

11-10-2010

## Robert Knight

Robert Knight

Margaret Devore

Follow this and additional works at: [https://digitalcommons.unf.edu/voices\\_stream](https://digitalcommons.unf.edu/voices_stream)

 Part of the [Environmental Studies Commons](#), and the [Oral History Commons](#)

---

### Recommended Citation

Knight, Robert and Devore, Margaret, "Robert Knight" (2010). *Voices from the Stream: An Environmental History of the St. Johns River*. 18.

[https://digitalcommons.unf.edu/voices\\_stream/18](https://digitalcommons.unf.edu/voices_stream/18)

This Article is brought to you for free and open access by the Oral Histories at UNF Digital Commons. It has been accepted for inclusion in Voices from the Stream: An Environmental History of the St. Johns River by an authorized administrator of UNF Digital Commons. For more information, please contact [Digital Projects](#).

© 11-10-2010 All Rights Reserved

Interviewee: Dr. Robert Knight  
Interviewers: Margaret DeVore  
Location: Gainesville, Florida  
Date: November 10, 2010  
Duration: 69:45

DeVore: Good afternoon. This is Margaret DeVore, graduate student in the Department of History at the University of North Florida. Today is Wednesday, November 10, and I am just north of Gainesville, Florida, here with Dr. Robert Knight, who is the founder and president of Wetland Solutions. And also I believe you are the current director of the new Howard T. Odum Florida Springs Institute. And we are going to be discussing efforts to protect Florida springs today. Good afternoon, Dr. Knight.

Knight: Good afternoon.

DeVore: Let's start with an easy question. How did you first become interested in working with Florida's Springs?

Knight: I had a very unusual opportunity to do my PhD graduate work at the University of Florida on Silver Springs. That came about because I met Dr. Howard Odum at the University of North Carolina at Chapel Hill where he was a professor in the Department of Zoology. During the spring semester of 1970 I took Dr. Odum's systems ecology class. I graduated with my bachelor's at the end of that semester and then I worked for Dr. Odum during the summer of 1970 at the North Carolina Institute for Marine Sciences at Morehead City, North Carolina, on a project concerning wastewater in wetlands. Dr. Odum had just accepted a job at the University of Florida, coming back to his original alma mater, in the fall of 1970. It was the first university he had taught at when he began his academic career in the 1950s. He invited me to start a graduate degree with him at UF in the fall of 1970 and I accepted the invitation. I originally only stayed at UF with Dr. Odum for one semester and it was a very good experience. But I was not quite done with personal issues at Chapel Hill, so I went back up to North Carolina in January 1971 and ended up getting my master's degree there, with the understanding that I would eventually come back and work with Dr. Odum on a doctorate degree.

In 1977 he and I were both ready to continue, and when I returned to the University of Florida in the fall of 1977, he asked me to re-study Silver Springs, the same location where he began his career at UF in the early 1950s. By 1977 Dr. Odum had observed that Silver Springs had visibly changed since he had originally studied it in the fifties, and he wanted to have a student – he thought I was the right student – re-look at Silver Springs in terms of the effects of the fish population changes at the springs. He thought that the apparent decline in fish populations between the 1950s and 1970s might have affected the whole spring's ecosystem productivity. Although that is how I got started working in springs, I had been to Silver Springs before. I first went there in 1953, roughly at the same

time when Howard Odum was doing his landmark ecological study, my dad was stationed at Jacksonville Naval Air Station and we took a family trip to Silver Springs. I have a photo of myself feeding the flamingos at Silver Springs in 1953, and I remember going on my first glass bottom boat ride at that time. So I have a recollection of Silver Springs from over fifty years ago, but then I didn't go there again until I started my research in 1979.

DeVore: Now did you update Dr. Odum's study? Am I understanding that correctly? You took his original study from 1957 and went back in and applied, I would imagine, your techniques and updated his study from then? Or did you look at new things compared to what he had done?

Knight: Both. Dr. Odum and I decided that my doctoral research at Silver Springs would be on the effect of consumers and toxins and how they control organisms and energy flow in aquatic ecosystems. I had just completed four years of research before I came back to UF in 1977 on the effects of heavy metals on stream aquatic ecosystems at the Savannah River Ecology Laboratory in New Ellenton, South Carolina. I combined that with new work at Silver Springs, where I was looking at the effect of consumers, which are the animals, on controlling ecosystems. I looked at toxins in South Carolina and then I looked at the consumers at Silver Springs, and the experimental design was that the fish populations had changed radically since the time of Dr. Odum's original studies at Silver Springs. When he came back to UF in 1970 he saw that the fish populations had declined at Silver Springs compared to the populations that were there when he had studied it twenty-five years before. We hypothesized that the decline in the fish populations was a result of the Rodman Dam being built on the Ocklawaha River, which was blocking the passage of fish that live in the ocean or the lower St. Johns River and come into the spring-fed rivers and fresh water systems to feed and grow up. And those fish, mullet and channel catfish, had really declined at Silver Springs. So the experimental design was that his study from the fifties was a good measure of the productivity of Silver Springs with the fish, and my study would be one without as many fish. And I would repeat the measures that he previously made. I would re-measure the productivity of the whole spring ecosystem and at the same time, I would document the fish populations like he had done in the fifties, and we would see if there was any apparent effects of that change. The title of my doctoral dissertation was *The Energy Basis of Control in Aquatic Ecosystems*. And it was basically a test of what was controlling the energy flows in ecosystems - was ecosystem productivity controlled most by consumers, pollutants, toxic metals, or other factors.

DeVore: After you finished that study, you went on to work in aquatic and wetland ecology after that. What do you see is the relationship between the work that you've done since, in wetland ecology . . . is it wetland treatment systems?

Knight: Yes.

DeVore: And the Florida springs?

Knight: It turns out they are closely related, but at the time it wasn't clear to me. I would say my Ph.D. research with Dr. Odum was possibly the last project that he oversaw related to aquatic ecology. Most of Dr. Odum's students after worked on human-related systems and economic systems and country-based systems and global systems, and not pure environmental systems. He really was looking at the relationship between humans and the environment after that for the rest of his career. But he started out as a limnologist, an aquatic ecologist. And his first publications were in the limnology journals and ecology journals. My Silver Springs study was really the last study he directed along those lines. I was trained originally as an aquatic ecologist and that's what I gained from that period of time with Dr. Odum. My early academic and research work, both my master's work at University of North Carolina, which was related to the effect of power plants on phytoplankton in lakes in North Carolina, and my work at the Savannah River plant, which was related to the effects of heavy metals on streams, to the Silver Springs work, which was looking at the effects of really a dam on a spring system, were all aquatic ecology studies. When I started working in environmental consulting in 1981, which was the job I got out of college once I finished my PhD, the opportunity was to work on the effects of wastewater discharges on ecosystems and how ecosystems could be used to manage and treat wastewater. I was working with CH2M Hill, a company that is well-known in wastewater treatment, and at the same time, well actually before I came back to University of Florida, Dr. Odum had just completed a five-year study on using wetlands for recycling wastewater, so the idea wasn't a new one. But he had started it. Actually when I worked with him in 1970 at Morehead City my study was related to a wetland system that was receiving wastewater. For my career in environmental consulting I focused on designing wetlands, using both natural wetlands and constructed wetlands, for treating wastewater and to removing nutrients and other pollutants from wastewater. I worked for eighteen years at CH2M Hill, and that's what I concentrated on. I got to be proficient in that field and I eventually co-authored the principal book about treatment wetlands. When I left CH2M Hill in 1998 I started my own company, Wetland Solutions, to focus on the use of constructed and natural wetlands for water quality treatment. For four years our focus at Wetland Solutions was treatment wetland projects. Then I got a call in 2002 from another Odum student, Dr. Mark Brown at University of Florida, that said that he understood that St. Johns River Water Management District needed some help on a springs project that they were doing at Volusia Blue Springs.

DeVore: Okay.

Knight: I got in touch with the water management district and they needed some help. They needed an expert to look at the effects of minimum flows and levels on the whole spring ecosystem, so I got involved with the project. I'm still working with

that project at Volusia Blue Springs eight years later with another three-year contract.

DeVore: Okay.

Knight: The Volusia Blue Spring project got me started working in springs again. Of course I've been swimming in springs the whole time I've been in Florida, but I wasn't paying much attention to the science of springs, because I was focused on wetlands. What I found out in 2002, when I started studying springs again, was that there were major problems. I went to Silver Springs again for the first time in years and saw just how bad the algae were in Silver Springs. I was at Volusia Blue where there are no plants at all - all of the plants are gone. It's all algae now. And I started reading up on the degraded conditions in other springs. That project rekindled my interest in springs issues and science. All of a sudden, over the next four or five years, I was spending over half my working time on springs-related projects. And getting back to those earlier roots.

DeVore: Kind of coming full circle then, coming back.

Knight: The two ecosystems – springs and wetlands aren't directly related, but they are both really aquatic ecology, because wetlands are aquatic ecosystems. They're just shallow aquatic systems. In other words, they are water-based systems. So many of the same functions that occur in springs occur in wetlands. The plant communities are very different, obviously, and the water depths are different and the clarity of the water is different. But many of their forcing functions are the same, so much of the knowledge I gained working in wetlands, transferred to springs. And the other interesting connection between the two is that one of the major problems with springs that we're having is the contamination of nitrate in the groundwater. And nobody has come up with a really good method of dealing with that groundwater nitrate contamination, how you're going to clean that up to protect springs. Well it turns out constructed treatment wetlands are one of the best ways to remove nitrates from water. They're much more effective than even conventional wastewater and stormwater systems in terms of the low concentration of nitrates you can achieve and they are more cost effective. So I've helped by working in treatment wetlands, carrying on Dr. Odum's work there, I've helped optimize a technology that is available to actually be a part of the solution for springs. So the two things are related. My company, Wetland Solutions is doing one of the first demonstration projects on a new kind of treatment wetland that is intended to clean the water that is recharging groundwater and ultimately the springs.

DeVore: Okay.

Knight: That demonstration project is for Gainesville Regional Utilities and it's what we're calling an infiltrating wetland project, so you recharge the groundwater, which is what you need to do to protect the springs flow, but you do it with water

that is low in nitrate. The treatment wetland removes the nitrate through a natural microbial process called denitrification) and then it recharges the groundwater with purified water.

DeVore: Okay.

Knight: Because there are so many springs that are being impacted by high nitrate in the groundwater, I am promoting constructed wetlands for groundwater recharge throughout the state. I'm giving lots of talks about the advantages of converting existing wastewater treatment systems to wetlands to benefit from the increased nitrate removal. There are some big communities thinking about it. Tallahassee is thinking about it right now.

DeVore: Are they?

Knight: Yes, I originally made a presentation to them three years ago about the concept and they may include an evaluation of constructed wetlands in an effluent master plan update. They have told me that they are thinking about wetlands. Their wastewater disposal sprayfield has been determined to be the main source of nitrate nitrogen contamination at nearby Wakulla Springs.

DeVore: Wakulla? ...okay.

Knight: Wakulla is one of the biggest springs in the world. Tallahassee's wastewater disposal practices were identified as the major contributor for nitrogen, so they're upgrading their whole treatment system to deal with that. They're adding about two hundred million dollars' worth of treatment upgrades right now in Tallahassee to reduce their nitrogen load to Wakulla Springs, but they're still not getting low enough with all those upgrades. It appears from preliminary calculations that if they would convert their spray irrigation system to a wetland, they could cut their nitrogen in half again by doing that. And that's what I'm trying to convince them and other communities to do.

DeVore: Now do you see wastewater as being the biggest threat right now to the quality of the springs? Is that where most of the nitrate is coming from.. from wastewater? Or is it a combination?

Knight: It's a combination.

DeVore: I'm still trying to figure this all out. I apologize. There's storm water runoff. There's urban runoff. There's sewage treatment. There's industrial waste, as well. Is all of this together what's creating this wastewater or . . .

Knight: Nitrate is the key pollutant that has significantly increased in springs. Nitrate nitrogen, which is a dissolved form of nitrogen, is invisible in water. You can't see it, but it's the same nitrate that's in fertilizer. It makes plants grow. Nitrate

concentrations have increased in springs up to a hundred times and more or more than ten thousand percent higher than it was historically. And it's not just in springs. Springs are just the manifestation of the groundwater aquifer. In Florida we have contaminated the groundwater under about one fourth of the state with nitrate, because of disposal practices that we've had. But wastewater is not the only source of that nitrogen. The biggest source statewide is probably fertilizer.

DeVore: Okay. So home fertilizing and agricultural-based fertilizing?

Knight: Agricultural being the biggest, but for any application of fertilizer in areas of the state that aren't protected with confining layers, some of that nitrogen gets into the groundwater. Once nitrate is dissolved into the groundwater, it stays there, because it's not a reactive environment and the processes that remove nitrate in wetlands, for example, don't typically occur in the groundwater. You don't have the conversion of nitrate that's in the water to nitrogen gas like you do in a wetland. When nitrate is in the groundwater, it stays there until you pump it out of the ground and you drink it or it goes to a spring, a river, a lake, or an estuary. Some of those groundwater nitrate levels are extremely high. They're highest in areas with high agricultural fertilizer loads. An example would be Fanning Springs in the Suwannee River District right on the banks of the Suwannee River. It has a nitrate concentration of about five milligrams per liter, which is a hundred times higher than the background of about 0.05 milligrams per liter. Most of the springs along the Suwannee River are contaminated by nitrate levels that are from fifty to a hundred times higher than background. The nitrate concentration in Silver Springs is about twenty times the background. And Silver Springs feeds the Silver River and then the Ocklawaha River which feeds the St. Johns River. Silver Springs is such a big source of water, almost a half a billion gallons a day of water coming out of that one spring system, that when you multiply the flow rate times a nitrate concentration of 1.2 milligrams per liter, it turns out there are hundreds of thousands of pounds of nitrogen a year that are coming from Silver Springs into the St. Johns River. Nitrogen is recognized as the principal nutrient pollutant in the St. Johns River. There is a total maximum daily load for nitrogen in the St. Johns. The nitrogen in the Silver River is probably over half from fertilizers and probably ten to twenty percent from wastewater disposal. Septic tanks are part of wastewater disposal practices that increase nitrate concentrations in the groundwater. Nitrate contamination also comes from manure from horse farms. In the Suwannee River Water Management District dairy and chicken farms are also a big source of manure. There are a lot of nitrogen sources and nobody is innocent. Everybody who flushes a toilet or goes to a privy is part of the problem, and anybody who uses fertilizer. People are not aware that anytime you buy fertilizer from the store, they are contributing to this groundwater contamination. We have been trying to get the word out and a lot of people aren't listening. [laughs] including their elected officials.

DeVore: That I do know. It carries all the way up to Tallahassee, that's for sure. I've seen what's happened, especially in the last year. And that might be a good place for us

to go from here. You said you kind of got drawn back into the springs and revived your work with the springs in 2002. I guess what I noticed when I was looking at the springs protection movement since, I would say, the 1970s, because you know we had the explosion of environmental protection laws that came out in the 1970s with the EPA and the Clean Water Act after that and so forth. And I don't really see a lot of activist work being done toward protecting the springs until it looks like the latter part of the 1990s. It's where I started to see it showing up again. Do you have any . . .

Knight: I can describe the history of that movement.

[Simultaneous talking]

DeVore: . . . that movement? And what was the impetus for that movement? And who led that movement? And how did it start there?

Knight: I can talk about that.

DeVore: Wonderful.

Knight: In 1992 Jim Stevenson was with the Florida Parks Service, I believe he was the chief biologist there, and he had become very interested in the health of springs. I don't know really before that how long he was interested, but in 1992 the first springs working group was started at Wakulla Springs. The degradation at Wakulla Springs was becoming more and more evident and he helped pull together a group of people who were interested in taking action to reverse that trend. He was also very interested in Ichetucknee Springs, and degradation at Ichetucknee had actually been looked at before by a graduate student of Jack Ewel's at University of Florida, a former professor here, Charles DuToit did a study looking at recreational impacts on the plants in Ichetucknee Springs. Ichetucknee was being damaged by recreation. It was the first spring where this was recognized. I think that was what got Jim Stevenson's attention, that study. Jim was with the park service then and Charles DuToit worked for the park service for his whole career. Jim Stevenson became involved with the spring issues at that time. Sometime around 1992. Of course, he'd always known about springs and been around them his whole life, too. He's still active, although he recently stepped down from his most active roles. He started a working group at Wakulla Springs in 1992, it went on for eighteen years and the reins to that, or the keys to that working group have been turned over to my company, Wetland Solutions. Jim is our advisor in helping with that effort. In, probably around 1998, Jim took Jeb Bush and David Struhs, the secretary of DEP at the time, on a canoe trip on the Ichetucknee River to talk with them about springs protection

DeVore: It's quite all right, because you're filling in blanks that I have. I had the original movement coming out in '99, .. you start seeing some of the working groups, and

the call from Jeb Bush at that time for the Springs Task Force ... and I was trying to make that connection.

Knight: Jim Stevenson would be the one to interview to get that information.

DeVore: Okay.

Knight: Jim was the first person involved with springs protection throughout that time. Like I said, I was off in treatment wetlands throughout that time. That's when I was writing my book. But I didn't realize the springs were in such danger. But he took that canoe trip and Jeb Bush went back and immediately by proclamation said we're going to have a springs task force and then a Springs Initiative. The springs task force started around 1998. The next working group that got started was the Ichetucknee Working Group, which Jim led also. It was organized somewhere around 1998. That working group has recently been turned over to a consulting firm named Pandion.

DeVore: Pandion?

Knight: Pandion. They're actually leading the working groups for three of the springs that the DEP is funding, including Rainbow, Ichetucknee, and Silver. They won those projects and my company won the contract to continue the Wakulla Springs Working Group. So the task force really became active around 2000. By 2002 they were publishing reports. The Springs Initiative was formed, I think the Springs Initiative started in 2002 and Mike Bullock was the first director ...

DeVore: That's quite all right. I've got the report . . .

Knight: Director of the springs initiative. Connie Bersok is the director of the Florida Springs Initiative now. They were funded at a rate of about two point four million dollars a year up through a couple of years ago, and then their budget started getting cut. This past year it got cut to less than a million dollars a year. I think it's at about three-quarters of a million dollars, about seven hundred and fifty thousand dollars, and with the change in administration in Tallahassee, everybody's anticipating that it may go away completely. But we'll see. There are enough people active on springs issues now to get more attention. For five years now, bills have been introduced into legislature to try to protect springs. The only bills that have ever protected springs directly are the two Wekiva acts, the Wekiva River Protection Act and the one before that. And those were because of Senator Lee Constantine of central Florida and his attachment to that spring. Of course, the last two years that Tallahassee tried to get a state protection bill but those have all been unsuccessful. I believe there is a ground swell that's occurring in the state, because the problems in springs are becoming clearer and clearer. Not only are springs contaminated with nitrate, but unfortunately their flow is slowing. There are actually very noticeable declines in flow just in the past decade, and they are major and scary, because they are an indication of just how much impact

we have had on the Floridan Aquifer and how we may be imperiling the whole drinking water supply for Florida by pulling down the aquifer too much. I can get back to that later, but historically that's how I know it grew up. In 2004 I started another springs-related project. The University of Florida was originally scheduled to do the project with Mark Brown to restudy Silver Springs, to do a retrospective study of Silver Springs. Since Mark did not have the time to work on it, I was fortunate enough to get to lead that project. The St. Johns River Water Management District came to me and said can you do this? And I said yes, I would love to do that, because I had studied it last time. Wetland Solutions worked with University of Florida faculty and with the St. Johns River Water Management District to completely restudy Silver Springs in 2004-2006. this restudy was much more comprehensive than I was able to do alone in my doctoral research. It was also much more similar to what Dr. Odum had done in the fifties, because we had a full year. We had four principle investigators on it. A lot of talent, you know. We had a fisheries biologist. We had bird and plant ecology and algae. And we had all the groundwater people at the District and my company doing all the ecological work combined together. You have probably seen that report. It is on the District's website. We brought all of Odum's data into the comparison. We brought all of my data in from the seventies and then we combined it with the updated data. Then we looked ahead fifty years to estimate what Silver Springs might look like in 2055. I won't be around to see it but it didn't look good.

DeVore: It didn't look good?

Knight: It didn't look good. Things were getting worse. They're getting worse and it's accelerating. We're not doing much in that basin to help the problems yet. Marion County has tried to do some things, but they haven't had any effect yet, and it's unlikely that it will in the near future. And so the nitrates are still going up and the flows are going down precipitously now. Since 2000 the flows have been declining very rapidly. And it's not just due to less rainfall anymore. In periods of high rainfall, the spring doesn't respond like it did in the past. One common dream that Dr. Odum and I had was to have an institute at Silver Springs, an actual academic institute there that just did springs research. It's such a perfect laboratory. He was the first one to talk about how springs would make a perfect laboratory because they have relatively constant flow, they have constant temperature, they have constant chemistry and they have fairly constant biology because of those things...

[Someone interrupts to which Knight replies "okay"]

Knight . . . they're just a wonderful laboratory, because you can go back and repeat experiments. That's why he put me back there twenty-five years after his experiments, and that's why we restudied it more recently. So it's a perfect place for a learning institute...

[Another interruption]

Knight . . . and so that's when we had the idea. Dr. Odum and I went to the university president and suggested it at that time. That's a great idea, he said. That's Robert Marston. He sent a letter back saying great idea I'll look into it and then we never heard anything else from him about it. And the State of Florida had just . . . the land around the spring had just been donated to the State of Florida at that time. The University of Florida, actually, and it was passed on to the division of state lands. And what they've done since then is continue to lease for the attraction there.

DeVore: Okay.

Knight: So it's still an attraction, but it's a decaying attraction.

DeVore: Right.

Knight: Actually, it's falling apart. So as I got more involved in the springs again in 2004 and 2005, when I was working at Silver Springs, I said I've really got to push this idea of an institute. And that was one of our recommendations in the fifty-year study we reiterated what Odum and I had said about it in the seventies. Since I still didn't see anybody stepping forward to do anything about it, so I said maybe I need to start a non-profit, or maybe I need to go do this through the University of Florida. I'm an adjunct professor at the university, so I thought maybe I could build up enough interest there to start a center for springs or something like that. I introduced that idea to them a year ago, a little over a year ago, started having meetings with faculty there that are working on springs, and got frustrated that it was moving too slow. They said no you can't have a center. No the university doesn't like to put money in centers, stuff like that, because they're not sure of the funding long-term, comments like that. So I started to think that an institute was not going to happen in my lifetime unless I did something myself. So this year I started the Florida Springs Institute as a non-profit organization. It's goal is to restore and protect springs and the idea is that I'm going to try to find funding for that wherever I can find it, including private sources, grants, and foundations. And maybe state funding, but state funding is dried up for springs. Literally, as springs are drying up the funding from the state government has nearly dried up at the same time. This is ironic because it was the economy that got springs in trouble to start with.

So that's what the institute is. It's called the Howard T. Odum Florida Springs Institute. I'm friends with Dr. Odum's widow, Elizabeth Odum. He died in 2002. And she's totally supportive of the Florida Springs Institute. She's on the advisory board for the institute. Jim Stevenson is also on the advisory board for the institute. I'm putting together that institute now. We have two grants so far. One is focusing on spring issues in Marion County, which would be Silver Springs, Rainbow Springs, and Silver Glen Springs, three of the big springs in the county.

We've just done spring health report cards for those springs. And I am also keeping track of what the water management districts are doing in terms of setting minimum flows and levels for those two springs. They're both being, Rainbow and Silver, are both being looked at for minimum flows and levels. I am involved to make sure the science is done right and to review them as an expert, I am trying to make sure they get the right science in there. Both of those springs have declining flows.

DeVore: Now do you see the goal for the Springs Institute, ... as leading, hopefully becoming an organization that leads efforts to get springs protection legislation passed or do you see it as supporting other efforts . . . ?

Knight: Yes.

[Laughter]

Knight: I hope to do everything. Obviously it's not much right now. It mostly me. I'm basically supporting it with my own time but I am using that time to build support for the Institute and to bring people together with the same interest in springs restoration. The idea is for the Institute to do whatever it can do to help with restoration and protection of springs. That includes a lot of things. Ultimately I want to actually have a physical institute. I don't care if I direct it or somebody else does, but I want a place where springs, the study of springs is the whole purpose for the facility. It will be a place where students can come to learn more about springs and their wise husbandry and there are a lot of little parts of it already in place. Like there's the Silver River Museum which is owned by the Marion County school system. It's at Silver River, but it's not at the attraction, because the attraction's in the way. The Silver river Museum is downstream, where you can't even see the spring. But all the school students come through there, but there's not really curriculum on springs there. The museum focuses more on the history of Florida and not on the biology and natural history of springs. I see possibility of an institute at Silver Springs one day. And it would be a center of excellence of springs and also a clearinghouse for springs information and a source of expertise when it comes to policy decisions and management decisions related to springs. In the interim I'm going to fill that as best I can. And where I can get support, I will either fund projects, I'll do them myself, or I'll hire staff to do those things depending on how much support I'm able to raise for this. And, you know, I basically know how to run a company, so I'm putting my time into trying to do that for Springs now. The idea is that the Springs Initiative at the state level is declining in funding. The Water Management District's efforts on springs are being reduced every year. There's not more work being done, there's less work being done to protect and restore springs. The Florida Geological Survey has been told that springs aren't their main focus anymore, and they don't have the hydrogeologists, the best experts there are retiring, they're moving on and the U.S. Geological Survey that has done a lot of this spring work is totally dependent on funding to do their work. They don't get money to just do projects

from the government. They get them from state agencies, usually, who hire them to do work. So the pot of money that feeds our knowledge about springs is getting smaller at a time when we have greater and greater problems. It's too little money considering the size of the problems in springs. So I'm going to try to build a bigger money pot and to fill it to get that work done one way or the other.

DeVore: Who are throwing the obstacles up? I've been following the legislation the last five years and I've seen it in the Senate and in the House, both come up and go down, come up and go down, and then most drastically this last year with the Springs Rally in February and . . .

Knight: Did you go to that?

DeVore: I didn't get to, unfortunately. It wasn't a good time for me.

Knight: It was a cold day.

DeVore: It looked like a cold day in the pictures I saw. Absolutely it did. Who do you see, in your opinion, what groups or what persons, do you see as being the biggest obstacles to springs protection and springs initiatives in Florida, either at the state level or at the Water Management District level, or even at the community level?

Knight: It's really complicated and it's not always visible. Some of it's invisible, but the development community is very concerned about any laws or requirements, environmental requirements that make development more expensive and that might discourage people from buying property and buying homes, things like that. And so is the Florida Chamber of Commerce and the Florida Homebuilders Association have been vocal. Their attorneys have been the most vocal I have seen at the legislative level, and a lot of what they do is behind closed doors. You never see all that they are doing. I've been hearing about it and I've worked with some of these people in the past and so I know some of the things they're doing. The agricultural community has been very opposed to anything, of course, that affects their bottom line, and any restrictions on the use of fertilizer or other farming practices have the potential to greatly restrict what crops they can grow successfully.

I don't think anybody is against springs. I don't know anybody who hates springs. And I don't think anybody is against clean and plentiful groundwater. It's just that it's a bottom line thing and it's their bottom line that if they can build just one more house or get one more bushel of crops out of this system then they get some more money from that, and they do not seem to think, or they do not take as important the side effects of those incremental sources of pollution. To get that extra bushel or that extra watermelon, you know, that extra hundred watermelons per acre for example, they add another couple pounds of nitrogen fertilizer to their fields, because they do a cost-benefit analysis that says that they can spend five hundred dollars on fertilizer and get a thousand dollars more in income and that's

worth it, because there's a net profit associated with it. But there is no cost to them for polluting their neighbors' and their own groundwater. They can do it because the laws are not protective or they are not enforced. So it's at the agency level, there are dichotomies within the agencies that you just wouldn't believe. They all have dedicated staff who are devoted to various types of environmental protection. The Department of Environmental Protection, the Water Management Districts, they have staff who are knowledgeable about environmental impacts to wetlands, to lakes and rivers and streams and springs. They've done tremendous amounts of work looking at the effects of nitrate on algae in springs and macroinvertebrates on springs, on manatees, and yet at the same time, they're the ones that have to write the permits for these discharges and consumptive water uses. And their staff are under a stressful situation where the management wants to be friendly with their clients, the people they write permits for, and they want to have good science, too. They feel like they're balancing things, but it turns out they're not. They're making decisions in more and more cases on the wrong side of being conservative. Instead of being conservative in protecting the environment, a lot of the decisions are ones that allow the environment to be hurt first and then maybe we can see a little more environment we can give away without destroying the system. But once it is hurt you can't get it back. That is the history of Florida – development vs. environmental protection. That's the degradation of the Everglades and that's the pollution of Lake Apopka and all these things, well, this was for economic development, we're going to do this, we're going to put these canals through, we're going to put these farms here in places that are inappropriate. And then we pollute the heck out of those water bodies, and eventually have to go back and spend hundreds of millions of dollars to billions of dollars trying to fix those things. And we're doing it again to our groundwater and springs. It's not even a matter of being the future, we've done it already to springs. We are in a situation now that, to actually restore our springs to say even ninety percent of their original health, I would estimate we're looking at billions of dollars. Probably ten billion dollars or more just to get . . . to reverse the problem. The springs problem is enormous because of the widespread nature of the nitrate contamination and the widespread decline in the Floridan Aquifer now that's affecting the flows.

DeVore: And with springs, it's not, my understanding is, there's not a quick fix. This is because of the nature of springs the way that they . . .

Knight: They can recover to some extent quickly, because most of the water that comes out of a healthy spring is probably young water. There is a blend of old water and young water in the aquifer, but it's not mixed from top to bottom. The older water is on the bottom and the younger water is on the top. And when you have a lot of rain, the groundwater table comes up and that water doesn't mix instantly, because the aquifer is a thick matrix of rock and caverns and things like that, conduits, so the younger water is on the top. And the water that comes out of the springs is mostly the younger water on the top of the aquifer, if it is present it flows out first. But it's a blend and you have both types coming out, because it's

all under pressure. So actually the problems we see now, may be continuing problems for some time because more of the older water is being contaminated too. We've put enough nitrogen in the groundwater that we are going to be paying for it for awhile. But in terms of getting immediate results, if you reduced the nitrate load in say the Suwannee River District, I would estimate if you, say you knocked it down fifty percent next year, Fanning Springs within two to three years would probably have half the nitrate that it has now. It's that fast. And I say that because of actual data that indicates that responsiveness. Wekiwa Springs is an example. Wekiwa and Rock Springs where the nitrate levels started going down when the orange groves disappeared from Lake Apopka. And almost right away (within a few years) the nitrate levels started coming down. That was the main source of nitrate contamination due to the fertilizer used on orange groves and the muck farms around Lake Apopka. Wakulla Springs is more complicated, but they were fertilizing the spray field and as soon as they stopped fertilizing the spray field the nitrate levels started coming down. But it's more complicated there, because there are other things going on. There is dilution from surface water inputs occurring. In general if you stop loading fertilizer and other pollutants to the surface of the ground the change at the spring may be fairly fast. It's not something that you have to wait for forever. In other words, you could make a decision right away that you are going to stop fertilizing and see an effect within just a few years. The funny thing is fertilizer costs money, so everyone should be happy if they are not allowed to fertilize as much.

[Laughter]

Knight: The only people who wouldn't be happy are Lowe's and Home Depot.

DeVore: Scott's True Green and ...

Knight: I know people who sell their fertilizer in bulk and they have a very strong interest in DACS. So DACS is just . . .

DeVore: DACS?

Knight: The Department of Agriculture Community Services. They are very much against springs legislation. They think that the Suwannee River partnership is a good model that will let the farmers regulate themselves as long as they follow the best management practices provided by the University of Florida, then they're doing enough, even though in doing those things they don't reduce the nitrogen nearly enough to affect the groundwater or the springs. And so everybody is in it, you know? The University of Florida is getting money to do research and their client is DACS or the farmers. And DACS clients are farmers. And the farmers' clients are people that will pay them more for that extra watermelon. And that's how they make their living. You can't blame anybody for that. And so what I see, for nitrate at least, is the state has created this problem, and EPA created this problem and the feds and the state should pay for the problem in terms of fixing the nitrate

issue in the groundwater and in the springs. To do that, they're going to need to move various types of agriculture off of the most sensitive lands. Agriculture first and then at the same time development is going to have to be done differently. You just can't have high densities of septic tanks on some of these areas.

DeVore: Now, the springs protection acts that have come up. I've noticed from what I've been reading there, they tend to take two different avenues. The ones that want to do just monitoring, and then there are those that actually want to restrict land use. Is that the one that seems to be the biggest problem, the one that wants to restrict . . .

[Simultaneous talking]

Knight: Yes, some people thought that the ones that required more monitoring were just a placebo and not a real solution.

DeVore: Okay.

Knight: But the bills that actually tried to restrict land usage are the ones that actually have the potential to do something meaningful for springs protection. None of the legislation has been very close to perfect. But all of the proposed bills, were better than what we have now. Springs generate a minimum of three hundred million dollars a year of economic revenue for the state. And that just includes the ones in the state parks, and just the direct expenses related to those springs. The true economic value of springs is probably much more than that. Agriculture always holds up a figure of a billion dollars or more. But springs are a very valuable resource for the state, and yet the Springs Initiative has been funded at the rate of only two-and-a-half million dollars a year, probably on average about two million dollars a year for eight years and that's really the only state funding that's directly aimed at springs. The Water Management Districts have put money into springs, but it has not been focused and it'd be hard to add it up. It is probably several more millions of dollars. But an industry as big as ecotourism in springs deserves a lot more attention, especially one that's clearly in trouble. Because like Silver Springs, the attraction's dying. At Weeki Wachee Springs, they had to go in, vacuum out the algae when the state took it over, because the mermaid show, the girls were in algae instead of the nice looking eelgrass that used to be there. Homosassa water clarity looks bad. The water is turbid there all of the time. Of course they have manatees there in the spring, but the water coming out of the ground is turbid at Homosassa. It is not clear like it used to be. The springs are in serious trouble. Volusia Blue doesn't have any vegetation in it. And yet we're spending less money on them. I don't think anybody is against springs. I think what people are for is what is hurting springs. People are for making a buck. Perhaps you've heard of the double bottom line? It's a new mantra for green industries and green companies. You have a double bottom line. Your bottom line is not just the net profit. It is also the net best for the environment at the same time. So you have two bottom lines that you pay attention to. And I don't know

much about it, I haven't read the book or if there is a book about it, but that's the way people need to be thinking. It's either that or we have to use a club. And that's what the legislation is about. I don't want to do that to farmers. I'm from an agricultural family. I don't want to be the person that farmers hate. But I don't think we should be putting, dairies or chicken farms on karst areas that are highly vulnerable to nitrogen contamination. Because the practices, even if you perfect those practices they have, best management practices, it's not enough to protect the environment. They still raise the nitrate level to as much as ten milligrams per liter, which is a groundwater standard. You know, the standard of the water is five hundred times the background for nitrate. The drinking water standard. It's not the standard for springs. The springs standard is going to be 0.35 milligrams per liter, hopefully next week when the numeric nutrient criteria is finally published by the EPA.

DeVore: Yeah, I think that was one of the most outstanding things I read in your report and in some of the other reports I read ... the difference in what's allowable, the nitrate load, that's allowable for drinking water versus what that much of a nitrate load can do in a spring. The difference was unbelievable.

Knight: Yeah. It's easy to say ten times, a hundred times, twenty times, I don't think people realize, you know, when we talk about a fifty percent increase or a hundred percent increase that is just two times. A hundred percent increase is two times something. We're talking nitrate that is twenty times higher than background at Silver Springs. At Fanning Springs it is close to one hundred times the background concentration. And this is the same water these people are drinking. The state, the DEP doesn't even want to talk about it. I'm raising the issue at the DEP right now through the Springs Institute. I just sent a letter to the secretary of the DEP, Mimi Drew, because DEP just issued a permit, a draft permit, to the city of Fanning Springs, to build their first wastewater treatment plant. Now that's a good thing, because they are going to take septic tanks offline and build a central wastewater treatment plant. But it is also a bad thing for Fanning Springs, because the state is not forcing them to go to advanced wastewater treatment with that treatment plant. They're allowing them to raise the groundwater nitrate under that treatment plant spray field to ten milligrams per liter. And so, I called up DEP and said do you see this? Connie Bersok at the Springs Initiative. She says yes, it's schizophrenia. It is the wastewater side of DEP that did that, because the law says you can have a spray field and discharge up to ten milligrams per liter to the groundwater. That's what part of the law says. The other part of the law says there is already a total maximum daily load, a TMDL, which is a legal document that says you will reduce the nitrogen load into Fanning Springs by ninety-two percent. And so you can't get there by spraying water at that nitrogen level. That is a dichotomy of purposes – protect the public treatment plants ability to contaminate the aquifer at the same time you are trying to protect Fanning Springs from that pollution. What can DEP staff do about this? She called the Jacksonville office that issued that draft permit and asked what can you do about this? They said we can't do anything about it. It's perfectly legal and this is what we have to

do, we have to give them a permit if they ask for it. I contacted environmental groups in the area and asked what are you going to do about this? And one of the environmental groups got back to me and said they had talked to their lawyers and they said they can't fight this, because it is legal for them to do this. So I decided that I needed to talk to someone higher in DEP. And the Springs Institute sent a letter to the secretary of DEP and she said she's got someone reviewing it right now. She agrees that it's not a good idea, so they're reviewing it. It probably won't get anywhere, but this needs to be raised to the highest level in the agency. They are doing opposite things on two sides of the same agency. They are supposed to be protecting springs and other surface waters, their type, nature, and function, the natural flora and fauna and all this stuff. Yet they have rules that let people pollute these same water bodies. They won't do anything about the nitrate contamination until it comes out of the pipe and the springs are at the end of the pipe, you know. It's land use practices. Nobody's doing it on purpose, but it you don't have agency people sticking their necks out about it.

DeVore: Why are the springs important? We talked a little bit about the economic reasons, and I think you can argue that an economic means is important to almost any issue that is brought up. Beyond that, in your opinion, why do you feel it is so important now to start paying attention?

Knight: It's not just now - it is always. It is the same question about why is the environment important? The springs are, you know, the cliché is that they're the canary in the gold mine. They are a manifestation of everything that is wrong with our groundwater right now. So they're important from that standpoint. They, for example, they woke me up to just how bad the groundwater was. When I saw Silver Springs after being away from it for a long time, it looked like the bottom of this pond here, you know. It's covered with benthic algae. There didn't used to be benthic algae in Silver Springs. And it's full of it now. It's very unattractive aesthetically. But not only that but it's changed the whole ecology of the system. When we went back and measured Silver Springs, the productivity was less than it was before when Odum studied it and I studied it. Even though it's got this weed growing in it, weeds aren't as effective at primary productivity as a diverse plant community that has evolved over a very long periods of time. Weeds always are the species that take advantage of something that's out of balance. And so springs are telling us that story. Actually they're telling it much more visibly than a lot of other ecosystems that are also being affected by nutrients. Like the St. Johns River, you know, people didn't wake up there until they started seeing green algal blooms on the surface. And it's just incredible. Well, you live in Jacksonville, right?

DeVore: I do.

Knight: So you've probably seen some of those algal blooms.

DeVore: About two miles from the river, as a matter of fact.

**Knight:** And so springs provide a lesson for us about the environment. But in themselves, they're intrinsically important. When you think that Silver Springs historically was putting out half a billion gallons of water a day, and you think about how much water the whole state of Florida uses and it's only about a billion gallons a day. Actually, around the time I was studying springs in the seventies, half a billion gallons a day was roughly equal to the whole water use by humans in Florida. The groundwater extraction that we were using to support all the people in Florida and all the industry in Florida was about somewhere in that range, about half a billion gallons, coming out of that one spring. Unfortunately, the flow in Silver Springs has declined now just in the last decade, by about a hundred and fifty million gallons a day. So it's lost about thirty percent of its flow. It's telling us we've got serious problems with the groundwater. Another important thing that springs are telling us, I've got a report on my computer right now that I'm reviewing, that the Florida Geological Survey did last year that indicates that there is a rising trend in salts in many springs. Salts being sodium chloride and other elements associated with the salt water being in the matrix in the groundwater. Alkalinity in the water and hardness. Those trends are rising across the state. All of the springs. And that's an indication that we're over pumping the aquifer to the point where we may "break" the aquifer is the term that was given to me by a hydrologist yesterday by the St. Johns River Water Management District. We may break the aquifer. We may up-well or cause salt water intrusion in our springs and inland groundwater the way we already did along the coast where we've over pumped. It's possible to do that in the middle of the state.

**DeVore:** Oh.

**Knight:** The water that we take out of the aquifer is just a lens of fresh water. It's on top of salt water. It's all salt water under Florida. It's just a lens of fresh water floating on the top. And that lens is finite in thickness. In some places, it's not very thick and in some places it's over a thousand feet thick. And it's in rock. So it's not all water. It's not like it's a big hollow tank full of water. It's mostly rock, but there's water in it. So if you pump on that fresh-water bubble enough, you might only need to pump a foot of water to drain all the water out of ten or hundred feet of the aquifer, but if you pump the top foot off, you know, you're taking the water out of the voids in that rock. But it's possible to pump enough of that water off so that salt water moves up. And it's happening. We're already seeing it under low-flow conditions in springs. And the Florida Geological Survey says this is a seriously significant issue that we need to be looking at. So those are just two reasons.

The other main reason that springs are important is all of the wonderful plants and animals that live in springs. And the recreation. I mean it's not just the economy, it's the recreation. The people that love diving in springs and seeing the hole in the ground, seeing the water come out, seeing the snails, the insects, the turtles, the fish, the alligators, and of course the manatees. You know, all the people who

love all these things about nature. There is no other water body you can go to, other than an aquarium, and see this kind of visible nature stuff. Other than the Keys. It's like the Florida Keys in that regard. It is a beautiful natural resource. When it's healthy. They're beautiful. Have you been to the Blue Path Exhibit over at the Florida State Museum?

DeVore: No. Actually that was one of the last questions I had for you here was about the Blue Path. I just stumbled upon that recently. Are you connected to that in any way?

Knight: Yes I am. The Florida Springs Institute was started out as a program under an existing non-profit. Which is called Florida's Eden.

DeVore: Florida's Eden. Okay. I was wondering if that was the connection.

Knight: Florida's Eden designed the Blue Path exhibit at the museum. Annie Pais is the director of Florida's Eden. She's very interested in all water issues, so we've been in touch about the springs issues for a few years. When she found out I was considering a non-profit, she said why don't you let us incubate your non-profit. We'll get you started and then you can go for your own 5013C non-profit status when you're ready. So that's how I started out so I could get the Institute up and running quickly and cost-effectively. They are going to be supporting the website, they will be supporting me administratively and they are just great allies, because everything they do is about having a sustainable community and economy that is dependent on a healthy environment. The Blue Path is a beautiful exhibit and it has some of these aesthetic things, some of Wes Skiles' photos and John Moran's photos about springs that just, they just fire you up. You know, if you get excited about anything, you will get excited about a spring, because they are beautiful. And they still are beautiful and they're still a wonderful resource. But it is bad news for springs. People get so tired of hearing bad news. But eighteen million people put a lot of impact on a system when we use as much water as we do. So Florida's Eden and the Blue Path are all about new ways to use water and how to conserve water.

DeVore: Okay. When I stumbled onto that in my research and I clicked on the link she has there on the Florida's Eden website for the Springs Institute and then it took me straight to the Blue Path, I knew there had to be a connection there, somewhere.

Knight: We have our own web page coming up. It's not up yet. They're responsible for it, like I said. And I'm looking forward to having it up.

DeVore: I am looking forward to seeing that. It's on the agenda from here. Okay, is there anything else that we haven't talked about that you'd like to contribute to this history of springs protection efforts in Florida since the 1970s?

Knight: Well, just a couple of things.

DeVore: Certainly.

Knight: The Florida's Springs Initiative changed their approach this year with the reduced funding and said they were going to go out and instead of just sponsoring these working group meetings, which were for information purposes, they are now going to start developing restoration plans. Like I said, Wetlands Solutions got one of those projects. And Pandion got the other three. And there are incredible activities going on now to develop restoration plans for springs where there weren't any comprehensive plans before. I am spending a very large amount of my time working on the Wakulla Springs restoration plan. It is fascinating how complex the issues are, how many stakeholders there are, how much work has been done previously, how many projects are already underway, and yet how much further we still have to go. It's an enormous challenge to even do anything about restoring a single spring, especially one of these large ones, that has gotten out of whack. It's like, I guess having a Hummer. You've got a Hummer in your yard, what are you going to do with that thing if you can't get it to run? And it's starting to run rough and you're thinking where am I going to take this to get it fixed? You know, it's expensive to get something that's really big and complex fixed. The springs are really out of whack. Wakulla Springs is. Silver Springs is. Rainbow and Ichetucknee all have serious problems. But at least we're going in the right direction to develop restoration plans. But one of the things I'm finding out with Wakulla. They've already had two different symposia there, where numerous speakers and experts, they've done dozens of studies, they actually did a plan that's close to a restoration plan in 2005, and yet the system is getting worse. And that's the scary thing. Although I am doing another restoration plan, it just scares me that it's going to be futile, because you have got to have people support it to really make it happen. There are two things that probably need to be done to get that support. One is to educate those people who care to learn. And I'm talking school kids right now, including college students, so that the next generation won't repeat the same mistakes. And the other thing we need to do is educate the people who are really difficult to educate. We've got to find the right tools to get the decision makers and the people in power now to listen and care about the problems with springs and their groundwater. I would not be able to sleep at night if I was one of those lawyers that is supporting a group that is purposely doing harm to springs. I mean, no matter how much money you've got in the bank and what kind of car you're driving, if you ever took time to think about what you are doing, they all use the springs. You would just feel really bad about it. You'd feel guilty about it. So we've got to educate both groups. I'm teaching a class at University of Florida on springs ecology. Yes, so that's where I'm trying to educate, at the college level. Trying to build the next generation of researchers in springs. I'm trying to pass on to them what I learned from Dr. Odum. I originally got into wetlands for my career instead of springs. I should have been in springs the whole time. Maybe I could have raised the flag sooner. But the next generation shouldn't forget those lessons. Plus we need to be educating the young people. That's really what Annie Pais does with the Blue

Path and Florida's Eden. She started some educational programs. There is one at Ichetucknee Springs at Fort White, at the Fort White schools. So we need to get models out there so the next generation doesn't have any problems with these issues, and realizes that there could be a double bottom line in their future.

DeVore: Okay. Well at this point that's all the questions I have right now, but I'd like to ask you, as I continue my research over the next few weeks or next month if there are other questions that come up, would you mind if I emailed you with any questions that may come up.

Knight: No. Please do and I'll respond to them as I can.

DeVore: I appreciate that.

Knight: Yes, I'm busy like everybody.

DeVore: I understand.

Knight: But I'm impressed by how much reading and research you've done to get prepared for this.

DeVore: Thank-you. It's near and dear to my heart, as well. Like I said, I grew up in Ocala.

Knight: Really?

DeVore: I did. So I have very fond memories of the springs.

Knight: What's your earliest visit to Silver Springs?

DeVore: I think I was nine when we went there. We had actually just moved to Ocala. Eight or nine years old, somewhere around there. And I still remember being totally fascinated by how clear the water was.

Knight: It's just amazing. It's like an aquarium, you know. The first time you see one you can't believe it. It seems like you're just floating on air.

DeVore: And swimming at Juniper Springs. I swam in Juniper Springs as a teenager every summer.

Knight: You saw the eels?

DeVore: Oh yeah. Screaming and splashing and running from the eels.

[Laughter]

DeVore: Absolutely.

Knight: That's good. I'm glad you have a passion for springs. Then you will probably be a collaborator with me in the future if you want to keep involved and help me where you can. That's exciting. I'm really excited about the fact that there is as much interest as there is, and I see people like you who have that attraction to springs and are smart and are in professional lines or taking their own time to put a lot of effort into springs. So I really think that I see a ground swell for springs protection in Florida, but it's slow, maybe a thousand people out of eighteen million [laughs]. But it's amazing what a few active people can do. It's just amazing what a few active people can do. Sometimes it appears that everything good that has happened for the environment was because of the work of a few dedicated people.

DeVore: Okay. I thank you for your time.

Knight: Please send me the transcript.

DeVore: I will. I'm going to stop this.

[END]