

WATERSHED SCIENCE AT COWEETA AND BEYOND

An interview with

WAYNE T. SWANK

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By

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INTRODUCTION

In 1897, Congress decided that one of the primary purposes for national forests created by presidential proclamation was to "maintain favorable condition of water flows." Almost all national forests in the American West have been established with this criterion in mind. Then in 1911, Congress determined that land could be purchased for national forests only if it would safeguard watersheds of navigable rivers. Nearly all of such subsequent purchases occurred east of the Mississippi River. Although these two statutes would be amended, supplemented, or replaced later on, there can be no argument that water--supply and quality--has been and remains of central interest in national forest management. It is very logical then that study of water has long been an important facet of Forest Service research. Thus, it was no surprise that Dr. Ann Bartuska, deputy chief for research, asked that Dr. Wayne T. Swank be interviewed, as his long and impressive career as a watershed scientist saw him rise to the top of his chosen field in the United States and around the world.

Swank was born on March 8, 1936 in Occoquan, Virginia, As he grew up he enjoyed the outdoors and decided to study forestry at the University of West Virginia, where he earned a bachelor of science degree in forest management in 1958. While in school he spent summers working for the Forest Service in the West-- Montana, Oregon, and Washington. One of his advisors told Swank that the University of Washington had a good forestry program, and so he enrolled there for a masters program to study watershed management. He received a masters of forestry in silviculture (the university did not have a formal hydrology major) in 1960. While in school and after, he continued to work on the Lake Wenatchee Ranger District on the eastern slopes of the Washington Cascades, generally engaged in traditional forest management programs. His on-the-ground assignments showed him the need for applying science to management, and so he once again enrolled at the University of Washington, this time for the Ph.D. to continue his studies in watershed science. He finished his course work and was appointed research forester at the Coweeta Hydrologic Laboratory in Otto, North Carolina, and lived in nearby Franklin. By the time he completed the degree in 1972, he was principal ecologist at Coweeta, and his remarkable career was well underway. Today, Scientist Emeritus Swank continues his watershed studies and still lives in Franklin, but in a rather different house than he and Roberta first rented in 1966.

In the interview that follows, Swank argues persuasively that watershed studies have long been and still are the best example of ecosystem research. He also believes that although there are other research watersheds that "Coweeta is basically the leader," in terms of "consistent, planned stream flow measurements." He further asserts that "the quantity, quality, and timing of stream flow provides a good integrated measure of the success or failure of land management practices." This view fits well with Forest Service needs since the broad scale transition to ecosystem management that began in full force in the early 1990s, and in fact the utility of watershed studies was obvious as early as the Multiple Use--Sustained Yield Act of 1960. It also squares with Swank's belief in the need for applying science to management, one he has held since he was working on a ranger district and considering graduate school.

Publications are a standard measure of scientific achievement, and Swank selected the ten "most significant" of his 215 total to date--he is still publishing--and the list is appended to this interview. Of the ten, two only hint at his international eminence in watershed science, with his papers included in the proceedings from a symposium in Wellington, New Zealand, and a conference in Aberdeen, Scotland. Another appropriate measure of achievement is the honors and awards that one receives, and Swank's curriculum vitae lists fourteen awards for performance, including the USDA Superior Service Award in 1992. He describes the significance of this high honor, as well as the thoughtful ceremony surrounding it.

Ahead of the interview we exchanged ideas on its structure and content, and Swank sent me a stack of his publications so that I would be familiar with his work and could better design lines of questions. When he received the interview transcript, Swank extensively revised and reorganized it, typical of scientists in general who have spent most of their adult lives working to master precision.

We did not know it until we began preparing for this interview, but Wayne and I were in graduate school at the University of Washington at the same time. Our schedules and classes were rather different and we have no recollection of meeting each other, but we had classmates and professors in common. There are many references to our overlap, and we spent off-tape hours reminiscing. There are also references to Donald Marx, another eminent Forest Service Scientist in the neighboring state of South Carolina who I had interviewed a few days earlier. And I would be remiss if I did not mention Princess, the family cat who spent much of the interview asleep on my notes.

Choosing Forestry

Harold K. Steen (HKS): How did you choose forestry as opposed to something else, and why did you choose West Virginia University?

Wayne Swank (WS): I grew up in an environment where the forest and rivers were my playgrounds in a little place called Occoquan, Virginia. It's south of Alexandria near Woodbridge. There's a little village there called Occoquan, which when I was a kid, was a main town.

HKS: It's still there?

WS: It's still there. It was originally an Indian town and then it was a colonial town and evolved into a trading center, being at the fall line of the river. Anyway, that was my playground. I was born in Washington, D.C., and at the age of three my mother and father divorced and then my mother, my older brother Gerald, and I moved down to Occoquan with my grandparents, Grover and Almeda May.

I was very close to the land if you will. That's where I fished and hunted and we had a black community, and I fished with them quite a bit. I was a fairly good fisherman and they got my fish when I caught them. And that's what they lived on, of course. They'd salt the fish down in wooden barrels and have meat throughout the year. I didn't know I was interested in forestry obviously at that time but I just had a good feeling in being out in the forest among the rivers and so forth.

HKS: I either wanted to be a forester or a civil engineer. I wanted to work outside. No one works outside very much anymore after the first few years, but that's how it got me started. Why didn't you go to Blacksburg, in-state tuition and all the rest of that?

WS: They did not have an accredited forestry school at that time, so that's the reason I went to West Virginia. Originally I was scheduled to go to University of Montana. In high school when I thought about what I wanted to do, I really thought about the ministry as a possibility, medicine, or journalism. And there are commonalities across those vocations that attracted me.

HKS: Public service?

WS: Yes, in public service and helping people, that type of thing. I was very active in high school in journalism and I enjoyed that. I thought well, you have to take foreign languages if you're in journalism. I think they had a requirement for foreign language. I was not too keen on that but ended up having to pass two foreign languages for my Ph.D. I'm very happy I did choose forestry, because it's a field where we can help people. We can help society.

HKS: Years ago I read a study about the similarity of people who go into the ministry or go into forestry. There's a sense of mission and public service. Not anymore so much in forestry, but it was when we started out. Did you take a standard forest management course at West Virginia? I don't know how many options you had.

WS: It was forest management. There was an outstanding faculty at West Virginia University, and “Doc” Percival was department head and the staff included people like Gus Tryon and Ken Carvell who were silviculturalists, and Maurice Brooks in wildlife management. Many of my classmates, as we attend reunions, always comment how fortunate we were to have such a good undergraduate education. Furthermore, I was very fortunate in another way. My mother remarried when I was sixteen and then we moved south of Alexandria, so my last two years I went to Mount Vernon High School. It’s right near George Washington’s home. The high school was excellent, a quality high school. For two years I really had to crank up my study habits and bear down on being able to do well in school.

HKS: When you were in say your sophomore or junior year, was it clear then you were going to graduate school or you were going to be a forest ranger or work for a lumber company, or what did you think your future was going to be?

WS: I don’t even know if I thought about that a whole lot. My older brother Gerald went to West Virginia University also and he majored in forestry. I had visited him a time or two when I was still in high school, and so I had some notion about Morgantown. The fathers of two of my best friends at Mount Vernon High School were cartographers with the Forest Service, and their office was located there in Alexandria, not in D.C. Pat Whitaker and Jay Arneson were my two best friends, and their fathers Dick Whitaker and Clair Arneson were cartographers, and so I knew a little bit about the Forest Service through them, of course. Actually, years later after I arrived at Coweeta, Dick and Clair laid the groundwork through Region 8 engineering for Coweeta to obtain a much needed, high quality topographic survey and map of the experimental basin. Our senior year Pat and I both worked for a city surveyor in the summer there in Alexandria. Cecil Cross was a very, very nice man, and we got paid a dollar an hour for our efforts in the summertime. I remember seeing George Washington’s name associated with some of the reference points that we used to start our surveys with, right there near downtown Alexandria. Somewhere in our senior year Pat decided he wanted to study geology. And I said, I think I’d like to probably study forestry. He said let’s go to the University of Montana. I said well, it sounds good to me. His dad Dick was from Missoula and, Pat’s grandmother, was still living in Missoula. So we said let’s get us a summer job out there after we graduate. Mr. Whitaker helped us apply, and he knew where to write and get the forms and all of that. After graduation we hopped in the car and drove out to Missoula. Pat went to the Lolo National Forest, and I had a job on trail crew on the Clearwater National Forest.

Summer Jobs

HKS: That’s pretty country, the Clearwater.

WS: Lovely, lovely country. I was on the Kelly Creek ranger district. Bill Hatch was the ranger and there was a guy, the district assistant I think they called them in those days, who had ridden with Pancho Villa. He was a real short, wiry, tough as nails kind of guy, had on a cowboy hat, you know. I was really impressed with him, rolled his own cigarettes, all that. Then the trail boss was “Hoot” Gibson and he was a seasonal worker but an older fellow. The packer was Earl and I

can't remember Earl's last name. It was a fantastic summer. I saw more elk in that one summer than I'll see big game put together in my lifetime probably. We busted elk out everyday. We were out on the trail for ten days and then back at the ranger station for four.

HKS: I was on trail crew about the same time in the Cascades, same ten and four.

WS: Where were you?

HKS: North Bend ranger district in the Snoqualmie.

WS: That was a fantastic summer, and Pat and I were both enrolled at the university there. Frequently, Forest Service funding would run out for the seasonal work, they never knew exactly how much they were going to have available. It ran out that summer in '54. Pat had a girlfriend back in Virginia. He decided to go back to the University of Virginia. He had a blank check and ticket, if you will, to any university in the country. He was quite an athlete, outstanding football player and pole-vaulter, trackman. I said I can understand why you'd want to go on back but I'm going to check around here a bit, wait a few days, and find out if I can get a part-time job in Missoula cleaning streets or whatever. Jobs were really scarce. I couldn't find a thing. So then I went over to talk to some of the faculty at the university, and they said we have an outstanding range management school. I thought, I'm not interested in range management really. So I told Pat that I would go back with him. I called my mother and asked that she send my transcripts to West Virginia. She said okay, but they've already started classes back East here. We hopped the train and we came back East. I arrived in Morgantown several weeks after classes had started. The registrar said your grades are real good, I have no problem letting you go ahead and start classes. That's kind of the story behind why I went to West Virginia.

HKS: I look at your vita. You're a forester on the Lake Wenatchee ranger district 1959, and you got your master's in silviculture at U of W in 1959. You graduated in '58. It's kind of a cramped chronology here.

WS: It should be 1960.

HKS: Your degree?

WS: Yes.

HKS: Okay, that puts a little slack in the system. You were doing two things at once, which is not impossible to do.

WS: At the end of my freshman year at West Virginia I wanted to go back out west again. I got a seasonal job again on trail crew as trail crew boss. There were three of us from West Virginia that were going west on summer jobs, so we loaded up in a 1936 Chevy that one of the guys owned and drove on out west. I was located on Willamette National Forest on the McKenzie Bridge district. I don't know if you're familiar with it.

HKS: You bet.

WS: It was a fantastic summer again. Ten and four and lots of memorable things that summer. I'd like to share just a few of them with them because they were significant in my life. Number one was that the other seasonal people there were top notch folks that I've kept track over the years. Bob Romancier was one of them. He was a fire lookout that summer, and he was a student at Duke University. The other guy was Kent Mays. Kent ended up in the Washington office eventually. He was foreman of a brush piling crew that summer. The ranger was Ed Anderson who just passed away in 2006 and the assistant ranger was Norman Gould. Norm ended up being director for timber management in the Washington office. One of our jobs that summer was to test using the Merry Packer. Did you ever see the Merry Packer (Mechanical Mule)?

HKS: We had one.

WS: Okay.

HKS: If you hit a stump with the chain housing it would turn ninety degrees and throw you both off the trail. I remember the Merry Packer.

WS: The first time we tested the machine we had it loaded near capacity. The trail was out-sloped, and you know what that meant. It was awfully hard to hold that thing on the trail. It kicked out and went down slope. I yanked it back up on the trail and pulled my back and I couldn't move. I'd pinched a nerve somewhere. They got me out of there and took me to the hospital. All they could do was wrap me tight so I wouldn't move too much. I had that pinched nerve problem until I was about fifty. So that was kind of a memorable thing. Another memorable thing was that we found a herd of over a hundred elk up in Wildcat Swamp on the McKenzie.

HKS: A lot of elk.

WS: Huge herd in the middle of the swamp.

HKS: The elk we had were always breaking down the tread of the trail. They'd cut across, you know, and we would do a lot of rebuilding because elk went through.

WS: When we returned to the station I told them about the elk and they said oh, come on, you're kidding. I said no, there are three of us that saw them. What happened was we had the Merry Packer that particular trip, and I saw Wildcat Swamp on the map. We were a little distance from it so I shut the machine off and suggested we look at the swamp. We walked up to the edge of it and that whole swamp just exploded with elk coming out of there. The bulls formed a semi circle with the biggest bulls' right in the middle and then they tapered off to the younger bulls, and then the cows and calves were running off behind them through thickets of lodgepole pine, just the loudest racket you ever heard. Very impressive.

And so the final thing that was certainly memorable, was finding a lost hiker up near McKenzie Pass. We'd been out on trail and had just come in for our four days off. They said we've got a lost hiker that's been out there for about four days. We're exhausted. They had worn themselves

out and wondered if we could lend a hand. I said sure, let us get something to eat and we're off and going, because we could run trails. I mean we were really in that kind of shape. We could just go all day. So we got some food and they took us up there and let us out. I'd say I'd been on the trail probably thirty minutes or forty minutes, something like that, and I was doing the point work with my crew behind me carrying the stretcher in case we found him. He came straight down the mountain, right across the trail in front of me. I yelled and he didn't even recognize me or know where he was. I had to tackle him and put him to the ground. He was out of his head you know and he had soiled himself. An unsavory situation. The guys behind caught up with me then, and we finally got him calmed down and on the stretcher. The hardest work I've ever done is carrying somebody out on a stretcher.

HKS: I did that once. It was a three-man crew. One man cut his knee with a hatchet, and we had to sew him up with fishing line with no anesthetic and carry that guy. Man that was tough work.

WS: This fellow did recover I learned later and was okay. But he'd been without food for that entire period of time and then he apparently panicked, and of course, Three Sisters area is big country.

HKS: In a lot of ways I've always thought trail crew was the best job I ever had because you could see what you accomplished at the end of the day. When you're sitting in an office, your in basket never is empty.

WS: Right. Bridges repaired, brush cut, telephone wires strung. I enjoyed that more than about anything. And there at McKenzie Bridge on the Fourth of July I was hanging off of a Doug fir putting some telephone wire back up and here came that big cloud across the valley and it snowed for about ten minutes. [laughter] It snowed and I still don't believe it.

HKS: Better than a lightning storm when you're up there with that phone line in your hand.

WS: My last seasonal job was during the summer of 1957 in oak wilt survey for the Virginia Division of Forestry. This entailed detecting infected trees from low level air flights, plotting the sites on aerial photos, and then later identifying land ownerships from courthouse records. We (there were two of us) then would contact the owners, usually in person, to obtain permission to treat infected trees and reduce spread of the disease. Our territory covered all private forest lands in the Shenandoah Valley between Winchester and Staunton Virginia where we were stationed. It was interesting work but not without hazards. We had a couple of emergency landings in fields and also returned to our air base with bullet holes in the wings, apparently because we came to close to liquor stills. Since both sides of my family came from the "Great Valley", I did get to visit with many relatives that summer. I also earned enough money to buy a used car.

Graduate School

HKS: So you graduated, how did you get to grad school? How did you pick the University of Washington? What's the sequence here?

WS: Dr. Gus Tryon at WVU was knowledgeable about the University of Washington because he and my eventual mentor, Dr. David R.M. Scott were both silviculturists. It was a chance occurrence of talking about going on to graduate school that Doc Tryon said that the University of Washington was a very good school. Moreover, I kind of wanted to go back out west.

HKS: Did you see yourself getting into research was why you went to grad school or did you want to become a better forester?

WS: I mainly wanted to become a better forester and work in watershed management.

HKS: So you'd picked the field at that time?

WS: Yes, I wanted to work with water resources.

HKS: Okay.

WS: They didn't have a forest hydrology major at UW at that time. In fact, very few universities had a hydrology program in forestry in those days.

HKS: And Washington had one?

WS: Well, not really, but they had the supporting sciences that go with watershed resources, such as forest soils with Stan Gessel. But I didn't know that at the time, of course, when I made that decision.

HKS: You went out and worked a year at the Lake Wenatchee ranger district?

WS: No, after graduating from WVU, Roberta Jefferson and I married in June and after our honeymoon, packed our '49 Dodge Coupe and headed for Seattle and graduate school. We arrived in Seattle and rented an apartment on 16th and 65th Northeast, just up from the university, and our landlord was a commercial fisherman. But when I checked in at the university, I found out that my assistantship didn't start until school started, which gave us a couple of months to try and live on the little bit of money that we had, which was hardly enough. As fate would have it, the Anderson's lived two doors down, and they had a son about our age. On the other side of us was another family and their daughter and the Anderson's son were going to be married. Well, come to find out, Mr. Anderson is a forester and he had a consulting firm in wood technology. They felt sorry for us and he said he would get me a project or two, which he did. One was determining the fiber length of thirteen different South American wood species, and it paid more money than I had in my pocket, so that saw us through that couple of months before graduate school started. Subsequently, I worked for three years on the Lake Wenatchee Ranger District between a MF and Ph.D. at UW.

HKS: That was doing routine forestry work?

WS: Right. I had one of the best jobs in the Forest Service then. I was a salvage sale forester. That's the time; you may or may not remember when the Forest Service developed a salvage program of harvest. Additional funding was provided by Congress to improve forest health by harvesting dead and dying trees due to disease and insect infestations.

HKS: I don't remember that, but you're East Side and I was West Side.

WS: When they actually created the salvage sale positions I was finishing my master's and I wanted to get some field experience by working in the national forest.

HKS: Was the idea behind those sales to also create jobs for gyppo loggers and so forth?

WS: The gyppo loggers certainly benefited from the program. I had, each year, probably between eight and twelve gyppo loggers that I worked with, and that was an education unto itself.

HKS: When you're scaling their logs, they're trying to distract you and they know all the tricks.

WS: They know all the tricks. For example fireboxes, they knew exactly what they were supposed to have in those fireboxes but would test you. I really enjoyed that job very much for a number of reasons and one of them was that the people I worked with were just outstanding. Dick Woodcock was the ranger and Dick was the quintessential ranger. He's about 85 years old now and I saw him this summer back at Lake Wenatchee and had a chance to reminisce with him. He was quite an outdoorsman and I think did some movie work for Disney where they needed somebody to run rapids or whatever. And he's still in pretty darn good shape.

We had a young staff of foresters including Jack Watson, Stan Pasin, and Bob Northman. It was just a great group to work with. Dick gave us some leeway to develop programs. In addition to salvage sales, I had the timber stand improvement responsibilities as well. At that time we were doing a lot of spraying of clearcuts to reduce competition from *ceanothus* after burning and planting, and so I had what we called then, Pete, administrative studies. So I did some simple studies like looking at the growth rates following spraying versus non sprayed, and some things like that. Then I initiated a commercial thinning study. We had no commercial thinning at that time. We wanted to generate some work and sales during the winter months, so we located these at the lower elevations where the logger would have only a foot of snow or something like that to deal with. That worked out pretty good actually. I saw some of those sites last September when I was there to talk to the ranger in Leavenworth. There's no longer a ranger at Lake Wenatchee.

We didn't know how to do the appraisals using standard procedures because it was different size materials you're selling, and it was going to be tractor skidding, but we didn't know what the cost would be in the wintertime. So we did an economic analysis and the logger made a little money. It wasn't gangbusters, but at least we gave him some work in the wintertime and at the same time improved the residual stands.

The Lake Wenatchee district is a fantastic ecological system because you go from the Ponderosa pine type at the low elevations all the way to the crest of the Cascades. So you're going through

the Douglas fir, hemlock and western red cedar forest types on through to the true firs, and it was just a real challenging management opportunity. I had the full cycle of the sale process. Laid out the sale, marked trees, did the appraisal, and then administered the sale. The annual salvage was five million board feet while the annual regular sale on the district was twenty-five million board feet.

Dick Woodcock was the master of prescribed burning. He was about the best around, period. I can remember one fall, it was Jack Watson, Dick, and myself, and the burning conditions were just right, and we were the only three available on the district. I can remember going in this one drainage and we were lighting unit after unit and leaving it. Usually we would be along the fire line until we knew it was safe to leave. We must have burned at least ten units that night, the three of us. And these are, you know, fifty, sixty, seventy, or eighty-acre units.

HKS: That was a fuel reduction program. You thought of it as fuel reduction, not as forest health.

WS: Right, it was fuel reduction, for planting. I revisited some of those same clearcuts several years ago when the stands were about 45 years old. The forests are fully stocked and healthy but need to be commercially thinned to sustain productivity and health. However, given the current restrictions on harvesting in the region, this is probably not a reality.

I made a mistake one year telling them, well, if there are any fires put me on them, because I was trying to make money to bring the family back east for a holiday. We hadn't been back east in a long time, and we had two children then. I made six hundred dollars that fire season in overtime, and that summer I had only one day off. That paid for our trip back east, the four of us.

HKS: I know we used to get in trouble with what we called you east side people because we'd be burning slash and it would get away. Elk season just opened up and guys had their permits, and then we'd call them over to help us put the fire out. They were always unhappy with us on the west side for burning our slash and letting the fire get away, and they would miss opening day.

Snowmobile

WS: Dick Woodcock believes that the first snowmobile that was tried on the national forest in Region 6 was at Lake Wenatchee in 1958. The first model tested was inadequate but the second one tested, a Polaris Forester, performed much better. I was the main one who was to use it, particularly for my small timber sale layout in the wintertime. That meant that we needed to have a reverse gear to unload the snowmobile, because it was much too heavy for one person to handle. The reverse gear also was useful in extricating the machine when it became stuck. So we took it down to Mr. Clayton Merry who had a shop, Pete, about eleven miles from Lake Wenatchee in Plain. He, of course, built the Merry Packer, Merry Scooter, Merry Tiller, and other machines.

HKS: Oh, I didn't realize. I didn't know it was named after a person. I just thought it was like having a merry time.

WS: No, Clayton Merry had his shop right there and the guy was a genius. He invented all this equipment, you know. We asked, can you put a gearbox in this? He said sure. He whipped that gearbox in there, and I had three forward gears and a reverse so that I could pull up to a snow bank in my pickup, drop the tailgate, run it up in there, take off, go to the end of the road or wherever I was going for that day's work, back it up to another snow bank, drop the tail, back her out, and away I went.

Ph.D. Program

HKS: So you were enjoying yourself doing standard forestry work on the Wenatchee, but you got serious about school and went back for a Ph.D. You really wanted to go into research. Even though you liked fieldwork for the Forest Service, you wanted to be more specialized?

WS: Right, what I really was directed towards was applying science to management. By working on the district I could see there was a lot of opportunity for that. Part of that formula is how do you translate the science to management. But there were lots of opportunities to do that to improve the management with the science, and I always wanted to make that linkage. I think that's apparent with some of the programs I eventually ended up in.

HKS: You said earlier that Washington didn't have a formal hydrology program but they had the support sciences other places on the campus. How did you know that ahead of time?

WS: Well, like I said, I really didn't know that, but after I got there I could see that there were those opportunities.

HKS: Who was your major professor?

WS: Dr. David R.M. Scott. For my master's and my Ph.D.

HKS: So he knew that there's somebody over in engineering maybe. What are the other fields where you had to find the talent?

WS: Actually the forestry school had a good relationship with a number of departments, and people like Dr. Scott and Dr. Gessel kind of paved the way to be able to set it up for forestry students to take courses in these departments. A classic one was micrometeorology with Dr. Beutner.

HKS: I took his course. Everyone had to take his course.

WS: In Geology, Dr. McKee was there before Dr. Porter came, and I took quite a few geology courses up there. Another one for me was civil engineering. Professor Campbell was a civil engineer. He was a hydrologist but from an engineering perspective. A great person, just one fine individual, and he went the extra mile to work with me. We did have forest genetics within the

College of Forestry and, of course, forest soils and many of the more traditional forest sciences. Another one too, Pete, was plant physiology with Dr. Walker.

HKS: He was a tough nut, I'll tell you, that guy.

WS: He was on my committee too and he was a very, very tough nut but he was fair and helpful, and I always enjoyed him very much.

HKS: I still remember his final exam in plant physiology. You have an acre of alder, what kind of a tenting device would you put over it to measure photosynthetic gases and so forth. God, I was a sophomore. How would I know how to do that? [laughter]

WS: I saw him for many years at professional meetings, particularly the Ecological Society meetings, and he was still active for quite some time.

HKS: I'm sure he's a very nice guy but in class he was pretty stern. No joking around.

WS: Not in his class, but he had a great sense of humor, which a lot of people never knew.

HKS: Well, I never knew that. Good to hear it. So this mix of courses gives you a Ph.D. in forest hydrology?

WS: It wasn't a formalized degree program.

HKS: Did you look at curricula at other universities just to see what they were taking or did you worry about that, you took what you wanted to take?

WS: I took what I thought I'd need.

HKS: Dave Scott just signed the paperwork?

WS: That's right, but of greater importance, he gave sage advice and support on many important matters. Doc Scott was an outstanding educator, mentor, and friend. He and Mrs. Scott warmly opened their home to numerous graduate students. I also have fond memories of the frequent bird hunting trips we took with him.

HKS: Were you thinking about working for the Forest Service in research at the time you were in school? You had watersheds up the wazoo there right around Seattle.

WS: When I was working on my Ph.D., I wanted to work in some water related area, research or teaching, either one. It reached a point where I needed to make some decision, and I'd been in school quite a while. My research for both M.F. and Ph.D. was on the Kitsap Peninsula, a place called Fern Lake.

HKS: Norm Miner used to talk about Fern Lake. It was his second home I guess.

WS: Norm was also working at Fern Lake and that was a good project. It was probably among the first ecosystem oriented projects that we had in the country. It was linking the terrestrial system with the lake system and focusing on steelhead production. The rainbow trout ran to the ocean and then came back as steelhead. The question was what was happening when they returned to the lake system, when they came back to spawn and what was the nutrient turnover involved there. The other part of the research effort was linking productivity of the forest with the lake productivity. We had a number of fisheries biologists on the project. Forestry supplied the link for the terrestrial work and that was funded through the Laboratory of Radiation Biology that was located in fisheries. So forestry and fisheries cooperated in training grad students and provided the funding.

HKS: I'm assuming from my experience in grad school that you'd finished your coursework and you signed on at Coweeta before you got your Ph.D.

WS: Right, I had analyzed some of my data and had written some of the dissertation.

Moving to Coweeta

HKS: But how did you get to Coweeta? How did that opportunity present itself?

WS: I started looking around for jobs. At that time in '66, over the span of time I was looking around for a job, say six months or whatever, there were only about three in the country. One was at University of Alaska that Keith Van Cleave ended up taking.

HKS: I know Keith Van Cleave. We worked together. I can't remember what on, a Forest Service job in the summer.

WS: We worked together following the International Biological Program. When I was with the National Science Foundation (NSF) he was the PI, the principal investigator, on their research that was funded through the NSF. We had a major review of their program. Tell you what, he was a class act, Keith was. So that was one job, which I didn't apply for. The other one was at the University of Arizona and I believe Pete Efolliott took that job.

HKS: Not Arizona State but University of?

WS: University of Arizona. I have known Pete for years. We have worked together on various projects and on the Man and Biosphere program and coauthored papers. But there was an opening at Coweeta and Dr. Scott encourage me to take that Coweeta job. I said well, that sounds good to me. It's back east.

HKS: Fairly close to home for you.

WS: The grandparents were certainly happy. Also, I had an aunt that lived in High Point, N.C.. Her dad was a professor at High Point College, as they called it at that time. And so I said well,

I'll apply for the job at Coweeta and I did and, as they say, the rest is history. We pulled into Franklin; there was Roberta, me, and three children and two gerbils, on September 7, 1966. As we got closer and closer to Franklin we came down the mountain on old Highway 64. It was about ten o'clock at night and Roberta said I don't see any lights. [laughter] Just can't imagine. We're almost there. I don't see any lights. I said well, you know, we knew it was a town of about three thousand. It hadn't really grown that much at that time. And so we finally pulled in. First day I said this is home. I like this.

HKS: So you've always lived in Franklin? I don't know what's at Otto. Is it just a gas station?

WS: It's just a post office, gas station, and Coweeta is just south of Otto. It's thirteen miles from Franklin. Then we started looking for a home to rent. There wasn't hardly anything to rent here at that time. They showed us a lot of places with outhouses you know, no indoor plumbing.

HKS: So at the time you weren't thinking you might actually live here, stay on after you got your Ph.D., or you were thinking that way?

WS: I could tell Coweeta was exactly what I was looking for.

HKS: Okay. Norm Miner was here. You co-authored a publication then.

WS: Norm was here. He had left Seattle and he never finished his degree. In fact, I inherited some of the work he was doing and that's one of the reasons it took me a little longer to finish the dissertation. But he had conducted some good stream gauging studies, so I completed that work on the water balance for the Fern Lake watershed. My other work was more physiological, looking at transpiration patterns in Doug fir and interception process studies. Because we were funded by the Laboratory of Radiation Biology, I had access to radioisotope techniques as well, so I used Promethium-147 (Pm-147) as a method to measure changes in leaf thickness, which reflected changes in water status of the vegetation.

HKS: It was the joke, if you want to protect your research plot, all you had to do is put a Danger Radiation sign and no one bothered it. [laughter]

WS: Hans Riekerk was a colleague of mine at Fern Lake and he was in forestry. He subsequently came to the University of Florida, and so we've kept in touch. He visits us occasionally. Hans used the radiation sign effectively. He was using P-32 which is more difficult to handle. [laughter] It wasn't a bluff.

HKS: I imagine the method of handling that material has changed rather substantially in terms of personnel safety.

WS: Right. I wasn't too keen on handling some of that hot stuff, but Pm-147 is a weak beta emitter, so it was fairly safe to work with. That group in fisheries was working at Enewetok and looking at the fate of some of the radionuclides from atomic bomb test sites in the Marshall Islands. But did you ever know Lauren Donaldson? He was the head of fisheries. He was Mr. Trout and Mr. Salmon, Super Trout.

HKS: Sure. Every time the salmon were running there in Lake Union, he'd be on television with his hip boots on pulling salmon out.

WS: The project at Fern Lake continued for quite some time. Some of that information was used by a fellow who developed a hydrologic model eventually, for Fern Lake. That's what we were trying to achieve some way of synthesizing information to use it in a forecasting context. Then when I arrived at Coweeta Jim Douglass was the project leader at that time. And he was preceded by John Hewlett who had a significant impact on a number of pieces of work at Coweeta. Jim was the project leader and then he went back to school at the University of Georgia and worked under John Hewlett in hydrology to get some additional skills and talents. He did that for two years.

HKS: So courses in geology are more significant to your kind of work than soils? Like a geology prof helps you more in your work than say what Stan Gessel taught?

WS: No, that wouldn't be true. You needed the soils.

HKS: You need both?

WS: Absolutely, if you had to pick one or the other it would be soils, as parts of hydrologic processes. I had not had any education in land forming processes, and when I got in Porter's course I did a special paper for him and I utilized all the things I'd seen at Lake Wenatchee but didn't know what I was really looking at. I had a tremendous number of photographs, and so after I got in his class I said to him that. I've got pictures of that. He said well, do me a paper on that. So I did, and he was really pleased with it.

HKS: So from your point of view, geology was to give you understanding of the parent material?

WS: Right.

HKS: And then soils were what you were actually working with?

WS: Right, how those are interrelated. The soils are very important.

HKS: When do you get to work on your own and design your own project? My guess is that basically all the projects are long term and you plug into the middle of one and keep it moving along.

Coweeta Research Program

WS: For some of the watershed studies that were ongoing, that's certainly true. It's a continuum of research that somebody else inherits somewhere along the way in terms of a long-term integrated watershed study. However, much of the research conducted at Coweeta is short-term,

five to seven years, and results are very useful to forest resource managers. But the approach at Coweeta was really defined by Charlie Hursh. Here's where the story is going to start: Charlie Hursh was the architect for the Coweeta research program and the establishment of the research area.

HKS: The four years I was in research in Portland I worked on a lot of little things, but my main job was doing the final measurements of a twenty-year study of the impact of slash burning. This was my reaction. I certainly wasn't a sophisticated scientist. I was working with only a master's degree. But I could see that when the project was started they weren't asking the right questions. Every five years these plots were remeasured. On paper there was a continuity but in reality it was a pretty thin line we drew back because we learned as we went along. When I took the final measurements for the final report I could see that if we had asked different questions at the beginning it would have been better and been a tighter analysis. Your long-term projects could well have been the same thing. With new technology you could measure different things. You could measure things better and more precisely today than you could thirty years ago. Things were measured to the closest foot and then the closest inch and then the closest micron as you go along. Is this a major issue in long-term studies?

WS: What you can do typically is, as you say, get more precise measurement of a particular parameter or process. I suppose a classic one in forest hydrology would be transpiration. Some of our plant-water techniques have been greatly improved over time, so you can apply those and get a more definitive answer or solution to a physiological process. The same could be said for soil moisture. But, with the watershed studies, we have an integrated measure from a piece of landscape (watershed) that can be evaluated in the context of quantity, quality, or timing of stream flow. Now we can measure that quite precisely at the outlet of the watershed, but you have to have process level studies internally within the catchment to define cause and effect relationships. That's where the techniques and so forth would enhance that understanding over time. But the basic methods for measuring streamflow are as valid sixty years ago as it is today because the method for measuring discharge has not improved and won't improve. Some of the ways we're recording the data have changed, but the basic measurement of discharge has not been improved.

HKS: When I was looking at your publications, I was thinking about when Coweeta was started. This is my guess now, you can correct me as you go along, the basic interest then was quantity and quality of water flow. You had a weir and you measure precipitation and you manipulate the vegetation upstream and see what happens to the amount of water downstream.

WS: There was also interest in timing of streamflow and several of the early studies centered around the demonstration aspects of land use practices on the water resource. Hence, the mountain farming, woodland grazing and exploitive logging studies.

HKS: But most of your publications are about nutrient transport. You weren't measuring sediment per se. How do you plug this new stuff in as you become interested in more and different things as time goes on, but you still have this long-term study?

WS: When they established the overall objectives for Coweeta it was based on the hydrologic cycle which dealt with individual studies of the cycle. That was the model that Hursh perceived the program to be. If you look at the hydrologic cycle you'd have to have somebody that's trained in soils. You have to have somebody that's trained in meteorology. You have to have somebody that's trained as a physiologist, etc., etc. So it's implicit in that type of structure that you're going to have different disciplines and that you will have people addressing topics using specific skills and talents. That was the initial framework that Coweeta was based on, and we've got his original notes and documentation on that. It's in the history chapter of the Coweeta book. Thereafter, following a period of watershed calibration, the treatments were started on watersheds after they had been calibrated for a period of time. At Coweeta we used the paired watershed method of analysis. Originally, Hursh's plan was to calibrate a watershed upon itself and be able through understanding of processes quantify the runoff relationships on a given watershed. Then go in and treat that particular watershed and continue to measure those processes and based on that, determine why things changed the way they did.

HKS: Can you use that same model in Arizona, same basic model, same basic assumptions?

WS: Sure.

HKS: So you can generalize from one watershed to another at one level of abstraction?

WS: If you have enough understanding you can. But actually that never developed. They wanted to start producing results because it was a big investment, even though it was a Civilian Conservation Corps investment, the 3-C days. So the experimental approach returned to the paired watershed method of analysis. This is the most precise way of assessing cause and effect relationships, where you calibrate two watersheds side-by-side for a period of years. Go in and treat one and keep the other as a control and then measure the difference and the change in the parameters, be it monthly water yield, storm flow runoff, or it could be stream temperature or any number of attributes of the stream. That was the process back in the early years of Coweeta's research history, to build a data base and then apply watershed prescriptions. Then a little bit later, in the '60s, John Hewlett went back to the original concept of structuring a research program. But then he joined the forestry faculty at Georgia so it fell upon Jim Douglass to restaff to meet those goals. So that's the reason they had the positions for physiologists or soil scientists or meteorologists. Lloyd Swift was the meteorologist, etc.

HKS: Was it Lloyd Swift that was big in wildlife management?

WS: No, this is Lloyd Swift, Jr., his son.

HKS: Okay.

WS: And so that's how we came back full circle to the original plan for staffing Coweeta.

HKS: When we were exchanging ideas on how to structure this outline, I believe it's your language that Coweeta is unique from the scientific perspective. What's unique if the model fits

anywhere? I'm just trying to get you to articulate why it's unique, because there are other watersheds, long-term projects, based upon the hydrologic cycle. What is unique about Coweeta?

WS: Dr. Eugene Odum at the Institute of Ecology, University of Georgia wrote that research on Coweeta watersheds represent the longest continuous environmental study on any landscape in North America. I think the breath and depth of the cooperative research program also sets Coweeta apart from most Forest Service research work units. Additionally, the rather broad interdisciplinary research programs at Coweeta, H.J. Andrews, and Hubbard Brook are rather unique.

HKS: We'll get into this more as we talk about Hubbard Brook and H.J. Andrews, but obviously there's lots of research watersheds out there, and I want to pin you down on why those two and not some others.

WS: I would say the other rather unusual feature at Coweeta is that we have, over time, retained the same basic objective from the start, even up to the present, in terms of the mission of the work unit. Of course it's been modified and molded somewhat, but the focus is still to assess the effects of forest management practices and natural disturbances on the water resource, and that includes quality, quantity and timing. That goal was never really altered substantially, and it is still part of the research work unit mission statement. It is generally recognized that an understanding of forest ecosystem structure and function is strongly dependent upon a knowledge of water disposition on the landscape since water is the primary carrier of sediment, nutrients, pesticides, etc.

HKS: The Wagon Wheel Gap Watershed studies of the '20s in southern Colorado, does that continue? I mean it was established for a particular mission to prove that the Forest Service was right that forests prevented floods?

WS: The Wagon Wheel Gap study began in 1909 and was a joint effort between the Forest Service and the Weather Bureau.

HKS: For a variety of reasons it didn't show anything. I mean it didn't show enough to prove arguments.

WS: Some of the clearest evidence of the basic relationships between forest and floods in the east come from experiments at Coweeta. These include three experimental/management prescriptions that clearly show the beneficial effects of a forest cover on reducing storm peak flow rates and quickflow volumes during major storms. But these are small watersheds, not river basins, and extrapolation of findings to major downstream floods is a matter of scale. That is, how much of the flood producing watershed has been deforested?

HKS: Are you familiar with Gifford Pinchot's battle with the Corps of Engineers leading up to the Weeks Act, which was based upon do forests prevent floods? The Corps of Engineers said that forests have no significant impact, you have to put in levees and dams and things. But Pinchot won in Congress and got the Weeks Law through.

WS: Yes the Weeks Law was passed in 1911 and that's the constitutional basis for purchasing lands in the East for public lands. We owe a great deal to Gifford Pinchot for his foresight, which is clearly evident in the southern Appalachians and other areas in the east containing national forests. In the absence of land-use planning and zoning in the region, some developers and real estate agents are in a feeding frenzy, carving up private land with little regard for the environment and water resources. The consequences are far more devastating and certainly more long lasting than the damage caused by timber barons in the early 1900's. The good news is that 40 to 60 percent of our western North Carolina counties are comprised of public lands.

HKS: Did you ever read a book called *Fire and Water: Scientific Heresy in the Forest Service* by Ashley Schiff? It came out in the '60s.

WS: I don't recall having read it.

HKS: He was a political scientist. It was his opinion and he had data to back it up and he didn't convince the Forest Service, but that the Forest Service's policy on fire exclusion, although that term wasn't used then, was so overwhelming that the people in fire research were cowed and stayed away from significant aspects of prescribed burning and so forth because fire was bad in Forest Service dogma and the Forest Service couldn't be seen having a good fire. Okay, and the water part was this forest and flood thing that it wasn't until Zon published his work in 1928 that finally admitted that the Forest Service had overstated the significance of forests to flood control. That's what the book is about.

WS: Okay, quasi-science on the part of Schiff and little direct experimental evidence in Zon's report.

HKS: I thought maybe it was required reading for you watershed guys, because here was a guy who was saying the Forest Service had spent all this time trying to prove that Pinchot was right, forests prevent floods. Everyone I talk to in the Forest Service who knew Schiff, such as Keith Arnold, said he came to work with an agenda and set out to prove it. He started with this idea that the Forest Service administratively regulated thought on fire and water because they were so central to its mission, and that research was adversely affected.

WS: Ok, maybe we have exhausted this topic so let's return to Coweeta. We are now at the point where Jim Douglass has gone back to school. He was there for two years and commuted back and forth to Athens from Franklin. In that period he was kind enough to let me be acting project leader and our staff was very small at that time. One of the scientists was Dave Helvey. Dave and I were classmates in undergraduate school at West Virginia University. Dave had earned a masters degree at the University of Georgia under John Hewlett. So anyway, I did know a few people when I arrived here, Norm Miner and Dave Helvey. Over the years, the staff at Coweeta has expanded some but not a great deal. One thing I would like to point out and I think it is true of most successful research programs, and that is that the quality of the technical staff is very important in the success or failure of research programs. We have been fortunate here at Coweeta for decades in having just really topnotch technicians who are local folks for the most part and very dedicated, very sharp, reliable individuals. So I count that as a real positive thing that we've

had at Coweeta over the seventy years that it's been in operation. I will probably repeat this again in our interview.

HKS: Don Marx makes the same statement about the marvelous technicians he had. They were dedicated. They worked twelve-hour days and they just loved the job and they took it seriously.

WS: And would do anything.

HKS: Would do anything, that's right.

WS: So I think that is a common denominator in successful programs.

HKS: You're running on a little different outline than I am and that's just fine. Go ahead and talk about whatever is significant, but I would like you to talk about the linkages to Hubbard Brook and H.J. Andrews and other watersheds, but maybe now is not the time in the interview. Do you want to deal more about Coweeta specifically, its uniqueness, and then you have these ecosystem management projects at Winesprings and the riparian restoration program.

WS: Let me touch on how the research program at Coweeta has progressed over time, keeping in mind again, that the basic underlying mission did not change a great deal over this period. Jim Douglass has said the same thing. He thinks that's one of the factors contributing to the success of the work unit and I agree.

HKS: In terms of Coweeta's long-term studies, are they based upon the standard scientific method where there's a development of hypotheses? You gather data and you accept or reject the hypotheses, or do you just measure and see what happens?

WS: Some of both. You asked the question previously in the interview. When I came to Coweeta I did plug into on-going watershed studies. However, I also developed my own problem analysis with specific studies. And in that process, yes, we use the standard scientific method of generating a hypothesis, designing experiments, and then test that hypothesis.

HKS: And statistics?

WS: You bet. The Southeastern/Southern Station has always had an excellent statistical staff. Early in my career I was fortunate to work with Dr. Hans Schreuder who was stationed at the Research Triangle Park in Raleigh. Hans is exceptionally bright and helpful. He explains statistics in a very straight-forward manner and addresses the basic question. He was quite helpful in associating the relationship between changes in stand structure of forest stands, evapotranspiration, and streamflow. I was sorry to see him leave our station for the Rocky Mountains.

HKS: There's a photograph that the Forest Service has used many times over the years of a watershed in Colorado. I was flying to the west coast from Denver and looked down and there was this area where they cut in strips in different patterns. I don't know if that was considered

long-term or short-term, but they must have had immediate response because they took a lot of timber out.

WS: Oh, yeah.

HKS: Is that an ongoing project, I mean that same study? I assume that those clearcuts by now have thirty-year old regeneration on them or something.

WS: I have no idea.

HKS: Okay.

WS: Long-term research is very difficult to implement and carry forward in just about any country because we want immediate answers to some complex, difficult questions that only time is going to reveal.

HKS: Or Congress is mad at the Forest Service for five years or the chairman of the appropriations committee doesn't like the Forest Service research program and funding is reduced.

WS: That's right. To have seventy years of continuous, high quality records is rather unusual. Now the questions that are attendant to that long term database have evolved with time to some extent, but part of the process of doing research on the watersheds at Coweeta has entailed definitive hypotheses or objectives that are still valid.

The early work at Coweeta over the first decades was one of looking at streamflow responses to a variety of land uses. There was mountain farming, conversion of hardwood covered watersheds to woodland grazing experiments, and clearcutting of hardwood forests. There were alternate strip cuts where part of the vegetation was removed, conversions from hardwoods to white pine plantations and conversion from hardwoods to grass cover. These all had basic questions related to effects on the quantity and timing of streamflow, and more importantly the causative factors involved.

That early work was instrumental in altering land use practices here in the southern Appalachians. But then the emphasis shifted from treatments on individual watersheds to one of orienting the research program around process related research, because the long range goal is to be able to predict the responses to management practices. In order to do that, we have to know the processes and the cause and effect relationships. Thus, the research program shifted to bring in more disciplines to conduct certain types of research so we could arrive at a methodology or model, to predict the consequences of alternative management practices. We've succeeded rather well with the hydrologic models that have been developed, but we still have a long way to go with regard to biogeochemical cycling models. It's a lot more complex when you add the chemistry and the biology in with the hydrology.

HKS: I suppose fundamental to any sort of research done out of doors, the first year you inaugurate the study you have an unusual amount of rainfall, either a whole lot less or a whole lot more than normal and there's never a normal year.

WS: That's right, there's never a normal year. [laughter] Good way to get a drought or flood is to put in a new study. Another point I would like to make about our research approach is that we're always in a continuum of developing a theory, designing experiments that test that theory, and then modeling it. We're always in that loop of coming back and saying hey, we didn't ask the right question or, we're right on target here. Then the next step is to apply that information through various forms of technology transfer. At that point it is important to be fairly sure that you have a good product before it's applied because once that approach or methodology is accepted, it is difficult to correct.

HKS: Do you routinely at certain stages of a project invite local Forest Service people who have watershed responsibilities to see if you're in synch with their version of the real world?

WS: Oh, yes.

HKS: Or is their view so short term that it really is not useful to have their input?

WS: No, it's very useful to have their input, and it's useful for the scientists to better understand what their approaches to practices are, because that's helps identify the approach to sharpen the question sometimes. At Coweeta we've always had a good working relationship with the folks in national forest management, as well as some of the private industries. We hold workshops and have joint programs with the practitioners, the user groups. Some of the congressional staffs are very interested in the research that we're doing and they have utilized results. Our congressmen are certainly interested in the findings.

HKS: So they're interested in more than sedimentation or timber management practices? I mean if you're going to log this watershed are you going to mess things up?

WS: In part it relates back to old questions of effects of fire in hardwood forests. In the southern Appalachians the Native Americans routinely used fire to reduce the understory. When the Europeans came they also burned annually. Of course, Smokey the Bear changed that substantially. So our forests have probably been under a no-fire regime for about eighty years. They have changed a great deal from the Native Americans /early European era. So to answer your question, it goes beyond just logging questions. It has to do with effects of natural processes, natural disturbances on forest ecosystems. And that's one of the real benefits of having long-term control watershed information. Natural events can have a significant impact on forest ecosystems that is beyond our control. Some examples include insect infestations such as the southern pine beetle, fall cankerworm, and hemlock woolly adelgid which are currently destroying our hemlocks. We have documented the effects of these infestations on forest structure and function. Likewise, we have developed a body of knowledge about the impacts of diseases on forests, such as the chestnut blight which killed the most dominant tree in the region and dogwood anthracnose that killed about seventy percent of our native dogwoods. The impacts of record droughts and floods (100+ year's recurrence interval) have also been documented at

Coweeta. So when you have a long-term measurement program you can separate out some of those effects due to natural versus human disturbances.

HKS: This may be premature but as you've been talking the question came to mind. During the past ten, fifteen years the Forest Service has officially changed to ecosystem management, which at first glance would make watershed studies right on track where you're looking at the totality of what's going on in that watershed. But is this an example of a paradigm shift in terms of what you're interested in, and you wish you'd thought about it thirty years ago because you would have started collecting different kind of data. Has it really had an impact on the research, the shift to ecosystem management, whatever that is, as Jack Thomas would say.

WS: Yeah, whatever that is. I will discuss ecosystem management as a major topic later in our interview.

HKS: But this is holistic almost 1960s crunchy granola everything is tied together stuff, which people in the Forest Service always knew. It now has official names and sanction, and supposedly it's a good direction to go. It's brought fire back to the forest. Fire exclusion is no longer the dogma that it truly was in the West. I mean fire dominated the cutting boundaries of our timber sales. The ecosystem didn't matter. It was fire prevention that mattered. Presumably there's been a shift, a lessening of that dominance of the fire mentality in silvicultural practices.

WS: In the last five years or so, sustainability has been substituted for ecosystem management. I prefer ecosystem management over sustainability. The thrust or the rationale for our ecosystem management research at Coweeta didn't start five years ago or ten years ago. It started really about thirty years ago. It's not a Johnny-come-lately thing for us, and I've always advocated that good forest management is synonymous with good ecosystem management. We're just chipping away at the edges, you know, as we go through time in terms of improving our understanding of the interrelationships that take place in all our forested landscapes. I believe that we've been able to maintain and actually improve our research capabilities, particularly in funding, by taking an approach of trying to understand how that landscape out there works. If you do that, no matter what the fashionable opportunities are as you go down the pike in terms of Congress, policy, or decision makers, no matter what that decision is, you're going to be able to address important questions. Case in point, acid rain. You think we've solved the acid rain problem, certainly not. When that issue came up and it was funded for a period of years, we were primed and ready to go because we had background data. It is still a topic of research at Coweeta. That's just one example and climate change well, that's another example.

HKS: Sure.

WS: For example, if you have a basic understanding of forest growth and succession and formulate this into a model, it would be possible to forecast probable consequences of climate change on forest productivity. You can link that basic science back to a whole host of issues. One thing that makes Coweeta rather unique is that some of the long-term process work we have conducted has been funded externally. I will address this in more detail later. We have our appropriations, of course, but then we also have been competing for other dollars fairly successfully over time. About twenty percent of our budget is what's called soft money and, of

course, there are times when that soft money is indeed harder than our appropriated dollars, because we don't know what Congress is going to do to Forest Service budgets.

HKS: But Congress by and large is sympathetic and supportive of long-term, I'll just call it baseline data collecting? The continuity is important to answer a range of questions and the deputy chief for research can testify because we have these baselines established when the acid rain project or problem came on line, we could address it. We need to have this because the problems keep coming up.

WS: That's right.

HKS: And Congress by and large says that's a good idea. We don't want to shut Coweeta down for ten years and every ten years go out and measure things. You need the continuity in order to know what's going on and also at H.J. Andrews and other places?

WS: Yes. And this has taken us time to really develop, Pete, because the early '70s was really the dark side for Coweeta. There were rumors of closing the lab. There was a philosophy of moving work units to university locations, the theory being they would have more interaction with academia if you put them on the campus. Well, it may or may not. It depends on the personalities of those individuals. But a lot of that occurred back in the '70s. A number of work units were either closed down or moved to a university location, and that was the rumor for Coweeta.

Our first NSF grant with University of Georgia was in 1968. Phil Johnson, who had joined the faculty at Georgia and I put together a proposal to NSF for mineral cycling research at Coweeta and that was funded. By the early '70s we were part of the International Biological Program, (IBP) the Eastern Deciduous Biome, that was administered out of Oakridge National Laboratory and funded by NSF. IBP was the first big grand scale interdisciplinary ecosystem effort in the country. That was the starting point.

HKS: Oakridge was interested in the carbon content of the atmosphere and global warming? Is that why they were funding this?

WS: They had a couple of watersheds at Oakridge and also were interested in biogeochemical cycling.

HKS: Why was Oakridge concerned?

WS: Oakridge was the manager of the NSF funding. Then we had a number of sites from New York to Wisconsin to Coweeta, etc., that were part of the Eastern Deciduous Forest Biome. That was the launching pad really for attempts to have large integrated ecosystem studies.

Reorganization Plans

WS: I think the kind of research structure that we had with the University of Georgia and with Oakridge National Lab and so forth proved to be quite useful in mitigating the plans to close Coweeta. That really never happened, obviously. In the late '60s the plan was to build a new lab at Coweeta. Some of our facilities were built back in the 3-C days. We spent a great deal of time planning and had the architectural money to draw up the plans and so forth and then, in the early '70s, the building initiative disappeared. We were just trying to keep the place open basically. Affiliations we had with scientists and programs outside of the Forest Service were instrumental in helping us convince administrators that maybe we shouldn't do that.

HKS: Again this initiative of consolidation with campuses, this was the Forest Service initiative, the Congress didn't say this?

WS: Right, this was the Forest Service.

HKS: Keith Arnold was deputy chief then? Okay, he was full of ideas.

WS: Our counter argument, and I could back it up to the hilt, was that if you're doing good science, they'll come to you, and that's exactly what's happened at Coweeta. You know, we had numerous graduate students and we had two dollars of outside money invested in our research for every dollar of Forest Service money.

HKS: Maybe your reprieve was when Keith suddenly went off to the University of Texas and Dick Dickerman became deputy chief.

WS: Perhaps.

HKS: Because Dick didn't strike me as a guy that rocked very many boats. I don't know if you had much interaction with the deputies.

WS: I did not, not with him. Bob Buckman was my kind of light.

HKS: Well, Bob was just gregarious and was excited about everything, and Dickerman was, I don't know if you'd say introverted or low key or what, but whatever his skills were he was not a dynamic personality. He said McGuire told him when Keith suddenly left, to go to Research and cool things down. It was overheated. This was probably the kinds of things you're talking about that Keith wanted to do, major shifts around to make it a different organization. It was too much for the organization to absorb without a lot of loss.

WS: That's right. That's the cause and effect relationship for sure. In terms of expanding the mission or expanding the scope of research at Coweeta, doing ecologically oriented studies was not in big favor in the station either at that time. In fact, it was frowned upon, like what are you guys doing that for. Then we had some changes in station directors and J. B. Hilmon became our

station director. He thought it was a valid direction for research and let us continue. I could be more open in terms of who we were working with and what we were doing, and then, as time went on, our approach to the research was supported by the station.

HKS: I'm sure you said it exactly right it just depended upon the individuals, because I could see that some Ph.D. scientists would welcome the chance to be near a university with more diverse laboratory resources, a wide range of colleagues, maybe teach a class, guide graduate students, and the wives would rather be in town.

WS: Right.

HKS: Whether it be in Athens or Asheville than in Franklin.

WS: Right. So as time went on, with a station director like Elden Ross, there was increasingly more support of ecosystem research at Coweeta. Jerry SESCO supported the work strongly and that continued with, Lamar Beasley and with Pete Roussopoulos. So it's been a transition from one of opposition to one of well, let's ignore it and maybe it will go away, to one of initial support to one of really strong support. But it's taken a while.

HKS: But it must have an impact. Of course, you aren't recruiting a lot of people every year, so if you have a happy staff and you can ride it out. Say a major player left in 1972, to recruit someone with sort of a cloud hanging over Coweeta might have been difficult. Maybe they would want to wait and see how it panned out.

WS: Well we didn't have the budget to recruit anyway. Our budget has always been somewhat marginal. We've gotten by, but it's the reason we go out and get other funding. That's been my approach. If I think it's really important and we really need to be doing it, I'll try to get grant money.

HKS: Don Marx made a comment that I'd never thought about. All of the time he was running his more and more high-profile operation that in fifteen years he hired only a secretary and one technician. Everyone else that came into the project was transferred from a closed down project somewhere, and the Forest Service was always looking for a place to put these people. I'm going to ask you the same thing. This must have happened to you that you got people reassigned from closed down projects?

WS: We had one that was assigned to the work unit in aquatics but he was eventually stationed over at Bent Creek, even though he was still attached to our unit at Coweeta. I retired six years ago, and I hired most of the staff that's presently at Coweeta. So we do not have much turnover of scientist or technical staff. One of the largest scientific staffs we ever had was six, and that was only for a short period of time. But some of the money, like our NSF funding, goes through the University of Georgia and we can't pay salaries, of course, with NSF money, but we can buy equipment, supplies and pay for travel. Furthermore, there are four fulltime UGA employees stationed at Coweeta who are supported through the LTER-program. Frequently, grants from other sources are used to pay salaries of temporary, fulltime technicians to conduct the proposed research.

HKS: I would imagine that station directors and deputy chiefs like that, that innovation on the part of the local projects being able to bring money in to support them.

WS: Sure. I'd suggest to you that there aren't many work units that do that, and that's another uniqueness at Coweeta. DOE money, EPA money, cost sharing with other programs. So we leverage the science, the resources, and the technology and so forth through cooperative research.

HKS: So in effect if you worked with the professor down at University of Georgia, design his grant proposal, you might get some feedback from that because that work would be compatible and maybe one of his doctoral students would be assigned to you? I mean even though the grant wasn't to you, the work at Coweeta would benefit?

WS: Right, and we incorporate the appropriate efforts into our research work unit description. But, there's some work that we wouldn't normally support.

HKS: Is that a federal ruling that you couldn't use NSF money for salaries, or is it just a Forest Service policy?

WS: That's federal.

HKS: So they can't make grants to feds?

WS: Right.

HKS: Okay.

WS: We can be a co-P.I. on a grant. That's just for administering and conducting the research. For years we had major research programs with Oakridge National Laboratory. There were some really classic examples of integrated forest studies that were conducted at national and international scales. We were one of the main sites looking at chemical deposition, and the fate of that in ecosystems. That was funded by the Electric Power Research Institute and was a six-year project and one of the more well managed programs I have experienced. We published a book on the state of the art analyses and understanding of deposition in forest ecosystems.

HKS: Don Marx worked with them, you've worked with them. All kinds of people have worked with Oakridge.

WS: Our contact, and I suspect Don's too, was with Division of Environmental Biology. Stan Auerbach was the director there for many years. Dave Reichle took over in later years. But their program has changed a lot in that division, and they've gone some different directions in the last ten or fifteen years. I presented a seminar there about fifteen years ago and I think there were about twenty of their staff I had worked with. Most of them are now gone due to retirement or a change in employment.

HKS: Do you think that shift is a political shift because the Clinton administration shifted from the Bush-Reagan years or something, or was it just time to change?

WS: I think it had to do with budgets and how they were going to try and maintain their funding or at least stay solid. That was probably part of it. But most of the people I worked with are now retired so I don't really have contacts there anymore. They were a good group to work with. In addition to the integrated forest effects study, we had a whole-tree harvesting project. That was funded by DOE and entailed about fifteen sites in the country, including Dale Cole's group at U.W., research groups in the northeast including Hubbard Brook and in the south, Clemson University. It was oriented toward trying to develop knowledge and information needed to assess the impacts of increased wood fiber utilization on soil nutrients and forest productivity. In most cases we were using small watersheds as the tool for assessing these questions. The project was conducted over a period of about eight years. In some cases we have gone back in re-sampled soils and forest floor and so forth to look at long-term patterns.

HKS: That's something more recent and different than the forest biome project? That was I guess in the '60s and '70s that they—

WS: IBP program you mean?

HKS: Well, I'm not sure what it was called. People talked to me about it said "forest biome," and there was one on the Olympic peninsula. It was ideally located for the study, because there wasn't any man made pollution as the prevailing winds came off the Pacific.

WS: So these were not biosphere reserves that were part of the MAB program?

HKS: I don't really know. I mean it's not what I've been involved in but at an SAF meeting I sat down having coffee with somebody and they throw words out at you or you read about it in the *Journal of Forestry*.

WS: May have been a biosphere reserve program of UNESCO.

HKS: My understanding was it was to establish a baseline, measure everything, and then we'll know what kind of changes we're going through, but I'm sure it's more sophisticated than that. Because I know Dale was out in the peninsula taking soil samples and people were climbing trees and doing cores and all that, measuring everything they could measure in that reserve out there.

WS: And that was back in the?

HKS: It was in the '60s.

National Science Foundation

WS: That was probably the International Biological Program (IBP), and they were in the coniferous biome. There were regional programs within IBP. The initial funding from NSF to UGA for ecosystem research at Coweeta was 1968. Then IBP came along and it was funded by NSF as a network which UGA/Coweeta joined. Then about '72-'73, NSF started withdrawing their funding from IBP. At that time, we went back to a joint Coweeta and Georgia proposal that was submitted in 1975. That was for the commercial cable logged clearcut study that we had at Coweeta, and we'll see that today. We were funded for two, three-year periods. That started to overlap with the long-term ecological research program underway at NSF. I took a rotators position with the National Science Foundation in '77-'78 in Washington. That's when the offices were located on 18th and G Street. You probably already know this, but they bring in outside individuals as rotators.

HKS: No, it's all new to me.

WS: Okay. NSF has a permanent, professional staff in their programs, but certain programs, like Ecosystems Studies, have rotators who come in as directors for one or more years. An assistant director, who is on the permanent staff at NSF, provides the institutional memory and continuity of the program. To work for NSF I had to resign from the Forest Service.

HKS: I was going to ask how your salary was paid when you were there in Washington.

WS: I had to resign from the Forest Service one day and join NSF's staff the next day. J. B. Hilmon was the director at that time and with a handshake, said yes, you can come back to Coweeta when you finish your tour with NSF.

HKS: Were you nervous?

WS: No.

HKS: Okay, you knew it would happen?

WS: Sure. I knew that J.B. was good as his word. That year I was with NSF, plans were underway to develop a more comprehensive network of truly dedicated research sites for long-term studies. We conducted several national workshops to further establish the groundwork. That was the year we had a review of the Ecosystem Studies Program for which I was director, by the NSF board that provided the springboard to approach Congress and start the process of getting funding for a new program. The LTER money was not taken from existing programs. It was new money in the NSF budget.

That was a very interesting year and a good professional opportunity. For my review presentations I used a lot of the science from Coweeta and Hubbard Brook to illustrate the benefits of long-term research. The boards' response was very positive and enthusiastic; they

were completely unaware of such research programs. The following year there was a line item in NSF's budget for long-term ecosystem research. The first six sites were funded, including Coweeta in 1980. There are now twenty-six sites in the network including a variety of ecosystems from tall grass prairie to deserts, to estuarine systems, lakes, city ecosystems, polar systems, etc. Grants are for a period of six years which is extremely helpful, because otherwise, if you only have a two or three year grant, you're constantly writing proposals. At Coweeta, funding is a little over six million for the grant period. That's leveraged with other resources. We combine that with other resources to really merge the science together and leverage the effort. We have had continuous funding from NSF for ecosystem research at Coweeta since 1968. Nothing is guaranteed from one grant to another; the process is highly competitive and one has to produce quality science to sustain funding.

HKS: When the Reagan administration came in, it started talking about partnerships, recreation partners, all kinds of partnerships. Is some of what you've been talking about working with universities under that partnership philosophy? Since Reagan it's become very fashionable. Annual reports of the chief now always include how many million partnership hours, and how many volunteers worked in maintaining trails. It's become a big ticket item. Does research benefit from that? I mean is there a way research can gear into the partnerships and volunteers and so forth, or is the work too sophisticated?

WS: We have partnerships but they're with universities, other agencies and scientists not with volunteers. However, we can utilize the volunteer program. There is a Senior Employment Program where we get one or two slots within the Forest Service allocation system. These are basically paid positions designed to provide training for older Americans.

The other programs that have benefited Coweeta have been federal, such as the Accelerated Public Works Program of the early '60s. We had some infusion of money, added a few buildings, and conducted several watershed experimental treatments. We are also fortunate to have the Lyndon B. Johnson Job Corps Center in the county and they built two office buildings and a vehicle storage building for us. Our main cost was carpeting and the heating/cooling system.

HKS: If a meteorologist or a soil scientist retired and moved to Franklin, could they volunteer effectively at Coweeta?

WS: Sure. In a heartbeat.

HKS: Emeritus means what on your title now? I remember when Max Peterson retired, he became emeritus chief and there was a lot of grumbling. He was the first emeritus chief in the agency's history, and some folks didn't like that. But now you and Don Marx are both emeritus scientists. Is that standard now?

WS: Yes, the station has a formal program for emeritus status.

HKS: Okay, it's more than an honor then?

WS: Uh-huh. You have to abide by certain regulations and there is an agreement related to the emeritus status as I described previously.

HKS: That makes it easier for you to travel and things?

WS: Right.

HKS: There's a budget already set up for emeritus programs then?

WS: No, it depends on the individual work unit which must support that effort.

HKS: I wanted to ask you sometime during the interview. This may be the time because you brought up the issue that Coweeta was threatened in the early '70s of moving everyone into the universities, and that was new to me. I didn't know that. But there were two other, I'm not sure threats is the right word, but disruptions that came out of Washington. Buckman went into rather great detail about the Reagan years with the budget cuts. Bob called them draconian cuts. The assistant secretary of agriculture, John Crowell, thought that the Forest Service research was over-funded, it was doing too much work where the benefits were too far out. He wanted research that had more immediate benefits, and that affected the budget. I mean there was a real tension but Congress usually, at least in part, overruled the president's budget on Forest Service research, that is John Crowell, when he would testify that we don't need more than a hundred million. Did you have a feeling there during the Reagan years that there was any jeopardy to the budget to Coweeta?

WS: There were some adjustments certainly in our budgets in the station, and the redistribution of the funding during that period. We had a RIF, reduction in force, and there were some adjustments that had to be made. But those decisions, of course, were made primarily at the station level and we tried to minimize the disruption of the research but still meet the goals of reduction in funding.

Women and Minorities

HKS: But research in general, and maybe you individually, were under substantial pressure to recruit women and minorities, even though there was reduction in forces in process. I mean it was kind of a complicated time.

WS: Yes, very complicated, because we did not have sufficient funding to support the existing staff.

HKS: Were you able to recruit adequately the women and minorities in order to keep the dogs off your back, as it were, on minority hiring?

WS: I recruited and hired two women who are outstanding scientists. I guess that was, no, wait a minute. That was several years after the Reagan administration.

HKS: Don said the problem he had is he couldn't hire anyone. I mean all of his spots were filled by transfers from closed down projects. Well, there weren't any women and minorities in those projects. I mean the system was feeding on itself there, and he got in trouble with the affirmative action folks from Washington D.C. who came out and wanted to know how many blacks he'd hired. Well, he hadn't hired any because there weren't any transferring in. This is Don's story.

WS: Well, in that period, at Coweeta, we lost some technician positions. We didn't have the money. And we didn't have the budget to support transfers. We lost several people and those were really hard decisions to face. By 1984 our budget started picking up for both appropriated and outside funding. Over the next several years I hired four new scientists, and they're still at Coweeta. Over the past few years, Jim Vose has been able to add several additional staff.

HKS: When you hire a scientist, are these people with Ph.D.s and actual credentialed specialists?

WS: Certainly.

HKS: What grade level are they hiring now? What's the standard entry?

WS: Entry level certainly can vary. It depends on the research need, you know, the level at which you want that talent, but it would probably average out at a GS-12 grade.

HKS: And these people had experience or were they fresh out of grad school by and large?

WS: They are usually fresh out of graduate school. One method of hiring is a post doc, so you get somebody for a two-year commitment. In that period of time, if your budget can sustain that individual, and the person proves to be worth their mettle, then you can try to convert them to permanent.

HKS: Sounds like a pretty good system because you get to know them and they get to know what they're getting into, so the compatibility is determined before they have a permanent job. That would be good.

WS: You get some really good scientists that way too. Of course, they hit the ground running. It's fun to watch them develop. That's been one of the things I've enjoyed probably as much as anything, administratively, at Coweeta is seeing the development, the maturity, and the self-confidence as people go along in their careers at all levels, technicians, secretaries, as well as the scientists. It's rewarding to see people develop to their potential.

The Sesco Reassignment

HKS: Sure. The other era is about a decade later than we've been talking about. I'm not sure how much substance there is to this but I'll just lay it out for you. Mike Dombeck became chief in January of 1997, and he had worked with the Forest Service for twenty years before in the

fisheries program and then went to Bureau of Land Management and was acting director. So he was familiar with the agency and he worked with Chief Thomas on things like spotted owl and grazing issues and so forth, so he was very familiar with the Forest Service.

WS: Right.

HKS: He'd never been in research even though he had a Ph.D. and published peer reviewed articles and all that. When he became chief, he had a conference call with regional foresters and station directors, and he had some follow up calls with individuals and so forth. What are the strengths? What are the weaknesses? What should I be putting my time in on, because the Thomas years as chief were disruptive and controversial, everyone agrees including Jack Thomas. I mean Congress was mad. The White House was mad. There wasn't anybody who wasn't mad about something to do with the Forest Service, a really tough time for the agency and Mike wanted to know what should he do.

The responses from RF&D was, the research arm of the Forest Service has lost its sense of direction. It's not providing leadership and so on. Pretty serious charges coming out of the field. Mike reassigned Gray Reynolds and Mark Reimers, two deputy chiefs, and they chose to retire. Mike also reassigned Jerry Sesco to be special assistant to the chief for special projects or some such title that told the whole world this guy doesn't have any responsibility anymore, and brought in Robert Lewis to be deputy chief for Research.

Do you share that assessment that the research program had lost its sense of direction, that Sesco wasn't doing the job?

WS: Well, it certainly wasn't apparent or translated down to the project level. Unless one was on assignment or something up in the Washington office it would be very difficult to pick up on that situation.

HKS: What did you think when Jerry was reassigned, or did you even key in on the significance of that?

WS: Yes, we did. That was probably like going into the broom closet. Well, budget wise, we were kind of in a backwater about that time. The reaction may have been that we haven't got the leadership to get the budget increased, whatever that entails, in terms of working at the Washington office level. Of course, there are a lot of people responsible for developing support. Maybe the wrong people were in the wrong place at the wrong time.

HKS: Well, that's quite a shift. I don't remember if Sesco was in at the end of the Bush 1 administration, and then Clinton came in the ground rules changed. Maybe no one would have done a good job during the Clinton administration, because the priorities were shifting so often, and the Forest Service was certainly everyone's whipping boy. I mean Jack Thomas had his butt in a sling a lot of the time he was chief.

WS: Yeah, that's right. Whatever he did was going to be wrong so it didn't matter. But Jerry was a very effective station director.

HKS: He's an economist, right?

WS: Yes, I believe that is right. His management skills, I thought, were pretty darn good and when he told you something you could take it to the bank. That's my experience anyway.

HKS: That's pretty important that you can get a promise and the promise holds.

WS: If he said he'd do something he would definitely try to do it. I always had a very good working relation with him, and I can sure work with somebody like that. He was, I thought, a very effective station director. We have been quite fortunate in having outstanding directors and assistant directors in our station.

HKS: Well, long as we're on this tangent of mine, when you get a new deputy chief like Robert Lewis, does he make a tour of the stations and goes on show-me trips and you get your chance to tell him about Coweeta and make sure he understands that it's there so he's supportive and all that? Is that a good experience when they come around?

WS: He came from the Northeast, so he was very familiar with Hubbard Brook and thus it was a no brainer to explain Coweeta research to him. Robert was very quiet but I think worked behind the scenes quite well. I did not have a whole lot of contact with him during his tenure. I had several assignments in Washington at various times to work on analyses or development of programs. Some of that was in association with some of the national forest efforts.

During one of those assignments I can recall meeting with Max Peterson and a group of regional foresters. We were socializing one evening by playing poker. Max loved to play poker and he is a good poker player. I was like a little kid sitting in a corner because I knew a few of them, the regional foresters, but didn't know Max that well at all, and he said do you want to play. I said sure. So we were playing cards. He looks at his cards and started betting around and people started dropping out, you know, and finally it was just he and one of the regional foresters left. Max says without changing his expression at all, you want to be reassigned to another region [laughing], making a joke, and the guy says, yeah, I fold.

I had a really wonderful experience in 1972 at the world forestry conference in Argentina. I had a paper there for the conference and somehow I got on the same flight as Richard McArdle, Ed Cliff, John McGuire, and Max Peterson. The older retired chiefs had their wives with them. I guess McGuire was chief at that time.

HKS: In '72?

WS: Yes.

HKS: Yeah, that's when he became chief. I'm not sure what time of the year this was but yeah.

WS: I was sitting across the aisle from Ed Cliff and enjoyed conversing with him part of the trip. Then we got delayed in the airport in Sao Paulo, Brazil. Anyway, we had a substantial layover so

we had lunch and just sat around and talked, you know. I mainly listened, and that was really interesting because you had such a divergence of personalities, but all had been very highly respected chiefs, you know, and for a young fellow still wet behind the ears that was informative.

HKS: Dale Robertson tells a story when he was very junior, came off a ranger district, and was assigned to a four-year program in the Washington office. He had an apartment out in Virginia and he rode the same bus as Ed Cliff did every morning. And once in a while Ed would motion him over and they'd chat a little bit.

WS: Dale was a very good person I think. I got to know him through some awards I received from the Forest Service and the banquets and that type of thing.

WS: We can go ahead with the outline and proceed on that basis, and then I've got some notes of things I mentioned earlier and we may or may not cover those in the process.

HKS: Right.

WS: So we've gone through my professional experience rather thoroughly.

Coweeta and Other Watersheds

HKS: It would be useful if you spoke specifically about the relationship that Coweeta has had with the other watersheds like Hubbard Brook and H.J. Andrews. Is it a formal network, or an ad hoc arrangement? How does this collaboration work?

WS: Hubbard Brook, H.J. Andrews, and the Fernow Experimental Forest are keystone hydrologic projects. Of course, Hubbard Brook and Fernow are within the Appalachian Highlands physiographic division, which we're part of, so it gives us a very broad view and a range of conditions hydrologically. For example, Hubbard Brook hydrology is more strongly influenced by snowmelt events, whereas here, we get very little snow. Fernow is in between these conditions. Soil depth and texture also vary substantially across the sites. We've also had collaboration with Leading Ridge Watershed at Penn State University. It's been a very good hydrologic project as well. And we do this by synthesizing our data in comparative analyses.

Jim Douglass and I initiated a synthesis of all the watershed cutting treatments, from Hubbard Brook on down the Appalachian chain to Coweeta, and see if there was some common ground there, some quantitative relationships that we could derive based on those experiments, because a great deal of money and a great deal of time and effort is invested in those studies. When we synthesized all that information and looked at the first year increases or changes in flow associated with various types of cutting, from clear-cutting to light selection cuts on the watersheds, we did find that flow increases were related to the percent basal area removed, but there was a wide scatter of data.

The next factor that we incorporated in the model was the potential solar radiation index received on the slope. When we factored that in we removed a lot of that variability, so we ended up with a very simplistic empirical model for predicting flow responses. There are programs to calculate solar radiation, and you usually know how much basal area you've removed in a prescription, so a two-parameter empirical model is reasonably good for assessing the first year increase. Then there is a time trend of streamflow recovery associated with regrowth that was defined by the data set so you can calculate the total amount of extra water delivered as a result of the cutting prescription.

HKS: Are the parameters or protocols, I'm not sure of the proper terminology, well defined and accepted so when Hubbard Brook measures something it's measured with the same yardstick and reported in the same vocabulary that you use?

WS: Oh, yes, with some standards.

HKS: Is that true internationally? If you go to India or some place else do they use different protocols that makes it difficult to translate what they've done into your understanding?

WS: In terms of measuring discharge it's pretty much the same protocol. Some of the instrumentation may differ and you have to take that into account. Also the other critical thing is the maintenance of the stream gauging stations. If they aren't maintained, you will not have good data, bottom line. So you have to look at the quality control that's put into a measurement. But in terms of the units, discharge is discharge, precipitation is precipitation, and that's a common metric everywhere you go. If you start looking at storm flow separation, then there are different methods and techniques for separating base flow from storm flow, and that is dependent on the responsiveness of the watershed. But you still use the same basic metric in terms of quantifying that. We collaborate with scientists at Hubbard Brook, H.J. Andrews, and Fernow by co-authoring papers and sharing data, sharing information, and so you gain a lot more insight into cause and effect relationships and important processes going on as you expand your scale and go to different ecosystems. I mean you can understand very well how your system works let's say, but then you're dealing with a set of conditions that may be unique to that particular site. As you expand and go to different sites you broaden your understanding of what factors are important in controlling the processes. That's a real big benefit in collaborating with not only Forest Service people but, other scientists as well.

HKS: Have you in your long tenure here at Coweeta from time to time gone to the other major watersheds, and say I'm thinking about this project. Do you want to do something similar?

WS: There have been some cases where we've had some prescriptions here at Coweeta, for example, like changing the cover types from indigenous forest to a plantation of some type and another program has followed suit with that, but it is based on cover types relevant to their management and region.

HKS: The length of your tenure is probably unusual, but generally speaking aren't there other experimental forests that have long-term employees so that there's a continuity of thought and leadership?

WS: Absolutely.

HKS: Okay. It's something about watershed work that you stay in that same place for a long time?

WS: I'd say in recent times that has been the orientation. Earlier we had a good bit of turnover here at Coweeta. I mean scientists stayed maybe five or six years and then they might go to another hydrology unit. For example, Jim Patrick, Dave Helvey, Ron Hibbert and Dan Neary left Coweeta at different times to work in other Forest Service watershed RWU's. Reasons probably ranged from budgeting situations to desire to work in another system or perhaps advancement opportunities. I'd say the folks at the Andrews have been there a long time and retired there. I knew quite a few of them when I was out in the Northwest. And, of course, Bob Tarrant, Fred Swanson and guys like that, you know, were well established leaders.

HKS: Do you routinely get together and swap war stories every five years at a national workshop of watershed scientists, or do you just meet routinely at various professional meetings?

WS: Several national watershed workshops have been held, but not at specified intervals. Much of our interaction is at professional meetings. I was up at Fernow in April working with Mary Beth Adams and others, and we're collaborating on methods for predicting storm flow. Bob Pierce was one of my best friends. He was project leader at Hubbard Brook for decades and an exquisite scientist and person. I also enjoyed working with Jim Hornbeck. We visit on the phone and also during the LTER meetings. So it's pretty close connections and very long-term friendships and partnerships with those folks. We kid each other a lot.

Ecosystem Management

HKS: I have only one more specific question I wanted to ask. One of the research notes you sent me compares two watersheds, Hubbard Brook and H.J. Andrews. And it said that this is the first project to study water flow and this is 1939, something like that. The eastern national forests have been established since 1911 to protect the headwaters of navigable rivers. Water flow is the core reason for the western national forests which resulted from the 1897 Organic Act. It wasn't until 1939 the Forest Service began a formal study of water flows if I read this correctly. It's kind of late in the game theoretically if the executive branch is to be responsive to the Congress, because the rationale for having national forests at all was to maintain water flow, and yet it wasn't something that was studied.

WS: Right. Coweeta was established in 1934; we've talked about Wagon Wheel Gap. There were also some early watershed studies in California but they mainly used lysimeters. In terms of consistent, planned stream flow measurements, Coweeta was basically the leader. And let's see, I forget the exact dates when Fernow, Andrews, and Hubbard Brook came on board but for the former two, I think it was 1948 and Hubbard Brook was 1955. But in any case it was determined that there was a need to have additional hydrologic studies in different geographical areas where

processes were different, i.e., again, snow and soils and vegetation types, etc. So there was a calculated effort to establish laboratories in additional areas.

HKS: Now as the Forest Service has moved into ecosystem management, and we could talk a long time whether it's the philosophy or if it's an actual marching order, does that make your job easier to justify when the commercial aspect of forest management has been downgraded in some way and the broader aspects of other ecosystem components is getting more emphasis? Does that make watershed research easier to sell to Congress and to the public than it might have been thirty years ago, or is it just the same story really?

WS: I think we've demonstrated very clearly through our science, as well as our management, that the hydrologic cycle is the kind of foundation to hang many different kinds of questions and other research on. We've demonstrated that and we can cite chapter and verse where that approach has been useful to quantify and interpret forest resources at a landscape scale.

HKS: The language in the Organic Act came from Fernow on maintaining forest conditions to sustain water flow. And that's kind of what ecosystem management is in a sense. There's a system there to maintain favorable conditions in a watershed so the stuff coming out down at the bottom is favorable, and that's certainly an ecosystem concept. But they weren't thinking in those terms because the vocabulary hadn't been developed yet.

WS: Well, the philosophy originally behind the approach that we've used at Coweeta for the research, and this preceded our ecological studies, is that the quantity, quality, and timing of stream flow provides a good integrated measure of the success or failure of land management practices.

HKS: And that would include recreational use?

WS: Yes, from a perspective of water resources.

HKS: Livestock use, logging, and the whole works.

WS: The whole works can be considered in the context of ecosystem management. But first let me go back nearly five decades ago to the Multiple Use Act of 1960. One of the earliest, and certainly most practical, demonstrations of the multiple use concept was initiated in a watershed context at Coweeta in 1962. The primary resources considered were timber, water, recreation, and wildlife. Objectives and prescription delineations were selected to evaluate conflict among uses and to show how forest resource management might be practiced in future years. That was a good pilot study and one that we continue to use for some of our visitor tours at Coweeta. The ranger districts in this region were making some of the same prescriptions but had no data to determine if they were succeeding or not.

HKS: They might treat what you just said in a friendly fashion sitting here in this room, but in the klieg lights of congressional hearings, I think the congressional delegations from Alaska and Idaho might challenge some of the stuff you just said in terms in how you measure a successful

Forest Service. But it's hard to separate what they say for the folks back home and how they really feel about it. But they've been reelected many times.

WS: Well, you're going to have successes and you're going to have different interpretations. More recently, we initiated an ecosystem management study; at least what we're calling ecosystem management, and I can share a little bit of that with you.

HKS: By all means.

Wine Spring Creek Basin

WS: In 1991 I organized a special technical symposium that was convened as part of the American Association for the Advancement of Science annual meeting in Washington, D.C. I thought it was very important and appropriate that it be in Washington, D.C., because we needed to get some exposure there. AAAS is, of course, one of the leading scientific organizations in this country. My goals were to share the concept, philosophy, needs, and opportunities related to ecosystem management and to illustrate, with the examples, specific applications of ecosystem research to multiple use management as viewed from a broader perspective.

We ended up with a very good array of speakers and topics, and those papers were published in a special issue of *Ecological Applications*. They weren't published until 1996, so there was a lag there. But I will say that, at the meeting we had very good response from the audience. It was a well attended technical session and encompassed perspectives from a wide range of disciplines. In our approach to actually implementing ecosystem research, I'd point out that there's no blueprint for this. And in fact, I would suggest that a variety of approaches are going to be required across the varied regions in the U.S. So in 1992 we developed and initiated the ecosystem management project on the Wine Spring Creek basin; this is an area that's about thirty miles west of Coweeta. In fact, it's Eric Rudolph's playground as it turned out, in terms of where he was trying to hide out.

The catchment is about five thousand acres in size, has a diverse mixture of hardwood forest types, and first through third order streams, and quite a diversity of flora and fauna over the basin. The project boundaries were defined by catchment boundaries and not by ownership. It's largely on national forest land, but there are portions of private ownership at the base of the catchment of Wine Spring Creek enters Nantahala Lake. Participants in this project include an interdisciplinary team of over fifty-five scientists and managers from five research units in the Southern Research Station, the National Forest System, seven universities, state agencies, conservation and environmental groups, and the public, so there is quite a mix of partners there. Our approach to research and management planning actually utilized, as a starting point, the basic framework of existing land and resource management plans. We didn't try to reinvent the wheel. We're starting with the national forest plans, but it was innovative in defining our future resource conditions in specifying prescriptions to achieve those conditions. So this was a consensus building process.

The centerpiece of defining project goals was a series of workshops comprised of interested and responsible stakeholders. It was conducted over a one and a half year period. The experience in reaching consensus was educational for all parties involved. The public, scientists, managers, and user groups developed a broader appreciation for the concerns, issues, constraints, needs, and options of others and for the complexity of ecosystem management. From this consensus building process, there were thirty-five desired resource conditions initially identified for the project area. The major themes for research and management encompassed both traditional values such as wildlife, water quality, timber, recreation, and non-commodity values: for example, increased need of fish populations, improved scenic values of trails, etc. The social and economic research inputs have been particularly valuable in the early stages of the project to identify need and expectations of user groups and the general public. Monitoring and adaptive management are critical aspects of the approach along with prescriptions involving stand restoration burning, oak regeneration, stream habitat improvements, and some other prescriptions to move toward the desired resource conditions. And there's a linkage across many of these desired future conditions. One example is research on sediment modeling and monitoring which is coupled with the stream benthic and fish production studies.

The project has been in progress for a little over ten years, and many products have come out of the research. In a sense, the national forest was a major player in the project. They've taken some of those findings and applied them elsewhere in their management activities. But we also developed a method for synthesizing the information in a way that integrates the social, economic, and ecological values of the landscape. This is achieved by applying emergy analysis to the databases that have been developed.

What this analysis does is finally provide a metric that provides a common denominator for evaluating the values and services of an ecosystem. Systems analysis provides the theoretical constructs which were developed by Howard Thomas (H.T.) Odum at the University of Florida. He's the father of systems analysis and has applied emergy analysis to a variety of ecosystems throughout the world. We had one of his students, David Tilley, working on the Wine Spring Creek project, and his recent paper is one of the first that describes the applications of emergy to a forest ecosystem in a very broad but integrative sense. It's not traditional economics by any means, and that's one reason Odum's work is slow to be recognized. But it's truly a synthesizing method that puts values on things like precipitation, streamflow, soil weathering, erosion, bird diversity, nutrient cycles, etc. You can argue with some of the transformities that are used in deriving the common denominator, but I think it's very hard to argue with the basic concept. But you do have to have data to understand and quantify some of the attributes of the ecosystem. Emergy is a modeling tool and addresses the problem of normalizing system properties. Imagery solar transformities are used to normalize forcing factors, state variables, and other system attributes to one metric, just one metric, and that's solar energy, which drives this world. Technically, the solar transformities defines the solar radiation required directly and indirectly to create and maintain another form of available energy. Based on the accelerating rate of scholarly publications centered on emergy synthesis, it appears that the methodology is maturing to a respected form of environmental assessment, which everybody keeps saying we need to have.

HKS: That's right.

WS: And this is the method.

HKS: It triggered the recollection of difficulty that Resources for the Future had coming up coming up with a value for forest recreation. Because they couldn't go out to the resource and put a value on it, they only measured the cost of access to it. I was never persuaded that was really more than an indicator of the level of interests there were in recreation resources. How you put a value on the view of the Coweeta watershed and so forth, and that was part of the problem. Timber you can measure. Go down to the lumberyard or Lowe's or Home Depot and buy a board. You know what that costs.

WS: This is a way of calculating equity in a variety of outputs or products of the landscape. It's not a straightforward easy thing to understand, but emergy analysis has been used for some very practical questions such as the shrimp industry. It has a very practical use but again you do have to have information, but for a lot of ecosystem products, we do have data. We know, for example, what the primary production of the forest is, we know precipitation and runoff and so forth. The bad news is that as you look at some of the applications of this method, you quickly realize that much of what we're doing is not sustainable. I'm not talking just the forest, but planet earth, because there's a finite amount of resources here.

HKS: I was very impressed maybe twenty-five years ago when we had gas rationing at the pump during the Carter administration. There was a series of articles about we should measure our agriculture in terms of the calories we put into an acre versus the calories that come out. India had the best energy budget of any country in the world, while the U.S. put in ten calories, mainly oil, for every calorie of wheat and corn that came out, and you didn't have to go too far in the future to know there was going to be a crunch coming somewhere. I don't see that kind of mathematics anymore. I don't know if that was a fad or something better has come along.

WS: We need to be paying a lot more for our water. What's it cost to make a gallon of water? What's it cost to make an acre of topsoil?

HKS: You go out West where it's openly subsidized ninety cents on the dollar, because of the Bureau of Reclamation dams, and throw that in, it's way out of kilter. Those pecans that come out of New Mexico ought to be about eighty dollars a pound.

WS: That's right.

HKS: But they can't compete with those from Georgia so by golly, we're going to sell them for the same price Georgia sells its pecans for by using subsidized water.

WS: It's kind of a downer to think about it in a way but, you know, it's just not sustainable.

Publishing Results

HKS: You have published in the *Journal of Environmental Management*. Is that a journal you routinely read or just from time to time?

WS: I review the content.

HKS: How do you select the outlet? I realize you may have several in mind when you start a project, but how do you pick this over some other academic or scientific journal?

WS: We usually go with the journal that's going to reach the primary user group or the interested groups. Also, most journals describe the topics they are most interested in publishing.

HKS: Our station editor in Portland was very helpful in that he had a list in mind. Of course, by this time in your career you pretty well have them all figured out where certain kinds of articles are well placed. But for us junior scientists, as I certainly was, didn't know where it would be most likely to be received favorably.

WS: In the case of *Environmental Management*, they have a good readership in the area of modeling related to environmental issues, so that was a pretty good outlet.

HKS: There was a major project at Duke at the School of the Environment, that was looking at it only from a distance. I thought this is really a great idea. It's dealing with toxicity, and the School of the Environment teamed up with the medical school. To a physician a toxic is something that's in your body. To the School of the Environment it's where the toxics originate, so they developed this relationship where they worked together on toxicity from ecosystem into human health. The interface was really pretty rough between what a medical scientist and a hydrologist would think about toxicity. I'm not sure what journals would accept their articles, but this reminded me of it when I saw who your collaborator was, resources engineering versus you working for the Forest Service, but it works. You can work together; use the same vocabulary, same parameters.

WS: I was on Dave Tilley's committee. He's currently at the University of Maryland and now a leader in this field. He's a very sharp young man and I think will make some real contributions in his career. I had some other students with H. T. Odum. Odum was a genius. He passed away a few years ago. His older brother was Eugene Odum at the University of Georgia who's one of the fathers of modern ecology, and he was at the Institute of Ecology at Georgia. Gene Odum was one of the world's leading ecologists but in talking with Gene I mentioned that I thought H. T. was a genius. He said you're right, Wayne, he really is a genius. A day working with H.T. would completely wear you out, because his mind was always just chugging away. He was analyzing stuff as he was driving down the road, you know, in a big systems context. He was quite a scientist. We're missing both of them.

University Relationships

HKS: Is this a good time to expand on this into a more general statement about your university appointment activities?

WS: Sure. My first affiliation was with the University of Georgia, first in botany, and then subsequently, in the Institute of Ecology. It came about because Gene Odum had a couple of students that were looking for a site to conduct their research on bird diversity and on small mammal diversity. He wondered if we had any sites here at Coweeta where they could work, and, of course, we said sure. And so that was the initial contact, and as those students developed their programs, there was a fellow by the name of Phil Johnson who joined the staff in forestry at UGA. We were developing water chemistry analyses in our research program. In fact, we wanted to follow the lead that Hubbard Brook had started a couple of years earlier on biogeochemical cycling, and we wanted to initiate some similar studies at Coweeta. Phil Johnson, D.A. Crossley, Jr. (Dac), and I wrote a proposal to NSC for mineral cycling research at Coweeta and that was funded in 1968.

I mentioned earlier the other program that came on board was the International Biological Program, and that provided a platform for adding and expanding our mineral cycling research at Coweeta. That's when the Institute of Ecology became our main contact and our main cooperator at UGA. The Institute of Ecology provides a focal point for interdisciplinary research and is comprised of numerous disciplines. I joined the faculty there in, maybe 1970 or something like that, and have been adjunct there ever since.

I want to mention some of these people who have been very important in the development and support of the ecosystem research at Coweeta. Gene Odum was always supportive of our programs but most of his time was committed elsewhere. One person that deserves a lot of recognition is Dac Crossley, who is an entomologist. He was a Co-P.I. or the P.I. for the ecosystem research from 1968-1996. Jim Douglass appointed me as the Forest Service cooperator, as the Co-P.I., to work with the folks at Georgia. So Dac and I have worked together for nearly forty years. Others who have served as Co-P.I. are Judy Meyer and Dave Coleman. Bruce Wallace, Bruce Haines, and others too numerous to recount have also provided research leadership for decades at Coweeta.

HKS: So for the reader, Co-P.I. means what? It's an acronym, right?

WS: Co-principal investigator. I've summarized all of that in a book on holistic ecology, at a symposium we had at UGA which was published a few years ago.

HKS: In my brief tenure at the PNW station in the '60s, the way we looked at university research was, and this is not being critical of it, that the primary mission of a university is education. So when you collaborate with a university professor you are really collaborating with his more advanced doctoral students, because he's always looking for funding for his students. That's the primary responsibility of an active research professor. So the nature of the research problems that professors tend to seek are short term, because of the short tenure of a graduate student. The doctoral students keep getting their Ph.D.s and moving on. And so academic collaboration has its

limitations as well as its benefits. Don Marx agreed with that scenario. Do you agree with that, that some profs really see you as a funding source, not as a collaborator. I don't mean that as criticism. It's just the real world of the academy versus the real world of Forest Service research.

WS: There are certainly instances where that is true, that the collaboration is there as long as the money is there. But our experience with our long-term projects is that the research questions drive the collaboration, not the bucks. The reality is that if you do outstanding science you don't have to worry about the money. You're going to get support. You may get turned down a few times if you did a sloppy job with a proposal or whatever. At Coweeta we have the evidence right before us. We've had highly competitive NSF funding since 1968.

HKS: That's a long time.

WS: A very long time.

HKS: The Organization for Tropical Studies is in Costa Rica but was headquartered at Duke and may still be. It was a very exciting program where they had short courses for the new secretaries of the environment in Bolivia and Uruguay and so on. They'd come there and they'd teach them about the environment. But OTS could almost never get a repeat grant from a foundation. They were always shopping for new money, and it was very tiring on the guy who was running the program because Rockefeller would give you four years of support, and then you had to go to somebody else. It was always starvation and riches, starvation and riches.

WS: It was interesting and educational during the International Biological Program, because for the first time, we had a source of big bucks for ecological team research. What we found was that you had basically two populations of scientists; one population was there because the money was there and another one was there because it was supportable and it was an opportunity to do important ecosystem research. So that was a good example, and when the dollars started drying up, you knew who was going to start jumping ship. You could predict that just based on performance. And that's fair enough. Doing collaborative ecosystem research is not easy. You make compromises and sacrifices, and if you aren't oriented that way, you've got no business being in it because you're going to be real unhappy and the people you work with are going to be unhappy. The positive examples I'm using here are of our collaborators at Georgia, and as I say, they've been around for nearly forty years. We're in the third or the fourth generation of grad students here. One of our initial students; Kermit Cromack, has just retired at Oregon State. Tim Seastedt is also at Oregon State but he's not ready to retire yet. We have alumni throughout the country. Alumni who have stayed in this region have had students who obtained their degrees at Coweeta, who have then had students who've gotten their degrees at Coweeta, and so forth. Jack Webster at Virginia Tech, he still has four or five students working at Coweeta as well as conducting his personal research, and he got his degree in 1975 based on his research at Coweeta. While there are scientists where the motivation is money, it's not true for many of the groups we've worked with. With Oak Ridge National Laboratory we were doing some important science and we did get refunded through various programs over the years, but as that money dried up they had to shift priorities in terms of their research. We have also maintained substantial cooperative research with Clemson University over the year. Dave Van Lear has been our cooperator; I am still Adjunct Professor at Clemson. Other adjunct appointments I've

held for shorter periods of time, to serve on graduate student committees, are Purdue University, N.C. State University, University of Florida, and University of Virginia.

HKS: It's interesting the influence a guy like Odum has, because he was a big name at Duke.

WS: Oh, yes, absolutely.

HKS: Georgia was the place. It's real leadership, and I don't know if Odum saw himself as a leader or he just did his job and people came to him.

WS: He knew he was a leader and he could articulate things in a way that promoted that leadership and shared that leadership with people. Gene loved to invite people to lunch. Then he would start espousing on this topic or that topic and waving his hands very gently and, you know, it was just fun to be with him and absorb some of his wisdom.

HKS: Before the highway was fixed up for the Atlanta Olympics, it must have been about a five-hour drive or something to Athens from here, right?

WS: No, it was a little over two hours.

HKS: Is that right?

WS: Yes, even using some short-cuts it was about two hours. I suppose I've made that trip between eight hundred to a thousand times.

HKS: You know the way pretty well.

WS: I know most of the alternative routes. We've had about two hundred and forty graduate students' complete degrees at Coweeta and about half of those were from Georgia. I have served on about 60 graduate committees, most of them from UGA and some of them are like sons and daughters. The Coweeta bibliography of publications now totals over 1500.

HKS: So it's fair to say that your collegial relationship, your adjunct professorships, are not incidental to your career, they're an important component of your career?

WS: Integral to the research at Coweeta. We identify in this holistic publication the role and contributions of our students in advancing our understanding of ecosystems.

HKS: So your relationship with the Universities of Florida and Clemson and so forth, they weren't as consistent or as intensive? Georgia was really your key?

WS: University of Georgia is our key institution because they had the same goals in terms of doing ecosystem research at the landscape scale. At Clemson, our association has been quite long but more focused on individual projects, studies involving site preparation burning or other types of disturbances. At N.C. State, some of those students we got through visits to Coweeta by undergraduate classes and so forth. That's where you can really fire up some enthusiasm on

those tours that we provide. Somebody would say boy, I'd really like to work here, and so that's how we got some of our students.

HKS: This publication you just held up, you sent me a copy. *Holistic Science: The Evolution of Georgia Institute of Ecology 1940-2000*. Here's my critique on a yellow sticky, "very good stuff." If you didn't use it, I was going to bring it up because for me as a historian it provided a context and a trajectory of activities. I mean here it is in one nice little document. So that's my authoritative evaluation, "very good stuff".

WS: Well, thank you.

HKS: You don't get higher praise than that. H.J. Andrews probably has collaboration at Oregon State of the same nature and longevity as you're talking about here at Georgia?

WS: Yes, and Hubbard Brook with Yale, Cornell, and Dartmouth in the early years.

HKS: Does Harvard Forest still do significant work?

WS: Yes, they do. They're an LTER site.

HKS: Oh, is that right?

WS: Yes, they are. I think they have been a LTER site for about eighteen years.

HKS: I don't know how long it's been, probably fifty or more years, but Harvard used to grant a doctor of forestry, not a Ph.D. but a doctor of forestry.

WS: Like Duke.

HKS: Like Duke did, yeah. And my understanding of the difference, it was narrow and more technical, where if you do a Ph.D. you generalize for the first two years in your coursework and you take courses in different programs and so forth and then your dissertation. But the doctorate program focuses from day one more narrowly on something. That may not be accurate but that's my perception.

WS: Yeah.

HKS: And that's been phased out. I don't think anyone offers a doctor of forestry.

WS: That's not true at Duke anymore, is it?

HKS: No, and Harvard I don't know if it even offers degrees like that anymore at all.

WS: Another aspect of students at Coweeta is that a number of years ago we developed an internship program for undergrads. We fund them through both NSF and our appropriated budget. I suppose we have employed, probably a hundred and twenty since we started the

program. We tend to get the better students, and we try to get local students if possible who are at universities and come home for the summer. We average about six interns a year now and they contribute a great deal to our research.

I always enjoyed having them on board. When I was a graduate student at UW, Pete, I had two young fellows, high school students, help me one summer. They were funded through the National Science Foundation undergraduate program. One is Jim Long who is an outstanding professor at Utah State.

HKS: When students come here as interns and stay in that dormitory, how do they eat?

WS: They cook.

HKS: So there are cooking facilities, but they have to buy their food in the grocery store and fix it themselves?

WS: Oh, yeah.

HKS: And they get free housing as a part of their stipend?

WS: Usually.

HKS: Any cash?

WS: They get paid a stipend that sometimes is cost shared between the Forest Service and a University. We also can get funding through the LTER program to support interns for the summer.

HKS: So when they finish the summer they can have some money in the bank?

WS: Well, could and should. [laughter] The way we've structured the intern program is that we plan and provide a topic or a subject, a program of study that encompasses the full cycle of research in the three months they're here. So they need to prepare a study plan that clearly identifies objectives or hypothesis, methods and data to be collected etc. Then they collect and analyze the data, and provide a seminar on their study before the assembled staff at the end of the summer. Students may also be required to provide a written report. Sometimes they end up coauthoring a paper as a result of their work. They work hard, I'll put it that way. They have to be paid because it's not busy work. We're using the data and it has to be done correctly. Of course they are supervised by some of the Coweeta staff.

HKS: I imagine that report is a pretty traumatic experience for some of them. Others have a lot of poise and pull it off comfortably.

WS: Exactly.

HKS: I'd be one of those that would be scared to death at that time in my life.

WS: There have been a few cases where we didn't have a specific project for a student. They would work across projects as needed. But that's the exception rather than the rule because again, it's part of their education. We do get some great students and they come from schools like Furman and UNC at Asheville that have excellent environmental sciences programs. And, of course, we get good undergraduates from Georgia, and other larger institutions too.

HKS: Or somebody who just needs the money. The talent has to be there.

WS: The talent has to be there. A lot of these kids have continued on and obtained advanced degrees. We keep up with them for a while or they come back and visit and so forth. Education has been an important part of the research program at Coweeta. You don't get many check marks for that when it comes to saying, what are we doing in research, but it's a product of our program.

HKS: Have you been able to key into McIntyre-Stennis funded projects at Ag schools? I don't know if there was any coordination of research between that branch of agriculture money and the Forest Service branch of agricultural money, but you've got the same kind of people on campus collaborating with both programs.

WS: Yeah, that's true. There have been a few cases where a research project we're cooperating on with an institution is funded through those monies. They're using those monies to support the student in that project. But there's never been overlap or transfer of that kind of money to the station.

HKS: An interesting footnote to McIntyre-Stennis, whether it was an oversight or a strategy, but Duke and Yale got left off the original list because they were private schools. And the legislation was well through the pipeline when this was discovered and there was general consensus that it was an oversight and Duke and Yale should be added because the nature of the research was compatible with the goal of the program. But guys in Congress said if you want it out this session we can't add those two schools, and so neither Duke nor Yale have McIntyre-Stennis funds. I don't know what difference it would have made. Hard to say that Duke is an agricultural school, but it has a forestry program.

WS: Well, it's interesting. I'll point this out. We've had some students at Georgia that were in the School of Forestry and did their work at Coweeta, maybe a dozen or so over the years. But the forestry program emphasis at Georgia for a period of time was pine production forestry. But they have several faculty members who are interested in ecosystem research, and they have been cooperators over the years, but not nearly as many as, for example, through the Institute of Ecology. And it's kind of waxed and waned in terms of what direction the faculty there goes in terms of their research orientations. But we do collaborate with them. It's just not as much as some people might think.

HKS: So the production foresters, I don't know how to generalize so I'll just fumble with the question, so their interest in Coweeta is sort of incidental because they have to deal with

watershed issues as a part of their timber management plans and production, but in their mind it's a constraint?

WS: Actually, in the past decade they have strengthened their hydrology program by adding faculty.

HKS: It's outside their goal but they recognize it as something they have to contend with?

WS: It's similar to several other forestry related disciplines in that it is secondary.

HKS: That's something that Mike Dombeck complained about. Wildlife was seen as a constraint on multiple use, and all the time he was a fisheries biologist he said that was the problem. That's what ecosystem management did was to bring those things inside the loop. Even though it wasn't well defined, they were no longer constraints on what the Forest Service was doing, they were what [emphasis] the Forest Service was doing, and that was probably to him the most significant shift of ecosystem management.

The Forest Service as Partners

WS: Another big cooperator, of course, is the National Forest System, and we've been very fortunate here Pete to have outstanding staff on the Wayah District. They just have very professional, well trained, dedicated people on the district, and they've been fun to work with. And they've provided the expertise and leadership in application of management prescriptions to experimental sites. Without their resources we would not be able to conduct certain types of studies. Wine Spring Creek is one example along with prescription burning. The commercial clear-cut cable logging study that we had at Coweeta is another example. It's a very synergistic partnership that we have with them.

HKS: Maybe it's an Eastern phenomenon as opposed to the Pacific Northwest, where we had no expertise other than timber management on the district I worked on. All the other uses were staff people in the supervisor's office. But here it's different. You have people at the district level who have more than traditional forestry skills?

WS: Definitely.

HKS: And it's probably more common nationwide for the Forest Service now. You have to have people at the district that know about wildlife and water.

WS: Soils and engineering and so forth, yeah. So it's a win-win situation in working with the folks here. As I mentioned before, we do have shared workshop meetings and information meetings and that type of thing. They're not on a rigid schedule and it's not formal. It's just sit down at the table with your information and have some unstructured dialog and visit with one another to find out what's happening. So it's been a very compatible relationship with the national forest staff. At one time we had scheduled periodic exchanges with the regional office

people, but that's not as structured as it used to be. There are certainly exchanges of information but not on a regular schedule.

HKS: There used to be a Southeast Area for State and Private Forestry and I think that was merged with the regional office, but there's still a major state and private forest program. Do you collaborate with them, because a lot of tours from local lumber companies and stuff would benefit from that.

WS: Right, we do partner with them in terms of sharing information. A lot of our technology transfer is accomplished through the tours at Coweeta, and we do host a variety of user groups like that. Those typically entail a day in the field or part of the day inside and the remainder in the field. As I mentioned earlier when we were out at Coweeta, we don't have just one person to handles tours. It's a shared responsibility among the scientific staff to conduct tours. We also have a schoolyard program that is directed at mainly the middle grade school levels. It is partially funded and coordinated through the LTER program and organized by Brian Kloepfel who you met yesterday.

HKS: Oh, yes.

WS: Brian is the LTER site director for Georgia, and he's an employee of the University of Georgia. We have four fulltime employees at Coweeta who are paid by Georgia and they live here in Macon County.

HKS: In the brief time we were at the station yesterday, I was impressed by, is it Kathy?

WS: Yes.

HKS: How many times she was interrupted, whatever her job is, by people dropping in and she did the little show me trip around there. Her attention span must be very flexible to deal with that. She has to return phone calls but somebody is standing in front of her desk and she has to put that aside and walk around, go back, and make that phone call.

WS: She does a very good job with it and is certainly a bright, hard worker.

HKS: Yeah, she seemed to be very congenial.

WS: Yeah. I've known her since she was a little girl because she grew up with my daughter and I've known her from time zero. She moved away after she got married and then, when they moved back, she had to drop her job. It happened at a time when our former secretary went with the National Forest System. And so we had an opening. It was just fortuitous, that I knew she was back here and so we called her and she said oh, yeah, I'd be real interested in the job. But we've been blessed with exceptionally capable secretaries at Coweeta. Mary Lou Rollins was my project secretary and then business management assistant and was here for years. She was always my right hand and James Buchanan, my technician, was always my left hand. They would take care of things. You could count on it. In a job like project secretary, where you're up

front all the time, you have to have somebody that's congenial and is not going to alienate people and give a bad impression of the station, of the project and so forth.

HKS: It's really a downer when you call an institution and the person who answers the phone doesn't really care about the program that they're representing. You can tell, they signed up for the job because it has the health plan that they need because they're a single mother or whatever it is, but they never get keyed in to having pride in the product, as it were, that they're turning out. And it makes such a difference when you meet a Kathy and the enthusiasm she obviously has for the job and saying the same thing and hearing the same questions over and over again and the same comments from the public. That's very nice, what I saw yesterday.

WS: Well, she'll be courteous and so forth but you aren't going to run over her, uh-uh. She deserves respect too.

HKS: She draws the line in the duff as it were.

WS: That's it. Mary Lou was the same way and like Kathy, she was very good with all these students we've been talking about. They knew who to go to and find out some things

HKS: I'm looking at the outline, which is even less of a guide than it was yesterday. It seems to me we've dealt with item seven, a case history of a major project, problem analysis review, approval funding and staffing and so forth.

Project Approval, Management, and Oversight

WS: The major management mechanism is our research work unit description. That's our legal document, if you will, that we're obligated to follow. We develop our mission statement and analysis of the situation and identify the problem areas within that research work unit description. It's revised every five years and signed off on by the assistant director, the director, and the appropriate Washington staff.

HKS: When you say signed off you mean just that or does that mean approval? Do you need "approval" from the Washington office for most of what you do?

WS: Yes, approval.

HKS: Okay. And they wouldn't approve it if the station director said I don't approve this? Not very often they would override the local authorities?

WS: Well, there would be some negotiation before that would happen, between the staff in the Washington office and the station staff and the work unit. This doesn't come out of the blue obviously. We have technical assistant visits out of the Washington office, and those are scheduled at about three to four year intervals. Those are very formal and not a casual meeting. We bring in some of our major cooperators to take part in the discussions of the research

program and to explain their role. It would be organized into an itinerary that addresses all the needs associated with a technical review.

So that's one way, Pete, I've got the description here that was revised in 2003. For example, our mission is to evaluate, explain, and predict how water, soil, and forest resources respond to ecosystem management practices, natural disturbances, and the atmospheric environment and to identify practices that protect and enhance watershed health. And that's the overall mission. Then we go through a justification of why we need this information and then provide a problem selection, okay. We basically have identified two problems in the work unit. Problem one is restoring, enhancing, or maintaining healthy watersheds that requires us to develop a fundamental understanding of the structure, function, and interactions among terrestrial, riparian, and aquatic components in forestry watersheds. That's a fairly broad problem.

The second problem is to develop knowledge, methods, and guidelines to evaluate the effects of natural resource management on forested watersheds. That's a pretty broad problem too. Now to answer your question of how you maintain this continuity over time, we also have a mission problem. And that mission problem encompasses our long-term data collection, maintenance, and analyses, which provides a cornerstone of the research program at Coweeta. The mission problems contain studies that go back to the '60s and are still carried in the study plan. So in the next revision, problems one and two can change; in some cases, studies that were started in those problems may be incorporated into the mission statement. Some studies require only three or four years to complete, so when that research is done, the work is closed out. But the long-term components can be carried over in the mission problem.

HKS: I was thinking in part when I asked the question using Don Marx's model where Buckman came down, and he was impressed by I guess Don as a person and as a scientist and also what he was doing, and said let's make you an institute. It frees you up from a lot of funding constraints that you have working on a regular Forest Service research project. You could raise money big time. And I could see where a station director might be a little bit nervous about cutting a guy free in that sense. And maybe you agree with that. I can see tension between the Washington office and the station director. When you're dealing with long-term commitments of talent this is not a minor decision to make, you know, because you're closing off their other options.

But I've been hearing you talking. You've been raising a lot of money outside and you don't have an institute. So I don't know if the nomenclature is significant or not, if the way Don characterized it, becoming an institute freed him up from the constraints, federal constraints on funding sources. But I didn't hear you say you've been constrained by outside funding sources, except by the people taking the cream off the top there in Asheville. and you dealt with that aggressively with a new station director. You were telling me about that last night. Institutional vocabulary is important to the institution, but I'm not sure it's important to history to have these different kinds of labels in terms of the work that gets done. But Don made me believe that an institute was almost like the old days of a pioneering unit where you from time to time reported in what you were doing, but you no longer had to justify and explain the way you did before you were a pioneer research, like Lou Grosenbaugh in mensuration and those kinds of guys who just did what they did.

WS: I thought Don's was a pioneer work unit but I guess I'm wrong.

HKS: If I recall I asked him was this like the old pioneer units, and he said yes, so to him the language was an institute.

WS: My take on that is that being an institute or a pioneering research work unit had little to do with the sources of your funding. In other words, if you're applying to program XY versus E, they're still going to view you as a federal employee. I don't care what you call yourself.

HKS: He said he couldn't use it for salary. He could use it for travel and equipment and that's what you've been saying you used your money for so I thought well, to me, what was the difference in what Wayne's doing, in terms of getting the job done, and being innovative and creative and all those good qualities, and what Don did. But he had the word institute on his thing and he said it made a difference.

WS: I think the big difference there is the infrastructure internally within the Forest Service and who has oversight of your program. That's the big difference. Being a pioneer work unit or institute, you are more or less your own boss.

HKS: I think of Frank Wadsworth in Puerto Rico for fifty years. I don't know that the station director even knew he was on his roster. [laughter]

WS: I got to know Frank pretty well when I was on the advisory committee of the Luquillo Experimental Forest LTER. I really enjoyed the trips down there.

HKS: He's quite a guy.

WS: But that to me is the big difference between a regular RWU and other research organizations. Again, some grantors would support salaries of temporary technicians.

HKS: Couldn't pay your salary though? I mean the career civil servant couldn't be paid?

WS: Right. For example, Clemson might hire someone who would be stationed at Coweeta and live here in Macon County. That frequently happened. We would have employees paid by a university like we do right now, University of Georgia, but they live here and work at Coweeta. So that's a way of accomplishing the job in an efficient way. But anyway, I think we've resolved that institute versus whatever. But they probably would not have to go through this process I'm describing in terms of the research work unit description and so forth. And I know that Don had some reviews of his program, but I think he was the one that called for the review [laughter] and there's a difference there. The thing that I would like to share with you or make more apparent if it isn't already, is that we have our process internally within the Forest Service for oversight of the research program at Coweeta. And that's formalized and I think it's good, you know, I think it's necessary. But what a lot of folks don't recognize is when we take part in cooperative research programs, we also have oversight or review obligations to that funding source. So we're not only accountable internally and have to spend time to manage and respond to questions and reviews and so forth, but we also have the same obligation to the granting agencies. That is no

small task at times. Next week we will have the midterm NSF review of the LTER program at Coweeta, and that's a two and a half day program that entails substantial pre-review preparation.

HKS: Do they come here or do you go there?

WS: They come here. They have a review team and it's the third year of a six-year grant, so it is a mid-term assessment of program progress.

HKS: From time to time do those teams include, not you for your own projects, but do you go out with NSF review teams to look at other projects as part of for your expertise? I mean who are these people who come here? Are they employees of NSF?

WS: Yes. It would be like my job when I was director of ecosystem studies. The director of the program sets up the time for the review, outlines the general scope of the review, gives a charge to reviewers, and selects appropriate reviewers from across the country. Of course, they don't pick people that you are working with because it would be a conflict of interest.

HKS: Oh, I understand that. In general, they're there to learn and to confirm, but they're not there to critique and nitpick? I mean it's a pretty professional operation? They're not looking for trouble; they're looking to make sure that NSF is getting its money's worth?

WS: That's right. But they will definitely have an impact. Whatever they say will be taken very seriously. So you know you're under scrutiny and scientific review. Are you going the right direction? Are you doing what you said you'd do in your proposal? How well are you doing it? Have you deviated from what you said you'd do? If so, why? How's your data management program? How's Brian doing his job? He's the site coordinator. How's the collaboration going between the Forest Service and all these grad students and faculty? So the point I'm making is that it's not a given; you have to put time, effort, and energy into that aspect of the administrative review of the research. Then for other grants like we had for the whole tree harvesting and the atmospheric deposition studies that we talked about yesterday, we met at least several times a year as a group to review progress and share information. So it's a double-edged sword, with internal infrastructure and you've got your external obligations as well.

HKS: This may be off the charts and if it is I'll just cross it out in the transcript but I was thinking as we've been talking here, I can't remember the senator, whoever gives this award, boondoggle award for the ten dumbest things the government does.

WS: The Golden Fleece award?

HKS: Yeah, Golden Fleece award. In the political context of Washington, D.C. where people say some really silly things, he would say and the Golden Fleece award goes to Don Marx who spends three million dollars a year growing truffles down there in Frogmore. I mean it would make a great headline and that's really all he wants, great headline.

WS: That's right.

HKS: And within their bureaucracy, which strikes me as being very thin skinned sometimes, there could be a lot of percussions far in excess what they ought to be of this kind of political grandstanding that members of Congress do from time to time in front of the cameras. But I guess that's the price you pay for being in research, because you can belittle research by making something sound so insignificant and obscure, who could possibly care.

WS: Care, yeah. What are we doing that for?

HKS: Yeah.

WS: And they have no responsibility to justify their statement either. I hope I've answered your question.

HKS: Yes, you have, and you've answered it before but sometimes it's useful to kind of redefine it so it's in one or two or three paragraphs; just cut the pie a different way so the reader does see what's significant.

WS: I will mention that we were particularly blessed to have Dick Smythe up in Washington as the staff person in charge of the watershed program for so many years. He retired a few years ago. It was helpful and enjoyable to have Dick and his staff members visit Coweeta.

There's another obligation that goes along with getting outside money too I might add. And that is you have a responsibility to review a lot of other proposals. I wouldn't even wager a guess how many proposals I've had to review in my career.

HKS: Most of them good or most of them sloppy and a few good? Can you generalize like that?

WS: A lot of good ones, for the most part.

HKS: Far more than could be funded? There's just not enough money?

WS: In many programs there is usually only enough money to fund 10 to 15 percent of the proposals submitted annually. But being a part of the team, that's another obligation, you know. If you're getting grant money then part of your obligation is to review other people's work.

HKS: This is all confidential evaluation or do they know that you are reviewing it?

WS: Typically, they would not know. In some cases they know automatically because of your knowledge of the topic. Sometimes you can figure out who the reviewers are but usually not. There is also reviewing manuscripts for the journals. Once you're in that pool, there's a real deep end there in terms of obligations, which again a lot of folks don't recognize.

HKS: Don Marx was recounting the difficulty he had getting *Forest Science* to accept one of his very first significant breakthrough type publications that could actually say it was this mycorrhiza that was causing the effect, not some unknown substance in the soil. The referees said you haven't proved it, go back out in the field. Took him three times to develop statistical

analysis that convinced the referees at *Forest Science* that he had proved it was the mycorrhiza was causing the effect that he was reporting, and that's something that no one knew about yet. I thought that was intriguing. He felt he had proved it. He was absolutely confident because he had three tests and in three tests it was a hundred percent mycorrhizal. That's not enough, Don. Got to do it some more. The refereeing was that rigorous, and the editor of *Forest Science* supported obviously what the referees were saying that you really have to take it one more step. Don obviously eventually did that. So it's not a given that you're going to get your stuff published.

WS: No, it's certainly not. In the old days there were far fewer outlets for our research compared to today. However, I believe I've had just one paper rejected. I've had to revise them certainly. I've had two published in *Science*. The rejected paper was co-authored with several others and submitted to *Nature*. The basis for rejection was not on the science but that the editor said *Nature* did not consider the topic of our paper to be appropriate for that journal.

HKS: Is *Nature* comparable in prestige to *Science*?

WS: Yeah. The white pine research we did on the effects of converting hardwoods to white pine was published in *Science*; in fact, the cover of that issue was an aerial view of the watershed. It's difficult to get a photograph in *Science*, that's for sure. But part of it is your editor too, you know, how much your editor helps you. In my case my mentor at Coweeta was Jim Douglass who was an excellent writer. I learned a great deal from Jim. He was real meticulous, screened stuff very well and helped me. And, like I say, our station editor, Bob Beisterfelt was a quintessential editor, outstanding.

HKS: I talked to him by phone a couple of times but I never met him.

WS: He would get that number two pencil out, and he would go up and down along the edges of the manuscript. [laughter] He was really a great help. We typically get two or three reviews of a paper and then it goes to the project leader and then it goes to the editor. By the time it gets back to you from the editor it should be in very good shape to send on to the journal. So I attribute my luck to some good help along all those lines.

HKS: A story I've told many times because it was really a wake-up call for me and really helped me focus and it was a big jump in my learning curve. My first research note manuscript was on the regeneration of ceanothus after slash fires, six-page, double spaced text. And it was sent out for internal review for people in the station. They refereed me before it went to the editor. One reader did his doctoral dissertation on ceanothus, I can't think of his name right now. I never met him personally. He wrote a ten-page critique. I don't think he even liked the size of paper I used. I mean he didn't find any redeeming qualities. He really went through and took it apart, and it deserved that. But it was his final statement that I thought was a classic. He says "this is just a once over lightly." [laughter] He knew how to twist that knife. But it's very rigorous. When I see your publication of two hundred and fifty or something, you don't just jot those down and put them in the mail. You obviously develop skills and the next one is easier than the last one and all the rest of that. But the Forest Service internally is pretty careful about what it puts out, that it has to be quality work, and you have different audiences, *Journal of Forestry* versus *Science*, different writing styles, and different kinds of data included.

Authorship

WS: I have many coauthored papers and that, in part, is due to the students I've had, as well as the cooperators. I've worked with. It also reflects the nature of interdisciplinary, team ecosystem research. Usually if my name is on it I've put pencil to the paper too.

HKS: I was going to ask about that. I think I've co-published something once. Historians almost never co-publish. Scientists routinely co-publish. And I look through that two hundred and fifty lines on your vitae for the stuff you've published and you're first, second, and third in line. Is that alphabetical sometimes or is it you put the grad student's name first because that's their first publication? How significant is the sequence generally of the authors listed? Is there a policy?

WS: Yeah, generally it's proportional to the contribution.

HKS: So the first author is really the architect of the article?

WS: Yes, usually the architect of the article. Sometimes it can be the person that came up with the idea or collected most of the data, that type of thing. It just depends on the contribution.

HKS: I see some articles have seven authors or something like that.

WS: Yes, sometimes those are alphabetical. There's no way to partition the order after the first several authors. They may have contributed equally so there's no way of doing it fairly. Just put it alphabetically. Then in some cases I've put other people's name first because I don't need it.

HKS: I can understand that.

WS: They need it. They need to have that recognition. It goes toward their evaluation, you know. It's part of their performance evaluation. It's not a blatant thing. I would never do that in a blatant way but only if it's reasonable to have that individual first.

HKS: Does it happen sometimes that you prepare a draft and you send it out to a colleague and his response is so detailed and has so much substance that you make him a coauthor, or do you start out with the idea you're going to collaborate with these guys and so it's always going to be coauthored?

WS: That hasn't occurred very often because somebody gave you a very detailed review that you would include them as an author. You would recognize them in the acknowledgement section of the paper for providing a helpful review

HKS: A footnote thanking them for their—help?

WS: For their review, yes, that would be the proper way of doing it.

HKS: So generally speaking, if a guy's name is in the one, two, or three, they've contributed to the basic architecture and substance of that?

WS: That's true.

HKS: In the original draft, it was not some afterthought you'd tacked them on or something?

WS: That's right. If they've been part of the group that did the planning for the research, the organization of how you're going to do the research, things like that. Or provided the substance with regard to developing the hypotheses to the work. Asking the right questions is sometimes ninety-eight percent of the research.

HKS: Some professors are notorious that their name comes ahead of all their graduate students, and the graduate students do the work but the professor takes the credit. I have no idea what percentage of profs do that, but it happens enough that you keep hearing about it and, of course, the grad students are always upset because they really want their name first on this important work of theirs.

WS: It's probably not as common today as it was I'd say years ago. The word gets out.

HKS: Well, in my experience, most professors are very generous with their grad students. It's a part of the responsibility of getting them started. They add their name to it mainly to help get it published.

WS: Well, that's true.

HKS: Not to get glory for the prof.

WS: That decision is a learned decision. I mean you learn where the boundaries are through experience in terms of authorships and so forth, but I've published with more than a hundred different people. And that's not the easiest way to write a paper. It takes more time because you've got to do some compromising at times of what you're saying and how you're saying it. In my career, there were a couple of instances where I withdrew my name from authorship for various reasons.

HKS: I could see because of cultural differences having international collaboration if you're co-publishing one of your authors is from Turkey and one is from Nigeria, it's difficult to smooth some of these things out because of what their needs are might be different than your needs or something.

WS: I ran into that with a Russian student I had and just on his dissertation, getting that smoothed out took a lot of time. His English was quite good but the thought process at times was difficult to translate.

HKS: This may no longer be true and may never have been true, but I had the impression in part because of the foreign graduate students I saw coming through Duke. The U.S. generally is more

rigorous than a lot of the Third World scientists, where their jobs are more, I'll just say more political than substantive. They've got the job because of they're king's nephew, as Frank Wadsworth would say, and they don't really measure up by our standards. Yet they're the best collaborator you can get for that subject there and you coauthor with them. Do you agree that there's some truth to what I'm saying? That's just an observation I've made. I certainly have never looked into it.

WS: I haven't experienced that much with our foreign students that I've worked with. They frequently had a mentor in their country. I don't know that it's been that biased, I guess is what you're saying.

HKS: Well, they feel less need for proof, I'll put it that way, than we do. This is the official policy of the Nigerian Forest Service and you don't referee that.

WS: In some work with Russian scientists, they were the old guard types, I'd say well, where's your data to substantiate this. Well, I don't need any data. It's true because I say it's true. No, no, no, that's not the way you do it. [laughter]

HKS: In history sometimes when you're the grand old guy you can write an essay and your knowledge and experience are the only footnote you need. I mean it's all of your life's experience and all of your publications and so forth, and you can write an essay as the first article in some particular history journal, and it's accepted and even cited because you [emphasis] are the authority on that particular small piece of history. But it's pretty touch and go. Jeff Burley at Oxford, who we were talking about last night, was telling me that he was on his way to Thailand and he said now we go there to learn from them. It was a role reversal. I mean Britain was the intellectual guidance for the Commonwealth areas and a lot of the Third World, but now they are good enough and they have enough talent in their research that you go there and they tell you what's going on and you make notes and cite them because they are the authority.

WS: That's absolutely true. Yeah, we have no locks on science in this country, certainly not, and that's what I've enjoyed in attending international meetings, is viewing a topic from a much different perspective. That's always been a benefit of going to meetings, international meetings particularly. I think I've been to probably twenty or twenty-five different countries and worked with people in many of those countries. I've been very lucky to be able to work with some outstanding scientists, who also happen to be pleasant people.

HKS: I remember my senior year we were on a field trip, and there was a student from India tagging along just to learn what he could. We were using increment borers to see response to a windstorm that had gone through on the growth rate. And we had trouble understanding his English, but finally we realized that there are places in the world you don't have annual rings.

WS: Yeah, right. [laughter]

HKS: Because the growing season and the species, and we couldn't even imagine how you could do research if you couldn't take an increment bore and look at the rings.

Administrative Opportunities

HKS: Were you ever under pressure to work at the station as assistant director as opposed to maintaining your job as a scientist?

WS: No, no pressure, opportunities but no pressure. I said I'll go to NSF in Washington but that will be my contribution to the Washington scene. The only other job I really seriously considered, and even went to the final interviews, was the department head in Forestry at Oregon State University many years ago. There were three of us that made the final cut. I had a great deal of respect for Oregon State and knew a number of the faculty. I came back from the interview and talked about it with Roberta, she was open to any decision I made. I did not want to be mainly an administrator, and I did not want to give up my research. So I called them and withdrew. That's the only job I seriously looked at. I was approached about other opportunities, but I just couldn't find a better place than Coweeta to do what I wanted to do. The data quality is just outstanding and very long term and that's what it takes to address some of the questions and issues that we're facing today. So that's my job background.

HKS: The field of science is pretty broad. It must be daunting from the standpoint of the head of NSF to figure out what's going on, how do you support American science.

WS: Yes, it was daunting to go in as a program director in Ecosystems Studies. I was very familiar with most of the terrestrial ecosystem projects in this country, but not the aquatic ones. I was not up to speed on the river and lake ecosystem projects, so that was a real education also. One interesting component of the job was when the principal investigators from universities came by to play fun and games about why they should be funded. In the grant proposal review process you have a panel that makes that decision. If push comes to shove that they're equal ratings and evaluations and so forth, the program director has to make some decisions, and that's when you earn your pay. I enjoyed going out in the field and reviewing projects. Anyway, NSF was an interesting place to work.

HKS: I was impressed when I was at Oregon State University interviewing Bob Buckman. There was a sense of vitality in that school and interaction between the Forest Service, the research people, and the academic part of that program. I thought it was very healthy. I could see justification in Keith Arnold trying to have more of that rather than less of that. You can also get overwhelmed, students knocking on your door and you're trying to get something done.

WS: Well, that's right.

Awards and Honors

HKS: One thing we haven't talked about specifically are your honors and awards.

WS: Okay.

HKS: I guess you could say generically it's peer recognition at local, national, and international level, the awards that you get or you don't get.

WS: I felt very fortunate to receive two USDA awards during my career. The first was the Superior Service Award in 1981 for leadership and research in the field of mineral cycling and productivity of forest ecosystems. It was surprise recognition. It was a good experience to go to Washington and to be received by some of the research staff there that I did not know and to be among some of the others that received the award in the past. Up with the big boys, so to speak. The actual presentation was very impressive in the ag building. I think it was in the ag building, and it involved, of course, all of USDA. I could invite my parents who lived there and also my aunts and uncles. So, you know, it was a nice celebration. You went up on the stage to receive your award from the secretary of agriculture and shake hands and walk across the stage. There were probably two thousand people in that auditorium, and at the conclusion of the ceremony I saw this older lady and younger lady making a beeline for me. They're coming after me? I don't know them. And I was trying to find out where my family was, you know, and they said wait, wait, Dr. Swank, Dr. Swank. I said well, do I know you and they said no. She said my maiden name was Swank, this is my mother. And so we tried to figure out the genealogy because there aren't many Swanks that I've met that I can't go back and tell you the linkage.

HKS: It's German, right, Swank?

WS: Yes. Anyway we stood there and talked and then my family came up. I introduced everybody. Her husband had received an award from ARS. We enjoyed talking; it was a very special day.

The second USDA recognition was in 1992 with a Superior Science Award for research and technology transfer in hydrology and long-term forest ecology. Again, the ceremony was well planned and enjoyable. Also, in 1992, I received an Institute Special Award from the Institute of Ecology, University of Georgia for 25 years of leadership in cooperative research of forested watersheds. This is a very rare event and I was certainly appreciative of the recognition. Probably the most meaningful award was in 1998, a year before I retired, when Coweeta received The Chief's Stewardship Award. Mike Dombeck was our chief at that time. This was a group award for the accomplishments of the entire research work unit, and it was well deserved. I have repeatedly stressed to those visiting Coweeta that the research support staff at Coweeta is the fabric of and provide the stability and continuity of our successful long-term field research program.

HKS: You were telling me off tape that your emeritus status has official guidelines, that you have to sign an agreement to what you're going to do or whatever. The term emeritus is now fairly common. How long has that been standard that certain people will stay on as emeritus? Is that something you ask for so you can continue your research, or are you nominated by some process as a reward for long service?

WS: I think that is a varied process depending upon your employment station. In the Southern Station we have a standard procedure. You can request it through your line of command, such as

the project leader or assistant director. But again, you would ask the person if they wanted to be nominated for emeritus status. So, if I was project leader, and someone retired at Coweeta and they wanted to be emeritus and I thought they would continue to contribute to the research effort, there would be no problem nominating them.

HKS: As a practical matter, if you weren't emeritus, would you have difficulty having office space assigned to you and maintaining your Forest Service key and those sorts of things?

WS: No, because there is also a volunteer program.

HKS: Because on campus being emeritus prof means you get an office smaller than your professorial office but you can come and finish your book and you have library privileges and so forth and maybe advise graduate students if you feel like it. It's more of an honor than of substance, but it sounds like what you do is more formal and there are expectations on the agency's part that you're going to do certain things as emeritus.

WS: That's correct.

HKS: Is there a term, every three years you have to be reelected emeritus?

WS: No, there is no time element associated with emeritus. What you have is a mutual agreement about one's status. What I've tended to do is just come up with a plan of work each year, and then document accomplishments for the year.

HKS: Well, I can see from the standpoint of management it's useful to have your commitment that you're going to be doing something, so they can sort of count on you for doing this as opposed to as a volunteer you may or may not show up today.

WS: It is a good mechanism to formalize things in terms of one's commitment and what the station's commitment is as well. It's an opportunity to finalize some things and bring them up to the present, get some papers out and I still review manuscripts. I generally decline proposal reviews and I'm on the committee for a graduate student at Georgia. It's the last one I'll probably have. I'm still adjunct at Clemson as well, but I don't have any students at the present time. But it is a good mechanism to formalize it a little bit more in terms of what your commitment is and what the station's commitment is as well.

Publications

HKS: What I'd like you to do and you can do it right now and put it on the tape or you can think about it. It would be useful if you would select the top ten or the top something of publications, and we'll append it to the transcript. These are the ones that you see as being most significant of the two hundred and fifty publications with your name on it, or however you want to do that.

WS: I can do that.

HKS: I don't know if that would be difficult or not.

WS: Well, probably the first five would not be too difficult. It would be the second five. I'll make the list later.

I think a scientist is very fortunate if they come up with one outstanding discovery that stands the test of time, forever. I mean you're usually building on somebody else's work and then the next generation builds on your work and so on. But if you discovered the silver bullet, that's going to always be there, no matter what anybody else does, that's unusual.

HKS: In physics there's Newton and Einstein and it's incredible that they are still significant even though our understanding has changed. But that's quite a tribute to them.

WS: Were you ever at Princeton University? There's supposed to be a plaque in one of the buildings above the fireplace, attributed to Einstein, that he said "God is subtle but He is not malicious." That equates in forestry and ecology, I think, to the fact that there is an order to things and it's just up to us to figure out what that order is.

HKS: That's right and we're still working on it. We're not there yet.

WS: Still working on it.

HKS: Especially in matters of evolution there seems to be some debate going on these days. [laughter]

Professional Leadership

WS: There are other activities or professional leadership that I think were significant in terms of time devoted to them, and the associated scientific benefits.

HKS: Good, let's put those down.

WS: I was quite active with the U.S. Man and Biosphere Program. I was on the Temperate Forest Ecosystem National Committee for about fifteen years and I was on the Biosphere Reserves National Committee about four years. This always entailed entertaining a lot of international visitors at Coweeta, but it was an efficient way to learn about programs in other countries. One reason I stayed with it was to try and enhance the capabilities in other countries to establish biosphere reserves. Recognition and support from the United States are very important,

HKS: Does part of your job description include release time for, say ten percent of your time you can do these kinds of things? Or do you have to go to the director and say I've got to spend some time on this and it fits in with my schedule, it's okay? You're talking about salary and travel.

WS: Well, I just pretty much did it on my own. It wasn't part of the job description per se. It was part in parcel of who we are at Coweeta. It was an opportunity and it was requested. So usually, when I was not project leader, I requested approval from Jim Douglass and that was all the approval I needed. Many times that would lead to opportunities to exchange research with other countries, as well as try to enhance their program per se. So it was, in a way, an educational opportunity too. But we did have some funding. Much of that came internally, from the Forest Service to support small research grants in the temperate forest ecosystem directorate, and so there was some opportunity to have an impact on which direction the science was going in Man and Biosphere. We worked with the Russians quite a bit in that program.

HKS: If I remember correctly, in the early '60s I was told not by people in authority but by colleagues that you could spend up to twenty percent of your time on things you wanted to do, and if it turned out to be some budgetary impact you had to get approval of that and you still had to do your job. But it was assumed that you had some notions you wanted to explore unofficially to see if it was a way to go and you did need approval for that.

WS: Right.

HKS: And if you got into it far enough, then you'd have to get a project plan and all the rest. And Jim Trappe was telling me some of the best research comes out of those ad hoc explorations that people go on. But from what I saw and it certainly wasn't a systematic sample, most of the people at the station didn't take advantage of that. They were so committed to their main thrust that they didn't have enough time to do even that, let alone branch out and look around. They had been there for a long time and I'd only been there a year or two so I wasn't committed yet to anything.

WS: As I think back in time, I believe there was a guideline about allocating X percent of your time that was uncommitted to the immediate needs at hand within the work unit, but I don't remember that we ever ran into any barriers whatsoever. Jim Douglass was very good about letting one allocate their time to other things if they were willing to put the extra time into it. For example, after I became project leader in 1984, I rarely wrote a paper at work. I didn't have time. I did all my writing at home at night and on holidays. And I'm sure that Jim Vose, who is current project leader is encountering the same thing because you've got a big job the way we operate at Coweeta.

About 25 per cent of the budget at Coweeta is funded from competitive grants. This involves writing the grant proposal, hiring and supervising temporary personnel to assist with the research, attending meetings and writing progress reports, and hosting on-site reviews. Since our research is interdisciplinary, research projects frequently involve a number of collaborators and graduate students; often we serve on graduate student committees. Also, we have a significant visitor/tour load of about 1,200 people annually and that is mainly handled by the scientific staff. These activities are in addition to the typical Forest Service research process and responsibilities. However, the grant money is important leverage to our appropriated budget and the visitors provide an opportunity for technology transfer.

The other activity I enjoyed was serving on two different committees of the National Academy of Sciences National Research Council. Those were very challenging and exciting committees because they included some of the top people in their fields; most of were from academia. Those assignments are not low key. They're major commitments of time. One resulted in a book *Opportunities in the Hydrological Sciences*. One of the products generated from that effort, Pete, was that we convinced NSF to have a separate program to fund hydrologic research. But again, that's a major commitment of time that people of academia can rationalize that they need to do that.

HKS: It's interesting. I see here you're the U.S. Department of Agriculture Coweeta Hydrologic Laboratory, not the U.S. Forest Service.

WS: Yes, that's the way they put it in there.

HKS: It's departmental. You represent the department, not the agency.

WS: Right. That was a good group, very professional, intellectual group of folks to work with. I guess the final item, you have in the outline is plans for emeritus activities.

Emeritus Activities

HKS: You talked about it briefly. Emeritus activities, that's what I have.

WS: Right now I'm trying to squeeze out some time to work on the next Coweeta book, and that's going to be about twenty chapters that I will be editing and pulling together. Dac Crossley said he would work with me again and he was coeditor on this first volume. The topic of this next book will deal with the long-term recovery of ecosystem processes following commercial clearcutting on the watershed we looked at yesterday. About eighty percent of the material is already published in other outlets and so forth, but the objective is to synthesize those papers into shorter more relevant analyses so that it all appears in one place, between two covers. And there will be about another, fifteen or twenty percent that will be new, unpublished information that will appear in the book. I talked some about those results earlier, and where I stand on it right now is that Oxford University will be the publisher.

HKS: I was going to ask if it was going to be Springer-Verlag.

WS: No, Oxford has the contract now with the LTER program headquarters, so we'll be submitting to them. I have about all the chapters except maybe two or three, so I'm in a position now to write a prospectus and hopefully submit it soon.

HKS: Springer-Verlag books are so expensive.

WS: They're expensive.

HKS: That no individual buys one. It has to be the institution. That's too bad because the whole purpose of the book is so people will get at it, and the station gets one copy and, anyway, it's a tough one.

WS: Yes, it is. They didn't do a very good job with the pictures and so forth that I gave them. They had so much turnover in who was in charge of this particular transaction that you had to repeat yourself or start over several times. I found it to be a difficult working relationship.

HKS: I thought they were top flight, that's why they stayed in business, but you're pointing out that they're more like the rest of us. They have some personnel problems and all the rest.

WS: Yes. Oxford University Press has a new editor for that organization, who seems really good so I don't think we'll have as much problem going with them.

HKS: Ten years ago when I was at Oxford for a project that never got off the ground that was going to be published by Oxford Press, I went to their bookstore. That's rather impressive. I mean I didn't realize they published the range of stuff that they do. That's big time operation.

WS: Oh, yes. I see their list of publications. The other thing I'll be doing is working with Kathy Flowers. We're revising the Coweeta bibliography so we can get that in one cover too and get it updated through '04 anyway. I have three papers in either progress or submitted right now and I'm still working with my colleagues in England on a regular basis. We have several more papers to finish with them. Then I have probably ten or maybe twelve major papers to write that entails long-term research at Coweeta. At least one is in preparation right now with Katherine Elliott on forest succession and what replaced American Chestnut at Coweeta', that's a paper that covers seventy years of data.

HKS: Are you still eligible for travel funds from the Forest Service to go to IUFRO conferences and present papers?

WS: Oh yes, but I haven't done much of that. Actually in most cases in recent years, I have not attended meetings unless someone other than the government paid for it. You know, save our money and if they want me they can pay my travel and per diem. I did a lot of that at the end of my career at Coweeta, but since retirement I just haven't made that many obligations.

HKS: The Forest Service is well served as are the taxpayers if people with your expertise and others in your situation represent the Forest Service at a lot of conferences. They don't have to pay the salaries, and yet they have all these high-ranking people with good qualifications reading papers and participating in these various organizations. The Forest Products Lab sends I think all of its former directors to these meetings. It's good for everyone as long as a person wants to do it.

WS: I went to the Ecological Society of America meeting in Portland this past year and had a paper there and that was time well spent. I enjoyed that. But yes, they can reimburse for some travel. I may try and make an international meeting next year. Sometimes I'm coauthor with some of the other Coweeta staff on papers. I'm turning a lot of data and information over to the appropriate Coweeta staff folks.

HKS: The few times I've traveled as a Forest Service volunteer, the greatest benefit to me was to have the federal plane ticket that was changeable without penalty.

WS: Well, that's true.

HKS: And you could come back a day early and you didn't have to eat the ticket or something. It was a perk for me.

WS: Let me tell you a little story about travel.

HKS: Okay.

WS: I'll tell it on myself. When I came to Coweeta I'd never been abroad and there was a cornerstone meeting in hydrology in New Zealand. And so Jim Douglass said, yes, you can go. I prepared a paper with Dave Helvy as coauthor that will be one of my ten I think. I was getting ready to go and was, of course, excited to be going abroad for the first time. I got a visa from New Zealand in the mail and I had to fill out all of the government paperwork. So I got this visa and I thought, man, that's a cool looking thing, beautiful engraving and all on it. So it came time to go and we flew from Atlanta to Fiji where we refueled. From there we flew to New Zealand and went through customs. When I got on the plane in Atlanta I just showed them that visa. When I got off the plane in New Zealand I don't think I showed them anything. I did not have a passport.

HKS: [laughter] Oops!

WS: Whoops! I got to talking to Ray Rice, a Forest Service hydrologist from California; we had just a few Americans at the meeting. They came from all over the world and it was a class group. So I told Ray what had happened, and Ray says you mean you don't have a passport? He said they're going to put you in the slammer when you try and go back into the United States. I said well, I just wasn't thinking. I didn't know what I was supposed to get.

HKS: Well, I've got my drivers license and my picture, what else do I need?

WS: That's right, and I had my Rotary pin on too. Rotary is big in New Zealand. We were there two weeks, great meeting, fantastic, formed friendships and contacts that last to this day. And so it came time to get back on the plane. I didn't have any trouble getting out of New Zealand, but when we landed in Hawaii the you-know-what hit the fan. So there's Ray Rice over in a line for reentry into the U.S. and I'm over in the other line. When I reach the agent Ray yells watch out, he's a bad one, he's trying to sneak into the country.

HKS: Thanks a lot, Ray. [laughter]

WS: I said you son-of-a-gun. And the gal behind the desk said let me get this straight. You left the United States, got out of the country without a passport, got into New Zealand, got back out of New Zealand without a passport, and you're now coming back into the United States without

a passport. I said yes ma'am, that's it. She said that's hard to believe but I do believe you. I had my government driver's license for ID. She said well, sir, you'll have to come on back here with me. So she took me back to this little office that had a stern looking fellah sitting there and I explained the situation. He said well, we'll just fill out the passport document now. You can sign it and be on your way. So it took about three or four minutes, I signed paid the \$10 fee and away I went. Ray Rice still wasn't through the line yet as I waved at him.

HKS: It could have turned out a bureaucratic mess but you had real people that helped you along.

WS: Yeah.

HKS: I'm not sure with all this 9/11 reaction.

WS: I'd still probably be in jail.

HKS: That's quite a story. This is a good place to end. Thanks for a fine interview.

WS: Pete thanks for your patience, interest and company the past several days. I have been very fortunate and privileged to have the support of my wife Roberta, my parents and other family members, my mentors and numerous colleagues; the Forest Service was the quintessential outfit to work for. In retrospect, I would not change anything.



Undergraduate days at West Virginia University, 1958.



One perk of being a graduate student at the University of Washington in Seattle is the close proximity of Puget Sound and the outstanding salmon fishing as illustrated by my first silver salmon (7.5 lbs.) caught in 1959.



Wayne Swank testing a Polaris Forester snowmobile on Lake Wenatchee District, WA, in 1959. Thought to be the first snowmobile to be used in Region 6, this model had a detachable canvas cab, wide wooden skis for flotation and a transmission installed by Clayton Merry which provided a reverse gear.



USDA Superior Service Award being presented to Wayne Swank in 1981 by R. Max Peterson, Chief of the Forest Service.



USDA Superior Science Award being presented to Wayne Swank in 1991 by F. Dale Robertson, Chief of the Forest Service.



The Coweeta Hydrologic Laboratory was featured at a conference in Washington, D.C. in the early 1950s. Secretary Ezra Taft Benson is describing the watershed research program to President Dwight D. Eisenhower while an aide to Benson (left) and Richard E. McArdle (background left), Chief of the Forest Service, look on.



Coweeta provides tours for more than 1100 people annually many international visitors. Here, Swank is hosting a group of scientists from Africa.



Aerial view of the 2185 ha (5,400 ac) Coweeta Hydrologic Laboratory bowl-shaped basin showing the numerous small watersheds distributed over a 917 m (3,008 ft) elevation gradient.



Another aerial view of Coweeta basin.



Swank measuring stream water at gauging station.



The chemistry of precipitation measured at Coweeta climate stations (above) and of stream water measured at gauging stations (left) was initiated by Wayne Swank more than 35 years ago. This research is among the longest and most extensive for forested watersheds in the U.S.



Undergraduate summer interns from universities in the region provide an important research role at Coweeta; the above group is the class of 1993.



While on three months visiting fellowship in 1999 at Hatfield College in Durham University, Durham UK, formal meals “in college” required faculty to wear their academic gowns... Swank borrowed the one in this picture from a well-renowned geologist.



Wayne Swank, ca. 2006



One of Swank’s hobbies is wood carving as shown in this sample collection of animal figures.



A recent photograph taken in the long-awaited new office building at Coweeta Hydrologic Lab Laboratory.



Pete Steen and Wayne Swank taking a break from the interview in June 2005.