

Ron Bruch Oral History
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Interviewer: KSK – Kathleen Schmitt Kline
Transcriber: NCC

Kathleen Schmitt Kline: I have got the recorder on.

Ron Bruch: Okay.

KSK: It is Friday, August 15th, 2008. I am interviewing Ron Bruch. Ron, what is your title at the DNR again?

RB: Fisheries Work Unit Supervisor of the Upper Fox Wolf Winnebago System.

KSK: That is right. It is a lot longer than it used to be.

RB: Yes. It's a lot longer. I can add more to it too, but –

KSK: [laughter] Well, Ron, I wanted to start with – I just pulled out a pile of papers that I have of – I was wondering if you could just do a quick review of the early sturgeon research. Obviously, you were not there for it, but just an overview on what was going on through the [19]40s and the [19]50s.

RB: Sure. Well, the first season, of course, opened in 1932 and really, there was no data collected at all. So, there wasn't any research, no management activity taking place through those years. It wasn't until the [19]40s that people started thinking that, well, we better gather some information here to understand what's happening with these animals. The first actual information was gathered by a game warden named Charles (Schlump?). He actually published a paper in the *Wisconsin Conservation Bulletin* that talks about the spear fishery and some creel census work that he did in the early 1940s, actually, even before World War II. It was after World War II then that the first biologist came on the scene. One of the most prominent persons – actually, the lead person was a fellow named Dr. Edward Schneberger. As far as I know, he was one of the first chief of fisheries in the state in the modern era after World War II. Very active in American Fishery Society and very well known. I believe he was a Madison grad. He got his PhD at Madison, I believe.

KSK: Yes.

RB: But he was associated with Madison anyways.

KSK: Actually, I have a photo that I dug up of him. He is up at Trout Lake and he's sitting right next to birds.

RB: Oh, yes.

KSK: Yes. [laughter]

RB: Well, so, he actually came and did some initial work, and working with – basically, almost a repeat of some of the work that was done by this game warden in the early 1940s, but with a little bit more scientific twist to it. They were interested in what the harvest was. So, they did this creel census again. But they were also very interested in how old these fish were, how fast

they were growing, what the sexes were of the fish that are being harvested. So, they did the first age and growth work, and they used otoliths. But they didn't really have the techniques or the technology that we have today to process otoliths. They had a real difficult time getting a good age estimate out of the otoliths that they did. But they did publish a paper out of that work. It was Ed Schneberger and a fellow named Lowell Woodbury that did that early work. That was the very first real scientific work that was done that we have any record of. After that, apparently, they recognized the need to have professional biologists here – research biologists stationed here to really gather the data that were needed to make good management decisions. They brought on a fellow named Robert (Propst?), who, he and another fellow named Edwin Cooper, who I believe was the head of research within our agency at that time, did an exhaustive age and growth study on lake sturgeon using pectoral fin spines. Probably, the largest collection to date, without a doubt, of lake sturgeon pectoral fin spines and lake sturgeon data, and one of the most comprehensive age and growth studies ever done on lake sturgeon was done here by those two people, primarily Robert Propst. Actually, that was the only thing he ever published, Robert Propst. Cooper went on to be a professor or something at I think Michigan State. But Propst kind of disappeared off the map. But I found out that he left biology. He went on to be a dentist and then ended up being a dentist in Oklahoma City, and at very elderly age, is still a dentist in Oklahoma City.

KSK: He is still alive?

RB: He's still alive. He corresponds occasionally with Tom Wirth, who is the biologist that came on board in 1949, and really, was the main biologist through the 1950s for sturgeon on the Winnebago system. He was the main research biologist. He was the supervisor of the whole work unit for – or he was kind of like the lead biologist, let's put it that way.

KSK: Okay.

RB: Tom still corresponds with him from time to time. Actually, I did look him up. I was going to try to interview him for the book, but I just never – the only address I could find was a dental office in Oklahoma City that had his name on it that I never did call in to find out if that was still him or maybe it's a son or whatever. But Tom Wirth claims that he still is practicing dentistry –

KSK: Wow.

RB: – at an age of about eighty years old –

KSK: [laughter]

RB: – out in Oklahoma City.

KSK: [laughter]

RB: So, that was the real pioneering work that he did. Then Tom Wirth followed in the [19]50s and initiated the first spawning assessments, where they actually went up and handled live fish instead of just dead fish in the harvest. In the meantime, though, they began to handle live fish

of all variety of sizes in the rough fish removal operations that were really increasing almost exponentially in the 1950s. Because the theory was, if you have bad fish out there, it's like having weeds in your garden. This is literally the analogy that they used. It's like having weeds in your garden. If you pull the weeds, the good plants will grow. So, what they wanted to do was to take out as many rough fish, carp, sheepshead, anything they considered was in competition with game fish – lawyers, quillback, whatever they could take out. They had massive operations to remove the rough fish year-round with huge crews that operated nets under the ice and open water year-round. These people lived on house boats and lived in rough fish camps. It was really quite an extensive operation. But they also handled sturgeon. As a result, the research biologists were able to get these operations people to measure and tag sturgeon as they captured them wherever they were fishing. They fished all over the Upriver Lakes and even up into the rivers.

KSK: That was Ken Corbet who got his start doing rough fish, remember, right?

RB: Ken Corbet worked on the rough fish. Exactly. Right. That's where he got his start. So, that was really the beginning of the research and almost the end of the early research. Because on the heels of that, in the mid-1950s, Gordy (Priggle?) came and worked with Tom Wirth and really was able to finish some of the work that had been done – started earlier that hadn't been wrapped up. For instance, aging some of the spines that had been collected and hadn't been processed. In 1954, in the Upriver Lakes Fishery, they collected sturgeon gonads from seven hundred and some fish, and had these things pickled in formaldehyde in big gallon jars. Or just gallon jars and different size jars. They sat on the shelf for five years until Gordy was able to get at them. He didn't collect them because he wasn't even here. But he went through all those and processed them and characterized them. His notes were so detailed that we were able to take the criteria that we use today for sexing and staging fish. Just simply by looking at his notes, we were able to very confidently assign a sex and stage to the fish that he looked at. So, it was very valuable information because it gave us a peak into what the sex and stage dynamics were of fish in the harvest in the mid-1950s. That type of work wasn't done again until 1991 when we started doing it on an annual basis in the harvest.

KSK: Wow. So, that was really valuable.

RB: That was extremely valuable because now, it's allowed us to go back and look at length at age by sex. So, we can look at growth rates by sex. The sexual composition of the harvest, all that stuff that took place in the mid-[19]50s, we have a little peak at what it was like. This little snapshot that we can use to compare to what it was like fifty years later. So, it lets us know what's happened over the years. Basically, I'm working on all those data up right now. Basically, what we found is that the sex ratios haven't changed much, and the growth rates haven't changed at all over the fifty-year period. So, everything is pretty stable in the fishery as far as the sex ratios and the age comp or the mean length at age once you account for the changes in the size limits. Because they had a much smaller size limit back then. But once you standardize things, things are pretty much now the way they were fifty years ago. Gordy was here through the [19]60s, but he shifted his focus in the [19]60s from sturgeon to walleyes. So, I believe they felt that they had the sturgeon program pretty well under control. Because with all the research that was done in the [19]50s, they used those data to pass a whole series of more

restrictive, more conservative regulations on the spear fishery. They were able to get all those in place by 1960 or thereabouts. I think they really felt that they had put this thing to rest. That they didn't have to do anything else, and they shifted their focus to other things. So, there wasn't a lot of research done in the [19]60s. As a matter of fact, by 1965, they even quit doing assessments up on the spawning stock in the river. There were no spawning stock assessments done from 1965 through 1974. What happened in 1974 is Dan Folz came in 1975 and reinitiated the spawning assessment work. Thank goodness.

KSK: Ron, were they still measuring and taking tabs on the sturgeon at spearing during that time?

RB: Let's say what they did beginning in 1965 is then they shifted the responsibility for registering fish. Because it was mandatory by law that fish had to be registered the day they were speared, and that started in 1955. But in 1965, Gordy Priggle was able to shift that workload off to local taverns and establishments around the lake system. Something, by the way, that he was very proud of being able to do – because at the time, it saved us – again, I think they believed that they had put this thing to rest. They didn't have to worry about it anymore. They could let the taverns register the fish. They didn't have that expense, that big workload of staffing all those registration stations. So, they moved it to the taverns. It stayed in the hands of the tavern keepers and the various shops and places that did this until 1996 when we took it over again.

KSK: Wait. So, you say it was under the responsibility of the taverns. Does that mean that a bartender was measuring the fish, or I mean, who was doing it?

RB: Yes.

KSK: Oh. [laughter]

RB: Bartenders or whoever they could –

KSK: Private citizens then?

RB: Right, whoever they could find to do it. What we've learned in hindsight now is that the measurement error was so severe on those fish that for some analyses where I really need to have a very accurate length of a fish – not for everything, but for some of these analyses. I had to throw out thirty years of data because it was totally unreliable. Because the people were not accurately measuring the fish and the error was on the high side. What they were doing is they were typically measuring the fish and giving the spear the benefit of the doubt and giving them extra length on the fish to make them believe their fish was longer than they thought it was. So, I ended up not being able to use thirty years of data for some of the models and data analysis that I've done over the last year.

KSK: So, that is – I mean, I guess it is not funny, but it is kind of funny to think about – I mean, you found that the error was on the high side. So, that was either trying to make someone feel good that they speared a larger fish. Or it was trying to avoid having to tell someone that they

had speared too small of a fish?

RB: It probably was more the former because not too many – people wouldn't bring a small fish in.

KSK: Okay. All right.

RB: But if you think about it, every one of these places had a pool. So, they're going to get in the habit of measuring things on the high side because it's to the advantage of their customer. So, things were just kind of floating along. Really, almost no research at all was done until the mid-[19]70s when Dan Folz came. That was also at a time when the sturgeon spears were really starting to become a little bit displeased with the state's sturgeon management activities and their sturgeon management program. Because they had gone through numerous years of very, very poor harvest. Two years of only eight fish. One year of twenty-one fish. Other low years in the late [19]60s and early [19]70s. They felt that the state wasn't doing anything. The sturgeon, for whatever reason, weren't as abundant. At least they thought they weren't. When Dan Folz came, that was basically dumped into his lap.

KSK: [laughter]

RB: So, Dan re-instituted the spring spawning assessment. Began tagging fish again so that we could actually measure what exploitation was and gathering the data necessary to make good decisions. Thank goodness he did that. They were able to start doing population estimates again. There's a whole flurry of population estimates that were done in the late 1970s as a result of Dan's work. The ones that had been done previous to that were done in the 1950s. There wasn't anything done in the 1960s. So, again, very important work because it gave us another little snapshot of what was going on with the sturgeon population and the fishery in the 1970s after really not having much data since the 1950s. Then they got into a routine of collecting data every spring on the spawning run. They still continued to have the taverns register fish and do all that. So, we still continued to have the problem with the measurement error and the inaccuracies as far as – they were tagging a lot of fish. But the taverns were missing tagged fish because you could register your fish until 7:00 p. m. and it's dark. A lot of people came in at that time because they wanted to be out there all day. So, at night, the people are trying to register fish. You got a person just running the bar that's got to go out there and do this. It's cold and they don't like messing with this fish, and all of a sudden, they're missing tags. We found that out by – we worked at registration stations beginning in 1991 through 1995. We let the taverns continue to register fish. Because Dan retired in 1989 and I came on in his role as sturgeon biologist in 1990. That was right after the season in 1990. So, I couldn't really do anything at that point until the [19]91 season. But in 1991, I set up a schedule where we had fish staff working at registration stations on a random schedule. So, we could collect data and compare the quality of the data we collect to the quality of the data that the taverns were collecting. We did that for four years, [19]91, two, three, four – actually, five years – for five years. That gave us enough data to prove that there were a lot of tags that were being missed. I didn't even think about the measurement there at that time. I didn't realize that until about two months ago. But I just figured I was more concerned about the tags they were missing. I didn't dream that they were mis-measuring the fish that badly. But we were able to get the data that we needed to

adjust the tag return numbers. That was very important at the time because the harvests were going through the roof in the [19]90s because the water was clearing up. When we're missing tags, it's underestimating the true exploitation rate. So, it was really important that we had an accounting for every tag. Then finally, in 1996, we'd realized that we can't let this go on. This is too important of information. The data is too valuable. We went back to manning all the registration stations and taking it from there. So, the other thing we began in 1991, as I mentioned earlier, was we began sexing and staging the fish again like they did in 1954 for that year. Then they had a few odd fish in a couple other years in the [19]50s. But 1954 had ninety-nine percent of them that were sexed and staged during that one year.

KSK: Can I just ask you a quick question? When you are talking about missing tags, how do you even know if you are missing a tag, though? I mean, you mean missing a tag is when a spear does not come into register?

RB: No. When they bring the fish in, the spear or spears of fish bring it in, but the registrar doesn't see it on the fish. So, that fish gets recorded as not having a tag and when it really did have a tag. We found out that it was almost fifteen percent of the tags were not observed by the taverns people registering the fish. So, basically, we were underestimating the exploitation rate by fifteen percent. We also used those tag returns for the population estimates, and it was, we'd be underestimating the abundance as well. So, very, very critical numbers.

KSK: Then did that also mean that those people were probably spearing more than one fish?

RB: No. No. Because they spear the fish, they put their registration tag on it, and bring it in. But if the fish had a monel tag on its tag that we put on in the spring of the year, we needed to get that information.

KSK: Okay. All right. Sorry, I got the tags confused.

RB: Yes.

KSK: Okay. So, let us talk a little bit about – you said in 1991, you started – well, you started up again since the [19]50s doing the sexing and the staging. Why is that so important?

RB: Well, the sturgeon literature suggested very strongly that female sturgeon are typically the larger – the largest fish are females. In 1974, our agency raised the minimum size limit from forty inches to forty-five inches. It had been raised in 1955 from thirty inches to forty inches, and then raised again in 1974. The purpose of raising the size limit both those times – what they believed at the time is that if – for two reasons. One, they wanted to try to protect the fish until they were old enough to spawn at least one time. But they didn't really understand clearly how old these fish were or how big they had to be before they spawned for the first time. They knew they had to be big. So, they kept raising the size of them and trying to protect them until they could spawn. They didn't understand that males – they didn't really fully understand, I don't think, how old these fish really are before they spawned for the first time. The fact that the females were so much larger before they spawned for the first time than the male. But the second reason is, they felt that, for instance, with a forty-inch size limit, if twenty percent of the

fish were between forty and forty-five inches, and if they raised the size limit to forty-five inches, they reduced the harvest by twenty percent. But it didn't really work that way because they might have increased the size limit. But the people just stayed out there longer until they could spear a bigger fish.

KSK: [laughter]

RB: So, the exploitation rate – really didn't change the overall exploitation rate. All that happened was more bigger fish were speared. More of the bigger fish are females. As a result, the exploitation on females specifically increased. So, it increased in the [19]90s then. We still had the forty-five-inch size limit until 1997 when we dropped it down to thirty-six inches. The adult female harvest, we were concerned that it was higher than it should be, but we had no evidence to say one way or the other. So, that's why we started sexing fish in 1991. We had to stage them as well to try to determine whether they were mature or juveniles and work out the relationship between size and maturity. That's where we came upon that we call all females fifty-five inches and larger mature and less than fifty-five inch is juveniles, just as a convenient number to draw the line. It turns out with the modeling that I've done recently with a lot more sophisticated means, that's exactly what the number comes out to be. Actually 54.6 inches. So, our fifty-five-inch educated guess on my part back then was close. But anyways, in the early [19]90s, once we started sexing fish, we found out that the adult females made up almost half of the harvest. So, they made up about forty-six percent of the harvest, but they comprised a very small percentage of the harvestable stock. So, it was really out of balance. At the same time, we also saw a real decrease in the number of really large fish in the harvest and the population. We felt that the decrease very likely was caused by the excessive harvest of adult females. That we were cropping them off and not giving them a chance to get very large. That we were truncating the age composition of the female population. We didn't want to see that continue because we didn't know at what point we're going to be in a real danger zone. So, that's why we started sexing them in [19]91.

KSK: If we can just – well, I guess we are right there right now. When you came on the scene in [19]91, I mean, you were taking over for Dan. Dan had been there for a while. How did you feel taking over the sturgeon program?

RB: Well, I started in February of [19]90 in Dan's position. I had been in Oshkosh since 1986 as the planner for the Winnebago Comprehensive Management Plan. So, I worked very closely with Dan during that planning process. I mean, I was trained in fisheries. I had been in fisheries my whole career before that point. So, this little planning thing was just like a little side thing. Basically, I took the job to get out of Milwaukee and into Oshkosh. I had worked on the Winnebago system as an intern in 1976. So, I got to actually know Dan at that time.

KSK: Right when he was starting basically.

RB: Right. So, second year he was here, I was an intern here and got to know him. I didn't work specifically for him, but I did get to know him and had a lot of respect for him. So, when I got the job in 1990, I was extremely excited about the prospect of working with sturgeon. Because I had been around these fish my whole life one way or another. Either fishing as a kid

or had the opportunity to work on different sturgeon crews through most of my career – a little of my limited career prior to that point. But then just to be able to follow in his footsteps and basically try to fill his shoes, which I think they're like size fifteens.

KSK: [laughter]

RB: But it was really a tremendous challenge, but really an honor. Dan is very special to me. He's like a second father to me. He's taught me a lot and I have just nothing but utmost respect for him. The program that he initiated here is – he really was Father Sturgeon that laid the foundation for this. So, to have the opportunity to inherit that from him, I felt like I was – and I still do, like, I'm one of the most fortunate fisheries biologists in the world.

KSK: Then how did you feel about – I mean, it must have been daunting too, not only to take over Dan's work, but to be working with this population of fish that there were so many unknowns.

RB: Oh, right. Yes. As much as we did know, there were still unknowns. We were right at a time where everything, all of a sudden, is in crisis mode. Because I had the job for a day, and we had the largest sturgeon harvest on record in 1990. I started the job officially about halfway through the spearing season in 1990. By the time the spearing season was over, they had exceeded – or they were at 2,903 fish at the end of that spring season. They'd never had speared that many before. So, it was daunting. Fortunately, the time that I had spent from [19]86 to [19]90 as the planner for the Winnebago Comprehensive Management Plan, I had been able to really develop a lot of contacts with the public. Because my job really was ninety percent public involvement and only ten percent scientist or biologist in development of that plan. So, I was able to get to know a lot of people in this sturgeon community around Lake Winnebago through that planning process. So, that helped me a lot because I had automatic relationships that I could depend on and work with. To try to figure out a process that we could use to answer some of these questions and deal with some of these contentious issues that were starting to surface. Because of course, the department – when you see a harvest like that, your first reaction as the management agency is, is this a bad thing? It probably is a bad thing. Is this a slow growing fish? We don't have enough information to make decisions right now. We need information. I was able to tap into the spearing community to get feedback from people on what they thought was going on from their perspective. But then lay out an accelerated program for gathering the biological data that we needed to make decisions. So, it took a couple years to really get that program up and running, where we put more effort into tagging fish in the spring. We initiated in [19]91, the sexing and staging. We started collecting aging structures from live fish and the spawning stock. We did that for four years in the early [19]90s. Then in 1992, I formed the Winnebago Citizens Sturgeon Advisory Committee, which is still functioning today as the Citizens Group Advisory to the department on sturgeon regulations and management issues on the system. So, they basically are the group that keeps me honest –

KSK: [laughter]

RB: – and raises all the different questions that could even be possibly thought of about sturgeon fishing and sturgeon management and the decision making. Then my job basically was to make

sure we had an assessment program in place that's going to answer all those questions. So, it was a very healthy relationship. It wasn't always smooth, of course, but very healthy relationship. The [19]90s were consumed with that – with working with those folks and making all the different changes. We've been at about a ten-year period, we were able to successfully get, I think twenty or twenty-two or twenty-five different laws and regulations passed. All of them are more restrictive on sturgeon fishing to bring the harvest management program to what it is now.

KSK: Wow. That many laws?

RB: Yes.

KSK: Wow.

RB: Laws and regulations. So, as far as research in the [19]90s, pure research, again, most of the activity was focused on these heavy management activities and dealing with the public. But the research end of it really involved stepping up our efforts to collect biological data so that we had better estimates of abundance, better estimates of exploitation, better estimates – or a better read on the size and age distribution of the fish in the harvest. Then there were some other things that I was able to get involved in. I worked with a couple colleagues from Manitoba to do some work on parasites of sturgeon and document what their parasitic fauna were. Which gave us some interesting insights into their life history. Just a quick for instance on that front, the sturgeon that we collected from Lake Winnebago had a parasite in them that needed certain mayflies as an intermediate host. Well, those mayflies were only present up in the Wolf River, which tells us that they had to spend a certain amount of time, at least when they were young, in the Wolf River in order to pick up this parasite and then carry it later in life. Because we didn't really know how long they stayed in the river. Do they all come down to the lakes after their first year or do they stay in there longer? So, then when we finished that parasite work, that prompted me to – well, let's go up in the river and see what we can find. So, we did initiate some extensive summer surveys of sturgeon in the Wolf River beginning in the mid-[19]90s. We did that for three or four years and tagged hundreds and probably a couple thousand fish. We tagged young fish up in the river in the mid-1990s. That gave us a lot more insight also into the size distribution of the fish that are in the river, and since then, where those fish show up. Those are part of the data that we're using now to characterize the migration patterns and distribution of fish throughout the system. We've learned now that basically, two percent of the fish live in the river all the time. They never come out of the river. About thirteen to fourteen percent live in the Upriver Lakes. They'll go up the rivers to spawn, but they make the Upriver Lakes their home and the rest make Lake Winnebago their home.

KSK: Ron, can you talk a little bit about that? I have on your list that you emailed me developing the criteria for sexing and staging sturgeon. Did that happen in the early [19]90s?

RB: Right. That's when we started, in 1991.

KSK: So, it sounds that that is used now all over the place.

RB: Right. Yes, that was a very time-consuming effort. Took us years really to put this whole

thing together. But basically, we began by just opening up fish and eviscerating them in the harvest. So, when a spearer brought his fish in, we wanted everything. So that we could take the gonads back and take photographs of them and begin to characterize what they looked like. Telling the sex is fairly easy. But determining the different stages of development – because if you consider the development of the gonads, they just aren't one thing one day and then three months later, automatically go to the next thing. It's a continuum of development throughout each reproductive cycle. Then the first cycle, we didn't know if that was – for instance, for females, if they spawn every four years, we didn't know if the first cycle was also where they went from not having any gonad development to full gonad development. Was that four years for females? Was it two years for males? Or what was it? So, none of that had been worked out. So, it took looking in the insides of thousands of fish and beginning to see the patterns of gonad development. Then you see what you see, but histologically, is it really what it is? Are these things the same or are they different? So, I was able to involve Terry Dick and Anindo Choudhury up at the University of Manitoba, who had been down working with us one spring tagging fish. I told them that we were doing this, and they became interested because they were interested in the same topic. So, we joined forces. After collecting samples for a couple years down here, I had sample jars with pickled sturgeon gonads of all these different varieties. I went to Canada, to Winnipeg – took my briefcase full of pickled sturgeon gonads and went to Winnipeg. I spent two weeks with Terry Dick in his lab preparing and doing the histological work so that we could look at the microscopic level, what was the development of these tissues? How do they compare along this continuum? At what point can we say, "Yes, we can call this one an F1, or this is an F2, or this is an F3, or whatever?" Because what we wanted to have been a set of criteria that would be very easily used in the field. So, if a person was looking at harvested sturgeon or even doing a biopsy in sturgeon, that they would be able to say, "Yes, this is an F1, or this is an M2," or whatever and not have fourteen different stages that they had to worry about. Try to simplify it as much as possible to make it – so that it's applied and so that's practically applied. So, that was our challenge. Once we got the histology done, we sat down, and we figured it out and it worked out really well. But one little interesting story or funny story on this, when I went to Canada with this hard briefcase full of pickled sturgeon gonads – they're in formalin I had, I don't know, like forty jars in this briefcase. I get to customs in Canada and the lady says, "Well, what do you got in your briefcase?" I say, "Well, I got pickled sturgeon gonads."

KSK: [laughter]

RB: She says, "What?" I say, "Yes, I'm working with this fellow up here and we're going to sort all this stuff out." She says, "You've got to come with me."

KSK: [laughter]

RB: So, they took me into this little room, and they interrogated me for an hour. What am I doing with these sturgeon gonads? What's going to happen with these? How do I think I can get these across the border? You're going to work up here? You have got to get a work permit now. I used the wrong word. I said work. This was right after NAFTA was passed or something like that. So, I had to pay like a \$200 work permit. Terry Dick had to come. He was in the field like 250 miles away. Because I was going to get there for a couple days and wait for him. He had to

come down from the field to the customs at the airport and get me.

KSK: [laughter]

RB: So, I waited there for hours for him to drive down there.

KSK: [laughter]

RB: Then I had to put on my own personal credit card, this work permit. But I finally got into the country with the sturgeon gonads, and we were able to spend two solid weeks of work and sort it all out.

KSK: Did you have a hard time –

RB: We put them all, by the way. I actually paid for my trip up there.

KSK: Oh, okay. Did you have a hard time getting back into the country?

RB: No. I left them all out there.

KSK: Oh, okay. [laughter] Yes. I wonder what that would be like today. [laughter]

RB: Well, I'll tell you, after that happened, for at least ten years, every time I tried to cross into Canada, I must have been flagged on their computer because I was called in a little room.

KSK: [laughter]

RB: I was interrogated as to what am I doing there now.

KSK: [laughter]

RB: Ten years.

KSK: [laughter]

RB: So, every other time I went, I always carried a fishing pole with me even if I was – I mean, every time I went, I was going to work. But I carried a fishing pole with me and said, "I'm just going up here fishing."

KSK: [laughter]

RB: Because I didn't want to pay another work permit.

KSK: [laughter] Oh, that is really funny. [laughter]

RB: Even when I went up to do the voiceovers for the IMAX film, just this year, they stopped

me again. So, I don't know if they re-flagged me because there were a couple trips where they didn't bother me. But they re-flagged me because I told them I'm going up here to – I'm participating in a production of an IMAX film. "Oh, you're coming up here to work, eh?"

KSK: [laughter]

RB: "Well, it's not work. I'm a consultant." "Well, when you're consulting, you're working."

KSK: [laughter]

RB: They just gave me a runaround.

KSK: You did not have your fishing pole?

RB: I didn't have my fishing pole, no.

KSK: [laughter] Wow. How about telling me a little bit about the spawning behavior research?

RB: Well, spawning behavior research, it was something that we did because we could and because we have such tremendous access to the fish. I mean, you've been there. You can see them so clearly. The only description in the literature of lake sturgeon spawning was about one paragraph. Actually, the first description of lake sturgeon spawning was done here on the Winnebago system in 1915 by a fellow that observed fish spawning on a shoal on Lake Winneconne. It was just one paragraph, but he very accurately described it in one paragraph. But he didn't get into the little nuances, like how often does a female have a spawning bout. Does she stay in one spot and how many males switch off? It's always the same males. Are they different males? Or how long does it take the female to spawn out – all these other little questions. So, because we had this opportunity to view these fish and there were still all these questions out there, when I first started working – in [19]86, when I first came here, Dan would have me come along and I'd work with him in the spring. To me, it was just fascinating watching them. So, I just started taking notes of what I was observing. Then I did that for almost fifteen years. Actually, spent a couple years towards the end there in the late [19]90s where I didn't even work on the tagging crew. I would go to a very quiet site where I could get right in the water with the fish. I'd spend at least eight hours, sometimes more, in the water with the fish, just observing them, photographing them, writing down, and taking notes. Watching individual females that had a particular scar or a mark or a tag that I could watch for hours. Clock measure the amount of time in between spawning bouts and the behavior of the males just before the bout and after the bout, and all these little intricacies of their behavior. I mean, there was one site up at (Krieger's?) where I could stand in the river with them, and they were all around me. At one point, I had a female and five males between my legs spawning. They just knocked me over, but I could see them working up. So, I stood there and just spread my legs [laughter].

KSK: They were all between your legs?

RB: All of them.

KSK: [laughter]

RB: They were all between my legs. What I was trying to do, I was trying to feel how hard the males, when they're thrashing like that, how hard are they hitting the females? Because the thing that we weren't sure about and where we didn't really have any idea, were the males causing the females to blast their eggs out because they were pounding with their tails on them? Or were the females doing this? I was able to actually feel how hard the males – and it's not very hard at all. It's very gentle. So, what that actually told me is that they really weren't slapping the female around. So, something else had to be happening in addition to that to make the eggs come out. Then I was able to actually watch this peristalsis on the females – on the sides of the female's bodies. The peristalsis – the wave of muscles goes down as they were spawning to express the eggs. So, only by spending literally days and cumulatively weeks in the water with these fish to watch these was I able to see these things that nobody had ever really seen before in the wild.

KSK: So, wait. To figure out how hard the males were hitting the female, did you just put your hand down there? Or did they actually just end up hitting you instead of the female?

RB: They ended up hitting me instead of the female.

KSK: Okay.

RB: Yes.

KSK: Then the peristalsis, that is just like –

RB: Like a muscle wave.

KSK: That happens in the esophagus too, right? Like, that is swallowing, the peristalsis is –

RB: Yes. Yes. But you could see it on the sides of the female. You could just see it ripple right down.

KSK: Oh, wow. So, then the –

RB: When the males would ejaculate, I could see get a sense of the quantity and the cloud and how big the cloud was of sperm that the eggs had to go through and all of that. So, it was really fun work because I'd be on these really quiet sites and just myself with these fish. No other noises, no other people, and just watch them for hours and listen to the sounds that they make and all that. It was just phenomenal. So, we took one paragraph that was described before and put it into about a twelve-page paper –

KSK: [laughter]

RB: – with nice photographs. Then I wanted to get the porpoising behavior also as part of this because we documented when they start porpoising, when they quit, and how often they do and

that type of thing. Before and during the spawning season, they don't porpoise much after. But I wanted to get a picture of a porpoising fish. So, I literally sat on a riverbank one spring with my camera on a tripod with my finger on the shutter button. Just a camera pointed off in a general direction of the river where I had seen fish porpoising and sat there. Every time a fish jumped, I hit the button. I took about 250 pictures –

KSK: [laughter]

RB: – which I haven't found yet, by the way.

KSK: [laughter]

RB: I had one really good one. [laughter] That's the one that ended up in the publication.

KSK: That was basically a whole day of just sitting there?

RB: Oh, days.

KSK: Days. [laughter]

RB: Days. I probably sat for four or five days.

KSK: [laughter]

RB: Just in a lawn chair, finger on the camera.

KSK: Ron, these sorts of things, have other people spent that much time observing different other types of sturgeon spawning behaviors? Or is this just pretty rare because we have so many sturgeon that can be observed? I mean, is there this type of information?

RB: I don't know any other place where you can make these kind of observations.

KSK: I mean, is there this type of observation on white sturgeon or Atlantic sturgeon or –

RB: Not that I'm aware of.

KSK: Because there just are not enough of them.

RB: Well, there's a lot of white sturgeon. But if there were any species, it would be white sturgeon. But I don't know that they spawn – they may spawn deeper, or the rivers are a lot bigger.

KSK: Oh, okay. They are not as accessible.

RB: They may not be as accessible. I don't know that for sure. There might be spots where they can be observed. But I really doubt that there's any place else on earth where you can make these

kind of observations at the number of sites that we can. With the water clarity that we have and the shallowness of the water and some of these sites to see these things.

KSK: You told me a little bit about this before, but that popping noise that the males make, can you just tell me about that again?

RB: Yes. Actually, that was another mystery because we didn't really know if the males were making that noise by hitting the female or exactly what was going on. So, in the observations that I made, number one, I saw males making the noise all by themselves. So, they were off to the side, they were excited, and they were trying to spawn. But the female was like five or six feet away. They were all by themselves, but I could hear the individual male making that noise. So, it was the male that makes the noise. So, that's one thing we found out. The noise itself would attract other males to that area. So, it probably served a dual function. Or maybe – I don't know. Maybe that was its only function as an attractant for other males to come into that area because then you have – besides, the females are there in fluid, which the males will react to very much. You have this noise, which maybe – the fluid only goes so far, but this noise is going to travel a lot further and draw more males into that spawning site. So, I'm guessing that's what the mechanism – that's what we suspected. It's not uncommon. There are other fish species where males make noise like that as part of their spawning behavior to notify other males that there's females that are ready to be spawned. They are ready to –

KSK: Is it quite that loud, though?

RB: Well, on a quiet bank, you can hear it. It sounds like a grouse drumming. It lasts about three seconds or so, and there's about thirteen, fourteen beats. Whereas when some grouse strums, it's like, ba, ba, ba. That's exactly what it sounds like. It's like a whomping sound.

KSK: No. But I mean, is it that loud with other types of fish that it occurs with?

RB: Well, there's a couple ocean species that it occurs with. I'm not familiar with what their exact habitat requirements are. But I don't know that there's any place else where people can – well, I mean, for instance, the drum make a sound also when they're spawning. That's why they're called drum because of the drumming sound.

KSK: [laughter]

RB: I mean, they'll do it also, even when they're not spawning. When you pull them out during the spawning season, if you pull them out of the water, they'll make this sound. It sounds like a frog.

KSK: [laughter]

RB: So, have the transcribers put that one down somehow.

KSK: [laughter] Yes, that is going to be hard. [laughter]

RB: I'm not aware that it's extremely common and I don't know of other sturgeon species. I assume other sturgeon species probably do something similar. I don't know.

KSK: Well, let us talk a little bit, Ron, about – is it okay if we talk about some of your current research right now?

RB: Yes.

KSK: I mean, it has been ongoing, and it is using data from a large span of time. So, could you talk a bit about that?

RB: Sure. Well, we have all these data. Even though it's not a continuous data set from the 1940s or 1950s, there's enough of it that we can link, or we can kind of fill in the spaces in between. Or we can at least look at patterns or trends over the last fifty years. Trends and things such as abundance, such as age and growth, maturity, relative condition of the fish. Are they fat? Are they skinny? Has it changed through time? Then just to also answer just some basic questions about the size and age of maturity. Just management questions such as, what have been the actual fishing mortality rates over the years? Because there were a lot of years that we didn't tag. There were more years we didn't tag than we did tag. So, there were quite a few years where we don't really have a good estimate of what the harvest rates were. So, the data that we have lends itself to figuring all these things out. But before we could go forward with any of that, we had to figure out how old the fish really were. We have been collecting pectoral spines since the early 1950s to estimate the ages of these fish. But nobody had ever proven or documented that the number of rings on the pectoral spine cross section was the true age of the fish. Pectoral spines have been used for sturgeon aging since 1916 in Russia. It was first published in Russia in 1916. But nobody had ever really proven this, that it's the true age. So, that was the first thing that we did. Using known age fish, fish that we've captured early in life, where we could estimate their age within one or two years of what it really was. It had to be very young and based on length. Well, to back up with, first of all, there had been some work done in 1924 by a Russian that had proven that for at least the first ten years, the pectoral fin spines were accurate. Where they had grown fish under seasonal conditions and taken fin bones of – grown fish from eggs – hatched them from eggs, and grown them, and taken fin bones off every year. The rings corresponded. So, that was one thing that led a lot of biologists and scientists to believe that, well, if they're good for the first ten years, they're probably good for the rest. But nobody had ever shown whether they were or not after ten years. So, we found forty-six fish in our database of almost forty thousand fish that we had sampled. That were captured at a young enough age and tagged. That they were less than ten years old, and that they were tagged and recaptured anywhere from two to twenty-five years later and a fin bone was taken. So, we had known age. We had fish that we had a pretty good idea within plus or minus a year, what the true age was. We had a fin bone that gave us an estimated age. Then for the really old fish – because we weren't even really earnestly tagging since 1975. For the really old fish that it would've been patched back in the 1950s or thereabouts. Those fish, we use the bomb radiocarbon dating of the otolith. Where the carbon fourteen that was put in the atmosphere by atomic bomb testing in the late 1950s and incorporated into living things back then. At different levels every year, beginning in 1958 through about the late 1960s, by looking at the amount of carbon fourteen in the core of the otolith of these really old fish, you could tell by the amount of

carbon fourteen in the core. Which would've been the tissue laid down in the first year of life, what year that fish was born. So, in combination, between the known age fish and the bomb radiocarbon dating fish, we did find that the pectoral fins were accurate up to about age thirteen to fifteen. After that, they underestimate true age. But the error between the true age and the erroneous age was consistent enough that we could develop a mathematical model that described it. Used that mathematical model to go back into our database and correct all the fourteen thousand ages that we had in our database. So, then I had corrected age data that I could use then to estimate mortality rates through the years for all – well, the mortality rates as well as the length at age. We were able to then see if the growth rates of the length at age in the [19]50s matched the length at age in the [19]90s and the two thousands, which as I mentioned earlier, doesn't look like it has. It looks like it's been pretty much pretty steady. Then also, figure out what the exploitation rate was by age as well. What the fishing mortality rate was, and then fill in all the blanks through time with the statistical catch at age model, what the fishing mortality rates were in the years where we didn't collect tagging data. So, the age validation data was really very, very important for jumping into all these other data analyses. So, at the bottom line of all this is, now we have good estimates of what fishing mortality rates were going all the way back to the early 1950s. For fishing mortality rates, what we found is that we had really high harvest rates in the 1950s. The harvest rates went down in the [19]60s as a result of the regulations. But also, not just the regulations. Also, because of environmental changes that took place in the lake system in the late 1950s when the water became much more turbid in the [19]60s and [19]70s. Which lowered the harvest rates and allowed the sturgeon population to recover from the extensive harvest that took place in the 1950s. So, it really was a stroke of luck – a stroke of good fortune that we had all the non-point pollution that we did in the 1950s.

KSK: [laughter] Lake Winnebago is surrounded by farmland, right?

RB: Surrounded by farmland, right. Not in the 1950s. In the 1960s and 1970s.

KSK: Yes.

RB: It's surrounded by farmland. We had a wholesale collapse of aquatic macro plants in the late 1950s in the Winnebago pool as a result of non-point pollution. Once the vegetation gets below a certain threshold, it doesn't come back very easily as far as the threshold of water turbidity. It's like you can't grow grass under a board. That caused serious problems for the lake. The water became more turbid, became more of an algae-dominated system. The winter water clarities were often – they were worse. We actually have records. They were worse in the [19]60s and [19]70s than they were in the [19]50s and the [19]90s. 1980s was a transition period, especially at the late 1980s. But as nonpoint pollution controls were implemented in the late 1980s, as a result of completing the Winnebago Comprehensive Management Plan, we began to see the water clear up. So, the fishing mortality rates that we were able to measure now with this new research actually showed the high harvest in the [19]50s, the low harvest rates in the [19]60s and [19]70s and [19]80s, then the exploding harvest in the 1990s as the water began to clear up. But at the same time, the adult abundance of sturgeon in the Winnebago system rose exponentially in the [19]60s and the [19]70s as a result of the low harvest rates and went well beyond what they were in the [19]50s, almost fourfold of what they were when the high exploitation was ended in the [19]50s. By the 1990s, the adult population had increased four

times. At that time, when the water cleared up, the water began – I should say, it was like all of a sudden, the cloak of turbidity was removed. The spearers, all of a sudden, saw all these fish. They had these high harvest rates and success bred more interest. More and more people came into the fishery, and effort doubled almost between the mid-1980s and the mid-1990s. That was a situation we found ourselves in the middle of trying to reconcile in the mid-[19]90s. The other interesting thing that the research that I'm doing now has shown is that the relative condition of the fish or the plumpness of the fish was fairly stable from the [19]50s, [19]60s, and the [19]70s. But in the early 1980s, the plumpness dropped significantly. So, the relative condition of the fish just went into the basement. That was also at the same time that in the Winnebago Pool here, we had some other really dramatic shifts going on in the fish community. We had a forage collapse in the mid-1980s that came on the heels of really high abundance of predators. But a lot of the forage species in the lake depend very heavily for sustaining themselves, depend very heavily on good macrophage communities, which we didn't have. So, with the exceptionally high abundance of predators that came online in the late [19]70s and early [19]80s, they basically outstripped the forage supply. We didn't have the habitat here to support the forage space that we needed, and the forage collapsed. There was a tremendous upheaval in the ecological stability of the lake at that time. For whatever reason, sturgeon also showed this symptom of loss of condition. In other words, the food resource wasn't the same as it had been ten years earlier by the mid-[19]80s. But then all of a sudden, the plumpness started coming back right on the heels of the gizzard shad explosion. Gizzard shad had been present in the lake for decades, but only very rare. Rarely saw any in the surveys. But in the late 1980s, a series of warm winters prompted a gizzard shad explosion throughout the whole Great Lakes region, not just in Lake Winnebago. Gizzard shad population just boomed, almost overnight exponential increases. Being gizzard shad out on the northern end of their range, they have a winter die-off every year, which the sturgeon immediately adapted to utilizing. As a result, their conditions pumped back up again. But now, it goes up and down like a yo-yo depending on gizzard shad abundance. It's been doing that for the last fifteen years. So, this new research that I'm doing has shown us – basically, these trends and condition are telling us that the population growth of sturgeon that we have witnessed, that now we documented through the [19]60s, [19]70s, and [19]80s, to get to the high levels in the [19]90s, has brought us close, if not, to carrying capacity of adult sturgeon in the Lake Winnebago system. That, in turn, has ramifications for another aspect of the research that we've uncovered, work that I've done on trying to determine what the stock recruitment relationship is. This sounds like a never-ending story.

KSK: [laughter]

RB: It appears, very strongly appears, that there's an inverse relationship between the abundance of adults and the number of yearlings that they can produce. So, when we had really high abundance of adults in the late [19]80s and [19]90s, we had the lowest recruitment of yearlings that we've ever had on record since the 1950s. This is not uncommon. There are many fish species that have this type of relationship. The thing is that typically, it's because the adults eat the young. But in this case, that wasn't happening because we've done extensive stomach analysis. We've never found a sturgeon in another sturgeon's stomach. But sturgeon does eat a lot of their own eggs. The other thing that happens on the spawning sites when you get high abundance of adults, you get heavy deposition of eggs on the spawning sites, which is (prime media?) for fungal infection. When you get heavy deposition and a lot of fungal infection, you

probably have very high egg mortality. So, it could be a density-dependent mechanism that, basically, Mother Nature is making – it's like a stock market erection. They're making a correction in the density, so that they're going to straighten this thing out. Typically, fish populations will go through a wave that has this type of stock recruitment relationship. For walleyes, you go from high abundance to low abundance of adults and then low abundance to high abundance of recruits. The two waves are opposite to each other. For walleyes, for instance, that wave might be ten years or less, a general wave. But sturgeon, the wave is over fifty years. That's something that we never really understood before. So, this research that I'm doing now is giving us some insight into the long-term stability and the long-term dynamics of the lake sturgeon population on the system. So, we're at a point right now. We've peaked in the [19]90s. The high harvest in the [19]90s probably actually helped recruitment a little bit, believe it or not. We're actually coming back out of the bottom on recruitment. Our recruitment has increased now in the last ten years. But the adults are probably going to diminish or go down now as the fish that was hatched in the [19]90s in relatively low numbers. In thirty years from now, those are going to be the main spawners. So, in thirty years from now, the spawner abundance will be at a low until it recovers again. Another thirty years later, they're about to be at a high.

KSK: So, Ron –

RB: So, those are the types of things that I've been able to uncover with my current research.

KSK: When you say that we are at the carrying capacity right now, I mean, does that mean that, historically, there was probably this many sturgeon in the Lake Winnebago system?

RB: Yes. Yes.

KSK: So, that is kind of exciting that we have reached –

RB: Yes. Yes. I think we're probably at – well, historic levels. It's hard to directly consider because the lake has been changed so much with impoundment. So, we really don't know where we were pre-impoundment days.

KSK: That is true. Yes.

RB: Then the sturgeon was here. They had to be here for them to be here in the 1900s. They had to be here in the 1800s.

KSK: You are right. The system is not exactly the same as it was, historically.

RB: It is not the same. So, the carrying capacity in the 1800s may have been different. But let's put it this way. We're at a level of sturgeon abundance where the system is, basically, supporting everything that it can. From that standpoint, we're similar to – and the numbers might not match up. But from the standpoint of we're supporting everything we can, that we are probably matching up to what we were pre-settlement.

KSK: Wow. Wow. That is amazing.

RB: Yes.

KSK: Can you just talk a little bit about that hole that you saw in the population?

RB: Yes. In the last ten years, we've been seeing more bigger fish in the harvest and the spawning stock. We feel that one of the reasons is because of the protections that we put on over the last seventeen years or sixteen years for reducing the harvest over the largest fish, the adult females, and providing greater survival for them. We feel that that's part of the reason why we're seeing more bigger fish now, fifteen, sixteen years later. But also, the rest of the story goes back to the Depression time. Even before that, it goes back right past World War I. In the early 1920s, the roaring [19]20s, fish that were hatched in the 1920s up until the early 1930s, those fish would have been subject to harvest as juvenile fish. As fish that were thirty to forty inches long would have been subject to harvest in the set line fishery in the Upper River Lakes when the season opened there in 1932. That season only ran for twenty years. The reason for that is because that it was shut down in 1952 is that the wardens at the time felt that there were a lot of fish that were being illegally harvested from the Upper River Lakes. Because at the time, every person with a set line license could harvest five fish. You had five tags. You bought your tags for a nickel apiece. There was no mandatory registration. It was just (on your honor?). So, they felt that there was an excessive amount of fish that were being taken off the lake without being tagged, or the tags weren't clicked. When they got to shore, they would take the tag off and use it again the next day. But they never really could prove it. So, when the biologists that I mentioned earlier began working in the 1950s, they found a population. When they mapped out the lake frequency of the population, there was a hole in the population of a lot of fish that were missing. There were young fish, but these medium-aged fish that would have been perhaps twenty to twenty-five years old or twenty years old in that range, those fish were gone. There was just a big hole there and they couldn't explain it. So, the lake frequency, instead of looking like a bell-shaped curve, looked like a two-humped camel.

KSK: [laughter]

EB: The part in the middle where the hump was missing is the part that they couldn't explain. They just thought maybe there were some bad year classes or something. But in this research that I've done now, and now that we know how old these fish really are, it turns out that those fish that were missing were actually fish that were very likely over-harvested in the set line fishery. That hole in the population finally (passed us?) in the last ten years. So, some of the bigger fish – part of the reason that we're getting bigger fish now is that hole is gone. The fish that were over-harvested in the [19]30s, in the [19]40s, that didn't exist to grow big anymore because they were taken out at a young age. That group of fish has now passed through the fishery. The first fish that were provided protection in 1952 when the set line fishery ended, those fish are the hundred pounders now, are the really big fish. So, it's just kind of an interesting dynamic or a testament, I should say, on how long a person really has to look at management of a sturgeon fishery and how far back you have to go to look at things that could affect what you have right now in a population.

KSK: It is not managing them by years. It is managing them by decades.

RB: Yes. It's managing by decades or even by a century.

KSK: Gosh. I just have one question.

RB: Sure.

KSK: The Upper River Lakes, I think, I talked to you before. Well, for quite a long time until – not very long ago, I think biologists thought that that was an entirely separate population, right?

RB: Right. Yes, they did. What we've come to realize, and why they believe that, they had good reasons to believe that, number one, the fish that were up there were generally smaller and they didn't seem to have the same growth rates. Although, they may not have enough data to really discern that, but that they were generally smaller fish up there. There was even a point where they felt that because the Upper River Lakes were smaller lakes, shallower, didn't have the abundant lake (clay larvae?) that they felt that they were going to do the fish a favor. They transferred fish from the Upper River Lakes. They caught them up there and took them down and stocked them in Lake Winnebago for years, trying to do the fish a favor and get them out of that –

KSK: [laughter]

RB: – place where they can't grow. So, they really truly thought that it was a separate population. The other reason why they thought it was is that they had the high harvest in the [19]50s on the Upper River Lakes because the season opened in [19]52. I think it ran for six consecutive years. Then it was every three years, and then in [19]71, every five years. They never saw it recover to the point where they had the high harvest that they had back in the [19]50s. So, that's another reason why they thought it was separate. It turns out that what really was going on is that they were partially right as far as a separate population because there's this 14 percent or 15 percent of the fish that do make the Upper River Lakes their home, the adults. They live there and then they run up the river to spawn and come back to the Upper River Lakes. But also, the fish that live there, it's a nursery ground for young stock. So, you've got this mix of permanent residents that live there all the time and this huge population of young stock that lives there that makes it appear that all you have are young or slow growing fish there. The other thing that confounds it is that the sturgeon that move out of Lake Winnebago to spawn move out in the fall. They didn't really understand that before. They thought that they just made their spawning run in the spring. You hear many stories about people saying that spearing was always better towards the end of the season because the big fish were mobilizing and getting ready to move out for spawning. That's an urban legend. What our telemetry research has shown us is that the fish begin to move out in September and that they move into the Upper River Lakes. In some years, more of them stay in the Upper River Lakes for the winter. In some years, more of them move up the river. So, what very likely could have happened in the [19]50s when they had high harvest rates and they had bigger fish in some years is that there may have been some years there where they just, by luck of the draw, had a year where more fish stayed in the Upper River Lakes for the winter instead of going up into the rivers. So, that dynamic we have documented

that the Upper River Lakes is not only used as a nursery ground, but it's also a wintering area for varying percentages or varying proportions of the adult stock from winter to winter. That probably has something to do with how much food is up there in any given year. What we've noticed since the gizzard shad have come in the system is that more of the big fish are wintering in the Upper River Lakes because of gizzard shad and feeding on gizzard shad before they continue their trip upstream for spawning. Then they did more of them in the [19]90s and the 2000s than they did in the [19]70s and the [19]80s. So, just the presence of that food source has changed the fish's behavior.

KSK: Then, Ron, with the study that you have done on the aging, verifying the age of sturgeon, so is that technique, the otolith technique now, is that going to be used by other sturgeon researchers? Is that probably going to be the way to do it now?

RB: Well, there probably will be some. There probably will be an increased interest in using sturgeon otoliths where they can get them. Most populations are either endangered or threatened and they have no fishery whatsoever, so they're not going to be killing fish to go otoliths. So, it may not be used very extensively using otoliths to age the fish because the otoliths do actually tell the truth. The cross section of the otolith, the rings on there actually do match to the true age of the fish.

KSK: So, the early data that you have then from Gordy Priegel, that aging, is that correct? Because he was using otoliths, right?

RB: Oh, that's all-pectoral spine. But what I've been able to do is to estimate the true age with the correction formula that we've built. So, at a minimum, what we've suggested in our paper is that people, if they're not able to do their own validation on their own population, that they really need to apply some kind of correction factor. They can use the correction factor that we've come up with for this particular species. The difficult thing is that the growth rates of the species vary tremendously depending on latitude. So, ours probably represent some of the faster growing ones within the species range where we have reasonable populations left. But the populations up in Canada would be – well, for instance, a six-year-old fish on Lake Winnebago is thirty inches long. A six-year-old fish up in Canada might only be twenty inches or twenty-five inches long. So, that confounds things a little bit. But at least people are aware now that this bias is very likely also occurring in their age data and that they need to take some measures to try to account for it. So, we basically just unveiled this problem. It's going to take years and decades for people to solve it, not only for other species, but also potentially for other lake sturgeon populations.

KSK: Would the Winnebago be able to apply to at least the Great Lakes –

RB: Oh, yes.

KSK: – lake sturgeon? Yes.

RB: Right. I think you could actually reasonably apply it to any lake sturgeon population if you don't have anything better because it's going to give you something better than what you have. It

could even be possibly applied to some other sturgeon species, especially sturgeon species that are similar to lake sturgeon living in a similar growth environment.

KSK: So, with the new age validation, are you finding then – sorry. [laughter] The age for females maturing is twenty to twenty-four years old? Are they actually older?

RB: They're actually older. A number that biologists like to use is the age of 50 percent maturity. So, in other words, you get to that point, 50 percent to mature, 50 percent have yet to mature. The age for that for males' lake sturgeon in Winnebago is twenty. The age for females is twenty-seven. Now, when you look at the literature, it's often confusing as to what people really mean when they write size of maturity or age of maturity because they're basing that on – and I did the same thing over the years. A lot of people have. They base it on their experience of handling fish that they know are matured that are expressing gametes. Depending on their sample size and whether they actually took aging structures or not and how accurately – whether they were accurate or not, you're going to get numbers all over the place. So, if we use this 50 percent thing as kind of the golden rule, that gives us twenty and twenty-seven. But we also have been able to estimate the age of when the very first males begin to mature. So, we maybe only have 1 percent of the males are mature. That age is fourteen. For the females, a similar number would be age twenty-one. The other number at the other end of the spectrum is when – are 100 percent of the males in the population mature. That age is thirty. For females, it's thirty-seven. So, there's quite a span of years where you've got fish that are mature and fish that are mature. It literally goes from 0 percent mature to 100 percent mature. For the males, it takes, what, fourteen to – what do they say?

KSK: Thirty.

RB: Thirty. So, it takes sixteen years for the males. For the females, it takes, what, fifteen years or whatever that is.

KSK: Wow.

RB: Sixteen years for the females. So, it's quite a span of time.

KSK: Well, I think I have got what I need right now. [laughter]

RB: I mean, if you come up with other questions, just call me, Kathy, on my cell phone.

KSK: Sure. I guess I just wanted to kind of wrap things up by – you are eventually going to retire, Ron. [laughter]

RB: [laughter] Someday.

KSK: I mean, talk about your career with sturgeon and what it has meant to you. What do you see a relationship with sturgeon doing in the future?

RB: Well, I can't imagine the day where I won't be doing something with them. So, I really

think that for the rest of my life, I'd like to have some involvement with them, either directly or indirectly, with either research or collaborating with work with other researchers, even in an advising capacity or in a direct role. I see myself continuing this for as long as I can. That doesn't mean being full-time employed for as long as I can.

KSK: [laughter]

RB: I mean, that'll probably go for a while yet, too, because it is such a unique position to be in, to be able to work with this tremendous fish and with this stock, that this is something that any biologist – it would be difficult for them to give that up. We've learned so much. It's so fascinating to continue. Every rock we tip over, there's a couple more things that we got to figure out. We have the opportunities here to do that. What it's meant to me over the years is just not only the opportunity to work with this fish, but to work with a lot of really fantastic people. Starting with (Dan Foles?) who really got me going in this and all the other people that he had around him that I worked with, and then my own crew that I work with now. Then beyond that, the people around the world that I've been able to get to know and to work with on various projects and my involvement in the World Sturgeon Conservation Society as one of the founders of that in 2003 with others from numerous other countries. All of that happened because of sturgeon, even bringing my families together from Europe and the U.S. that were separated for 117 years, came together because of sturgeon.

KSK: That is how you started connecting with your family in Germany?

RB: Right. I went to my first international meeting in Italy. I was invited to serve on the scientific committee in 1997 at the 3rd International Symposium on Sturgeon. I had never been to Europe before. I knew my great-grandfather, Matthias Bruch, came from Germany someplace. I wasn't sure where. I was always interested in genealogy. So, I did some genealogical research at a Mormon church here in Oshkosh and was able to find where the village was that he came from. Because I had this trip planned already, the Italians were paying for it, I took extra time, took extra vacation. On my own, rented a car and went to Germany and went to the village of my great-grandfather, and checked into a bed and breakfast and then asked, "Where can I get something to eat and a beer?" They told me, and I went down to this little place, little, tiny village, and went in there. It turns out this place is owned by my third cousin whose great-grandfather was my great-grandfather's brother. This was their carpenter workshop that she made into a restaurant.

KSK: [laughter]

RB: So, it was because of sturgeon that that happened. If I wouldn't have gone over there for sturgeon, I probably would have never done it like that at that time. That was in 1997, and we've been reunited. We travel back and forth almost every year and have been reacquainted with each other all because of this fish.

KSK: [laughter] Ron, I talked to Dan a little bit. I mean, there is Dan. He is your role model. He has not missed a spawning season yet, right?

RB: Actually, when Gordy Priegel first came in the [19]50s, Dan was a new biologist. In the late [19]50s, early [19]60s, Dan was actually helping Gordy tag fish. On the river, he didn't have the responsibility as a sturgeon biologist then. But because he's such a big guy, big strong guy, he was a perfect guy to put on the dip net to (snort?) these massive fish out of the river. So, that was his first opportunity, as I understand it, to work with sturgeon. Then he ended up coming in Waupaca County and ended up coming over here to Oshkosh as a biologist on the Winnebago system in the mid-[19]70s, and then took over as the main biologist. Yes. I mean, Dan is, like I said before, he really has been a role model and a mentor for me.

KSK: So, that is over fifty years then that Dan has been –

RB: Over fifty years.

KSK: – working with sturgeon?

RB: He hasn't missed a year.

KSK: [laughter]

RB: He's been here every year that they've tagged.

KSK: When I was talking to him about when they went out to collect eggs for the first successful –

RB: Yes. That was in 1979, and they were successful in collecting eggs, but nothing hatched from that batch until the next year when Fred got involved. Or that was 1978. Then 1979, Fred got involved, and they were able to get it going.

KSK: Dan was just saying he spent all this time with the one female that they took eggs from. He had to go take her back into the water and kind of helped her get back going. I was just talking to him about his relationship with sturgeon. He said of all the fish that he has worked with, that is really the only fish that he said that he could really have a personal relationship with.

RB: Yes. I feel the same way. It is very personal for me because it does go so far back for me. My dad would take me when I was only eight, ten years old up to the (Palamo River?) to see this fish. We catch one every once in a while. It was just always something that's so big and colorful and prehistoric looking and just such a unique enigma. It was just something that you were in awe of. Then early in my career, I had the opportunity to work on sturgeon surveys up on the Menomonee River. A matter of fact, the week before I was married, I was up there that whole week running a shaka boat and taking sturgeon in 1978. I mean, I was so excited about working on sturgeon and stuff. I mean, I did get down in time to get married and everything.

KSK: [laughter]

RB: I wouldn't miss that. As a matter of fact, we had our thirtieth anniversary two weeks ago. But it was just really a memorable experience. Then having the opportunity in [19]86 to come

back and work with Dan. Finally, in [19]92, be responsible for it. It's been a very wonderful career.

KSK: Well, I think that is it then, Ron.

RB: Thank you, Kathy. Well, good. Well, thank you so much.

KSK: I am turning it off.

[end of transcript]