

## **Oral Histor**

**Name:** David Klein

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**Location of Interview:** Home of David Klein in Fairbanks, Alaska

**Interviewer:** Karen Brewster

**Brief Summary of Interview:** In this interview Mr. Klein is talking about colleagues and students he knew and the projects they worked on together or separately. He also talks about what the state/federal responsibilities were, a pipeline in the Taymyr region of Russia, insect harassment/relief of the animals, why he didn't want to be called an environmentalist, and good and bad relationships the Wildlife Unit had with oil companies. He shares a few stories about various events that happened concerning the oil companies, and explains why we, as humans, feel the need to feed wild animals.

DAVID KLEIN: And then I can mention these people and how that played out.

KAREN BREWSTER: Okay, and I can just tell that there is sound, and I can hear both of us. And I can say that today is July 24, 2014 and this is Karen Brewster and Dave Klein continuing with Dave telling us about his life. And today we're going to do more on the research, and people he's worked with. So Dave, you were saying before I turned on the recorder about, sort of mentors and colleagues and how you wanted to talk about that a little bit.

DAVID KLEIN: Right. Sometimes if you're among your colleagues at the university, you know, you have longer term people in full professors versus the associate professors, and the newer people are associate professors. And when everybody starts in up there, especially when you're coming directly from your first time as a faculty member at a university and got a lot to learn about, you think when you apply you're pretty good in this field that you did your own research in and you've got a lot of good experience, but you don't have the experience of working with students. And you're not alone, fortunately, because any degree that's being done there by a student, whether it's a master's or a PhD, there's an advisory committee and the chairman of that committee is the major advisor for the student. And so the concept of advanced degrees at the master's level is, in a sense, primarily training that you want them to contribute to science, if possible, but it's not essential. I mean, if they're learning all of the skills necessary to do research, that in itself, if they do it well you might have a little bit of research, but it's not necessarily justifying a full publication from it. But if you get one, so much the better. And the PhD, it's a bit different. The student has more freedom in choosing their research and then the PhD thesis is supposedly primarily the work of the student with advice and approval as they proceed by the major professor and periodic meetings with the whole committee so that sure they're on track to meet university requirements for the degree

programs. But also they're making progress, and should they need help to be sure they make progress.

KAREN BREWSTER: And the PhD also needs to be more of a contribution to science?

DAVID KLEIN: That's the intent, yeah, and it usually is the case. So sometimes depending on upon how much -- how the research might be fractured in relationship to how the research was done. So some things naturally fall into two or three papers or more, whereas others might be one big paper which would be like a monograph because it's hard to break them up into individual papers. So you could have chapters but it would be all -- And from the standpoint of their future career, of course, the number of papers is unfortunately emphasized more than the quality of the papers. But the major professor wants to ensure that the quality is high, 'cause that reflects on him or her with the major professor and the university program where they are and the university where they come from. So you get a reputation, the university gets a reputation, and it's dependent upon the faculty and the students and their productivity and the quality. And over years, that's all important. And what I can say in terms of the University of Alaska Fairbanks is that we went from when I first was there as a -- well as a student, but even starting as a professor, I was one of the few people that was considered working primarily at the graduate level with students. And other faculty had so much responsibility and their salary was tied to teaching courses, they didn't have time to do much advising. I could be on a committee but not as a major professor. Well, gradually, the research institutes gained reputation nationally and internationally here at UAF and our own graduate program, which was initiated very early on in the 1950's. Gradually, we got more students and they helped to build a good record of theses. Early on, some of the master's students before we were approved to have a PhD program, the master's theses were literally PhD theses because the students were so turned on and their advisors were turned on and they went ahead and did outstanding degrees and then they frequently -- those went on to do a PhD somewhere else and we were being criticized that they were being over trained at the master's level. It wasn't fair to the students. Well, our view was it was definitely fair to the students, because the students when they applied, they had this beautiful work at the master's level, with maybe a publication or two out of it, and that meant they could get into a better university and they are going to do a better job at the PhD. And it's not just having a degree because it helps you to get a job, if you get a degree and then you have a CV that supports it with a publication record and advisors, and people -- references that are willing to say, "Yeah, this is an outstanding person. They proved themselves already in the master's and definitely could take them on for PhD's." But, for example, some of the colleagues that I was working with here as a new faculty member or one was like Dale Guthrie who was a paleontologist. And he was a good one, but he had got a degree at the University of Chicago and worked with -- mainly with the fossil teeth of small mammals like voles and mice, and maybe as big as ground squirrels, but not with bigger animals then. And learning how to examine and use the teeth and differentiate down to the species level even though all you found was a tooth when you're sifting through some old soils that go back for a long ways.

KAREN BREWSTER: Well, I would think, yeah, as a paleontologist like that you would need to have some experience with biology.

DAVID KLEIN: Oh, they did.

KAREN BREWSTER: A modern animal to make those comparisons and understand what they're looking at.

DAVID KLEIN: They had good training in biology, but not much in general ecology. They had good in other areas, whereas I was well trained in ecology because I was interested in not just wildlife and wildlife management, but also the plant relationship and where do these big herbivores like moose and elk and deer, how do they feed and what do they get out of it.

KAREN BREWSTER: Did some of that come from the education you got in Connecticut and who you studied under and they were looking at those bigger issues and it got thinking about them?

DAVID KLEIN: Some of it came from my interest in plants as well as mammals, primarily. I was interested in birds, but it was primarily mammals. And it was primarily deer and larger. But then when I arrived here, I'd done my PhD in southeast Alaska on deer ecology, but it was definitely a plant animal interaction.

KAREN BREWSTER: So you always were conscious of the plant/animal interaction?

DAVID KLEIN: Yeah.

KAREN BREWSTER: That was always your interest?

DAVID KLEIN: How does the animal influence the plant and how does the plant influence the animal, and what does the plant -- And then I got into this field of what did the plant have, if it's nutritious and good for the animal, why isn't it eaten to the point where it couldn't survive? Well, sometimes it is, if the density of the population is so high they're overgrazing or browsing what's the natural vegetation and selectively removing all the good high-quality ones and nothing left but sort of like junk food that doesn't digest easily and the body condition of the animals go down. So, and the same is true, you have to think about the evolution and the ecology and the nutrition of the animals. And that's where Bob White, Dr. Robert White who was -- he came as a post-doc from Australia after I'd been here a couple years and was the Wildlife Unit leader. And I sort of adopted him because I liked him. And he was an animal physiologist and he was interested in how the function of the rumen of sheep and cows worked in relationship to horses, which have a different kind of a system. And they'd done research and some of his PhD work in Australia was that way. And he continued some of that up here before he finally finished his degree. And so I could give him lots of opportunities to work with caribou and reindeer out in the Aleutians, which I was working on and studying plant and animals relationships. I'd invite him along, and then he would -- opportunities for him to

collect data on animals that -- I would shoot some to get body condition and look for parasites and diseases. And he could work with the fresh-killed animals and do some quick studies to see what kind of organisms were in their stomachs, but also what kind of fermentation processes were going on. And bring samples back and see which -- whether protozoa or bacteria were more important in the kind of food that they were digesting, and especially when they were taking a diversity of species which don't normally occur on range lands, like range lands that are dominated, especially in Australia, by grasses. And in Alaska in wild habitat for caribou, there's grasses but there's also sedges and lichens and note the difference there. And so both he and I had interests that overlapped, but they overlapped with northern animals, northern mammals, and northern herbivores. And so we made -- frequently, one of us would make contacts with someone overseas, they would stimulate some kind of collaboration and the other person would be involved, too. And so we both did a lot of traveling and had research that would enable us to work in -- especially in Scandinavia and other places like Greenland, and Iceland, and Canada. And so when we had students, they frequently were working on a topic that was related to either his interests or mine, but we'd each serve on the other's graduate committee because we brought this -- For him, I brought in this ecology, and for me, he brought in physiological ecology. And so we were broadening our own knowledge. And he was just a physiologist and he was becoming well established as physiological ecologist and was actually starting to work with wildlife, too. And a lot of that was collaborative research, and our students sometimes were -- we were sort of like co-advisors for them. Sometimes we were on each other's graduate committees.

KAREN BREWSTER: It sounds like you and Bob had sort of a symbiotic relationship. You would maybe kill a caribou to understand it for what you were looking at like body condition and all that, and then, oh well, there he could get his samples all at the same time. And it was a great collaboration.

DAVID KLEIN: And we were always kidding one another because when we were out in the Aleutians, there were sheep out there, and I always kidded him that he was happier when he could jump into a corral with a bunch of sheep.

KAREN BREWSTER: As an Australian?

DAVID KLEIN: Yeah, right. And it was a similar situation with Dale Guthrie because he became focused on ecology and he was trying to explain what kind of environment these animals were living in, like mammoths, and muskoxen, and horses in Alaska when it was full glaciation. And we knew there weren't many trees around then, and what were they eating? Well, there were other people doing studies on vegetation and on south facing slopes, which had sort of a relic of what -- Artemisia and a lot of grasses and some flowering plants, and they also had pollinating insects that were typical of those places, which were the same ones that would be out there. And some, he, by looking at ground squirrel nests and often sometimes with ground squirrels in them because they got frozen out, there would be the seeds that the male ground squirrel brought in there. Because when they come out of hibernation, there's nothing to eat. They do it because they're males and they have to establish a territory, so then they dig into the tunnels of females

and breed them when they start to arouse. And by that time, the snow is melting and there's some food out for the female. She doesn't have seed cache. She comes out, she's ready to be bred and then give birth to the young and then she's got to eat green, high quality food. Whereas the males, they want to breed as many females as possible, but they have to have a territory and that means they fight other males. But they're also coming out when the snow is the background, and they're not cryptic, they're not white, and so they're very vulnerable to being killed by big avian predators like big hawks and eagles and by ground creatures, like foxes, and particularly wolves, wolverine. And even ravens will kill them, because they can harass them if they can get them away from their burrow and gradually wear them down. So the animals have to adapt and the food that they use can -- has to be -- in the Arctic, there's frequently not a lot to select from. There's not that many plant species. So that's what I was keenly interested in, but Guthrie also wanted to know, well, what plants were there. And sometimes he'd get that information by finding a ground squirrel frozen into the sediment and could get a lot of information from that. But its food cache was there and they'd get seeds out of it. And he got a few seeds of grasses that are no longer growing here. They are grasses that are typical of the prairies, northern prairies, in Canada.

KAREN BREWSTER: And he found that in a ground squirrel fossilized?

DAVID KLIEN: In a nest, or a cache in the ground squirrel's tunnel where it hibernated. And so they cut that from the surrounding area. And well, there were a lot of other kinds of grasses and other foods that were in there as well, but it shows that it was a different environment. And he knew that because there were things like badgers here which are prairie creatures, don't occur in Alaska now. And there were ground squirrels then, but they were more wide spread because there was better conditions with a lot of wind blowing loess fine silt from the glacier outwashes. And the ground would thaw, even though it was cooler in the summer, there wasn't a lot of insulated material from trees that insulates the permafrost and keeps it from thawing in the summertime. There the wind would blow this stuff and the plants weren't so close together and some could have fire. It was like a grass fire then, totally different. It wouldn't do long-term damage. It would just stimulate re-growth. So Dale and I would discuss these questions of what kind of a -- what was the habitat like for those times for not only these animals but, of course, it has -- when people came into the scene and they were hunting these animals, well it was for humans because they were hunting the animals and they were there because of the habitat. And of course the archeologists were also trying to get this information, but paleontologists are different, they're focused more on the animals that were there, not so much the humans.

KAREN BREWSTER: Right. Some people don't understand that distinction, but there is definitely a difference.

DAVID KLEIN: Right, but I mean that was fun with them because they had hypotheses. And the university then was small enough we had more interaction with other people from other disciplines. Geology and the physical sciences, as well. And, you know, the whole idea of the loess and build-up of sediments, that's a geological question. But it

wasn't getting much attention until we worked together with geologists. And we could stimulate their interests, they could stimulate ours and correct us if we were misinterpreting what was happening because of the winds and the amount of – the size. Whether it was sand being blown in or forming sand dunes or whether it was all loess or not much of anything.

KAREN BREWSTER: Well that's what I was going to say is, when you mentioned working with Dale Guthrie, that, yeah, you guys were really doing interdisciplinary collaboration, which is not always so common or so easy.

DAVID KLEIN: Within the biological sciences, that's right. But then we branched out, too, occasionally into geology and particularly Dale, because he was working with animals that were coming out of the – when the -- this windblown loess or silt was thawing and it was being thawed by the gold miners.

KAREN BREWSTER: Right.

DAVID KLEIN: So then these bones would come out and so then – And frequently it was hard to interpret them because by the time they were washed out, you didn't have a -- they weren't in a layer where you could date.

KAREN BREWSTER: Yeah, they were out of context.

DAVID KLEIN: They were out of context, right. And so Dale could do a lot of work in a museum, which he did, where a lot of these things were sent back. The American Museum, the Frick section of the American Museum. He was -- Frick was the one that paid Otto Geist, who our museum is now named after, to collect these bones from the miners when they were preparing the ground, getting rid of this overburden down to the gravel that had gold in it, which were the dredges we're working on then. So they were thinking about environments that existed 15 to 25, or 30 thousand years ago, and then if you found – then there would be gap with nothing because then that was another glacial epic. And then you would find different, but closely related animals like the big saber tooth tigers and the extra-long horned bison. They were from an inter-glacial -- separate from the one that we're in now. And it was another glacial epic. It was here in North America, the Wisconsin glaciation was the most recent one and then the Illinoian was the older one that was 150,000 years ago that it reached its peak, and was advancing before humans had arrived on the scene here and in Europe, as well. So I think -- I feel that I was really fortunate to start working professionally in the field. and here at the university, where there was all of these disciplines that were very relevant to Alaska, but wouldn't have been particularly relevant to many universities in the Lower 48. And this forced all of us here to think more broadly and draw on one another as collaborating colleagues. And the net result was, I think, we did better science and our students got broader within those disciplines -- a broader education that better equipped them to go on in those areas if that's where they were going to go.

KAREN BREWSTER: Yeah, I mean, I would think as a student if you have a faculty committee made up of this mixture of people from different perspectives, you as the student are going to learn from all of them and be informed on a much broader level.

DAVID KLEIN: Right. But on the other hand I should point out that, especially for me because I was heading up the Wildlife Research Unit and we were training young people, many of them getting a master's degree were going to be employed by the state and federal governments that they wanted someone to deal with present animal populations and understand their ecology and management conservation. So a lot of the student projects, when we didn't know enough at that stage about the detail lives of say, bears and caribou and moose and mountain sheep and mountain goats and furbearers, because furbearers were then important to manage because the fur prices were moderately high. Trapping was an important part of the economy. And then because we were a cooperative international -- not international but cooperative within the United States between the federal government, the Fish and Wildlife Service at that time, and the universities, land-grant universities and the --

KAREN BREWSTER: State programs right, weren't they part of the -- ?

DAVID KLEIN: The state programs. Here, the Alaska Department of Fish and Game. And then there was a Wildlife Management Institute, which was lobbying for our program based in Washington. So at any rate, the federal government's interest were heavily based on say, migratory waterfowl and some marine mammals they were responsible for like polar bears and sea otters and seals. But not the whales, because they were not their responsibility.

KAREN BREWSTER: Oh, okay.

DAVID KLEIN: So NOAA (National Oceanographic and Atmospheric Administration), the National Marine Fisheries Service had the responsibility. But any rate, it forced us to not just be stuck with -- for me, for example, with members of the deer family, deer and caribou.

KAREN BREWSTER: So the feds were interested in certain things and that meant the state had interest in other things, and the university -- ?

DAVID KLEIN: Well, you can't be absolute in that regard because once Alaska became a state, the wildlife management on state and federal lands, with the exception of national parks, were state responsibility for managing wildlife. But this is where there was a problem, because I was working on plant-animal relations and that means habitat. What's habitat like? And the state structure for management of wildlife was narrow according to the state constitution. That the focus was on understanding animal population dynamics and therefore how that related to their productivity and then how they could be harvested by hunting. And in the case of furbearers by trapping. And whether it's sport hunting or subsistence hunting. Then you have to know how many animals are out there in order to determine how much, how little the harvest can be. And that's hunting licenses and bag

limits. And for the federal government, their interest was in migratory waterfowl. The state didn't have any responsibility there directly; it was the federal government. And so their interest in habitat, wetland habitat particularly where ducks and geese and other wetland birds -- all bird habitat could be dealt with. And the state then, when the constitution was written up, unfortunately, they didn't appreciate that these wetlands are - For example, they're good for others than just migratory birds; they're important for moose and furbearers and fish. So it wasn't just federal interests, it was federal and state. Whereas the state constitution allocated -- or gave responsibility for management. Their mandate for management was management only if the population of the animals and assessing, counting them, assessing numbers available for harvest, whereas habitat itself under the state constitution went to -- on state lands as they selected them, went to the Department of Natural Resources. But they didn't have anybody and never had -- and neither did -- Then the Department of Environmental Conservation also had some responsibility for the quality of waters. And the constitution says specifically for human welfare and fish and wildlife, but the Department of Natural Resources and Department of Fish and Game think that's only if it's pollution issues that might relate to the Department of Conservation being called in to check the water and what it is rather than thinking, well what about natural problems where the water quality is changing because they have climate change and warmer conditions and not enough flushing of water in lakes. And when that happens, how does that affect fish and other wildlife that use those waters?

KAREN BREWSTER: It sounds very fragmented, the state system.

DAVID KLEIN: And that's been a major problem in the work that I've been doing recently in Quartz Lake, because the state has not done a good management job because they tend to think that wetlands, they can designate them on state lands as primarily for fish and wildlife but they don't do any investigation to see whether they're being changed by say, climate warming, forest fires too frequent, or damage by all-terrain vehicles or airboats. And that's been a major problem. And then, then it gets into politics.

KAREN BREWSTER: Oh, you mean there's politics involved in wildlife management?

DAVID KLEIN: Well, that's part of the problem. In the early days, of course, before statehood the Fish and Wildlife Service employed people and that's when I was employed as a deer biologist in southeast Alaska, we were a territory. There was a so called Game Commission, but that was like five members of senior citizens who had been fishermen, or hunters, or trappers, and experience in that. But any studies and research was done through the Fish and Wildlife Service. And then the Game Commission played a big role in setting hunting regulations and fishing and trapping regulations. And they drew on us, on the Fish and Wildlife Service, for our studies to know again -- And we were covering both habitat then, and animal population dynamics. So then with statehood, it's hard to blame it on the state because the federal government - - most of the land was still in federal ownership and the state hadn't selected lands yet. And so technically, it's federal land and they should have been responsible for the habitat studies. Well, they continued good habitat studies on refuges and sometimes in national

parks or in national forests, but the state then, you know, why should they even hire anybody or establish habitat division. So nowadays, they do have a habitat division but their only job is to respond to requests for permits to do something that might affect a habitat like build a road through habitat or build a fish processing plant along the coast, or build a dam. Do other things that would obviously have an effect on habitat and then it would be up to the habitat division to do some investigation to find out whether there would be serious consequences or it could be done safely if it's done in a certain way without significantly destroying habitat. But of course, times change and lands have been selected by state and Native land claims settlement under the Alaska National Interest and Conservation Lands (ANILCA-Alaska National Interest Lands Conservation Act), then there was selection of more federal lands for expanding national parks, refuges, and to some extent forests and creation of -- And the remaining lands were under administration -- I mean federal lands were under the administration of the Bureau of Land Management. But then the state was still -- You know, they weren't dealing with habitat. Unfortunately, there was a good reason for them. It could be both financial and they figured the federal government should be responsible. But the federal government when they were -- when the territory became a state, they had to lay off a lot of people because they didn't have jobs for them and they couldn't carry on what they did before. And the state technically, or ideologically, wanted to ultimately take control of managing habitat but they never have because it requires establishing many new positions and a whole new program and division within the Department of Fish and Game. So that hasn't happened. And it's because it's split between state agencies. No specific agency takes responsibility for it. And that's common wherever you are, if it's federal government and it's different agencies responsible, for say, fisheries in the ocean, no one takes responsibility. It's usually the fishermen complain, because -- Or it's the same problem with trying to share management of the marine environment between state and federal, it doesn't work very well. And sometimes it's the fishery is more than just state and federal. It's international because of Canada or because of the marine -- other countries that are using the marine resources.

KAREN BREWSTER: So the collaborative element that you were talking about with the work at the university, did that also trickle down in terms of working with students. Was it very collaborative?

DAVID KLEIN: Yes on --

KAREN BREWSTER: Did you work on projects together?

DAVID KLEIN: Yeah, that was one of the good things about the Cooperative Wildlife Unit. Its cooperative nature meant that a lot of student projects were jointly funded by the Department of Fish and Game and the Fish and Wildlife Service. And I should point out that later the federal government moved the Fish and Wildlife Service research into the U.S. Geological Survey. And so the Geological Survey then became the federal component of the Co-op Unit program. That was much later though that that happened. And it's present situation now.

KAREN BREWSTER: Now, I was thinking you were talking about the collaboration between you and the other faculty. Were you also very collaborative with the students? The graduate students got to really work collaboratively on projects or they went and did their research and you went and did your research?

DAVID KLEIN: Oh, for our individual students that we were advising, no, if it was in research in something and the majority -- At times, the majority of students were working in different aspects of say, caribou or muskoxen ecology. And that included plant vegetation and plant/animal relations, but it also included things like insect harassment of caribou. Which, of course, relates to their nutritional well-being if they can't feed in the summertime because of the effect of the harassment disturbance of the caribou, they have to try to get away from the mosquitoes and can't feed when they should be feeding all the time. And so those kind of studies. And then, you know, studies that Bob White would be doing, would be how do these animals respond and use of their body fat for the winter? Is it related directly to temperatures, or is it related to the snow depths and how much work they have to expend -- the caribou have to expend moving around through snow or digging through snow. So he'd be working with students doing that. I would be researching with students that were looking at the migration and timing of migration and how food had to be available during migration and that determined partly their migration route. Whereas they were working on the costs to the animal, energetically, of migration, then the two just fit together. And so, sometimes we had students that we were both working together on with the students. And sometimes more than one student would be working on the project; that usually only happened when there was a large grant to one of us, say from National Science Foundation, for example. And we had the funding to focus -- have the students focus on different projects but they were related projects and they worked well together in the field. And that was true sometimes with waterfowl studies or furbearer studies, as well. In wetland habitats, particularly.

KAREN BREWSTER: Well, it makes sense that all the work you were doing, the students were all doing sort of like sub-things building to understanding. Like you were trying to understand caribou, so everybody was working on some different part of the questions related to caribou and then it all kept building on each other.

DAVID KLEIN: Yeah, and to elaborate on that, I'll just mention that after oil was discovered at Prudhoe Bay, then we became very involved in studies to assess the impact of oil development, pipeline design, how could it be designed, and what is the routing of the pipeline, both of which might affect, have less -- minimal effect on say caribou and their movements on other wildlife like moose. And what are the disturbance effects that are associated with having a lot of planes and helicopters flying around and vehicles, all-terrain vehicles, on the landscape? What was the effect on caribou and other wildlife? In one case of this question of collaboration with funding agencies, was then I particularly, but other people working in the biological sciences, were critical of the oil industry's desire to move right ahead and build a pipeline when they didn't know how to build a pipeline in Arctic conditions without -- They had no experience in what to do with -- how to deal with wildlife such as caribou. Particularly with caribou, but other species, as well. And so because we were so critical, we were -- the agency, and of course environmental

organizations were critical, too, but they frequently didn't have the background and knowledge to -- to -- they were just sort of trying to -- view it as trying to stop the pipeline from being built, stop development. Well, we were trying to slow down things until studies could be done, and, of course, it costs a lot of money to do studies. And so, in one case, the oil industry then challenged us, through the Wildlife Unit, saying, well okay if we put up the money to build a simulated pipeline up there in the oil field area and using culverting and snow fences that the animal couldn't see through, building a typical type of model crossing, ramps over the pipeline or elevated pipeline that they could go under. At that stage, they hadn't decided how they're going to build a pipeline, and that was one of the reasons, of course, we felt they should wait. And they were forced to wait, because, the main reason they were forced to wait was because they had to settle a Native claims settlement as to who owned the land the pipeline was going to go over. And would the Natives be compensated properly if they went over their lands, etc. And so that gave the time for the studies and the oil industry, after four years' delay, they were honest enough to admit that it would've been a mess if they started right away to try to build a pipeline. It would have cost them much more and they would have made more mistakes including mistakes -- Well, engineering mistakes, but also mistakes that would have had a very negative effect on wildlife. Well, this pipeline study, we had to draw up a contract with the oil industry. They were kicking in most of the money, and virtually all of the money except there might have been a little state money through a stipend program for the students. And so they insisted initially that they would have control over the data, and that it couldn't be released to anyone until they approved. This was unacceptable, of course, in science to have an agency controlling the data and we're doing science. The standard, as your project advances, you do -- you give papers at technical conferences and do small publications, but not necessarily the completed one. The question was whether the pipeline -- For the oil industry, they wanted a solution to building the pipeline and they were ready to make some adjustments, but they didn't want to make too much because it costs to do -- engineering costs would go up high. So it's reasonable to be concerned on their part, but at the same time it was unacceptable to have a student working up there and not be able to publish the data. So I said, "Well, sorry, we can't do this." And then I went -- I didn't want to do it. I figured we could maybe get some change and I figured the best way is to go to the Fish and Wildlife Service and say, "Can you kick in 10,000?" And this whole thing was like about 100,000. Kick in about 10,000. "And if you kick in 10,000 then it's federal money and by federal law it has to be open access information for the scientists."

KAREN BREWSTER: Yeah, it's public domain.

DAVID KLEIN: It's in the public domain, right. So when we went together and met, I said, "Well, I think we can do it, go ahead with you, but it can't be tied up by you because the federal government is involved in this." So they realized they were in an awkward position and they said, "Well, okay, we'll let it go." And then surprisingly after we did this, they were the first to -- We didn't agree that we wouldn't release primarily data. We're collecting studies as to how many caribou, when each time they moved through the area went -- used the ramps and how you -- Well, it was only a -- Sometimes there were only 25 or so animals and we wanted large numbers before you drew any

conclusions. So that kind of data, yeah, you don't release it right away and draw conclusions it. So they violated -- Right away, they had some media, news and camera people, were coming up from the media and they were giving them a tour around and one of their so called biologists was jumping to conclusions and that got into the press. And we complained and they backed off, but it was already published and leading the impression that, say gravel ramps were going to work best and our studies didn't indicate that at all. And they didn't mention that most of the animals were deflected and didn't use any of the facilities. So they didn't want that information out. Anyway, when we finally had an invitation for our PhD student to present his paper in a conference in Canada, he submitted an abstract and it would draw the conclusions from that study that was completed for the summer showing how much, what we learned from that and what the ratios of animals moving across the pipeline was. And the oil industry said, "No, you can't do that. The study -- you didn't clear it with us first." And we said, "No, that's true, we didn't, but this is the student just presenting his information. It's not the final publication. Yeah, it will be open and available to the public for sure, but you violated the rules anyway earlier." And they're great at saying, "We're going to hire lawyers and we'll take you to court on it." Well, we got our university lawyers and they quickly pointed out that no, it wouldn't go to court and we were on firm ground. So we helped educate the oil industry a bit about dealing with this.

KAREN BREWSTER: Well, that sort of leads to a question of the neutrality of science and for you in becoming an environmentalist, how you reconciled those with things you may have been finding out in the oil fields, that maybe you didn't like?

DAVID KLEIN: Well, before I respond to that is, I'm not sure how you define an environmentalist when you ask that question?

KAREN BREWSTER: Well, I have a sense of you that you believe in the protection of, or the conservation I should say, of nature and wild places.

DAVID KLEIN: But I also believe in some management. And in some cases -- and if there's things like big projects that need to be done to -- need for the, say the economy and the country and to produce fossil fuels, which we are dependent on, then, then I want to be sure that it's done in the best way possible. So I didn't want to be identified as an environmentalist at that time. And so I frequently supported them, a token financial support to some, especially like the Northern Alaskan Environmental Center and others. But I didn't want to be an officer on them. In fact, our advisors, supervisors in Washington for the Fish and Wildlife Service said that they didn't say no, absolutely, but it's best not to assume an officer's position because then you are identified as an environmentalist. And environmentalists are assumed to be somewhat biased toward issues to the point where they might try to stop projects, which are going to go through instead of working to make the project go through in a safer way. So I dealt with that by belonging to the organizations but when I had data that was important and which was supportive of what the environmentalists were saying politically, then I would make that available to them and without being identified. And I even went to the, you know, I could be considered an environmentalist because I was frequently on the side of

environmentalists, but I was not deliberately on the side. I just happened to be there because I was doing the science that enabled me to make a stand that was in agreement with the environmentalist concern. So examples are, when – for the -- during the Alaska National Interest Lands Conservation Act and this question of whether the coastal plain of the Arctic Refuge would be even part of the refuge. The pro-development interests wanted it open because they were convinced that their seismic studies that there must be oil down there. And whereas our research showed that this coastal plain was a considerable – was a major -- especially for caribou but for migratory birds, as well, and for other species, was critical habitat that were essential for caribou herds. And that if you're going to be considering developing the area, you got to know consequences for caribou. And we were doing intensive studies. Some of it was according to the -- When the final legislation was passed, it was a compromise that it was not given wilderness status, the coastal plain, but it was also a special D2 status that allowed some surface -- surficial seismic work to better understand how much oil might be there. But also time and money was appropriated through the Fish and Wildlife Service to study the effects of how wildlife -- What was the status of the wildlife and then how development might affect them? So the botanical studies that identified critical habitat components for say, caribou and muskoxen. And we were involved in all of these studies and had several graduate students working on aspects of this. And then when Congress would attempt -- say a pro-development Congress would attempt to change the status and open up that area or oil development, then the Congressional Sub-committees would be studying this and what was known. And so I was frequently called to go to Washington and testify before the -- for the Fish and Wildlife Service. And then once you're there, then I was expected to be a good scientist and stick to that and not tell your personal feelings. And it was difficult at times because we had people like Don Young and Senator Stevens who were on these committees. The Senate one Stevens, and the House one Don Young. And they were -- especially Don Young, they were trying to discredit you as a scientist and trying to do anything to make your presentation questionable to the whole committee because there were representatives from both development and conservation interests on there usually related to party politics, but there were often – there were always good people there. So there was – I usually could come -- you'd have to boil everything down to, you know, like not more than 25 minutes or something like that with charts and maps. And that was a challenge. But the big challenge, which I ended up enjoying, was the questioning from the members. This went into the Congressional Record. And then Don Young would ask questions and I -- I mean, his weren't often thought out well and he'd say, "Well, look, if they – caribou can go over the Brooks Range with mountains so high, why can't they go over a pipeline?" So I could point it out that even reindeer don't go over pipelines. And we had another study out on the Seward Peninsula with reindeer and they don't go over pipelines. They're not jumpers. If they were antelope, they could jump it.

KAREN BREWSTER: Oh, but don't reindeer fly? Can't they just fly over the pipeline?  
[chuckling]

DAVID KLEIN: No, this was when they were going to lay the pipeline on the ground. So then he asked, "Well, why do they have to go there anyway? Why do they have to get

to the winter range?" And so he just opened himself wide. And I'd say, "Well that's where -- Their winter diet is different. It's on lichens." And he said, "Well, why do they have to eat lichens?" He had checked on some literature that some caribou some places like out in the Aleutians, the reindeer in the Aleutians, they can live without lichens. If there's green vegetation available all winter, they get by fine without lichens. And when they're put on islands, they sometimes eliminate the lichens. In South Georgia, reindeer, they adapted. They eliminated the lichens and the population boomed first and then crashed and they eliminated a lot of plants. But it was mild enough and some of the plants were resistant. Grass, some bunch grasses were very resistant to overgrazing. And so when he asked me about this I said -- I could respond by saying, "Well" -- When he asked why they couldn't digest something else, I said, "Well, they're especially adapted. You know, they have a rumen. And they have to have built up microorganisms to digest - - that are especially designed to digest the lichens. And then in the wintertime, they're somewhat unique in this regard." And so then he realized here I was going on lecturing him and he said, "Oh, I know all that!" "Then why did you ask the question," is what I felt like saying. But it was obvious to others that he had put himself in that awkward kind of position. And then when he realized he was just embarrassing himself, he'd say, "Well, no more questions." So that's all in the record, which is nice. And then another time, later, another effort much later under -- it was a Republican administration. I'm not sure whether it was Reagan or Nixon.

KAREN BREWSTER: Or Bush?

DAVID KLEIN: I don't think it was George Bush, but at any rate -- It might have been. At any rate -- not the most recent George Bush, but at any rate, again there was an effort being made by the Republicans in Congress to try to get this up on the floor for a vote as opening up the coastal plain of the Arctic Refuge for oil development. So the Fish and Wildlife Service had been -- you know, the head of Fish and Wildlife was a Republican appointee and his attitude was, "Well, we want good people working for us. And they're supposed to be outside of politics, but just lie low on these things and don't get too involved." But our immediate supervisors were great. You know, well, if Fish and Wildlife Service wants you to go there and testify, that's fine. They'll pay your way and everything and pay your living conditions while you're there. So in this case, I had a phone call from the Alaska Coalition of Conservation Organizations. And they wanted to know if I would be willing to go and testify there on this issue on the importance of the coastal plain area for mainly caribou but also muskoxen. And I said, "Yeah, I would be willing to, but I have to get approval to go on something like that. To get travel approval to do it." But they said, "Well, assuming you're willing to go and we pay for your way, could you go?" And I said, "Well, the only way I could do it then is if I took leave of absence from my work." Which I knew I could do and it would be unhappy for the people in Fish and Wildlife Service at the top. So they said, "Well, first we'll ask the Director of the Fish and Wildlife Service, if they pay the way could I go there without going on leave of absence?" Because they felt -- they wanted me as a scientist and I work for the Fish and Wildlife Service. And they said, my immediate advisor [means supervisor] said, "Yeah, just go ahead and put in a travel request and it's up to them whether they approve it or not." So I submitted it, and they didn't approve it. So then I

contacted the Alaska Coalition and explained things. And they said, "Would you be willing to go if you were subpoenaed? If we had you subpoenaed to go?" And I said -- I hemmed and hauled, and I said, "Yeah, I would." And so they said, "Well, we're going to use that approach on the Director of the Fish and Wildlife Service. But we -- I think he'll cave in then because it'll come up in the public and the media. And we realize we don't want to put you on the spot." And they were good about that. But they said, "Don't be afraid to say no, you wouldn't do it, because we realize it's going to be awkward." I said, "No, I believe in what I've done and I think it should get out there. And I don't care whether it's you or the Fish and Wildlife Service that pays for my way." And so the Fish and Wildlife Service Director caved in on that. And they said, "Okay, he can go, and we can pay his way." And then my advisor [means supervisor], who was head of the Co-op Unit Program, he said, "Okay, we can pay your way and we can pay for all of your housing and everything, because we'll have you stop by the office. And we want you back there and talk to you, too, about the program. And we don't get a chance to do this enough, and want you to talk to some of our people about what you're doing." And so, then we told the Alaska Coalition that yeah, it'll be okay.

KAREN BREWSTER: Well, that's a good example, maybe, of how you reconcile. So you had done this research, and the research, in your mind, showed the importance of the habitat, and so therefore, in your mind, you didn't want to see that opened to oil development?

DAVID KLEIN: No, I didn't say that. In fact, they would -- Don Young and people would ask me, "Well, how do you feel personally about it?" I said, "My personal feeling is I want to see the public well informed because they're the ones that should be making this decision, not me. And if you're representing the public and you're constituents, I want them to be well informed, too." And that's the way I believed. I mean if you tell them your emotional feelings and that's what guiding you in your science, you lose credibility immediately. I mean, maybe they respect you as an environmentalist. I didn't want to be respected as an environmentalist, I wanted to be respected as a scientist who frequently is doing studies that's supporting environmentalists' position. So yeah, if he asked me if I was an environmentalist, I would have said, "Well, probably about like you. We all would like to see -- don't want to see the environment destroyed. And I'm interested in using my science to make things go as smoothly as possible. And I think -- I don't agree with opening it up without adequate information. And I'll point out what still needs to be done before we even consider it. That this thing be done that we have the knowledge to pass on to the public and inform them adequately, and this is a democracy." I didn't say all this, of course, but it's what I feel. I could have -- would have said it if I was forced into it. And it's the only way to beat people like that. If you do it -- otherwise it's polarized. And then you lose. That's the problem with the two party system is that it gets too polarized so easily. In a democracy, it's the middle ground. It's compromise that makes democracies work. And so we lose sight of that frequently.

KAREN BREWSTER: And so the studies that you were doing at Prudhoe and on the coastal plain, you didn't go seek out those studies and say I want to go figure this out because I want to stop this development?

DAVID KLEIN: No, definitely not.

KAREN BREWSTER: You did it the other way around? You were wanting to understand the caribou and their behavior and --

DAVID KLEIN: And to me, that's informing the public. And this is a public area, not just Alaskan protected area. It's a nationally protected area. And yeah, it's a wildlife refuge and I'd be willing to say, yeah, it's a wildlife refuge and if you're going in there, you got to have special consideration. It's just like research for oil impact on the Kenai. I was involved a little in that. And, you know, the government can override you, they can interpret what you're saying as you're trying to hold up development. Well, people don't like this. You know, it's like the scientist used to joke about scientist going before members of Congress or a committee, sub-committees and the legislators say, "Those God damn scientists." They say, "We've got to tie their hands behind them because they say on the one hand, but on the other hand."

KAREN BREWSTER: And so how do you deal with that?

DAVID KLEIN: This is what I'm saying. I mean, if you don't know -- You've got to have humility. Scientists frequently don't have, and that's a problem with a lot of young scientists that are called to testify or are interviewed and they don't know the answers, but they think -- the interviewers say, "Well, you're an expert on this, therefore you should know the answer." And the question they ask them is not what they were doing, but it's an ecological question. Well, an ecological question is so damn complex and you have to do a hell of a lot of studies before you even can build models. And models are not good representation, they're the best you can do at the time and you use those to project into the future. The best thing to do always is to say, "You know, this is the li -- where we're beyond -- going beyond the limits of our knowledge." And if you're building models then you can't say it's -- they're educational. They help us to point out where we don't have enough knowledge and it's great for doing more research. So where do we need to do more research? Well, this can go on forever. And that's what Don Young will say. And he did say it once when I was giving a talk. They asked me to give a talk in Chamber of Commerce and Don was going to be giving one or had given one. And I got up and I said we -- in effect, we don't have enough science research done yet to be able to answer a lot of these questions. And one of our -- the deans at that time who was the head of engineering, he was a good guy, but it was like all the biologists were environmentalists and the engineers were all pro-development. And he made some statement once that, "I don't know why we need to -- why you have to go up there and spend all the taxpayers money up there, it's just a vacation for you to study moose or caribou and stuff like that. We don't need all that information." And it was -- and he was saying, "Well, we've got lots of experience building pipelines in the desert, there's nothing that could be more difficult than a desert." And you'd say, "Well, maybe not more difficult, but the desert is certainly not the Arctic, and there's different issues up here." "Oh well, we can engineer that. We'll do -- we have a good research component in our industry." And they do. And, you know, they were trying to find the best way. And

then the pipeline, the – what the -- were dumbfounded. How do you keep this hot pipe from thawing the permafrost? And somebody, non-oil industry, came up with the invention of these pipes with the non-mechanized cooling.

KAREN BREWSTER: The venting kind of?

DAVID KLEIN: They cool the -- It had a refrigerant in them, so they cooled the -- they worked only in the winter in terms of cooling because of the colder temperature up here than down below in the permafrost, so it literally pumped the fluid down. The fluid would liquefy up here or solidify, but not until it got super cold. More than 40 below. And so it would be pumping heat out and replacing it with super cold refrigerant. So super cooling this way, it was doing it. And so, you know, it made sense. And then these steel pipes sucked the heat down in the summer, but there was this ball of super cool around the pipe supports that it wouldn't be enough to thaw the permafrost.

KAREN BREWSTER: Well, and this was thanks to engineers who figured that out.

DAVID KLEIN: Of course.

KAREN BREWSTER: Right. So you needed biologists and engineers.

DAVID KLEIN: Oh definitely, yeah. Yeah. But the engineers figured it out and they could figure it out with biologists. They figured it out. The engineers didn't have to use biology on that, they had to use physics.

KAREN BREWSTER: No, I know, but you're saying how they said you didn't need one or the other. You needed both.

DAVID KLEIN: Well, not in our studies. Well, we did need some things like radio collars and things like that. But no, you had to have humility about -- if you're an expert on the environment and you got to know the environment and you can't know it unless you've done adequate research. And so you should know the limitations of your knowledge and not be afraid to say, "Well, I'm sorry I can't answer that question." I had dealt that -- used that approach with Bill Wood, the president (of the university), once when we were down -- I was giving -- on a panel and I think Terry Chapin was on that about vegetation and I was on there about caribou. And he was in the audience. Bill Wood was in the audience. And just right there down there in front of me. And I'd had run-ins with him and he said -- he raised this question, "Well, why don't caribou do something different than what they were doing? And why is this -- ?" You know, the -- and it had some behavioral related to -- I think it was related to migration. "And why do they have to go to a specific areas and how do they know to go to other areas?" And so I looked at him and the rest of the audience and I said, "Well, that's a good question. I could answer that for you if I was a caribou and could communicate with them." And he saw the humor in that. And he said, "Okay, I see your point."

KAREN BREWSTER: Maybe that was your next research was to become a caribou?

DAVID KLEIN: No, there's a limit to knowledge.

KAREN BREWSTER: Right.

DAVID KLEIN: About somebody else's ability. Some organism's ability to think differently than us humans.

KAREN BREWSTER: Yeah. Yeah, so I was wondering that how you got involved in all this research up in the oil fields and all of these? That the oil industry approached the university to say, "We need research done and we know you know about caribou" or did you go to them and say, "You're developing up there, we need to understand it better."

DAVID KLEIN: No, here's where the environmentalists played a big role. I mean, there were things like the Alaska Conservation Society, and I don't know whether Northern Environmental Center was functional then or not. Probably was just getting started then. And they were essentially asking good questions. So, how can you build this and you don't have any experience? And sometimes I was being asked to talk to people about this and caribou and pipelines. And yeah, I had some knowledge but my knowledge was based mainly on some of the work I did in Scandinavia where they had pipelines for hydro development. And how it might interfere with movement of -- some of their caribou are domestic and wild reindeer, and some even domestic reindeer. And power lines, we were starting to -- we didn't have much data but these were the concerns. And then the Russians in the Taymyr region where they had found all this rich nickel and other minerals and it's where the biggest herd in Eurasia occurred, caribou herd. And there were a lot of problems there with pollution and impacting lichens. But the main thing with regard to caribou at that time that related to pipelines was they were building -- they'd -- there was even more polluting then there was. It didn't -- is still polluting, but they were using coal. And then it wasn't a lot of coal, but they were mining as close, 'cause everything had to be really close. And then they finally got natural gas. So they built a pipeline, almost the same size as the Trans-Alaska Pipeline.

KAREN BREWSTER: This is in Russia?

DAVID KLEIN: Pardon?

KAREN BREWSTER: This was in Russia?

DAVID KLEIN: Yeah. In the -- it was, at that time, the Soviet Union and it was in the Taymyr, which is down near the lower -- It's in the Arctic and it's down near the lower end of the Yenisei River. And so they founded this town of Norilsk in 1939. And at that time, it was like 300,000 and they learned the hard way. It was also part of *The Gulag Archipelago* when they were building it. And so the prisoners went on building and being worked over. And they didn't think about cement if you freeze it. They were using blocks and bricks. And it was just how many and how hard they could make these people work without feeding them too much. And they went ahead and used the cement without

putting stuff in it other than water and it doesn't set up properly and doesn't have any strength. And so these things were falling down frequently as fast as they were building them. And then they were building them on permafrost with a heated basement, and the buildings were cracking. At any rate, they were learning the hard way. But the pipeline thing was, it was wonderful to reduce the pollution to some extent, but how the -- what about the caribou? And they just built the pipeline, didn't ask these questions in those days. And they had biologists over there were trying to get them to do it right, not too many but some. And the response, some places they could get under it when they kept the pipeline going across the ravine or something if they went down under it. But they weren't mak -- And then they started making crossings like gravel ramps or wood ramp and then put gravel or vegetation on it. And so there was some experience, but basically - - and then they had a -- the caribou were being deflected. So they were being deflected and they'd come into the town and they weren't getting into areas where there was good food. And there were a lot of other problems with the caribou but that was hardly it. And so then the big question was, if they continue to be deflected they eventually give up and then they're over eating the range where -- right there where they're all bunched up against the pipeline. So then they figured to build some fences to deflect them away and toward other places where there're better lichens available. And some of those were places that had been reindeer areas but when they collectivized the reindeer, they shut down these Native peoples that were in those remote places and that made some range available. So they have a lot more experience than we had on, you know, what was done. Then there was a railroad in southern Norway through the alpine area. Had given a railroad between Trondheim and Oslo. No that was between Oslo and Bergen, yeah, and a road. Part of it was -- yeah on a branch to Trondheim. And what happened there is the caribou, what they call wild reindeer but they're caribou, stopped crossing the railroad and the road. And then they overgrazed this one side and the other side went un-grazed and the lichens came back. And so that was an example of, well transportation corridors are going to obstruct the movement of animals, and in that case it was trains and vehicles. And that went on for many years, and finally the herd went down. And then it started coming up again after there was some recovery and then suddenly a bunch of them crossed and then they did well. They didn't cross and you had two separate herds. And any rate, the limit ended up -- What they were learning on and still are learning is that you can't extrapolate too much between herds in terms of their behavior and movements. It's tied to the habitat, but it's also tied to the tradition and whether there's hunting in some areas or not. It's like the Natives saying, you know, you never shoot at a river crossing or something. You never shoot the first ones that come. Let them go. Otherwise the herd probably would be turned. And it makes sense, and the Russians had learned the same thing. So there were a lot of things like that. It's not clear cut, and the oil industry hates that if nothing is clear cut. But any rate, it was the environmentalists that -- and they would ask me to talk about what we knew and then what is needed, they'd ask. And that's great to ask the scientist what is needed before it can be done right, because it was pretty obvious to environmentalists that the pipeline was going to be built. There was so many megabucks involved in all of this, but let's do it to minimize the impact. And, of course, the oil industry says, "Yeah, we want to do it right." But they didn't know what was right. And so yeah I -- and then from then on ,since I was frequently being asked to talk about this, and I wasn't saying -- I was careful in using my language and saying that

I was responding as a scientist and I was speaking as a scientist and an ecologist and a caribou expert, if you want to call it that. And that there's a big limit to my knowledge, but there are kinds of research if we could do them, we could better answer the questions that related to the pipeline. And some of the studies that weren't just us doing them, there was a proposal then to build a gas pipeline right away across the Arctic Refuge because they wanted to get over into Canada right away rather than going all the way down. And it was, of course, the timing was poor but there was oil money, or gas money, that oil companies that funded these studies because a lot of people were saying it's the compression noise. It's not -- The pipeline, a gas pipeline, was a lot different because it's not heated and you could probably put a smaller one down on the ground that they could jump over or you can make ramps without trouble. Part of the problem with ramps, then how do you keep it from thawing that area right under the ramp if you cover it up? So then you have -- yeah, we told them the only way you could do that is to build -- either refrigerate the pipeline, so you have to have a compressor and power for that. And it's -- it was done down on the -- for the Nelchina herd along Glennallen there, they did it because our studies showed that in forest habitat, they're more likely to be obstructed than in tundra because they can't see the pipeline until they get there. Well, that was the behavioral study showed that, but in reality they didn't seem to be so mind because they're going under branches and everything going through a forest area. And sure it's cleared for the pipeline but they would go under elevated pretty easily and this is where there's permafrost. And then the conclusions made, and I wasn't so involved in that, it was people in Anchorage working, biologists, and I probably would have made the same assumptions. But they also had movements of moose in that area. And so that had to have pipeline higher and the company wanted to bury it there if at all possible, but then they didn't want to have to build a refrigeration deal. It turned out that they did bury a long stretch of it, a couple miles, and had a refrigeration unit with pipes down in the soil and motors that were going all the time. So the animals didn't have anything above ground except the clearing and it was just like walking across the road with no traffic. There were no shoulders or anything, it's all smooth. And so that's questionable whether that was justified or not. I don't know if there's should -- now it's buried they have to keep it refrigerated anyway. So there were -- we couldn't -- What we learned from that study of crossings was if you make a ramp that's the width of this house, say, it's not enough from a distance in the tundra and a group of caribou and they're trying to move to the coast to get away from insects, they see the pipeline and if it's a ramp it's higher and we found out they don't like to go across something that they can't see the other side. Like a road, if it's built up, they can't see the other side. Why? Because it's the same as if they're going through shrubs, riparian vegetation on the stream. That's where wolves can sit there and when they come across there, there they are. Not that the wolves would be there, but the wolves also did use the road to get up high and watch where the caribou were coming. There's a lot of these things that, you know, it's so complicated when you factor in predation and the behavior of wolves and then that's really complicated, too. And so that's a big problem with people don't want to address and attempt to understand ecology because it's too complex. Well, if you don't study it, you pay big prices economically because you do things that are not necessary or you don't do it right and it doesn't work. Whereas if you did it right, it would work. But it's hard to convince anyone, oil industry or anybody else, whether they're highways or what have you that

this was the way to do it. It's just – it's almost impossible to teach adults ecology in relationship to animals and their habitat relationships as related to things that need to be done like building roads or building dams, and what have you, that interfere with the movement of animals. Not just the movement but their access to food and stuff. And in the meantime, there's a lot of things being learned about big implelements [?@1:34:6] and how that affects caribou back in eastern Canada in Quebec and Labrador, where they had -- For a lot of while, that was the largest herd, the George River herd in Quebec and northern Canada. And that's where, Quebec particularly, had all these fabulous lakes. And so they dammed them and produced energy and got rid of fossil fuel dependency and sold this excess to the entire eastern United States and still do. I mean, it's great. Relatively clean energy. But there's never enough, of course. But what they learned is on these reservoirs there were problems because when you have a draw down in the wintertime, before the draw down it's just a lake and they don't have any problem going across. But as a drawn down comes, the ice cracks and goes down the part that's floating, and the rest of it is on the banks, just these steep, icy slopes. So if they try to cross there, they're going to have a problem climbing back up again. They can always find places, but they may have to go several miles before they can find a place where they can get up. And how much energy do they spend doing this? And maybe they don't get back and forth and if there's wolves around they might be more vulnerable there by wolves going down there. And in some cases, the snow conditions on the slope, on top of the ice they could go up without too much trouble but other cases not. Well, then the big thing that happened there is they had this big dam and they needed to do some work on it, so they let a bunch of water out and the caribou were migrating below the dam. And the usual crossing place, which was kind of tricky, it was already rapids and rock, going through rock spires and splitting up. It was -- caribou would do it and maybe there'd be a loss of a couple of animals in a big herd going across, but 10,000 drowned when they did this because they were releasing all this water to lower the dam to do some maintenance on the thing. And they'd released it all at once, and it was just too much. And so here are these 10,000 caribou on the beach and the people down river, Native people at the village, they were concerned in the past because of the water getting too much mercury. In the new reservoirs there was more mercury coming out of the rocks. And for a while it was coming down. After a while it slowed down, but it was dangerous and the Canadian government was trying to do all kinds of things to clean things up. And they were right down on the Hudson Bay, the village. And then when this happened, the Natives heard about it and said, "Well, they're all decomposing and that's coming down into the water that we drink." You know, 10,000 caribou, that's a lot of decomposing animals. So then they did all kinds of things, they got helicopters and just carried these a long way inland away from the river, which was a quick solution. And they could obviously be scavenged on and decompose and what over time, not a big deal. And it was too late to salvage any meat and when they finally got into this, but it made the international media. And it shows that you think things are all okay with these big dams and stuff, and then suddenly this goes wrong. Well, you've got to think about this all the time that these possibilities can occur.

KAREN BREWSTER: So, on the studies you did on the caribou up north and the things you learned, do you think those things have been applied? Do you think you were listened to?

DAVID KLEIN: Oh a lot, a lot was. A lot was. And it varied -- how it was applied varied with the companies. BP was one of the better ones at that time. The present BP isn't. You know, they've sold out and then they bought back in. But at that time, some of the heads were Englishmen who were working up there and they were good to work with. And sometimes they offered to fly me up in their jet and they wanted answers to quick questions. And one of the questions they had, not requiring me to fly up there, but was the caribou movement to the coast. And they need roads and they need work camps and good facilities for the people. And then they're going to have gathering pipelines, but the big problem is any infrastructure, where can you put it that's not going to be -- At first, they tried to find a place where the ground was not too wet, not shallow lakes and stuff. But -- and they had this problem with water, too. Fresh water. But any rate. So then we were able to -- we had a study that was done, we were involved somewhat but it was done through ABR (Alaska Biological Research), but it was some of our former students. And they did these aerial -- in the summer or in the fall, let's see it would be in the spring, I guess, it was. Before it greened up. They could fly and take pictures of these routes where there were lakes and they couldn't -- the caribou wouldn't go across the lakes to get to the coast, they would go between them. Sometimes the corridors were narrow, you know, they were only like half a mile or so wide or less. And from the aerial photos you could see the old trails where they were all going through certain of these corridors. There was more than one corridor and some of them were primary corridors. Well, we could show these to the BP and could say that this would be the wrong place to build a work camp or whatever. And infrastructures there. And be careful with the pipelines there, the smaller diameter pipelines. And BP in effect said, "Well thanks, we'll do that." And they did it. And so we had a lot of good relations with some. And then the ConocoPhillips, no it wasn't ConocoPhillips it was just Conoco, was a much smaller company. They only had, at that time, only had -- in Alaska, they only had this one area where they had a couple of wells, but they needed to get a road about 12 miles long into the facility that they were building where their workers would live and they were designing everything to have minimal impact. So then they wanted to know where's the best place to build a road because caribou are in there and some areas were pretty good insect relief area and others were not. But they had to move parallel to the road frequently and so you had to know more about where the insects were bad. So we had a student whose name is -- he's currently in charge of this western Arctic herd management for Fish and Game. I knew him, he was my student. His name, I always have a hard time pulling it out. And I know him well and he's a terrific guy. And he did his study -- it was a hard one because he had to deal with both mosquitoes -- and for mosquitoes he'd use a net and you'd walk through at certain times of the day and you had to do it enough because it varied with -- if there was any precipitation, it was different. And mosquitoes -- in the right temperatures, when mosquitoes would be -- if it was too cold the mosquitoes were all down in the -- and wouldn't come up. And they weren't bothering. They were down in the vegetation. But you wanted to walk through there so about the same as when they're most harassing. With a net. And then you walk a transect line and then you sweep

with your net periodically, measure the distances and then you count the mosquitoes that you get each time, quickly, and they go into this special net at the bottom of the net. And you can put a vial in and took these samples, then you can do the counting later on back when you're in a building or something or tent or whatever you're staying in. And then you do these over again in different weather conditions. And so you can see the weather but also then you're comparing these transects as to where is the best place for the road to go. And ConocoPhillips were so good there. I mean, they tell him, you know, you could - - "part of the contract we're not supposed to provide the services to you that costs us money, but yeah, if you want to wash your clothes in their washeteria and use the facilities here when you're in the area and eat in the cafeteria, yeah, just go ahead." And they were just really nice people. So then he finished this and he did the master's thesis and passed all that. And it was a nice thesis. And they got a copy, Conoco, and then shortly afterwards they announced that -- to the media, that they were giving this conservation award they have in the company that covered all of their areas in the world where they had conservation projects going on. That this one was the best one in doing a good study that related to the environment that helped them build a road more safely. And so it was like about a \$5,000 award. And some people were saying, "Well, the student should get the money." And the award was to the Wildlife Unit. And the student should be acknowledged that we got the award and the student -- I said, "No, we're going to use that money to support students in the future and we really appreciate all this." And then finally there was an agreement and -- Why can't I remember his name? It's right here. It's in this, right here, yeah, there it is. He's responsible for co-management there. Largely responsible, not completely. Jim --

KAREN BREWSTER: Jim Dau.

DAVID KLEIN: You got it.

KAREN BREWSTER: Okay.

DAVID KLEIN: And he's just -- so proud of that guy, more for this stuff but for all of that. With working out a co-management program. There's only one in Alaska for wildlife management and it works. And it doesn't keep the herd from declining, but it gets the local people involved and they know why it's declining and it's not because they weren't -- it's because they weren't harvesting as many as they could have but they had so little harvest they couldn't bring it down. And though they weren't -- you know, they didn't spend -- waste a lot of money on wolf control there and things like that. But he'd bring the Natives along as observers and they got to be good observers, and counts, and so he's had wonderful cooperation with the local people. And they respect him highly, which is great.

KAREN BREWSTER: Right. So you gave some good examples of things where you were listened to on your recommendations based on the science up in the oil fields. Were there other instances where your studies showed the way caribou might react and the oil industry ignored your suggestions?

DAVID KLEIN: Generally, Exxon/Amoco I think it was, that combination at that time, they were not good to work with. They were hiring consulting firms that had a poor reputation but just to discredit, not so much our work, but the Fish and Game work that they -- I mean, Exxon's always had this problem of spending millions and millions on studies to discredit good science, and climate change related, not at that time, but that's what they've done. And of course, they're the ones that don't stick to the Cape Thompson project. You know, they were supposed to have the gas and oil coming out of there years ago.

KAREN BREWSTER: Oh, the Point Thompson.

DAVID KLEIN: Point Thompson.

KAREN BREWSTER: They had been given the lease and then they never developed it.

DAVID KLEIN: Yeah, and they get away with it because they've got -- the state government would okay it, you know, let them give 'em more time. And they're apparently building a pipeline right now. And, of course, they didn't pay for the damages that -- the criminal charges for the oil spill. And they finally agreed, after it'd been reduced from about 2 billion down to about 300 million. Unbelievable. And they spent probably close to a billion in legal fees fighting all that. And that's sort of the same way BP is now behaving in the Gulf of Mexico on that Deepwater thing (Deepwater Horizon blowout oil spill).

KAREN BREWSTER: They don't want to take responsibility.

DAVID KLEIN: Yeah.

KAREN BREWSTER: So do you feel like the development that's happened on the North Slope has met your standards of being done appropriately in that the caribou are being protected or what? I don't know what the right word is.

DAVID KLEIN: The answer's no. But on the -- they went along with a lot of things, but they -- and so there was a compromise in what they did. And sometimes, like for example, one of the problems our studies as well as the ABR studies showed that when insects were harassing, the caribou were -- before they started harassing the caribou located inland from the roads and pipelines, the gathering pipelines and what. And they were in one of my student's vegetative study showing that, that was the highest quality green vegetation. At that time of the year was what they needed, that's where they were. When the mosquitoes came up, then they started milling around and trying to get to -- move into any breeze coming from the coast because of the sea ice there and cool. They try to move there and they mass up because you reduce the number of mosquitoes per animal, but they can't feed, and so then they try to move to the coast. And the big problem there was the main transportation corridor to the Kuparuk field from Prudhoe. And a lot of traffic and big trucks and sometimes if it was dry, lots of dust flying. From a distance, caribou in big groups don't move readily across roads. Small groups will move

more readily. Partly because a big group, they're still waiting for the more adventurous ones to start moving and once they start moving, they go. And then they'll go across. But if a truck comes across, that's the end of it, they jump, go back and it's going to take a long time to settle down. Meantime, they're being fed upon by the mosquitoes. So the recommendation was there's no simple solution. The simplest solution is to convoy the trucks and traffic. So that's what they -- the both state and federal came down on them and as a result -- the study was saying you've got to convoy and most of the convoying will be done at night when it gets too cold for the mosquitoes. Then you open up. But, if you had convoys that have to go through during the daytime, all the trucks go together and then none of them for a period of a couple of hours. And especially if there are groups of caribou that you could see were waiting to get across. Well, if they're in a distance, didn't make too much of ten trucks that went by versus one. Whereas if none, then they go across successfully. And the oil industry responded and said, "No, it's inconvenient for us, but yeah, we'll do it." And they didn't say it that way. They said, "Yeah, we'll do this, it's for the well-being of the caribou, etc., etc." But then, you know, what are these cumulative effects on the caribou use of the area? Well, that's what we couldn't study that because -- we could point out to them that they asked if there's a problem for the small drilling field and pipelines, how do you build this so that it'll have minimal effect. Okay maybe you do it, and then they say, "Well, we're going to do another one over here." Well, same way. And, of course, they reduce the impact by directional drilling, which wasn't in the original plan and reduced the footprint, yeah, that was good. But, you know, what are the long-term, cumulative effects? And we couldn't address that. And as an environmentalist, I could say, "You know, that's what we don't know." But we should start measuring cumulative effects now separately from what was recommended to how to do one system, but if you have three systems, it's different. So if you knew how much was planned in the long-term future, you could do a better job of recommending how things be done than if you do one at a time. So the cumulative -- there was a National Academy of Science study done on that, which I would have been on but I was already on another one that was down in the Yellowstone area and had to do with the elk populations down there and their management. So I couldn't be on that, which was good for me because it would have been a tough one, too. And so, but the people from here, there was good people on it including Ray Cameron. You know him?

KAREN BREWSTER: Ray who?

DAVID KLEIN: Cameron. He did a PhD here with Bob White, but he was working for Fish and Game and he had a plane up there, a Super-Cub, and he was doing all this monitoring of the caribou and how they moved in relationship to pipelines, etc., etc., etc. And he was on the committee. Skip Walker, you know him?

KAREN BREWSTER: I know the name, yeah.

DAVID KLEIN: And he was doing it. He was from his botanical standpoint. And there was a whole bunch of others. And those are interesting things and they're done very objectively and they finally published a book, *Cumulative Impacts*, and that's available. And yeah, it was important to get that out so to start thinking that way rather than

thinking that you do one project well and there's no problems. And you do another project well and there's no problems. But you put them together and there're many problems.

KAREN BREWSTER: And also, as you say at the time you started the research, you couldn't study cumulative impacts, 'cause you were just trying to get the baseline information. But now it's thirty years later, you can look at cumulative impacts, and do you have a sense of --

DAVID KLEIN: Well, no.

KAREN BREWSTER: --t he results?

DAVID KLEIN: You can't look at it because like it's so huge a project. The costs to do this. How many people do you have to hire to do this, to measure these things? Like you've got to go back and do sampling the way it was done early on for, say, mosquito harassment and avoidance for other species like nesting of shorebirds, where some cases they're really close to drill rigs when they're drilling, but they're not so close to roads unless it's dust that flies from the road, melts the snow first and they've got to nest right away, so they nest beside the roads. And then the foxes know that there's nesting beside the roads and they clobber the nests. So those are cumulative impacts. I mean, in one sense, the same with the caribou, when they're blowing dust and oil that they use to keep the dust down. It's flying mud and stuff. Or the stuff -- what's the effect on the vegetation and then how did that affect caribou? Well, again caribou are eating some green vegetation close to the road. Sometimes it was put there because there was some erosion and they plant some plants that are planted and grow quickly and fertilize it, so it's higher quality. But is it good? And then the caribou gets clobbered by a truck, you know, who's fault was it?

KAREN BREWSTER: Well, what I was thinking about the cumulative impacts, too, is, maybe you faced this when you were involved and were testifying, the oil industry will say, "Well, you know, look it's all great. You know, look there's caribou right here in the middle of the oil field. You see we're not causing any problem." How do you answer that?

DAVID KLEIN: Well, I'll have to say it's a hell of a lot more complex than you think. First place, there were some nice pictures for the oil industry to release to the media. Why? Because they were mostly all big bulls with big antlers. Whereas a lot of people don't even know that females have small antlers and they shed them late so they don't have any antlers frequently in the early summer when they've got calves. And so they'd see these animals without antlers and they'd say, "What are those animals?" So then why were the bulls there, and not so many cows and calves? Because the cows and calves are displaced. It's too risky for them to be close to the oil fields and stuff because they don't want to be places where things can sneak up on them like bears, grizzly bears, and wolves. And sometimes there were more bears in that area, because bears were getting food from improperly put away garbage. So you have increased number of bears, and that

means increased predation on the new born calves. And they don't have a lot of wolves down there close to the coast, but there's some increase in wolves. And then what effect on birds is the fox situation? The foxes' population is higher than normal because it's almost impossible to keep food away from them. Truckers just throw sandwiches out the window, and the foxes know there's food there. And then if foxes learn that there's more birds nesting close to the road because the snow is gone earlier, and so they clobber the nests. Well, these are all the kinds of cumulative, biological cumulative impacts. But there's other potentially biological ones that other people should be measuring, like what about any carbon in the atmosphere and fall back on the land. Does this affect the snow and the quality of the melt water, etc., etc. And other containments that might be there. Fortunately, most of the pollution bloomed from the compressor stations and all these things that are burning, and the gas that they're burning off for safety reasons is blown out to sea. But we don't ask the question of what effect it has on say, like polar bears and seals that use the sea ice. And it's in the sea ice, too. What's the effect in the marine environment? Well, it's almost impossible to measure that, but you can build models that the way it should be and expect this. And, you know, some people are now working on -- Matthew Sturm has been doing really good snow measurement stuff, and a lot of other people are beginning to work on that. That's good. But all that's costly, and so it's usually separate projects and they're not cumulative. The only way you can do the cumulative is to address -- interview the people that have done research in different things and say if you put all these together how is it going to likely effect? Then one of the cumulative effects, what's the cumulative effect on the Native people that used to use that area? And well, it's horribly complicated and you can't answer it in either a positive or negative way because it's human culture. We're not able to do good research on us. It's easier to do it on caribou. Well, yeah --

KAREN BREWSTER: Well, I understand your point about how hard it would be to do cumulative research but I was thinking, you know, well something that you studied -- you know your studies showed that caribou need a certain route for insect relief or something. And now you can go back and look and say, yeah, they're still doing that or no, now they've changed their behavior and are doing it differently because of the road that's there or --

DAVID KLEIN: Well, that's the problem. I mean, the oil industry wants us to look only at herd numbers, because herds have increased frequently during all of this development. But at the same time, some other herds, with no oil development, have decreased. And so what conclusions can you make from that? All herds are a bit different because the habitat is all a bit different. And you can't generalize on any of these things very well. Some aspects of caribou behavior you can generalize about like, we know that they don't -- cows with calves don't like to cross rivers with a lot of tall willows, so it's a corridor with -- blocking visibility. We saw similar behavior when Dan Roby did some of this work on avoidance of the road and the pipeline by caribou. And then ABR, too, and found that the pipeline is not as bad as roads, because roads have traffic. And the Haul Road is a good example, there's so much traffic there, yeah they're going to avoid that, caribou are going to avoid that. Whereas -- and pipelines the same, too, if the pipeline is by itself, you don't have this traffic. And so they're frightened by the movement, not by

the thing so much. It's the same with the noise, for example, if you get close to a big diesel engine driving a well pump, it's pretty God damn loud. And the caribou go right on feeding through it, but it's stable, it's not moving. What will disturb them is if there's a lot of people out on the pad moving around and they can see them or vehicles coming and going. That's what is disturbing to the animals. And when they did this -- some of these simulated compressor sounds for gas pipeline in the Arctic Refuge, they had permission to do that, and this was not in the coastal plain but it was up in the hills, sort of. And the caribou -- they had cameras there and the caribou just marching along in migration and they heard this noise and it got louder, and louder, and louder, and they marched right by it and walked away from it. And it sounds, I mean, if it's stable and it's not related to something moving, and when you realize -- I mean, what do they do when it's thunder and lightning? And the thunder, how do they react to that horrible noise? You know dogs have -- some dogs have a horrible time. They've just recently -- they talked about these animals that were -- a group of caribou in the headwaters of Jarvis Creek that were killed by lightning years ago.

KAREN BREWSTER: Oh right, right, right.

DAVID KLEIN: I remember that, yeah. And I remember working with mountain goats on the Kenai Peninsula and I was sitting up on the south side of a slope looking across this lake, Ptarmigan Lake, and the north slope where the spring was delayed so the snow was avalanching there, but in these avalanche shoots it was spring and the goats were down in these shoots because the avalanche shoots would wipe all the snow out. You know, there'd be a few alders there but they just bend over, and once the snow was gone things greened up fast and there was all this really good stuff growing there. And the shoots would be sometimes less than the width of this house and the goats would be there and you'd hear this rumble, rumble and the goats would hardly notice it unless it came from above. Then they bounded two or three times and got out of there and stood on the rocks and watched as the snow come crashing down. And once it got through crashing down they went back to feeding. So they related to the noise in that way, but we did these studies in Greenland once with muskoxen in east Greenland. Amoco Oil Company had negotiated with the Danish in Greenland, the government to do -- this was one area that was unglaciated and there were a lot of muskoxen and it stuck quite a ways, a relatively low hilly country. There weren't big mountains there. Big fiords on both sides and huge icebergs coming off. But this was good muskox habitat. And there were no wolves, no bears there and a little bit of hunting by Native people, controlled hunting. So our job was to -- I was with a team from Denmark and I was involved with that and with one graduate student from here. So part of our job was -- we were doing vegetative work, too, that's the primary reason, but we tied in with this -- We were marking caribou with -- muskoxen, we'd have to drug them and put a big plastic tag, like about this size, in their ear.

KAREN BREWSTER: Like, what a 4 x 6 size?

DAVID KLIEN: Well, it was like 4 x 5, I think. And it had a big number on it. And so we could read that with binoculars or a spotting scope from a distance so we could

identify these individual animals after we put this on, and they'd be in groups. And so the question -- We knew that the groups were fairly stable but there were also exchanges between groups, so we wanted to know whether the seismic explosions -- they would use -- they didn't have a problem with -- The terrain was sort of rocky till and it wasn't permafrost problems of thawing. So they would use the small track vehicles with a little trailer rig on them to drill down and then those were gone and then they laid these charges and had wires going to a recorder. So there was not a lot of infrastructure on the ground, and then they'd set these off. And one at a time. And there would be an explosion and the dust would -- like they were only about 25 feet deep or something and then they were measuring the time that it went down to the different strata, but a big cloud of dust and then there'd be a big bang. And so we then when they told us when they were going to be doing this so that we could set up a camp out of sight of that where the muskoxen were close to where the charge would go off. And these groups were like 15 muskoxen in a group. And there would be this *boom* and the muskoxen would sometimes look up, a lot of times they didn't look up and if a couple hundred yards of the thing would go up, they'd watch it go up and come down and then they'd go on grazing. They wouldn't move and they didn't fracture up the groups and stuff. Well, this grouping is predator avoidance behavior for muskoxen, and they don't move into that until they see something moving in the distance that's going to be a bear or wolves. If they're there in that country in Alaska, that's the way they operate. And they do in other parts of Greenland when there were wolves present. So it's predator avoidance behavior is all important, and it's true for the caribou. And caribou want to see the predators before they get too close so then they can run and out distance the predators couldn't get them, whether they're wolves or bears. For muskoxen, they can't run very fast and the calves are vulnerable. The adults got these sharp horns, well, they can pull down a single -- wolves can pull down a single muskoxen running. The best bet is to stand your ground and try to defend yourself with their horns. But with a group -- and the females have just as sharp and as long horns but they're not as big at the base, 'cause they don't used them to hit together during the breeding season. So they all run to a knoll, they like to be on a little knoll, and they get on top of that and the calves are running like hell, and the calves are automatically caught right in the middle of this group and their butts are all touching. So if a calf makes a mistake and starts to break out, a big adult, or male, will come out and butt the calf, "Get back in there!" And pretty hard, too. But they don't try to hook 'em. And so then they face -- all of these adults are facing out, and if the wolves just sits on one side and stay there, they're there and they're a shield and the calves are behind, but wolves tend to run around if they're in a pack, and that forces them into a circle. So there's this nice circle of tight animals close to close and the calves right in the back. And so they want their group size to be big enough to do that. Two or three cows and one bull is not enough to do that, so they tend to get into bigger groups. And that means they have to move more frequently or keep moving, because if they're in one place and they're all grazing, you know, they graze it out and they keep moving, which is fine, you know, that doesn't make much difference than if they were scattered and the same number feeding. And so at any rate, that worked for them but in that case seismic explosions didn't have any significant impact on caribou.

KAREN BREWSTER: On muskoxen.

DAVID KLEIN: They were doing some others in another area then where there're flightless geese. After the – in the season when the adults were flightless and had young. And it was a little more disturbing on the geese, but they would run away from the deal.

KAREN BREWSTER: That was on seismic also?

DAVID KLEIN: Yeah. But it wasn't too significant. Partly, because the geese would be close to water and when something like that, they would tend to move out onto the water as a group, which they will do with predators, too. Ground predators, foxes there or wolves.

KAREN BREWSTER: So given all the politics of all that --

DAVID KLEIN: Pardon?

KAREN BREWSTER: Given all the politics of all that oil field caribou research, are you glad you were involved in those studies?

DAVID KLEIN: Well, if it didn't --hadn't happened, I wouldn't have missed it, you might say. But no, yeah, it was fascinating. I learned a hell of a lot about oil industry and drilling and all that stuff. I wanted to know as much as I could. I wanted to better understand the oil industry's perspective and what was capable, too. Were they capable of -- where were they capable of using this diagonal drilling and you have to know something about what's down there. And so they were good about explaining things and I was always interested in that. And then, you know, there were a lot of other things like how they located airfields and things, so it minimized -- having animals on the airfield would be a big problem for them. And that was -- they were pretty good about that. It's pretty important to the airfields. And before -- eventually they could fence them. But, they didn't want a big group of caribou under insect harassment standing out in the middle of the oil field. And they sometimes would get -- when they're under insect harassment, if the roads, big gravel roads, with not any traffic -- they're work roads. They would get up and stand on those roads, caribou, and there would be fewer mosquitoes because there's no vegetation there. It was all gravel, and possibly a little bit better breeze up a little bit higher.

KAREN BREWSTER: So do you think you learned important things about caribou through all those studies that apply elsewhere?

DAVID KLEIN: Of course. Of course. And, you know, some things I couldn't have learned without it being under those conditions, whereas if I was just up there with no oil industry, yeah, you learn a lot and the logistics were simplified if there were roads. Whereas, in the summertime you come to a river and you can't get across unless you've got a helicopter to move you across or something like that. And then there's always a differential effects. The helicopters, too, in the construction phrase, they're a big problem because they -- they were -- they are pretty disturbing for caribou. And in the winter

they're disturbing if the helicopter pilot swoops down to give their passengers a chance to take pictures, and they don't realize that at 30 below if you run caribou hard, they're liable to get emphysema.

KAREN BREWSTER: Oh, from breathing the cold air?

DAVID KLEIN: Bringing it in so fast, the cold air, right. And then I've got pictures that - - while Dan Roby was working on that. And he made friends with the helicopter pilots. And then the industry, that was where there was a problem, too, because we said they weren't supposed to do that. They weren't supposed to go down. And the helicopter pilots would frequently say -- they were working for a separate company under contract. They'd say, "Well, nobody told us not to do that. We won't do it." And so we'd go to the oil industry and say, "How is it that these guys didn't know? You agreed to not allow this to happen. How come they didn't know?" "Well, they're subcontractors. We're not responsible for them, period." [inaudible@2:20:25] They were responsible and then we had to report all this to the both state and federal surveillance teams and they would get a -- be a reprimand and they'd do a little better. But, you know, from their standpoint, they were -- they couldn't train all these people fast enough because sometimes they didn't have enough helicopters, they had to send some up from Fairbanks and these guys hadn't had that training. And part of it was just sitting down and seeing a film and told what not to do. But, yeah, that was the same problem with the other things like not having adequate garbage disposal, quickly incinerating the stuff before the foxes and bears and other things got attracted. Well, they said, these were subcontractors and they weren't working under the same standards as the big companies that we made agreements with. So there were a lot of problems like that. And those are bound to happen in any construction operation. Things are going to happen, but they shouldn't happen so regularly and such a massive and can have significant impacts. If you don't want any animals killed, you know maybe half a dozen caribou suffering from these harassments. But you've got to be absolute on those kinds of things, otherwise it gets out of control. And it's human nature to want -- a pilot wanting to show you where there's wildlife. You know, it looks like a barren land in winter. It's just pure white. And I say, "Oh no, we'll be going over some caribou here shortly" or "I'll swing over and you get a chance to photograph some moose." Or some, not moose, muskoxen, a group of muskoxen over there. That's human nature.

KAREN BREWSTER: Yeah, it is.

DAVID KLEIN: One time I was up there with a bunch of -- Bob White and some others. All biologists. And we were doing -- we had big vans and I was sort of guiding them on a tour, not in the oil field but on the Haul Road. And we'd stop where there was some of these problem areas like dust from the road blowing and re-vegetation and use of tracked vehicles where they shouldn't on the tundra and was causing thawing of the permafrost. And these were guys that I knew and I was sort of responsible for explaining some of these things. And we were in two vans, and we're driving along and oh, there's a wolf, so we stop. And this wolf is one that's been fed by truckers, sandwiches. And the wolf is seeing us stop, figured, and we're -- cameras were out, we roll down the windows and

lots of pictures are taken and the wolf then is drifting back towards the second one. And someone threw out a sandwich. One of our people.

KAREN BREWSTER: Oh, my goodness.

DAVID KLEIN: And so I got out and walked back there. They plead first not guilty because, "Oh, we didn't really know." And I says, "You didn't really know? We talked about this." What they should have said was, what the truth was, "We're just humans and we like to feed animals." Go to the zoo, you know, and they give you opportunities to feed them, if they let you feed them. If they don't want you to feed them, they don't want you to feed them and there's good reasons. They can understand that. And kids – you know, it's kid behavior. It's pretty hard to convince them not to feed animals.

KAREN BREWSTER: Yeah, but kids are different than adults.

DAVID KLIEN: Not much difference in terms – it's when's the transition between kid and adult.

KAREN BREWSTER: It varies from person to person.

DAVID KLEIN: No, no. It's an age phenomenon there. And some people become more responsible as adults than others. And look at the workers, they're a lot of young guys. And we've got a student, Dan Roby, he was a good photographer. One time he's cruising along in this pickup and he sees workers are stopped and it looks like a bear. And so he got his binoculars out and camera with a long lens, and here's a big grizzly and these workers are standing there. They've stopped working and they're sort of in a line looking at this grizzly and the grizzly is interested. And this one guy is walking out with a sandwich.

KAREN BREWSTER: Oh my God.

DAVID KLEIN: And so, you know, there's all of those things there. I mean, feeding the animals. Macho to be out there doing that with such a big dangerous animal. And stupidity because he doesn't understand the potential problem there. Both feeding it and getting it addicted, but also it might take his hand off. And --

KAREN BREWSTER: Or more.

DAVID KLEIN: Yeah, only one sandwich. And he got pictures -- he was great. He parked for a while watching the trucks go by, especially if there was a wolf there. He's got about three pictures of a truck going by and out of the window comes an arm and a sandwich in the air and the wolf grabs it before it hit the ground.

KAREN BREWSTER: And this guy was your -- this is Dan, what's his last name?

DAVID KLEIN: Dan Roby.

KAREN BREWSTER: How do you, R O --

DAVID KLEIN: B Y.

KAREN BREWSTER: Okay. And he was one of your grad students?

DAVID KLEIN: He was one of the greatest grad students. Because he then did a thesis on this caribou behavior in relationship to oil field developments, etc., and particularly these problem things. And then he went on and -- well, he was such a good student and we were great friends. We used to go moose hunting together and would go the rest of my family and just a terrific guy. And so then I had a chance to do some work with -- invited to do some work in West Greenland with caribou when one of the Danish biologists was working on his PhD when caribou habitat relationships there. And so I said -- well, he needed -- he had some good funding and so paid my way over and then he said he really could use someone like Dan Roby who was familiar with the caribou work and working with me and the work he did there. Although, his main interest was bird physiology, but we didn't have a project of that nature. And so I said, "Well, I think Dan Roby would be a good one." So he was able to go and spent five or six months working with this Danish biologist who was a top-notch guy and he had broad interests like Dan. He was interested in birds and everything else. And it was great because the two of them work well and a lot of it was tough work with big packs and hiking long distances and sometimes carrying caribou that they shot to get information from. Carrying it back for food or something. And they just clicked perfectly. And so then they got up to the northernmost part, north -- up near Thule, where -- and they were paid to check out whether there were actually caribou in that area that had come across from Ellesmere Island because they come and go, and sometimes they're gone completely. But this was where, in the springtime, there's these little dovebies --

KAREN BREWSTER: Those little birds?

DAVID KLEIN: -- that come into the cliffs. And the Natives there, it was just like the old days, they were out there with nets capturing and laying down the nets and picked them up and catch them and eat 'em. And so they were able to do some banding and working with the Natives and living with the Natives in the community. But working with these dovebies was just nirvana for him, because he was mainly interested in seabirds. So then he came back after that expedition and he -- then he did a PhD at University of Pennsylvania, I think. Or maybe it was Penn State? I think it's University of Pennsylvania under the best seabird guy, physiology, which was his field. And did a terrific PhD. You see, this gets complicated. He got -- He worked for a while for Fish and Game right after he got his master's degree on some caribou related stuff mainly, and other things. And he was always doing a little bit with birds on the side. Then he worked -- his PhD was off in Labrador in that coastal area there where there's lots of different seabirds and a little bit in -- yeah, and along the coast of Labrador. And then after he -- I think before that he had married one of our students in biology, a grad student, Karen. And they produced two kids and then they went -- When did we hire him? Then we hired

him. Yeah, we hired him as a faculty member here as assistant unit leader. So he was working under me but he was a faculty member and advised students. And then he started doing work on birds, in general, and as well as on caribou and other things, and started getting funding for work on marine birds. And then – Oh, then Karen didn't -- I may have gotten this mixed up.

KAREN BREWSTER: That's okay.

DAVID KLEIN: Any rate, he went back and got a job before we were able to offer him a job, I guess. He and Karen went back to a small university, state university in Illinois or some place. And then he built a program, a graduate program there and did a great job and they loved it there. Karen didn't like the cold weather up here. She did at first but when she got older. I think she had some asthma or some other kind of problems that she couldn't take the cold very well. She was, you know, a runner mainly. So at any rate, then he's now -- then we hired him and he was assistant unit leader. Then she couldn't take it, the cold weather, and so he transferred to Oregon State as the assistant unit leader. He's now the unit leader there and he continues to do a lot of seabird research but also, because it's a co-op unit, he has to do work on -- and he likes to do a diversity of things. Elk, a lot of work with elk and others. But he's just -- and the calendar over here, and he -- he -- and then finally he and Karen divorced and he's remarried and he goes on vacation to Africa and he takes these tremendous photos and he makes these calendars.

KAREN BREWSTER: Well, I have one last question about the caribou up on the North Slope and your work. And then I think we'll quit for today. Which is there something that you can think about that may be the most important thing that was learned about caribou through all those years of research? I don't know if that's even possible to answer.

DAVID KLIEN: That's not. There's no one, there's a lot of important things.

KAREN BREWSTER: Well, some of them. I didn't mean one in particular.

DAVID KLEIN: Well, I mentioned one, is that the herds are all different, like the Porcupine herd is different from the Central Arctic herd. One of the things we learned was, yeah, and that was in collaboration with Bob White and the physiological work. But how is it that some caribou can stay up on that North Slope in the winter time when there's some lichens, but not very many compared to the wintering grounds where it's forest, open spruce, or pine forest in Canada. I've got a lot of lichens and that's where they're wintering, and then they go back up there in the spring. Well, they go back for a lot of reasons. They always go back to the same place. Well, one thing we can see is that the timing of the green-up vegetation is important in these areas where they go. And that's partly, they feel safer if it's a cryptic environment and that means patches of snow and patches of bare ground. Because if one is standing on a patch of snow, you might see it because it stands out, but they move across them and then you lose sight of them. The same would be true if a wolf, or from a distance, or bears they're cryptic. And, of course, with calves it's good. But the snow goes and then it greens up, it's greening up and it's fast and the new growth vegetation is the highest quality. They have to be selective to get

it because it's just coming about these little buds and new greens. It's so digestible and it's loaded in nitrogen, which they need for growth and everything, especially the calves. And it's just ideal. And then they may have to go to different places for insect harassment. If they're close to the mountains, they go up high on the ridgetops, but they can't feed very well up there, but there's usually a breeze but sometimes not and you get just nothing but caribou on top of a ridge. And where things are milling because the ones on the outside of the group have most of the mosquitoes and so they try to work their way into the middle. But they can't feed. And then they're there all day long doing that until the sun gets down – or lower and it cools off, then they start -- the mosquitoes go down, they move down and spread out all over this lush green valleys and feed like mad. And it's like they forgot about the – the -- and other things, the interaction with other animals but mainly the predators. Bears and eagles and wolves, mainly those.

KAREN BREWSTER: But, so you're saying like the Porcupine herd, which migrates from the more wooded area, the foothills, out to the coast versus like the Teshekpuk herd stays more around that area, they don't --

DAVID KLEIN: Well, it's changing, see that's --

KAREN BREWSTER: And why -- yeah, I mean that's interesting.

DAVID KLEIN: Why are they changing? It seems --

KAREN BREWSTER: No, no, I was thinking like why it is that like the Porcupine herd does this big migration and there's other animals who just stay out on the --

DAVID KLEIN: Stay on the North Slope.

KAREN BREWSTER: Yeah, all winter. They don't really migrate.

DAVID KLEIN: Well, it's simple and complex. The simple is that there are lichens but they're here and there, and so they spend more time and energy moving around and looking for lichens. Whereas on the wintering ground for the Porcupine herd animals, they get – they don't have to -- they're moving as a group and there's more -- there's fewer wolves up there on the North Slope in the winter. And the Porcupine has more wolves but they have a lot more animals so the average animal isn't harassed much. And they have deeper snow but it's softer to dig in. And once you get down to the ground level, you can fill up in two or three of those craters so you have to factor in the energy costs of this plus migration to get there. So they may go several hundred miles in migration and that's a significant energy cost. And they do that twice a year, coming and going. The ones up on the North Slope, they don't have to do that, but they're not getting as much food per unit effort as when they're feeding because there's fewer lichens. So there's a tradeoff. And why migrate long distances if you're at low density? You can just scatter out and feed and if you don't have a lot of wolves around, you don't have to be so bunched up as they do down there. But it's hard to say which one is more important. The food thing, well, you measure and have -- and that was Bob White, mainly, the energy

costs of – Well, I did with this Danish guy, too. Energy costs of digging through the snow. Then you have to do a lot of snow measurements because cost varies. Not just depth but it's ice lens or wind blowing harder in different places. And so you've got to factor in all these things, but you realize that caribou are super adaptive, too. And sometimes how do they know to make the change when over in the next range of mountains conditions would be much better but what's it going to cost them to get there? And you can do the same thing with muskoxen, which are not very snow-adapted for movement. They're short-legged and yeah, they're big animals, they just kind of plow their way through the snow. And they're not good in deep snow digging for food. Their hooves are small per unit body weight, so the hoof loading's much higher. They sink down more in the snow and so it's best not to move. To be in windy areas in Greenland -- in places in Greenland, some of it is just nirvana because there's virtually no snow. It's all blown into drifts and they can wander around without having to deal with snow at all. But some of the best food is under those drifts so that as it's thawing, they're there and they winter along the edge of those drifts and getting this that hasn't been eaten yet.

KAREN BREWSTER: Right. But it is interesting that, you know say, two groups of caribou. Caribou are caribou, and why one group behaves one way and the other group behaves the other way?

DAVID KLEIN: Well, in different -- there's differences, morphological differences in caribou, woodland caribou, for example. They don't have very big antlers. In fact, frequently the females don't have any antlers.

KAREN BREWSTER: So the Porcupine herd, is that a woodland -- ?

DAVID KLEIN: No.

KAREN BREWSTER: No, they're a --

DAVID KLEIN: No, they're a barren ground caribou. But I'm talking about in northern Canada and in the western, southwestern Canada in the mountains, the caribou there are mainly feeding off lichens that get blown off of trees or the snow gets so deep and it gets hard and they can walk on 'em and start reaching it from the trees.

KAREN BREWSTER: Would that be the same for the Nelchina herd? Are they a woodland group?

DAVID KLEIN: No, we don't have any, technically, woodland ones. They used to claim that -- how you define a woodland is complicated.

KAREN BREWSTER: We won't get into that.

DAVID KLEIN: The only ones that they used to call woodland were the ones that Canadians call woodland. And those are the ones right on the border of the Wrangell Mountains.

KAREN BREWSTER: Okay.

DAVID KLEIN: And that's based mainly on the leg length, body size, and a few other factors. And the woodland caribou there in that area, they have big antlers. It's the ones that are down in the thick forest further south that don't have antlers.

KAREN BREWSTER: Well, that makes sense, you've got all those trees you have to walk around.

DAVID KLEIN: Yeah. Plus the antlers play a role in communication between the caribou. So for example, in cows, why do the female cows that are pregnant retain the antlers until right at the time of birth of the young, before they shed? Generally accepted now, it took a while, and then not everybody agrees. They retain their antlers because their calf is with them. They're also bearing a developing embryo. It gives them an advantage over other young males that are with these groups and younger females that some of them may not be pregnant but most of them would be. But it gives them an advantage over – and it gives them an advantage over males that have shed their antlers. So males separate out into male groups once they shed their antlers. The older males, because they don't want to be – being second nature to the food from -- because these females, they use their antlers to signal, threaten another one. But if necessary they will use their hoof and sort of like kick if another caribou comes – another -- a young male or another female comes and tries to feed out of the same crater that the antlered female is digging. So if they're not pregnant, they lose their antlers much earlier so only the pregnant animals --

KAREN BREWSTER: So it gives them the advantage that they can have more access to places where there's food, 'cause they're keeping the other animals --

DAVID KLEIN: Hold on to it. And they allow their calf of the previous spring to feed out of their own crater. But they won't allow calves from other cows to move in to it, just their own, and the others behave the same way. So it's definitely the case, but if you're in woodland area, they don't form as big groups. They're frequently solitary or a couple of animals. So it's kind of pointless to have antlers, and the males don't have as big antlers, as well. And if you don't have good visibility, you can't interact as a group well and be social. And then there is a pecking order and antlers are involved in that. And early they were saying, no they keep their antlers until they have their young because they can fight off foxes. Like red foxes, and even Arctic's, could kill a newborn before they're up and about. And that doesn't make sense, because if you determine that an average time that they lose their antlers it's about the day before the calves are born or something like that.

KAREN BREWSTER: It doesn't work then. So any other things you wanted to highlight from what was learned about caribou with those -- all those oil field studies?

DAVID KLEIN: About caribou or oil -- oil industry?

KAREN BREWSTER: Either one. Or what you -- what it led to about your environmental philosophy? I don't know. But --

DAVID KLEIN: Well, one of the things that as an ecologist that is increasingly bugging me is that it's partly human nature. And, you know we're trained -- I was trained as a -- Well, I thought I was training to be a wildlife manager, but I was being trained to be a biologist and a scientist, too, and that's basic, I felt. So what you're trained to do is to try to understand a complex system of ecology. And to me, I see that as a challenge. Some people don't take the challenge. They stay focused on, say, one aspect like physiology, period. And what's going on in the room and in the lab studies and they're not too concerned about what's going on in the field. Well, that's fine. That's some scientists, they're working on nuclear energy or something else and it's all great advances that way. Some scientists are studying the universe, you know, pretty damn complex. And ecology is the same way. Most people don't think about it. I mean, you go out with a bunch of kids and you say, "Oh, look at that nice butterfly." And you try to explain it and they're really interested and then you tell them that, "Well, the young are feeding on the leaves of the trees." And you find like a -- and you show a leaf that's been chewed by an insect. And "oh yeah. And then, you know, that this -- animals like to eat those leaves. Like moose like to eat the leaves of birch and aspen. So yeah, if there's a lot of insects there's not so much food for the -- oh, but yeah, the moose and caribou they always have to be concerned about -- if they've got a calf, the wolves and bears." And so you can start to explain all these connections. The kids love that as long as you don't go too long. But you start talking that way to the average person on the street and their eyes start rolling because it's too complex. They want a simple explanation. Now the monarch butterfly is a good one that migrates and you think of butterflies, unless they know anything about monarchs, how can they possibly -- birds migrating, they're smarter than insects. And here are these monarchs, how can they be smart enough to migrate like birds and caribou and fish? How can they be smart? They don't -- They're an insect, they don't have much of a brain. How can they do this? Well, you've got to start explaining that it isn't brain size alone that's a factor. It's amazing, and you know what the -- what do they call that moth that hovers like a hummingbird?

KAREN BREWSTER: It's something like a hummingbird moth. It's called something like that. Yeah, they're big.

DAVID KLEIN: Then how can an animal like that be behaving and getting nectar from flowers just like a mammal or bird? We're taught in an evolutionary process that vertebrates are higher, but it's not a question of higher, it's different. You know, the next generation of conscious intelligence may be insects. By then, let's hope all humans are gone. It'd be hard for us to accept that.

KAREN BREWSTER: Yeah, well they used to say, you know, in case of a nuclear apocalypse, you know, what's going to survive? The cockroaches. The insects.

DAVID KLEIN: Yeah. And now this whole deal of finding life on other planets, there's so much money spent on that and it's just academic. It's no real value. And they get all excited because, look there's bubbling sulfur up there and there's some possibility of some organisms that can be living and get energy from this bubbling sulfur. Yeah, it's nice to know that from an academic standpoint, but is it better to spend mega bucks, billions, on this kind of thing rather than resolving some of our problems on Earth with human beings or even better understanding what's down in the deep sea? Life on our own Earth we don't have this -- we want to understand what's happening on Mars. On the other hand, there's a lot of good engineering science technology comes out of this space research. But is it worth it? It's sort of like these hip operations I had, you know, why is it so successful? Why was it so successful? It was because of war and a lot pilots were injured and it was the hips.

KAREN BREWSTER: They had to find a solution.

DAVID KLEIN: And then they found ways because doctors worked hard as hell, and then they realized that it could be done better if you had -- did it with replacements. And they experimented and did it. So was this war that was so good that created this capability? You can't buy that.

KAREN BREWSTER: Well, perhaps we should end for this evening?

DAVID KLEIN: Yeah.

KAREN BREWSTER: It's getting late. Okay, thanks.

End of interview