridge. Why not? (Prichard: Right.) There may be an eastward migratory tendency (Prichard: Ah.) in young Chinooks, too. We don't know that. But, they sure like to migrate from Swan Bay to Lake Michigan. How do they know to go (Prichard: Right.) to Lake Michigan unless there's an eastward—

PRICHARD: Or, westward.

JOHNSON: —tendency? Or *westward* tendency, excuse me. Go west, young Chinook. (Prichard laughs) But it's all speculative.

PRICHARD: Well that's interesting.

[01:13:34]

PRICHARD: Well that wraps up everything I had thought to ask you about today, and so I really appreciate taking the time to do the interview with me.

<sup>12</sup>Johnson clarification: Washington State gave the State of Michigan Chinook salmon eggs from a tributary to Lake Washington

JOHNSON: Yeah, it was fun.

PRICHARD: Yeah.

JOHNSON: Yep. Yeah, and hopefully this can be useful down the road to the museum as we tell the story. What we really need is, you know, we're going to be telling the same story I was telling about top-down bottom-up, and I'm hoping that the work that the Quantitative Fisheries Center is doing right now on that for Lake Huron will help us sort it out, so we have a peer-reviewed position that we can take, that it was mostly bottom-up and that the DNR probably couldn't have done anything about it. But some people argue, If you guys had just quit stocking sooner we'd still have alewives. (Prichard: Right.) So we want to tell the story that's supported by the best science, and I'm really looking forward to a synthesis of what really happened, and how important was the stocking of Chinook salmon at the time to the collapse of alewives. I don't want to make the story up, (laughs) I want it to be science. (Prichard: Yeah.) And right now it's still a little bit unresolved, but I think the stuff the Quantitative Fisheries Center is doing is going to clarify that for us so we can tell that story, too. But oral histories are really big here.

Do you have a moment? I could show you just what the fishery display looks like, we could walk past a couple of boats.

PRICHARD: Yeah, sure.

*end of interview*