

Name: David Klein
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Interviewer: Karen Brewster

Brief Summary of Interview: In this interview, Mr. Klein is talking about international trips he made to Greenland and Iceland, the work he did, and he shares some stories about his time there. He talks about the various people he met and worked with including students he helped advise who were working on their master's or PhD projects, and he continued to keep in contact with after they were finished. He also mentions the international conferences that took place for reindeer, caribou, and muskoxen.

KAREN BREWSTER: Today is October 16, 2014, and it's Karen Brewster and Dave Klein. And we're continuing on your international work and you were going to talk about Greenland, and I guess Iceland blends into that.

DAVID KLEIN: Yeah. And a lot of this international work -- Well, we talked about the Fulbright Program, and that, of course, was -- stimulated that. But also one of the reasons why I was able to work internationally as much as I did was because our program here was developing well on my work and Bob White's work with -- Well, my work with caribou and then Jack Luick and Bob White working together as students on physiology. And then we mentioned, I think, the radioactive fallout and the studies that Jack Luick was doing. Well, we were the organizers of the -- we, I mean, UAF people that were working with the caribou mostly, but also muskoxen. We were the first to organize -- we organized the first international reindeer/caribou symposium. We had it broad because most of our work was focused on caribou here, but we were doing some work with the reindeer here, plus we also had this reindeer work being done on the Seward Peninsula with the other people at the UAF. And reindeer was the focus for a lot of the work going on in northern Scandinavia and Russia, as well as with caribou, which they called over there wild reindeer. So we interacted with all of these people at these meetings, which occurred every three to four years, once every three to four years. So we started the first one here and then the next one was in Norway, I think, and the next one might have been Canada, and the next one in -- another one in Sweden, one in Greenland. About this time, I primarily, because I was doing a lot of work with muskoxen and had grad students working on the ones on the North Slope, mainly. And so we did an International Muskox Symposium, and we did two of those. It was mostly Canada and Alaska, but there was some experience from Greenland with muskoxen. And then Denmark was scheduled to host the next one because of the Greenland work with caribou and the guy that was chief organizer was working with the caribou, but they had started working with muskoxen, and so his attitude was, "Why don't we meld those two together?" So it's the International Arctic Ungulate Conference, so muskoxen, caribou and reindeer are all ungulates and they're the only ones that are adapted to life in the Arctic. The muskoxen, caribou and reindeer, are two species really, because reindeer and caribou are the same. So that was good, too, and then those went on.

KAREN BREWSTER: So what year did you do the first one?

DAVID KLEIN: Dates on those, I can't come up with. It was probably in the '70's, early '70's.

KAREN BREWSTER: Okay.

DAVID KLEIN: Part of the deal was, too, if we organize it -- the organizers were supposed to put out the proceedings, so there would be something, a record. And for the most part that happened, not as smoothly as it should at times. But we got stuck often. I did and Bob White and Jack Luick and then Peter Lent, who was assistant unit leader who had done a lot of work with caribou and some with reindeer. So all the three of us were -- three or four of us were a committee and shared the editing and stuff, although we'd lay it on those who had the experience and ability and then time. But we worked as a team pretty much so it wasn't just laid on one person's shoulders.

KAREN BREWSTER: Well, how many researchers would participate in these conferences?

DAVID KLEIN: Well, the attendance would be -- we'd get -- since they were only say, about four years, and sometimes the host country couldn't get their act together, like Finland, it took them five years or something like that. And Russia, which -- or Soviet Union, which wanted to host it, they couldn't do it until the last one, I think, it was done. And it was in Yakutia, and it was a disaster in terms of pulling it together. At any rate, most of them were good once they got going and we went to --they were usually hosted in a place where you could get people out in the field associated with it. Which was always, you know, if you're going to a place where there's caribou and reindeer and you can get out there and with the others and they have organized field excursions, where the focus would be on that. Or if they wanted to do excursions on their own after the conference, yeah, we'd encourage that, but that could be maybe to look at human cultures and architecture or whatever.

KAREN BREWSTER: So when you're talking about the number of researchers at these conferences, 50 people, 200 people?

DAVID KLEIN: Oh, around 100.

KAREN BREWSTER: Okay.

DAVID KLEIN: At maximum, but it went over sometimes. It depended on how many locals could be attending in a given situation.

KAREN BREWSTER: I was thinking --the reason I was asking was putting together the proceedings. To put together 100 papers in a proceedings is a big task.

DAVID KLEIN: It wouldn't be 100 papers, because especially a lot of locals were not presenting papers or their papers were from a group of them, but they all wanted to come and had found travel money because we didn't have any travel money. We tried to find cheap housing and things like that, and sometimes housing for students, you know, where students wouldn't have to pay anything. But a few that we got students over, the one in Greenland, we were able to get about four of my students were able to go, all doing projects there, some on muskoxen and some on caribou. And that was so great for them because it was just a fabulous experience to go there to begin with, and to get there you had to go through Copenhagen.

KAREN BREWSTER: Right.

DAVID KLEIN: So you get exposure, too. And then usually we'd be meeting up with some Danes there, and so these students then were meeting these people and getting opportunities to talk. They all were always in English, although we had -- the Finns put one on and they had simultaneous translation for Russian and English or to Finnish sometimes, because the Finns weren't all that good in some of these other languages. They were good compared to other places. Well, at any rate, these deals, you know, you'd make connections and you'd share data and stuff with people from other countries who were doing similar work, and that was one of the reasons for the conferences. And then this often meant we would, here at UAF, we'd take on a foreign student to work on a master's degree here or on a post-doc project. And there were some exchanges in the other direction, but it was usually because English was the common language, from especially Scandinavians, they could handle English by the time they were doing graduate work, quite well. Whereas to bring people over from Russia or other places was not -- plus Scandinavia usually, they had some support from within the country to help them travel, students to travel, whereas that often wasn't the case in Russia. And then in Greenland, there were some -- many Native students could get there frequently and there were good exchanges -- moderately good exchanges through the Northern Studies Program and stuff like that.

KAREN BREWSTER: So because of these symposia and conferences, you started meeting other researchers in other countries doing what you were doing, and then you'd propose, "Well, I'd like to come and work in your country," and you'd start building collaborations?

DAVID KLEIN: It usually was they would invite you to come or you'd say, "Well, it'd be great if we could get together and get out in the field in Greenland with you," or something like that. And because I had these connections, especially from the sabbatical with the Norwegians. You know, when I was over there on sabbatical we were doing collaborative research on caribou, wild reindeer. And then in Greenland I had been doing -- already been doing research there because some of the early work I had done in Denmark with roe deer, the same people, they graduated into becoming -- working in Greenland. And that research institute that I was associated with to work with roe deer, there was nobody working in Greenland then. But then the Greenlandic government was

wanting to get more attention focused on – Well, the Greenlandic government didn't exist then as a separate entity.

KAREN BREWSTER: That was part of Denmark still?

DAVID KLEIN: Yeah. And, of course, it still is, but they have a lot stronger voice and they want to be more involved in things like wildlife management whether it's terrestrial wildlife, or marine or whatever, everything. So at any rate, the way I got connected with the situation in Iceland was that two young biologists, one was botanist and the other was wildlife ecologist, and Icelandic. And they got problems because their -- at that level, if they -- they both were -- these two guys were fluent in English but we'd been invited over there for other symposium. Both Bob White and I separately dealt with grazing lands and they did have a -- then they didn't have a lot of people working with the wild reindeer. Iceland had introduced reindeer in the 1700's in about three places. They got them from Norway, I think. And they put them in areas. Well, there's no area in Iceland that isn't going to be used by sheep, especially in those days. And so it was a matter of having other wildlife there and it was starting -- and at that time it was like it was here when bringing reindeer to Alaska, there's no firm government policy other than that initially the farmers shouldn't shoot them for meat or because they thought of them as competitive with the sheep, competing with their sheep. On the other hand, some of them thought, "Oh, it'd be great. So we wouldn't have to shoot our own sheep to eat and we could --" And wool was the big thing for sheep, and within the country, lamb for meat. So then the only one in one area, one of the more remote areas around where this biggest ice cap is, that was the only place where the introduction took and they were there. And it was remote for the sheep herders. They would drive sheep up into those areas but close to the glaciers, and then they'd have to round them up in the wintertime because the winters up there, at the higher elevations, were more severe. But the caribou did fine, or relatively fine. There was always, in the early days, a lot of poaching by the locals. But if they were remote, it was hard for them to get to where they were. Well, what happened there was there was a -- Iceland was starting to develop big hydro projects as a source of economy. And what would they do with the energy, electric energy? They already had geothermal energy and they had a lot of water power because they had all this high country with glaciers and plenty of rain and these big waterfalls. And they could -- There was some controversy about they don't want to dam a big waterfall that was a major tourist attraction, but there were lots of others and so they started that way. And then, well, who wants cheap energy? Aluminum processing. So they were able to sell the energy before they actually built the dams because they had far more than they could use. So the aluminum companies would be mining the ore in Africa and other places, and they load it on a ship and they could come to Iceland by ship and have a processing plant right there on the coast, and they'd have plenty of electricity so they didn't have to use coal or other fossil fuels for the processing.

KAREN BREWSTER: So when did you first start doing fieldwork in Iceland?

DAVID KLEIN: I think it was in the early 1980's. So they invited -- Well, these two young guys who I was impressed with that were starting these studies because they had

the money for the environmental studies. You know, what was -- the damming was going to dam a lot of habitat that was good for the caribou, as well as sheep. And it was in an area where it was particularly rich biologically because on the northern side -- in the southern side it, you know, there's a volcano right in the middle of this icefield, and when it erupts it causes flooding and everything and most of that goes down to the south side and there it washes out bridges because it's just a narrow bit of land between the ice cap and the sea and the main highway there that goes around the southern part of Iceland and into two or three towns over there on the coast. Fishing is what most of the towns were living on. And so it changed the economy a bit, but they had the funding to do these environmental studies, as what would be the impact and there were different ways of damming rivers so that you could dam two or three smaller ones and then not have smaller reservoirs or could have one or two big ones, which were usually not good because they interfered with everybody. And it was hard enough to get around in that country because there were no, frequently no bridges, and you'd have these roaring streams, glacier-fed streams that had cut down in the lava, steep cliffs and big canyons. Spectacular. Walking on the tundra up on the higher part, and you'd see this fog and it's just a line of fog. And, "Well, what's that?" Well, it's not fog, it's spray from the roaring canyons and the water rushing down there all full of glacial silt, too. At any rate, because I had focused heavily on the vegetation and the plant/animal impact whereas other people like our Fish and Game were focusing on population dynamics of the caribou as a basis for management without much focus. And that's where I was frequently at odds with state and other caribou work in North America that too many people were focusing on things other than the relationship of the animals to their food and how that had accounted for there to be separate herds and migrating separately. The winter range was important, the summer range was important, the calving grounds were important. And then why are these herds separate and are the calving grounds comparable? Well, some longer term research showed that no, they were different. And why were they different and still be used as calving grounds? And, well, some of the reasons were, it was the best place for them to calf because there were a lot of lichens there. And during this brief transition from winter grazing to summer, they could do as well there as they could where there weren't many lichens and everything was greening up. It might affect the timing of calving a little bit and things like that. And then predation. Were there more predators in one place or another? But I was focusing mainly on what were they getting, specifically what plants were they focusing on and what was the ratio of lichens to others in this transition period, during migration as well as others. So I was considered sort of an expert on the plant/animal focus. And that fit well into what they wanted to find out about the -- In Iceland, it was the question of plants as supporting sheep grazing and the reindeer. There was only one population of wild reindeer and that numbered about seven or eight hundred animals. But they allowed hunting on their quota system by locals, or by people that would go there and hunt. And some of the locals, the farmers, then realized if the hunters are coming from Reykjavik or from overseas, Europe, to hunt these wild for the big antlers and stuff, the locals, the farms, they could act as bed and breakfasts and even guiding. So they could make money. Their economies were always really spartan in terms of income for locals. They were living close to the productivity of the land for -- And too focused on just one thing, like sheep and wool.

KAREN BREWSTER: So you came -- you went to Iceland and worked with these young biologists, botanists, and what particularly were you looking at?

DAVID KLEIN: Well, they took me into -- I was mainly an advisor for them. They took me in the field so I could get a feeling of the vegetation types, which were very similar in terms of alpine flora. But Iceland was different because it was so isolated from every place else and it was volcanic in origin. It didn't have a lot of things, like they didn't have any native, big carnivores like bears or wolves. And they did have Arctic foxes and that was about the extent of it. And they didn't have small voles that were competing and they didn't have hares that were competing, and they did have ptarmigan, but wildlife wasn't usually competitive except for the caribou and sheep. And so if the farmers could diversify by having income from several sources -- and they're also starting to plant forests there, and it was a slow process. And they were coming over to Alaska, soil conservation people from Iceland, and getting plants that were good for helping restore habitat that was destroyed by overgrazing by the sheep from the Viking era in areas that were volcanic soils which are very easily erodible and once they're eroded you're not left with much except a sort of a scree. And to get that back into grass production, you have to -- or production, you have to fertilize for a while and not overgraze. And prevent erosion. And that's where the plants they were getting like lupine, they were getting from the Kenai, and it did very well because it was a nitrogen fixer in the soil and so you didn't have to fertilize as much and they could put them in erosion ditches and pretty soon the whole thing was loaded with lupine. But if lupine -- if the sheep were stressed with not enough food, they eat lupine too much, it's toxic to them.

KAREN BREWSTER: So they put lupine in thinking that the sheep wouldn't eat the lupine?

DAVID KLEIN: Yeah.

KAREN BREWSTER: Is what you're saying?

DAVID KLEIN: Which happened. But then if you go through a generation or so of people, and here you have all this lush lupine there that the sheep aren't eating and the farmers -- some of the younger farmers were saying, "Oh, this was a terrible mistake. Should never have introduced lupine there." But if they hadn't introduced the lupine, they wouldn't have any grazing area up there, and they would have lost more soil. And so it wasn't that big of a deal, I mean, but it is a little difficult to get rid of the lupine if it's in ditches like that and places where it's controlling erosion. And it was just, you know, why shouldn't we get grasses and stuff in there. Well, you could after the enrichment by the lupine, but it's a gradual process and how do you get rid of the lupine. And, well, it's like lupine grows up on the North Slope and it's eaten a little bit when it's just coming up because it's not toxic then. And the floral parts are favored by the caribou during early the flowering, and it's non-toxic and highly digestible and good source of food. But later in the summer, no, they avoid eating the lupine.

KAREN BREWSTER: Well, it's sort of like that ground cover we have that's now this big invasive species.

DAVID KLEIN: The bird vetch.

KAREN BREWSTER: The vetch.

DAVID KLEIN: Yeah, that's right.

KAREN BREWSTER: They put something in to deal with one problem and it creates another problem.

DAVID KLEIN: Yeah, and it's introduced from the Lower 48 with hay that was brought in here.

KAREN BREWSTER: Right. So the lupines in Iceland, they put in for a reason but then they became the problem?

DAVID KLEIN: I don't think they -- I think it was an accident that it came in here because I have personal experience in -- when I worked for the experimental farm there was the one patch only of this blue lupine, right on the entrance across the road from the entrance to the experimental farm. And it was there and nobody thought it was -- it had nice blue deal, and nobody thought it was a bad species, but over time it gradually spread. And it's like starting from one little spot it takes a long time for it to spread but once it gets moved around onto the road systems, and especially with the wintertime plows move the seed along and wind, and it grows well on these shoulders.

KAREN BRWESTER: Now are you talking about the vetch or the lupine?

DAVID KLEIN: Vetch.

KAREN BREWSTER: The vetch, right. 'Cause lupine are a native species to the Arctic, aren't they?

DAVID KLEIN: Yeah. But on the Kenai it was probably a slightly different species than the one in the Arctic, but the Kenai was -- the climate conditions were more like Iceland.

KAREN BREWSTER: Right.

DAVID KLEIN: So at any rate, the main thing that I did was size up the situation with these guys and then figure out the best way to do studies. So essentially, you did some line transects and had study plots where -- so you could identify the vegetation types and so the seasonality of the quality of the forage for grazing animals. And lichens were not as big a factor as in other areas because the winter season was shorter there and a lot of rain. And plus like other places some of the good grazing areas were -- Well, even by the airport, the road out to the airport, which is quite a ways from Reykjavik. It's old lava

fields, which are pretty sterile. The only thing growing there would be a little bit of one kind of moss, which animals don't usually eat. And then a few lichens on the rocks.

KAREN BREWSTER: So what are the sheep eating?

DAVID KLEIN: Well, there was little patches where grass would get started. And it was mainly building soil up as erosion took place over hundreds of years. So the sheep would move around probably, so you couldn't have very many sheep there.

KAREN BREWSTER: Right.

DAVID KLEIN: So where they were able to do the most in re-creating -- Well, during the Viking era when they first got there, there were a lot of birch forests. And the birches, some of them got this big.

KAREN BREWSTER: Six inches.

DAVID KLEIN: But they didn't -- they're more twisted a bit. In the southern part of Iceland, where the early settlement occurred, had these valleys with a lot of wood. Well, wood was valuable because it could be used for construction of -- Mainly, how do you build a sod house, how do you hold up the roof? Well, driftwood is one way, but you don't -- there's not that much driftwood. And so they would use -- the birch was great for that and then they used it for boat building, and there was just too much. One of the reasons they became farmers instead of fisherman -- there was an era when the Vikings had settled and the population was up to thirty or forty thousand people. And it was a big deal for the Vikings to settle there, 'cause they had all this land and they could have a big farm. Vikings originally were farmers and seafarers. In Norway, they had farms and they were also seafarers and raiders. And the men and the women would stay, and older people, and manage the farm when they're out looting and de-spoiling, and trading and settling. So in this one area there was this big estuary that was mainly volcanic ash that had been eroded after a big eruption of one of the big volcanoes that erupts every five or six years. And this ash, it walked [?@32:51] down there, and it has potential to be good soil. It created this huge wetland, estuary, and it became popular for migrating geese to hang out in these places. And, of course, they were harvested by the farmers, the Viking farmers, but the soils could be -- they were very erodible if they weren't -- but it being flat, fairly flat, it wasn't as erodible as up on slopes, hill slopes. So there they created a Soil Conservation Service early on because they finally realized, and it was them that showed that this erosion had gone. The erosion had been, you know, you had soil that was like this, a meter and a half thick, was ash that gradually built up over thousands of years and it had vegetation, a nice mat of vegetation. But if you grazed it too heavily, you broke that mat, then you could -- erosion on slopes and by all the rain that they have and melting snow and everything, it would just wash the stuff away.

KAREN BREWSTER: It would be sort of comparable --

DAVID KLEIN: And wind.

KAREN BREWSTER: -- comparable to melting permafrost, that --

DAVID KLEIN: Almost, but it wasn't permafrost.

KAREN BREWSTER: Right.

DAVID KLEIN: But it also the very erodible -- And sometimes you'd see these pillars the size of this house and they still had a vegetative cover. But all around it is the drop off to this just scree and rocks. And animals grazing and moving between these places and eat a blade of grass here, a blade of grass there. If they could get that stuff back into production, well, it's really hard and they've done good work and even included aerial seeding and aerial fertilizing to get things started in keeping the sheep out. But in this big estuary, they did amazing things there. They learned how to drain it without -- these wetlands that were not all that productive except for migrating geese, a handy place to stop and eat a bit. But it wasn't really highly productive for other wetland uses. You could graze some animals to a limited extent on it. What they did was, early on, they were grazing a lot of horses there and then they -- Grazing had the advantage that it converted a lot of the organic matter into other nutrients, including mixing the organic matter with the soil or ash. But they were able to finally realize if you could fertilize a bit and you can make fertilizer from -- with this hydroelectric energy, you could make fertilizer. And then they went -- it was highly productive. They could produce this highest quality alfalfa. And then they pelletize that stuff and they'd use plenty of energy, they could dry it, and then they sell that to the farmers. And not too high a price. And they could feed it to their sheep all winter long when they couldn't be grazing them and losing them in the wintertime from tough storms and what. So this whole area was so rich and green, it's amazing, and they could use big equipment to harvest it. And they grew a lot of vegetables, too, and things like that.

KAREN BREWSTER: So what was your role in all this in Iceland?

DAVID KLEIN: Well, we spent a lot of time with the soil conservation people. They wanted to meet with us and we were involved in some exchanges here in Alaska with them, and getting them over here, the soil conservation people. My particular role when I worked over there for a couple of months was working with these two young biologists. And it was a learning experience for me but, yeah, we could help them design experiments. And they were good learners, and it was a terrific area to work in because they were -- down in the lower areas, there were a good road system, just gravel roads. But there were farms that were widely separated, sheep farms. And then they had regional schools so the farmers would take the kids and drop them off at school and pick them up a month and a half, or they could bring them -- if they were closer to where the farms were they could come home on an occasional weekend or something, but they had to provide their transportation. And farmers all had four-wheel drive deals, so they could handle the roads, even in the winter usually. And there was some road maintenance, but - - And we stayed with one of these farms. And the reason we stayed at this particular one was the farmer's wife had died. Well, she was probably in her 50's when she died. And

so the farmer had three children, two boys, younger boys, and then a daughter. And the daughter was the girlfriend of this one biologist.

KAREN BREWSTER: Biologist.

DAVID KLEIN: So he worked out that we would stay there and pay them for some kind of rent. And we would eat --they'd provide all the food and cook it and stuff. So the daughter was home at that time because it was the summer. And it was -- she helped a lot of the work, but the farmer himself, of course, had to do this when -- She was going to the university in the wintertime.

KAREN BREWSTER: What a great experience to be -- You know, you had that in the Soviet Union, too, to have that local --

DAVID KLEIN: Especially with living with them and you could get how they were so dependent upon what they could grow themselves because it's so costly to buy stuff. Well, they had plenty of land, but they were happy to have -- go out and hunt a few reindeer. And they had these fields that they could produce some hay for feeding the sheep. And they sometimes, usually had -- Yeah, they had a couple of cows, milking. And so they produced this wonderful kind of yogurt that was skyr, which is a special kind of dessert. So what would they have? The primary meals were ham, not ham, mutton, but cooked in various ways. You know, stews. But a lot of this fresh, fried on the frying pan with a good gravy and then boiled potatoes. They could grow potatoes.

KAREN BREWSTER: Right.

DAVID KLEIN: And boiled potatoes. And there'd be some vegetables like, they could grow cabbage and things like that. And they bought some things. Onions, they couldn't grow them there but they used onions as flavoring. But they were pretty standard and sometimes they'd have some fish that you could get. You could get dried cod and it wasn't very expensive because they fished it on the coast areas. And that wasn't too expensive.

KAREN BRWESTER: So where was most of your research based out of then? These farms or did you travel all over the country of Iceland?

DAVID KLEIN: It was mainly this one region on the north side of this big glacier. And we had -- we could use a conventional station wagon or something to travel out into that general area that was provided by the Icelandic government. And then they had to use, also provided by the Icelandic government, some four-wheel drive rig. Well, at that stage, the cheapest four- wheel drive things were military surplus, Russian four-wheel drive. All I can say for them is that they were tough. Because they sounded like they were coming apart and they had to put them in the shop and do maintenance, but they were sort of like big jeeps with a closed cabin. Yeah, then you'd be traveling on roads along ridge tops, where there was no road, it's just old volcanic ash and boulders and stuff. And sheep farmers might have moved a few boulders out of the way. And then we'd get up

there -- there was one, we went as close as we could get on the conventional road and then two of us got out and we started this long hike. And then the other guy had food for two or three days and he went back down and then picked up this four-wheel drive rig and was able to go on a different route. See, the problem is these big rivers, you couldn't cross these rivers, there weren't any bridges except maybe one or two down low where they started fanning out. And so if you wanted to get to this area, you had to go here but then to get just across this canyon you had to go all the way down and come up the other way. Or do it separately.

KAREN BREWSTER: You can't get there from here.

DAVID KLEIN: Sort of, but you could get there but just it had to be a separate expedition.

KAREN BREWSTER: Right.

DAVID KLEIN: But then we did this long hike and finally we got up high and we saw, well, there was -- we knew that we were going to a hut which was like a Wannigan on skids that had been hauled in there associated with the sheep herding. And they didn't tell me at the time, but it was right on one of these canyons' edge, so you could see the canyon there. And I wondered about the water and so I said, "How do you get water there?" And they says, "Well, we've got a spring right there." It turns out it was a hot spring. So we hiked and --

KAREN BREWSTER: It's a pretty luxurious field situation.

DAVID KLEIN: Well, this guy that got there with the truck earlier and there was, I think, one other technician that was based there. And this Wannigan, you know, was about the size of here to the deal, and it had bunks.

KAREN BREWSTER: Is that like twenty feet?

DAVID KLEIN: Yeah. You know, like you could pull it on a tractor on skids, and that's how they got it in there in the wintertime. And it had a little stove that burned kerosene or something like that, and they had to bring that in. But just outside, not too many feet away, was this hot spring and it was like built up in crustacean of stuff. And so it was like a drinking fountain stuff. You could go up there and it was -- it didn't have a lot of bad stuff in it, so you could drink it and it was okay. It didn't have a lot of sulfur and stuff. And you could take this thing -- the temperature of the water was about 100 degrees, and you could take in tea kettle and you had hot water for tea and stuff in a short order of cooking. But then we were hiking back towards this place, then we saw that there was a pool and it was vegetated around this pool, and it was warm water. And they were swimming in it, stripped down and went swimming. And that's when got -- after we hiked the long days, before we had a meal, we did a dip in the hot springs. And it was not -- it was good water, too, it was the same kind of water. And it was a little smoky

colored but not much. And they'd been using this thing for a long time. And so that was very luxurious.

KAREN BRWESTER: Yeah.

DAVID KLEIN: I never expected that, quite like that way.

KAREN BREWSTER: So you have to let your water cool off for drinking water?

DAVID KLEIN: Yeah. You had your water bottle that you brought in with you and they brought maybe a little bit of water because we were frequently not there at that spring. And so we had water in the vehicle in a bigger plastic container. But that was good because the botanist was really -- he knew his stuff pretty well. He was not trained much in wildlife ecology, but he was an excellent botanist. And his major research he was doing and his doctoral degree was based on the nunataks that stick up through the ice with the vegetation on them. So he was -- sort of the world expert was his major professor there at the university in Reykjavik. But he was a top-notch guy. And then the other guy was also an excellent biologist. And they were a good team, they got along really well together. The botanist was gay, I didn't know it at the time, but when I visited him later on in Reykjavik when he was associated with the botanical museum, he had come out of the closet. And he was a little bit different guy because he was getting involved in politics, and he had a lot more self-confidence once he came out too about himself. And the other guy had married this gal and started a family and he was sort of the chief guy for wildlife work in Iceland. So it's fun working with young people that are so good and talented and eager to learn. Of course, I was always eager to learn, but I had the experience and the research and other things that I could draw on. And I felt good about being able to work with them. And I'm always interested as much in people and the cultures and how they lived with the land. And Iceland is just a remarkable place, because they have this Reykjavik, you know, there's no smoke stacks.

KAREN BREWSTER: Right.

DAVID KLEIN: They've got all this hot water and they're up on top of a hill, and they've got this huge swimming that's a public swimming pool and showers and everything, very modern. And then the reasonable sized towns, usually, in most cases have big swimming pools and for the kids in school. And they've had Olympic swimming medalists, which you'd think is unusual for a place --

KAREN BREWSTER: A place like Reykjavik.

DAVID KLEIN: -- Iceland. And there's like only about 300,000 people in all of Iceland.

KAREN BREWSTER: So what years was it that you were going to Iceland when you worked with these two young guys?

DAVID KLEIN: It was in the early 1980's, I think. But I'll have to check the dates on those.

KAREN BREWSTER: So did you end up publishing with those guys?

DAVID KLEIN: No, I don't think I published anything there because they had to make reports in Icelandic for what they did, and they presented papers at the International Symposium on their work and my work wasn't -- they acknowledged help but I wasn't involved in the research, directly.

KAREN BREWSTER: You were just sort of showing them how to do habitat-based research?

DAVID KLEIN: Right. And then we arranged -- we helped them arrange an opportunity for them to do more education in, I think it was Sweden, when we did the International Reindeer/Caribou Symposium there. And so they were able to do more Swedish work. But we had, you know, we've had connections, the University of Alaska, with the Icelandic people. And we had one guy who's on the faculty now in UAA, who's an expert on lichens and on tree line vegetation and really a nice guy. He did some work with collaboration with me and Bob White when we were doing some modeling work on the North Slope. And I'll think of his name. And we would have -- I did this course, graduate course, on herbivory and we labeled it grazing ecology, I think. And we'd have this, as part of the course -- it was a graduate level or upper division, and we'd go out in late winter and stay in this cabin in Cantwell. And he would come up and bring a grad student. So here was UAA and UAF working together, which is a good deal, and it was good for the students to get mixed there in the field. And we'd go out in the field together. And Bart -- Bart Sveinbjornson [sp?] is his name. He's a nice guy and good guy to have on the faculty down there in Anchorage.

KAREN BREWSTER: So then, was it just that one project with those guys or did you do other work in Iceland?

DAVID KLEIN: I got around and they showed me around, so I became familiar with the Soil Conservation Service, too. Sometimes when I was over there I'd go out with them and they'd show me some of these places where they're starting to grow trees, where they can grow usually conifers of different kinds that grow at that latitude but the seeds have never got there before. And, of course, they would have been cut down and used when there weren't enough, but now they're starting to produce wood themselves for telephone poles and fences and stuff like that, and some lumber. But Iceland, in Reykjavik there's no wood framed houses, because they don't have any wood. Or I shouldn't say no, but virtually none. And so they're all concrete and they can be extremely cold unless they're designed properly. But on the other hand, there's a lot of mass there and if they get warm they don't cool off so much and they hold the heat better. And, of course, they like to have windows, but virtually no landscaping. It's starting to change now but they didn't have -- the Vikings didn't have landscaping.

KAREN BREWSTER: No. Well, you were there a little bit more recently than the Vikings.

DAVID KLEIN: But even in early days in Norway when I was over there, the rural areas, you know, you're surprised that there is no landscaping around the houses. And that was sort of the way in New England where I lived in Vermont. You frequently wanted snow to drift up around the base of your house because they weren't insulated very well and sealed very well. And they used to -- one technique to reduce heat loss in New England in these old houses, which were part of farmstead or something, is you had this -- you built out a deal with some boards and then you took all leaves from the trees, and you put them in there. So you use this -- you had about this high --

KAREN BREWSTER: Like three feet.

DAVID KLEIN: -- around the base of the concrete or stone.

KAREN BREWSTER: Yeah, so like two or three feet wide insulation around the base?

DAVID KLEIN: Yeah, and all around the house.

KAREN BREWSTER: Yeah, that makes sense.

DAVID KLEIN: So that stopped any -- if you had wind, stop the wind from blowing but it was insulation, too. And you were getting heat loss from the house itself and this would reduce the heat loss because they were very poorly insulated in the walls in those early days.

KAREN BREWSTER: So what about Greenland, when did you first go there and why?

DAVID KLEIN: The first time I went there was, let's see.

KAREN BREWSTER: For one of those symposiums, maybe?

DAVID KLEIN: I've been there so many times, but the first time I went was when we had a post-doc -- Well, he wasn't a post-doc, he was a grad student who had finished -- in Europe at that time, a doctorate degree was at least ten years. And you did it necessarily -- a lot of the work, you do the final write-up after about ten years. And so you had to have a lot of research and then it was like a monograph and you had to defend that, so you didn't have to do a lot of time at the university but you had to do a lot of time getting the data and what. So this one student had been -- Did I meet him when I was working on the roe deer? Yeah. No, he wasn't there. But I think I did because he was a student then in Denmark in biology. And he then -- he and his wife managed to get some funding. I met him and I met -- he was working part-time at this research station where I was working on the roe deer. And so I got the funding for -- while got some funding, and then he was able to get some Danish money for study abroad. And he and his wife -- she was his wife then, I think they were already married, but they deliberately hadn't had kids because

they both wanted to finish their education. And she was in exercise physiology, so she -- both of them came over here and she took some courses here and he did, too. And he did some work with me, mainly with me then, out on the -- a little bit with Bob White but mainly with me, and the funding was through the wildlife unit that I had. And we worked out on the Western Arctic Caribou Herd where I had a student studying foraging behavior in late winter on the Western Arctic Herd. And we lived in a big white wall tent with a big wood stove in a little valley that had some trees, but most of it was open tundra around there so it was not too far from Kotzebue flying in to get there. And so he wanted to do a project. The student I had was doing a master's project on the behavior and energetic cost of foraging time in different types of habitat that was there. And then the Danish student, he said he wanted to work on the energy costs for the animal of foraging. So what -- how much was involved in actually digging a crater, a feeding crater? And they'd get data by observing. The two of them could work together because they were getting somewhat similar information but they were using it differently, or collecting data differently and for different projects. And they worked perfect, they were good. They worked well and bring a long bond of friendship. And I spent time out in the field on the Seward Peninsula with them and that was -- on the Seward Peninsula, as well as up in the Waring Hills [Waring Mountains] where the -- we had this camp in the mountains. We always used that type of winter camp. And if wood was available, it was wonderful to have a wood stove and you could -- This was in late winter when temperatures would drop down to thirty below at night. And we should have had, but we couldn't afford at the wildlife unit, a double canvas. But these were pretty good because we'd make a bed up high and then have a couple of logs and then have it down to the ground where you had the stove, so you could sit on the -- and then you'd put piles on the bed and then your air mattress on top of those. And if you're lucky and had some caribou or reindeer skins, you could put those down first and they were really very comfortable. And those guys just loved that, as was well as did I. We spent time cutting a little wood but we could handle all that. So he did a -- the Dane did a nice write-up and we got that published in the biological papers of the university.

KAREN BREWSTER: But he did that when he came here?

DAVID KLEIN: Yeah. So then he went back and then he was working on his PhD in Greenland, in west Greenland, on the caribou. Then he invited me to come over. He got some money to allow me to -- partly pay for coming over, and spending a couple of weeks with him. And his wife was in the field with him. They had a -- they were based at this airfield that had been -- during the war was U.S. military and then gradually it became Danish. And Søndre Strømfjord, now they gave it an Icelandic name, it's called Kangerlussuaq. But it's the main flights can come in there from Copenhagen, so it wasn't all that expensive, whereas if you went some place in Greenland, now once you got there by air then it's really expensive, 'cause they have to use big enough planes that -- but also didn't land on little strips and none of the villages don't have any and they have to use helicopters to get around, etc.

KAREN BREWSTER: This was in western Greenland?

DAVID KLEIN: This is in west Greenland, right. So these were caribou that had been there from earliest explorers, and there were no wolves there. Wolves had never got there. The caribou, it was assumed, came across the ice on the Baffin Bay and Davis Strait from Canada, the Arctic Canada Archipelago. But they were obviously a long time ago. But wolves never made it across. And they were -- later DNA work showed that they weren't Peary caribou from the northern Canada, northern most Canada, they were barren-ground caribou like the caribou in the big herds in northern Canada.

KAREN BREWSTER: But they were able to adapt?

DAVID KLEIN: Pardon?

KAREN BREWSTER: Isn't barren-ground caribou -- isn't their habitat a little bit different than they'd find in Greenland?

DAVID KLEIN: Habitat is what?

KAREN BREWSTER: A little bit different than what they would find when they got to Greenland?

DAVID KLEIN: Well, not in west Greenland. West Greenland is an unique place in that it's -- you have quite a bit of area between the ice cap and the sea. And so there's big fjords that go way in and close to the ice cap almost, sometimes close enough so that you're getting ice going into the fjords. But traditionally the archeological work showed that the Native people would make expeditions with big skin boats, whole community, family, extended families and what. And a couple of kayaks and some sleds and they would go in by boat, by skin boat, and then -- or go in sleds on the ice in the fjords in late winter, yeah, just about late winter when the land is already pretty free of snow and they would go over land into these lakes systems where the caribou were moving seasonally from out closer to the sea inland to the mountains -- the ice -- in search for the best food for them. When they were close to the inland ice, there were not many lichens there because it was so dry they didn't grow well and they grow slowly and caribou would eat them faster than they could grow. But you had a lot of other vegetation and it was good summer range because you had enough precipitation so that you could have vegetation, sedges and grasses, and dwarf willows and stuff. Then if you go out to the western coast, closer to the sea, then there's more precipitation, the snow would be deeper so frequently it would be too deep for the caribou to dig through to get lichens. But lichens grew well out there, so there was this transition, gradual increase in lichens as you went to the coast, but the availability to the caribou was dependent on snow and how the snow fell, etc. And then what was controlling the population because the harvest by Native people was not -- they were mainly living off the sea even though they'd made expeditions and live at certain times of year in where they could harvest a lot of caribou. And then they'd go back to their villages and go -- so their whole lives were seasonal in relationship to what was the best way to harvest food for them. So they were mainly marine mammal and fish dependent people, but they did these big harvests. And we could go to an archaeological site where they did this. And one place where they did the hunting was a narrow valley, it

was very narrow and this stream, it wasn't a roaring stream, it was a clear water stream, too. Had fish in it. But the bank was eroding there and it was kind of mountainous around there so it had had more ice earlier at times, but people, you could see these old traps where they would -- and blinds that they built with rocks and they would -- right where they'd arrange the rocks so they could only move on this narrow trail and then they could --

KAREN BREWSTER: Oh yeah, they herded the --

DAVID KLEIN: Herded them

KAREN BREWSTER: -- caribou.

DAVID KLEIN: This other place where they went with their boats and kayaks, well, there just the bank was eroding and it's just loaded with caribou bones, and occasionally you could find an all broken flint point or something. But then the other place where they went, it was -- the way they harvested mostly was -- this was a big social event for the Natives. And then a lot of good archaeological work there that showed how they'd line up rocks to make it look like people from a distance.

KAREN BREWSTER: Yeah, the Inuksuk.

DAVID KLEIN: Yeah.

KAREN BREWSTER: Yeah, that's all like what they did in Anaktuvuk Pass area.

DAVID KLEIN: Right. And then they would -- these would funnel down to an hourglass shaped lake and then they would swim across the lake. Well, this is where they used their kayaks, and they would spear the caribou when they were swimming. But while they were driving them, they would have people hiding behind rocks and you could make some kills that way. But they also had this -- rocks, flat rocks up on the nice slope that was on a hill. It was kind of like a game of hop-scotch. And, yeah, you could still use it and jump from one to another and it would go. And it was a hundred yards long. And so people waiting for the caribou to come could have something to occupy them. Then they had places where they had to -- almost like winter homes but not quite, where they would have fires using willow mainly, dead willow, because there were some places with willow this high. There they would -- obviously when they go in there -- they're not using these -- weren't using these at this time, but it wasn't very long before that that they were being used.

KAREN BREWSTER: So when was it you started going to Greenland?

DAVID KLEIN: It was in the '80's sometime.

KAREN BREWSTER: Also in the '80's?

DAVID KLEIN: I think, yeah. So then I spent some time there and it was just terrific.

KAREN BREWSTER: Did you have a particular research focus you were looking at?

DAVID KLEIN: Well again, they wanted me to come and go with them so I could see what the terrain was like. And he's doing his PhD and so he wants ideas of how he should approach this.

KAREN BREWSTER: Okay.

DAVID KLEIN: And so I did that. And it was -- Both he and his wife were terrific and it was nice that she could be out there with him. So she took leave from her education while she was out there and helped out in the field and cooked and stuff, and when we did long hikes. It was good hiking. And she was always involved, too. And they were in top-notch physical condition, as was I. And sometimes we were in close enough so you could see the ice and we'd hike up there. But the situation is you have this big mass of ice and they get -- collects the moisture out of the air and turns it into snow and ice. And then you get this cold air drainage when it's cold, cold weather, you get the cold air drainage from up high. By the time it gets down to the edge, it's a wind, a strong wind. It's called a foehn wind. And that wind can be really powerful and you have to be careful with the tent, if you've got a good tent that can suffer that. But it maybe keep you awake all night with a thing.

KAREN BREWSTER: And how do you spell it?

DAVID KLEIN: F, furn, F-U-R-N, I think. [foehn]

KAREN BREWSTER: And that's --

DAVID KLEIN: I have to look it up.

KAREN BREWSTER: Is that a Scandinavian word?

DAVID KLEIN: Yeah. And it's used in describing those types of winds in all the places where you have glaciers. And, so, yeah, I always felt at the time that I was not giving enough for what they were getting, paying for to get me over there to work, as an assistant, not as an assistant but as an advisor. But we had a really strong relationship develop between us because of his work over here and I worked with him in the field over here. And he's just a really top-notch dedicated guy.

KAREN BREWSTER: Well, it's just that -- brings up a point that some of all this work is not just the science, it's the relationship you build with each other and then that fosters ideas and collaborations.

DAVID KLEIN: Exactly.

KAREN BREWSTER: How much you just learn from each other.

DAVID KLEIN: And I had the experience of how we would tackle something like this here in Alaska. And he knows the constraints on tackling it and was learning the constraints on tackling it in Greenland. And he was getting a lot of experience and then, subsequently they lived in Greenland after he finished. Well, even before he finished the degree he was still doing research and they were living in Nuuk rather than flying back and forth. His wife then, her training was she had a teaching certificate so she started teaching, especially physical education, but also in general in the local schools. And, of course, they were using Danish in the schools and she could handle that. She could handle English well. And they were learning a little bit of -- and especially Henning was learning a little bit of Greenlandic Inuit.

KAREN BREWSTER: Kaggalik, I think it's called. I think the dialect is Kaggalik or Kangalik or something [Kalaallit]. And so what was this guy's name? You just said his name.

DAVID KLEIN: Henning is his first name. H-E-N-N-I-N-G. And his last name, T-H-I-N-G. Thing.

KAREN BREWSTER: Henning Thing.

DAVID KLEIN: Henning Thing.

KAREN BREWSTER: And he was Danish?

DAVID KLEIN: Yeah. His wife was born in Poland, and she and her mother migrated to Denmark associated with the Second World War.

KAREN BREWSTER: And now -- So did you do other -- after you finished helping him, did you do other research in Greenland?

DAVID KLEIN: Yeah. And then for that, while he was becoming -- Henning was becoming sort of an expert on wildlife in Greenland. And he worked well with the Greenlandic government when it came about, as well as the Danish government. And then he was -- over here he made contacts with grad students and the one grad student that was a close friend and he was one that was doing studies up on caribou and relative to the pipeline, and how caribou movements were being affected by the pipeline. Dan Roby. And so Dan Roby was working on a master's degree with me on that aspect of it, and so they got to know one another while they were here. And Henning got up on the North Slope once with him, I think, and got familiar with that operation. And then when Dan finished his master's degree, I think he worked for Fish and Game for a short time here in Fairbanks, still doing work up there with caribou.

KAREN BREWSTER: He's the one in Oregon now?

DAVID KLEIN: Yeah. So then he -- Henning had some funding for some of his research and for other work in Greenland and he wanted -- they had funding for an assistant and so he asked about the possibility of Dan going over there as his assistant. And frankly, I thought that would just be terrific because Dan was developing to be just a really a top-notch student, but his interests were broad and he was interested in marine birds, too, and doing some work with them. And one of the projects that Henning had to deal with was to go up to Thule and look at distribution of caribou up there because they would be Peary caribou that had come across from Ellesmere Island in the narrow strait there that is -- at least portions of it are frozen over in the winter. And so it was known that they're there periodically, but they didn't know whether they were a resident population or what. So they went up there and then they -- Dan saw -- they lived in one of these little Native villages and the Natives were -- in the springtime they were harvesting these little dovekies, little seabirds, and they used a net and they get down in so they can catch them in flight. And so they tied in with the interests of the Danish government and Greenlandic interests, but mainly it was Danish government interest, in banding some of these birds. Working there with the Natives, so that they had some money so that they could hire the Natives to help catch them and teach them how to do it. Both Henning and Dan just -- this was frosting on the cake. It was just a wonderful experience and helped stimulate even more Dan's interest in marine bird physiology and ecology. But then the two of them worked together on the caribou work, and they sometimes -- Dan's a big, husky guy. And Henning is husky, but he wasn't as big a frame and sometimes they would have these heavy loads they were carrying. The two of them. At the same time, I was -- when I've been in the field with Henning in east Greenland, I was over there again for work with muskoxen and that was relating to the -- this was later, and relating to the proposed oil exploration by Amoco who had gotten a -- made a deal with Greenland and the Greenlandic government to do seismic exploration on this peninsula called Jameson Land. In east Greenland, the ice is usually closer to the sea there but this one deal that -- and so it's more of a narrow corridor. But there's not many people on the east compared to the west because this ice hangs out close to the shore all summer long. It doesn't melt away completely usually and so getting a ship in there is sometimes --

KAREN BREWSTER: And there's not as much usable coastline because there's more ice right up to the edge?

DAVID KLEIN: Except for Jameson Land, where it's mostly --

KAREN BREWSTER: Jamison Land?

DAVID KLEIN: Jameson Land. Probably has a different Greenlandic name. And there was one village close to the one end of Jameson Land, but there that's -- the muskoxen density was higher there than any other place originally in Greenland. And naturally. And they also had -- wolves had gotten down there. They'd come around to the top and where there was scattered places where there had been muskoxen and there's Arctic hares, and a lot is the same as in northern Canada. And there were Peary caribou or Peary caribou like in northeast Greenland and they died out about 500 years ago, 600 years ago. So you

could still find antlers there. And that was -- there's one antler is one that I picked up, that's up there on the wall.

KAREN BREWSTER: That's up on your wall.

DAVID KLEIN: From -- they're an extinct subspecies of caribou. But they were there when the explorers went there around the turn of the century, just before the turn of the century, end of the 1800's. There was a sailing ship that went there and they went ashore and there were lots of caribou on Jameson Land. And they shot some and they brought the skin and bones back from one to the Copenhagen Museum. And then there was like five or six years before another expedition, sailing expedition, got there. At that time, I don't think there was any village. The villages had been moved north like the Canadians did from Angmagssalik [also spelled Ammassalik and now called Tasiilaq] when the south part of -- southeast Greenland. At any rate, the caribou were gone. They had died. And there was one guy, a senior biologist, who had done a lot of work in the old school way and a really diligent and hardworking guy. But he kept -- he did a lot of work based upon interviewing local people, the priest, and also he had data from a shipment of skins of caribou, which were valuable in those days. And it was all -- everything had to be monitored closely because this was a colony of Denmark then. And so the big companies that handled that trade and the government wanted everything to be recorded. And including the number of ptarmigan that were killed and shipped out, the number of caribou, the number of seals, and all the marine mammals and stuff. So this Danish biologist was able to kind of reconstruct a lot of the history of the Danish -- of the caribou in that area. But not very much because it's like a different county on the other side with the ice in between and no communication in between. And then --

KAREN BREWSTER: And so you were there to look at the muskox population? You were there to -- in relation to this Amoco development?

DAVID KLEIN: Yeah.

KAREN BREWSTER: So what was it that you were doing?

DAVID KLEIN: We were trying to -- I was working with Henning and a veterinarian and a team from the -- Well, the guy I'd worked with in Denmark on roe deer, he was head of one of the expeditions, one of the study groups. And he and Henning suggested that I come over and work with him. And I brought another grad student with me, Kent Jingfors, who was a Swede who'd worked in Canada and he'd done some work as an undergraduate student in Canada on muskoxen in the Canadian Arctic and then he applied for a master's with me. And he came, and was just another -- he and Dan Roby worked together. Dan assisted him when he was doing his muskox work in Sadlerochit area on --

KAREN BREWSTER: The North Slope.

DAVID KLEIN: -- the Arctic Refuge.

KAREN BREWSTER: So how do you spell --

DAVID KLEIN: They were a good team.

KAREN BREWSTER: How do you spell Kent's last name?

DAVID KLEIN: J-I-N-G-F-O-R-S, I think. Jingfors.

KAREN BREWSTER: Okay.

DAVID KLEIN: And so he later became head of the -- He was Canadian citizenship even though he was originally from Sweden. And he later became head of the Yukon Territorial Wildlife Branch. And I think he's retired now. But he was a terrific guy, and he was like -- he and Dan were very similar, you know, big, husky guys and could handle skiing and all this.

KAREN BREWSTER: Well, you handled all that, even though -- Maybe you used to be a big, husky guy?

DAVID KLEIN: Yeah, that's one reason why we all got along so well. Then Kent came over and worked with us with the muskoxen and he had a lot of knowledge about muskoxen and that was good. But what they were doing primarily is -- they wanted to know if Amoco was required to determine -- to pay for environmental studies. And they were going to do seismic research, which is explosions. You know, drill a shallow hole and you explode it and you have instruments on the surface that tell you a bit about the structure underneath. But that terrain was -- it was all glacier outwash, mostly, and so it wasn't -- permafrost wasn't a factor. You could run a small tracked deal, and a big helicopter could lift it from place to place and they could drill these holes and then rig them up. But this was right in the area where the muskox were in the summer and pretty good concentrations, so there'd be bands of muskoxen here and there. So the approach they were using was to -- they wanted to know if -- what would be the -- how would the muskoxen respond to these explosions, 'cause they would be close by to where they would be foraging sometimes.

And then if they broke up in a group, if they were close to the explosions, was there mixing between other groups? So how frequently did they mix with other groups and how frequently was the exchange? Well, how do you figure that out? Well, one way is to live capture, dart the animals. And then we put ear tags with a big plastic number that you could read with binoculars or spotting scope from a distance.

KAREN BREWSTER: Yeah, I was going to say you mark each one with colored paint, but putting an ear tag in was probably better.

DAVID KLEIN: No, we had to know the individual animals. Had to have numbers because we had to know whether those individuals were in the next group we saw or were they mixing naturally. We needed to get all that information. So they did a -- And

they had the veterinarian along because they were darting these animals with a drug and they wanted to be sure they had minimum mortality involved in doing this. And then they -- so how do you get close to a -- safely, to shoot these things with a dart? Because they can be very dangerous if they take it -- if they're chasing you, a big bull or something. There are no trees to climb, and so you -- and you can't rely on just shooting them. So they got -- they hired a Native from the village. It was legal for them to hunt muskoxen and one of the things they wanted, too, to learn, not them, but the Danish and Greenlandic government, relative to managing the harvest of the muskoxen, as long as there were plenty of animals, taking some on a limited quota would be okay and these people were most happy because they didn't have that much available to them over there, there were marine mammals and birds but that was somewhat seasonal. But they could go out in the wintertime and hunt muskoxen and they found that -- they learned that it's bad to kill a big muskox in a group because they're going to be responding to you as -- they're going to bunch up and then how do you get to this animal that's laying on the ground because they don't know the difference.

KAREN BREWSTER: Right, they just see it hit the ground.

DAVID KLEIN: Yeah. So at any rate, what the strategy was to -- When the Natives learned of hunting muskoxen, at first they realized it was a disaster to break up groups by hunting, through hunting. It was better to hunt small groups and kill all of the animals in a group. And they found that the best way to do this where they could get close to -- hold the animals and get close was with dogs that are sled dogs that are trained for hunting muskoxen. So that the muskoxen respond to the dogs as they would to wolves. They form their defensive circle and hold their ground, and the dogs are trained to run around and bark, but not to go in too close. And so that was good and so they -- I went over there with Kent and they had already learned the technique and it was working well.

KAREN BREWSTER: So they were using this technique of hunting this -- They were applying it to the darting or were they actually hunting the muskoxen?

DAVID KLEIN: Who?

KAREN BREWSTER: Kent and you guys for the research.

DAVID KLEIN: We were working with the effort to mark them, which meant hunting them but not killing them.

KAREN BREWSTER: Right, exactly, that's my point. Yeah, you were using the hunting techniques but you were just darting the --

DAVID KLEIN: The Native guy, who had been trained to --

KAREN BREWSTER: He was the good shot.

DAVID KLEIN: He was the hunter and it was his dogs.

KAREN BREWSTER: Right. But you were not killing the muskoxen?

DAVID KLEIN: No.

KAREN BREWSTER: No.

DAVID KLEIN: We used two dogs, his dogs. At the camp, the tent camp, you know, we kept the dogs chained up and fed them food that we'd bought for them. And then when we'd go out, we took the dogs on chain leashes, and two dogs so they weren't running free. And we'd hiked across the terrain until we saw a group of muskoxen we thought we could work with. So then we tried to do all this without exposing ourselves to the muskoxen, and then we'd try to sneak as close as we could get with controlling the dogs. And then when we got as close as we could get or if they started moving before and saw us, we would release the dogs. The dogs would run like hell and the muskoxen would -- they liked to go up on a little knoll to form a circle so they would run up and get on a knoll, any high ground even if it was just slightly. And they'd form their circle with the calves in the center and they'd put their butts right together touching one another. And so then, we'd go up when the dogs were -- got them localized and were rushing around barking. Then we would go in, carefully, and you could call off the dogs, they were trained to be called off and we put them back on their leash. Not until though the hunter got up close. So this made it safe for the hunter to go because they were -- the muskoxen are focused on the dogs then the hunter you'd get fairly close because you're shooting a dart and you can't be too far away. It's only going to go so far. And you want it to have enough power to get and release the --

KAREN BREWSTER: Yeah, muskox have that thick --

DAVID KLEIN: And you had to be careful that you hit in the rump or someplace where there was a lot of muscle tissue and not a bone close to the surface.

KAREN BREWSTER: And muskox have all that fur and thick hide.

DAVID KLEIN: And it's thinner over their rump, and so you want to hit it then and be very specific. And this guy was a good -- he knew what to do and he had a belt with different charges marked in the -- he knew, he learned, with different charges. So if it was a big one, he used a greater syringe with greater amount of drug in it. If it was a young one or smaller one -- but we didn't mess with the calves at all.

KAREN BREWSTER: Right.

DAVID KLEIN: So then if you had say, five to seven adults in a group with say three calves, then we had to be really careful over there. And as soon as he would dart all of the adults, and by that I mean all but the non-calves. But the calves. We didn't dart them. And they would go down sequentially but they would stay right there. The others that were not darted, they wouldn't go away because here were the animals all together and

they stayed together. And then finally had all the adults down. And then we rushed in and got the dogs in so the dogs wouldn't go in and bite them, and then we'd tied the dogs down to a rock or something with their chains away from there. And then we'd go in and the vet would immediately get blood samples and we would collect some qiviut, a little bit, but we put on the ear tags. But we had to be fast because you shouldn't have these animals down without breathing for -- ruminants like that. And you had to be sure that they're all laying in a position they weren't going to get any draining or they got stuff into their throat, which would kill them probably in the long run. So we were rushing around doing this thing and getting the ear tags on, but we always stayed together and worked around so the calves would stay on the opposite side of the group that was down on the ground. Because we didn't want to scare the calves because then they may become orphaned calves and not rejoin properly and try to join up with other groups where there was no mom. And so at any rate, while I was there we marked another thirty animals. We did kill one female that we had -- the first one went in and we thought it had hit a bone because the animal didn't go down. And they gave it another charge, and maybe it worked its way out of the bone and released the drugs so that it got an overdose and it died.

KAREN BREWSTER: But you had dinner.

DAVID KLEIN: Pardon?

KAREN BREWSTER: You had dinner because of that.

DAVID KLEIN: Yeah we did, and the dogs did too. We learned a lot from it because we skinned it and could see how the fat was distributed at that time of the year.

KAREN BREWSTER: So what else did you learn about?

DAVID KLEIN: So then we -- I should say that just before I'd gotten there, they had marked some and it was working. And that's when one of these dogs, a younger one, was a little too eager and it rushed in there and got hooked by an adult muskoxen and thrown through the air.

KAREN BREWSTER: Oh yeah. I think you told me that before.

DAVID KLEIN: Yeah, and the guts were all spilled out. And they gathered it up and the veterinarian put some sulfur drugs in through there to try to eliminate any infections and sewed it up. They took it back to the camp and tied it up there and they had to get another one flown out, so they'd have two dogs. And finally it was -- it recovered fine and they took it back to the village and was able to use it again for hunting and sled pulling.

KAREN BREWSTER: I wonder if that dog wanted to ever go near a muskox again.

DAVID KLEIN: But then after we had them marked then we would -- did some observations of them where they couldn't see us from ridges and areas where we could

view. Where they were going to be doing the seismic work. And so we had close contact with one of the -- this very nice woman who was in charge of these environmental studies which we knew well from -- I'd known her from the other studies. So she would sometimes get helicoptered in from the Amoco camp while we were getting everything organized. It was terrific. She was a beautiful woman, Danish woman, and very intelligent and in the camp, you know, the helicopter pilots loved to fly her. So she came flying in with this helicopter pilot and that day we'd discovered that -- On some hiking that there was a flush of mushrooms that were growing on the roots of willows. And, man, they were edible, one of the edible mushrooms. So we gathered up a few and she came in with the pilot and we were in these little tents and squeezed in there and said, "We've got all these nice mushrooms which we're going to cook up, can you come back, hitch back, and have dinner with us?" And she said, "Well, I don't know." And the pilot said, "Oh, I think we could probably organize that." But he was working under other orders. So then she came back in the evening. And we had a little gas stove, you know, for cooking. But we all squeezed into it [the tent] and it was kind of foggy then and miserable out, cool outside, so this was fine. We're all in the tent. And this young pilot, who was Canadian, he was Canadian and the company that was flying the helicopters apparently was Canadian. He was a nice young guy. And he just loved this whole operation. And so here we are with this beautiful Danish woman, and she brought -- she was able to, with some encouragement from this helicopter pilot, get an already cooked roast beef, and brought that out. So we had this luxurious meal there. And she joined us and then she then got helicoptered back to spend the night in the deal. So at any rate, then they finally -- we coordinated when they were going to do the seismic work, and, of course, it had to be when it couldn't be super foggy, which it sometimes was, because we had to see the animals. And we were up on a ridge top far away but with the spotting scopes we could see them closely and read numbers and stuff. And then they had set these things off and then they could fire them remotely.

KAREN BREWSTER: The seismic things?

DAVID KLEIN: Yeah, the explosion. So they did that, and, yeah, they got pictures and a puff of dirt went flying in the air. And from a distance it looked --and we could hear the bang. The muskoxen hardly -- I mean, they looked over at this. And the explosion was only a couple hundred yards away from where they were. And they looked in that direction, and the dust settled and they just went on feeding. So it didn't --

KAREN BREWSTER: It didn't bother them.

DAVID KLEIN: It didn't bother them.

KAREN BREWSTER: Now is that perhaps because it's a population that's used to being hunted, so the sounds don't bother them? Is it a similar sound?

DAVID KLEIN: No, we observed other unmarked groups, too. And that wasn't the only one where they were doing the seismic work. And -- or we sometimes broke up into two groups. And the other groups reacted about the same way. And it makes sense, because if

you're in close to the -- there were glaciers, and you'd have these big icebergs that would crack and you'd hear this crash and it was just part of the sounds of the environment. And unless you see something moving that you can associate with that. And the same with studies on the North Slope with the caribou, and the gas line for example, you know what would be the pumping station with a gas line, the sound of this thing going? So they simulated it up there. I wasn't involved in that study. That was done through a consulting firm. And they took movies of the caribou moving through the area in migration and some of that was in the Arctic Refuge or it was close to Arctic Village. And the caribou was -- a continuous sound like that, it was like a waterfall or something. They just came on through and it was a -- there was box that it was coming out of, but they didn't pay attention to it because there was no movement. Whereas on the oil field, we saw the same thing, too, that oil well, while they were drilling it, it was a horrible noise of the diesel engine, and "bang, bang." And as long as there was no movement on the pad, like vehicles moving around or people walking around out on the pad, caribou would be feeding through the area or laying down and resting and they wouldn't pay any attention to this. They wouldn't avoid this sound. They would avoid it if there was any movement of people or vehicles. And we found the same with the Haul Road and the pipeline, in general. It was activity of people. And when we saw other things that -- like the Haul Road, wolves were killing more animals close to the Haul Road than away from it. So the wolves were not a bit disturbed by the vehicles. Of course, some of them were being fed, but then -- This was what Dan Roby was getting information on. The wolves would -- where the Haul Road was elevated, especially if it was a slight hill, you couldn't see across to the side. So if there were animals on one side, they couldn't see the animals on the other side. And the wolves, when they're hunting, they would not go hunt on the road surface, necessarily, they would be hunting and then they would come to a place where there might be caribou on the other side of the road. And if you're way up high in an airplane or helicopter, you could see this, and there was some of this observed from the air, as well. The wolves would sneak up and use the road as a platform, very cautiously, to look over and see if there were any caribou laying down on the other side. And, of course, for killing caribou, if you can make a rush and get them when they're just getting up, you can reach them. But if they have a chance to run -- The whole strategy of caribou is being in groups, being in open terrain, and then move out before wolves can get close enough to actually make an attack, a successful attack. So we were seeing this kind of stuff. And it's like the studies, too, showed that what was deflecting the caribou up there, frequently, other than the pipeline and the Haul Road, was riparian shrubs along the rivers. And caribou would be moving and want to go through that. The bulls would usually go right through without much bother. But females with young calves were cautious and --

KAREN BREWSTER: They knew something was hiding in the bushes.

DAVID KLEIN: None of them wanted to be the leaders of that though. And finally, the whole group wanted to get across and they move rapidly through -- much more rapidly than the males. They wouldn't stop to feed on the new leaves of willows, which are good foraging.

KAREN BREWSTER: Well, no, they know something could be hiding there in those bushes.

DAVID KLEIN: Exactly, exactly. So then they'd get through and then they'd settle down when they got on the other side. So there were a lot of things like that that were collected incidental to all of these studies and collectively was important. But it ain't that simple when you have to deal with the oil industry and they don't have a clue about ecology and behavior of animals.

KAREN BREWSTER: So that these muskoxen in Greenland who were not bothered by the seismic explosion noises, that gave Amoco the go-ahead to just do what they were doing?

DAVID KLEIN: Sort of. There was also a lot of geese in some of the wetland areas there and they were -- during the flightless period when the young geese were still -- didn't have flight. And the adults were flightless. What would be the effect on that? I mean, the geese could just fly away normally but if they've got young they can't fly, they can't fly away. And the adults, when they're flightless and the young can't fly away. So they did some similar studies and the geese were more disturbed by the deal than the muskoxen. And we didn't have the history on whether they'd been hunted, the geese had been hunted before they arrived there and their migration.

[phone ringing, break in tape]

DAVID KLEIN: So there was some interesting things that I should mention, too. One is -- this was when -- during the, I think it was the Reagan administration. And so my way was going to be paid to go over there, so it wasn't as if I had to use U.S. money, but my salary, of course, was -- I was working for the Fish and Wildlife Service. So you're required to get approval for foreign travel. Had to go through the Secretary of the Interior, I think. So I had to submit this -- I talked to my supervisor in Washington and he said, "Yeah, that shouldn't be a problem since we're not having to foot the bill and it'll be -- it's your area of expertise, and this is great, and especially it's another country." He was a good guy and appreciated that value of working internationally in science. So surprisingly, the thing was rejected. My travel was rejected. Or it could not be approved until I explained what would be the benefits to the United States. And so I quickly, in talking with the Danes, I said, "It's obvious. It's an American company, oil company. If they find oil, the United States would be beneficiaries of getting oil -- a market for their oil. But they also had foreign oil that they could depend on." So I sent that in, and oh, they bought into that right away, and approved it. And then finally when the letter came authorizing travel, unbelievable, there was a standard letter that warned you about working in a socialist country. I couldn't believe it. And Denmark was a socialist country and, you know, that you have to be careful. And sort of implied that you could be brainwashed. I mean, it was just stupid mentality at that time.

KAREN BREWSTER: That was the Reagan --

DAVID KLEIN: Reagan administration.

KAREN BREWSTER: Do you still have that letter somewhere in your files?
That would be fun to read.

DAVID KLEIN: I might. I hope I do, but I haven't gone through all those old files. That was amazing.

KAREN BREWSTER: So did you do other work in Greenland?

DAVID KLEIN: Yeah.

KAREN BREWSTER: What else did you do?

DAVID KLEIN: This was just sort of the beginning. And then, let's see, I did that, and then we had the International Arctic Ungulate Conference in Greenland in Nuuk. And I was able to get several of my students over. And that was terrific, because we went to Copenhagen and we stayed -- that veterinarian who was a great guy. He was sort of a freelance veterinarian.

KAREN BREWSTER: He was a Danish vet?

DAVID KLEIN: Yeah, but he -- he had bought -- he had been married and then divorced and he had a son that he raised. And he had bought this old house, beautiful mansion-like house, on an island in a lake in Copenhagen. But it was like, who'd want to live on an island because how do you get -- and work? If you could get to the other side to a store, it was right on the tram line. But what happens when it's freezing up and not frozen up and stuff. He was just an amazing guy. And he had his -- they kept a little boat with an outboard. They could dock it right there by the train station. And he worked in town and the boy went to school, and they could go in together and then they'd meet up and go back in the boat. But what about when the ice was freezing, when it's solid, and some years it would never be solid but in most years it would be. Well, then it's not a problem, you'd just ski across to the landing or walk across on the ice. But when it's freezing and breaking up, it's dangerous as hell. Well, they found techniques. One of them was got these long poles, and then you use them like skis and you could go across this thin ice when it's just freezing up. And you spread your weight over such a vast area, it would work fine. And they would do it together, and taught the kids and both of them learned how to do this safely. They never had any problems. But then they started doing renovating of this house. It was a mansion, but it was a beautiful place. And it had -- they had ducks and geese and chickens there that were free ranging. And they had goats at one time. And it was just such an interesting place. And so when we went to Greenland, we had a couple days of layover there in Denmark, and he volunteered, he said, "Well, we can give you cheap housing out there. You won't have to pay anything. And we'll try to rig up some way, if you could chip in a little bit for the food, we can --" He had another girlfriend, who was a good cook, and so they would put together, in this old-fashioned kitchen with a big stove and everything, would cook this fabulous meal. And, of course,

they had lots of --and we could stay there. And we had brought sleeping bags anyway because we were going to be camping out on an excursion after the Greenland thing. So it was great. And they had plenty of Danish beer and maybe even a little Aquavit and wonderful food and a terrific party that one night. It was great.

KAREN BREWSTER: And so other biological work in Greenland, more muskox?

DAVID KLEIN: Yeah. Then I was becoming interested in the high Arctic and the ecology of the high Arctic, especially in northeast Greenland where there were complete guilds of herbivores, there had been at least, there were muskoxen, had been caribou up until 500 years, and wolves moving in and out from Greenland, from Canada. And there were Arctic foxes, there were lemmings that cycled. There were weasels that were based mainly on the lemmings, and there were birds of prey. And in north Greenland there were ptarmigan that migrated out to the south during the darkest part of the winter, but they'd come back and they were the same species as the ones south, but they were different. Genetically. They had huge breast muscles, so they were much stronger flyers because they had to fly long distance to south or central, or south Greenland where they would winter. And they -- but they'd come back and it'll still be winter, the snow thawing and, you know, they would scatter over the landscape pecking willow buds and stuff and things that would be sticking through the snow. And they were adapted to doing all this and they weren't over abundant. And Arctic hares. So I was getting interested in all of these resident herbivores and especially the hares, lemmings and muskoxen, the mammals, all dependent upon vegetation. And how did they possibly do this when it was classified by botanists as a polar barrens, because it was not covered by ice because it was so dry. And on the other hand, the winters were long but any snow that fell got blown around into drifts and that was mainly what fed the green things. And then you had the sun, like this, 24 hours a day in the short summer and the plants grew like mad, but they had to start from not much. And so it was fascinating with me. And so I teamed up with this botanist, Christian Bay, who had been doing some vegetation -- Well, he was working on his doctorate on the vegetation of north Greenland. And so -- and his mentor had started him on that, who I knew and had done a lot of work throughout Greenland. And they're both with the Botanical Museum in Copenhagen, which later became directly tied to the university where they have a fabulous botanical garden and a park right in the city. It's quite nice.

KAREN BREWSTER: How do you spell his last name?

DAVID KLEIN: Christian Bay. B-A-Y. By, I think it's pronounced that way. So we worked together in 1987. And to work up there is a real expedition because we had to -- He took responsibility for organizing all the gear and the food. In 1987 -- and he had a slim budget and I got some NSF [National Science Foundation] money to pay for my travel. And some of the -- well, mainly travel, which was fairly expensive because you had to -- we had to go up in a Twin Otter from northern Iceland, and you had to get there by regular airlines and then the Twin Otter. We shared that cost for the Twin Otter with another expedition of Danes and one Greenlandic guy that were -- they were sort of historians. There was one writer, Danish writer, a senior guy. The guy that headed it up

had been in the Danish military, an officer, and he was trying to find the last occurrence where a team of Danish explorers dropped off with dog teams from a sailing ship and they didn't get back to the ship in time so they had to over-summer in north Greenland. And they weren't too concerned about over-summering because there were muskoxen, but they had to feed their dogs and then wait for winter to come again. And then go to a pick-up where there was a supply of food and wait for another sailing ship to come in the next spring. And they didn't show up. And when the ship came there to see whether they made it, the one Native guy was -- his body was there, he had frozen to death. He had gotten there, but just barely. And he had to abandon the other two guys who were infirmed. And so they wanted to find these cairns with all this information that they had. They never found these, and so this team was trying to re-locate those. So we split the charter, and then the first half we were in a different place than they were and then we went back to the Station Nord where there -- was the base for the Twin Otter. And then we joined up with this other team and they took us to another place called Blasule [sp?@2:10:03], which is a little bit further south but not much and it was up around 79⁰ north. Than where we were the first time was about 82⁰ north.

KAREN BREWSTER: And how long were you out in the field on these trips? See I didn't ask you about the other ones.

DAVID KLEIN: About three weeks, and then you have to figure travel time.

KAREN BREWSTER: Yeah, but on most of these you're in the field, you're about three weeks out on the land?

DAVID KLEIN: When we were in the field, there were three of us because they had funding for an assistant so we had a Danish, young guy, who was the assistant. And we really didn't need an assistant, but that was paid for and it wasn't a problem with the Twin Otter getting us out there. And that was a good idea to have somebody else. And he was interested in wolves, but chances of seeing wolves or a sign wasn't very good. And so he came along. And I had a permit to take -- this was in the national park area of Greenland, which sort of -- they still allow mining exploration. But we had to have a permit to kill any animals, so I had a permit to take ten Arctic hares, and ten -- No, I don't think we needed a permit for the lemmings. They were harder to get. And then we collected poop from all of those animals, too. Could differentiate between winter poop and summer poop. So we could take those poop samples and do an analysis of plant types that were present in the poop. And it was harder to collect poop from lemmings because there weren't many visible. Summer's a disaster for the lemmings because you've got these birds of prey, the snowy owl and the gyrfalcon, primarily those two, and then Arctic foxes. They were really serious predators for them. And the weasel, of course. The weasel could go into their burrows and get them. It was a fascinating place to work. And it's fascinating for a lot of reasons, including the geology is all exposed and interesting. And then we were trying to get an idea of things like, how could there be say, 200 muskoxen in this big valley area, which was a big area, but scattered out into various groups. We weren't covering the whole area, but were covering a lot of it. And then frequently there wouldn't be a connection between muskoxen unless a wandering bull

wandered through, and especially they'd have to wander over a glacier, you know, or a frozen fjord or something, during the breeding season to spread genes around then to keep populations going. So we mapped -- we did a lot of measuring of biomass of forage types that we could do with a lot of clipping and small plots with Christian and I. And then we were able to dry and weigh these samples and take them back for chemical analysis, too. And then we also were able to mark where we saw the animals, but that -- that first year, we had funding to put three radio -- satellite radio collars on. Well, that meant we had to have -- be able to dart three animals. And we wouldn't have dogs with us.

KAREN BREWSTER: And this was for muskoxen?

DAVID KLEIN: Yeah. And so we were doing observations on feeding behavior and group dynamics in relation to feeding. Were the group sizes larger or smaller? Smaller, we assumed, because there wasn't much vegetation and it was more patchy. So major focus for me was on patch dynamics, you know, how -- and I could do that -- It involved both the muskoxen as well as the hares and the lemmings on this. But the Arctic hares are fascinating too because they're not ruminates and they can move over the terrain about like caribou in the wintertime. And they're in groups. It's predator avoidance primarily in the winter. Big groups. And so big group, hard for wolves to make kills because it's so mixed up with the animals running in all different directions. And the lemmings are under the snow where the snow has drifted, and that's where there's -- the willows have enough moisture there to grow. They prostrate. One species of prostrate willow because of the melting snow, especially if it's a south facing slope, will melt and water goes down and feeds the sedge meadow below. But then the snow -- the willows, the earliest leaf out and the leaves are high quality forage. And under the snow the lemmings are eating the twigs of these willows primarily, although they eat almost anything that is left if they're in a peak population. And in the summer, they just try to survive and they can't be too far from something to eat but they -- the ideal places where there's rocks and they can make burrows under the rocks that foxes can't dig into. And they take their chances on the weasels, but the weasels are also denning up and they usually take over, not take over, but they take abandoned fox dens and they use those and do fine. And come visit us in our tents while we're -- and they don't have much fear of humans.

KAREN BREWSTER: The lemmings.

DAVID KLEIN: Yeah, no the weasels.

KAREN BREWSTER: Oh, the weasels?

DAVID KLEIN: Yeah. I've got some good pictures of weasels at their den. But you know we'd be cooking or something and the weasel would come and look inside the tent and then go away.

KAREN BREWSTER: They were just curious?

DAVID KLEIN: They were just curious, yeah. At any rate --

KAREN BREWSTER: So what did that research show?

DAVID KLEIN: Well, the vegetation work and the patch dynamics and coring [2:18:37], that went well because we could do this vegetative work together and I was also helping Christian find new plant species. And a lot of information on seed dispersal. How do plants get started in the high Arctic where everything north is sea, frozen sea? And these are plants that have to live further south and then -- but then they have to live there. And so it was fascinating. You know, you find some of these -- one species of grass that would come in and on the whole lake bed where the glacier had dammed the -- made the lake and then it finally washed out. And the lake bed had all this accumulation of sort of clay on the bottom and all cracked up, but it was these lush, green plants. So the seeds got in there, windblown probably. And then there would be muskox tracks. You know, come to one nice, lush deal about this big of green grass --

KAREN BREWSTER: About six inches or so?

DAVID KLEIN: -- and take a bite and then move on to another one, and you'd see these tracks, and you saw the same thing with goose tracks going. And then, then what's good for the plant, they didn't kill the plant and then they crap right next to it, both the geese and the muskoxen.

KAREN BREWSTER: So there's fertilizer?

DAVID KLEIN: And then when a muskoxen would die and there were no wolves around and Arctic foxes could get to the carcass until they're froze up and then they couldn't deal with it. And so they'll often just mummified, half decomposed and mummified. And then they would be sticking up over the rocky, or gravelly, terrain where there would be very little vegetation and suddenly now two or three years later, there's grass and other things growing around this 'cause they get snow accumulating there and the seeds are being blown around and then it's fertilized by the decomposing muskoxen. And if a muskoxen dies in the summertime, I mean then the flies, there's blowflies there, and they decompose rapidly, except for the bones. And the bones, you could get -- the skull was laying on the ground in a place where it was mostly rocky and some moss there over that one horn, but that's all you need for the horns to start decomposing and eventually the bones, as well. But if it's dry, it's cold, it could be there for over a hundred years without decomposing.

KAREN BREWSTER: Well, interesting that, you know, so many people might think of you as a caribou or reindeer biologist, but here you were doing all this plant work.

DAVID KLEIN: Right. Yeah, definitely. I mean, that's the problem. And here I want to include in the book is that habitat just falls through the cracks. And that's why I'm trying to write this opinion piece that -- so that nobody's employed to -- and nobody's -- and

they're not even trained well because it isn't very popular to be -- if you were a wildlife type, you want to work with animals.

KAREN BREWSTER: Right, the botanists do the plant thing.

DAVID KLEIN: Yeah.

KAREN BREWSTER: But the wildlife people don't look at the plants. And so I think it's interesting, what a glamorous thing you were doing, you're collecting poop and analyzing poop. One of the glammers of being a wildlife biologist.

DAVID KLEIN: One time when Dan Roby and Henning were over there and I was here and I said I wanted to get some muskox droppings. I think it was winter dropping or maybe it was summer, I don't remember. And just dry them if it was summer droppings. But technically, you have to have some permit to ship something like that. So I said the best thing is to dry them and get the temperature high enough that it would kill any organisms, eggs and things like that. Even though drying for a long time would do the same thing, mostly. And so they did all that. And I guess Dan figured, well, how do we label this package? They didn't have a permit to send it. Said, there probably isn't going to be a problem in sending a package.

KAREN BREWSTER: Right.

DAVID KLEIN: And it wasn't very heavy. So I get this package and the package was about so big, and it was labeled, "Contents: bull shit." [laughing] And it was never -- the Customs never bothered with it.

KAREN BREWSTER: Well it's true, that's what it was.

DAVID KLEIN: [Laughing] Yeah. We had a big laugh on that one. They were prepared to try other ones if that didn't work.

KAREN BREWSTER: Well, that's a good story to perhaps -- Shall we -- ?

DAVID KLEIN: I should finish on the --

KAREN BREWSTER: Okay, finish.

DAVID KLEIN: -- on the satellite --

KAREN BREWSTER: Oh, right.

DAVID KLEIN: -- collar set. Here we were and it was -- and then it cost us, you know -- We had some money from the National Science Foundation, I think, to cover that 'cause we couldn't guarantee we could do this. 'Cause the big problem was how are we going to put these on animals if we don't knock the whole group down? And we weren't prepared

to do that. And you have to have dogs anyway if you're going to do that kind of thing. So we naïvely thought we could maybe, you know, knock one cow down. We really would prefer to have it on a cow, and knock one cow down. And after watching the animals for a while, there's no way we can knock a cow down and handle it and get a collar on and we had to antagonist so [means antidote?] the drug would --counter the drug, but you had to be able to get it to the animal. And if you couldn't get to it because the others were there and especially bulls -- a herd of bull. We couldn't drug them all and we didn't have that. And we didn't want this to be a major operation, the main thing was the other stuff. What we wanted was to get radio collars on animals so that in the wintertime when you can't fly up there anyway, and it's so damn cold, and the muskoxen still have to go on eating, where do they go? We didn't have a clue where they went. And then the worst case scenario was that the -- we were carrying this Danish technician. He liked to hunt. And he was killing with a -- we had a .22 rifle, I guess, and he was killing hares and he was a good hunter and he enjoyed that and that was good. But he wasn't a good guy to be studying any wildlife because he just -- he was just so superficial. I mean, when I'd want him to be -- and we had a hut that we could stay in there. It belonged to the dog team, the Danish Military Dog Team Patrol. They let us use this hut. And it was at least a little warmer than outside when it was cold. And we didn't have a lot of cold weather.

KAREN BREWSTER: What's -- you were there in the summertime?

DAVID KLEIN: Yeah. But we were there until August when it would freeze -- start freezing at night, and still pretty good weather in the daytime. If there was no clouds and no wind, it was usually good temperatures, and get up to 75. And if there was no wind, yeah, suddenly there were like one, or two, or three mosquitoes, otherwise no mosquitoes. So at any rate, this guy who was carrying the gun, he had it -- I don't think he had a dart in the gun but he had the dart in the packed sack. Darts and ready to go, but we had to load them just before -- you didn't load them ahead of time, 'cause this was early on and darting under those conditions -- And then there are two things that happened, one was my fault because I got -- my wife at the times brother wanted to come up and visit, and wanted to know if it was a good time, from Anchorage, and I said, "No, it's the worst time because I'm going to be just packing up to leave. And I was still building this house up on Chena Ridge. And she told him, "No, it's not a good time." And he says, "Well, I'll come anyway." And he was that kind of a guy. "And I won't bother --" but he's one of those guys that had to watch everything you're doing, you know, if he was around, and ask you all kinds of questions. He was naïve about the fact that scientists at times have to stick to a rigid schedule and procedure, and how do you do things without -- If you take time to answer his questions, how do you keep concentrated on this list that you're working on. So I left behind this little package of -- the way the darts worked, you had a shell that you fired like a .22 and it propelled this dart. And then inside the dart, when it hits something, there was this little charge that went off and it squeezed the drug into the animal. Well, that charge that went inside there, the package got left behind. And that was my fault because I hadn't checked everything to be sure. And so then, I had to figure out is there any way we can use this? I had these collars and we still hadn't tried anything out. I figured, well, I knew the history of these darts a bit that I read up on, and I figured that the early darts had a weight in back that would slide.

When it hit the animal, it would slide like a syringe and the weight would force it in. But you wanted to keep this thing as light as possible because it's trajectory with the drug and everything would be short anyway. So I figured, well, I can possibly do something like that because I had some lead. I forget what the lead was for, like soldering lead, a coil of that. So I could take with a pliers, I could cut chunks of that off and make a weight that would fit inside there and squeeze it because the lead was somewhat malleable. And then it would work, we hoped. So then we decided -- we got to settle for bulls because there were solitary bulls around. We were going to have to settle for bulls, or even if there were two bulls, I think, they wouldn't -- if you shot one, the other one would not stay there because it's not their behavior. So we were -- the first one we were able to get. And we were loading this thing up and shot and it didn't go down, and it didn't go down, and so fortunately we were able to get up and get another one in. And then we began to see a little bit of effect and so my conclusion was it was getting -- only a small charge was getting into it. So put a little heavier weight and tried to get closer and then finally it went down. And so then when we looked at the darts, they were -- it hadn't bounced out or something, and we could see that it wasn't fully discharged. So we were lucky that at first it did work but only because we were able to get several shots in. And maybe the first one was enough to -- the animal didn't run away right away. So then we were able to get a second one in a similar kind of situation. And then we had one -- and that's -- so we felt, well, we got the collars on two and we got one more collar, and then we were going out -- I was -- was finding another single animal was not that easy. And I went up -- was doing some long hike by myself and to a place where we had been once before. It was a flat top. Highest mountain in the area. It was a flat top. It wasn't all that high but it was like a thousand, fifteen hundred feet above the surrounding terrain. And you could hike up there fairly gradually. But when you get up on the top, there was a lot of muskox droppings there. It was a place where these big bulls would go and just hang out because after they fill their guts up in the summertime, and it was mostly summer droppings up there. And here was the -- there was an old horn core of a skull that had been up there for years and all just the essential part, and so I picked that up. And I thought, well, I wanted to go up there and check again, so I went up there again by myself, without the dart gun. And I got up there -- and the reason I got up there, now that I remember, was there was a shed antler and we found like three or four all the time we were up there. And they could be anywhere from five hundred to seven or eight thousand years.

KAREN BREWSTER: Wow.

DAVID KLEIN: And if they're in a dry, rocky area, they would last. So here were all these droppings. And then I got up there and I came over the top and, well, there's a bull, big bull, muskoxen laying down and he's looking the other way. I think, I want to get that antler, and how can I get it without him seeing me. If he does see me, then what do I do? Well, there was a huge boulder that had been left by the receding glacier right up on this flat thing that you could jump up on and the muskoxen probably couldn't get up there. And I was pretty sure they wouldn't try to get up on. I mean, they just mostly bluff anyway, but you don't want to risk it.

KAREN BREWSTER: No.

DAVID KLEIN: And so I tried sneaking over there and just when I was almost there he looked around and he got up and I grabbed the antler and I ran and I jumped up on this rock. Well, this muskoxen was not happy. And probably hadn't see humans before. And it came and made all these bluffs where it rubs its foot, puts its foot down on a tussock or a rock and puts his head down and rubs. There's a gland, right here.

KAREN BREWSTER: Under their eye?

DAVID KLEIN: Yeah.

KAREN BREWSTER: Or on their cheek?

DAVID KLEIN: Yeah. And it doesn't smell strong but it's an important smell for them. And they rub that on the hoof and then sometimes they'll stamp their foot a little bit. And then they -- and I've seen this happen up in the North Slope, and then most of the time you figure, that you stand your ground, don't run and just bluff the creature and wave your arms and stand up straight. And we did that when Christian and I were out picking vegetation and here would come this bull, and it's beginning of the rutting season so they're looking for anything that moves that they could -- that might be a cow. And usually when we'd see one and it was wide open, well, could we move quickly into a drainage ditch and then move laterally so it wouldn't see where we were going and then keep an eye on it. Because if they don't see anything, they're not going to come. And that worked two or three times for us okay. And the one time we just had to stand up together and separated a little bit and waved our arms and it eventually decided it didn't look very appealing to it as a cow muskoxen. At any rate, so then after I got back -- up on this rock, it came and even butted the rock.

KAREN BREWSTER: Wow.

DAVID KLEIN: So I took a -- there was a couple of smaller stones up on top there, and I could drop that down there and it would just make it angry. I'd just drop it on it. And so I figured, well, I'll try to get over on the blind side of the rock so it couldn't see me and see what happens. Well, I did that, but it just stayed right there. And I thought -- and so then I came -- crawled back up again. Of course, I was eager to get off and head back. So the main thing is just to go over the edge of this flat top deal, and so it just stayed right there by the rock. And so I did finally slide down on the backside quietly and walked very slowly. At the last glance I could see was it was still laying looking in the other direction and couldn't see me if I kept the rock between me and it. And I went over the edge and then went back. So then I said, "Okay," to the other guys, "let's go back up there." It was like about a three mile hike. I said, "Let's go back and see if we can get that bull for the third collar." So we went back. We get up there and then -- before we went up to the top, I said, "You better load up here." And the guy had lost the -- the bolt had fallen out of this thing, so we had no way of firing anything. So we went up and the muskoxen had gone down some big boulders where we probably could have gotten close, but there's no

way we could find that. We had looked and we didn't know where -- he didn't know where it had fallen out.

KAREN BREWSTER: So it was the bolt from the gun, or from the -- ?

DAVID KLEIN: From the gun.

KAREN BREWSTER: Okay.

DAVID KLEIN: So we couldn't have any alternative to dart the animals. So at any rate we only got two animals out, which under the circumstances was pretty good.

KAREN BREWSTER: Sounds pretty good under the circumstances.

DAVID KLEIN: And then it did -- one of them -- two of them lasted for -- they had batteries that was supposed to last for about two years, I think. And one of them lasted about eight months, and the other one was still functional. And so we were able to get downloaded from that satellite showing where they had wintered. Because it gave you a location every day, I think it was. Once a day, maybe it was twice. The more frequently, the less the strength of the -- the long the batteries would last. And then Christian, by this time, had been able to get some satellite imagery of vegetation. He'd learned how to ground truth it and make a map of the vegetation in the study area showing that where they were going was one of the richest places for willows in the whole north area of Greenland. And that the two had moved -- one of them had stayed there until the battery ran out and then the other one had moved to another patch, which was also another isolated patch of vegetation. So they didn't tell us whether the female and young were doing the same thing, which was likely, but at least we had this information that these animals had to feed all winter long and they could do it and survive up there at the northern most land area in the world. And that was great. I could --

KAREN BREWSTER: Yeah, that's pretty exciting.

DAVID KLEIN: -- included that in a publication on that and patch dynamics and it was a major publication. And then I did -- and then I got up there again in 1992 and we went to a different area which had more muskoxen. That was the area where there was about two hundred in this huge, two valleys with a fjord on either side. And it was protected with the high mountains from the influence of the frozen Arctic Ocean, so it was sort of like an oasis that wouldn't have the cold winds coming off the ice, and the mountains would absorb heat, dark rock in the day time and radiate it in the springtime so that the plants could start growing long before they could in other areas. And then we were able to collect hares there and lemmings and look at -- and got length in relationship to snowshoe hares, or, yeah, mainly snowshoe hares showing how the guts were longer and allowed for Zika [?@2:45:38], which where they do some fermentation in the lower gut. Hares do as well as geese and horses that aren't ruminates and helps digest food. And then also did some gut length on the -- and morphology of wild hares through the morphology on lemmings, as well. And then we had the feces we could analyze to see

what -- basically to confirm what we assumed was the case in what they were feeding on. So now I was into the ecology of high Arctic vertebrate ecosystems, including the migratory birds and the ptarmigan. The ptarmigan, which are also feeding on many of the same plants the hares were feeding on and lemmings and the muskoxen. So that was one of the best papers. And then they started this research station at a place called Zackenberg. It's 75 degrees north in northeast Greenland. And Henning was now with the Polar Center, Danish Polar Center, and he was one of the key players getting the -- overseeing the actual planning and design and the physical structures, or infrastructure for the research station as well as doing some research himself. But now he was really good with electronics and he was able to set up these remote sensing cameras on this one mountain that could watch the landscape when no one was there all winter long and see how the snow accumulated and how it melted off. And that was a new advantage for Arctic work. And then when they were there, they had a cook and biologists from studying all kinds of things there. And I was working mainly with the muskoxen, lemmings, and vegetation. And then my focus was mainly on secondary chemicals and how that affected the -- what was -- how do these plants survive when they're primary food for these herbivores? How can the willows, one species of willows that are all prostrate, that are fed on -- they're all important for the lemmings and the hares and the muskoxen. For hares and muskoxen, their primary value was when they were just leafing out, but they would be eaten -- the twigs that were exposed and not covered with deep snow and drifts would be -- twigs would be eaten by hares and muskoxen. And if it was under the snow, the willows under the snow, then it was the lemmings. And they would be fairly secure then under the snow, and they breed under the snow and the population could increase and suddenly in the late winter then lemmings all over the place.

KAREN BREWSTER: They all come out of the snow, yeah.

DAVID KLEIN: Yeah.

KAREN BREWSTER: So when did you do that Zackenberg Research Station? What year was that project?

DAVID KLEIN: That was 2000.

KAREN BREWSTER: Okay.

DAVID KLEIN: And that was great. And I was having some hip problems so -- I mean, I could still hike but it was long hikes like I could do in the other places, I could do. I had to do them so damn slow, I -- But mostly we were able to hike to the areas. And then I had one grad student with me, Fiona Danks [sp?], who did some work for a master's on the North Slope. And worked really based on what she learned working with Christian and me, but Christian on the vegetation and remote sensing. So she was able to -- and her interest was in, more in landforms and geography in relationship to animal distribution. So she was interested in remote sensing. And so it was -- but the three of us worked together picking willow leaves, and comparing male plants versus female plants. So when they finally did a ten-year summary of research at the Zackenberg Station we had a major

contribution to one chapter. I was the co-author, and that dealt with willows and secondary chemicals and how they differed in female versus male plants. And there had been a little research getting started in Canada on this and so we could build on that and do our own. And show that the male plants and the female plants were so different. It was like this is kind of the reverse of what the -- human sexual differences. The female plants were more robust and maintained the secondary chemicals, but they grow fast, much faster than the male plants. Male plants tended to be located and germinate on little bumps on the -- if you had the high-centered polygons, they would be in the high places where it tends to suffer from summer drought, but it was the first place where plants could start to grow. Whereas the females were down a little lower on the terrain. Lower and they were right next to each other, really. And they were -- an adult fits with -- the male plant has to produce this pollen. And so they have the -- in the buds going into the winter and then they have this growth spurt and produces pollen. So the pollen is there and the female plants, all they have to do is produce the floral parts and then their big job is nurturing the developing embryos, the seeds. Whereas the male plant is all over as soon as it pollinates and drops off these catkins, whereas the females hold on to these and then they become the seedpods that eventually will open up. But the flowering stems of the female plants have more surface area and bigger leaves than the male plants for their catkins. And the male plants are designed more to prevent they're being browsed in the wintertime by lemmings, maybe, under the snow. Then the female plants, their effort is focused on getting those seeds out and getting them developed. And the seeds can germinate the same summer, although they can overwinter but they're so tiny, they can't last very long if they don't germinate fairly soon. And they're so light they scatter all over the place. But then they have these color changes and leaves that -- the pods turn red, almost like that shirt or your deal -- and dark and that absorbs the heat from the sun and also that protects them from most herbivores because they're going for the lush green leaves that have less -- they're photosynthesizing hard that they don't have as high secondary chemicals and not as defensive. So you just grow fast, produce more leaves, and the herbivores can include caterpillars and butterflies which aren't usually that abundant to be significant but there can be other insects that could be defoliators as well.

KAREN BREWSTER: So was 2000 then the last trip to Greenland?

DAVID KLEIN: Yeah, but not to Denmark. And this one book --

KAREN BREWSTER: I was going to say, maybe we save Denmark for another night 'cause that's a whole other -- I mean you already talked about your roe deer work.

DAVID KLEIN: Yeah, probably the follow up in Denmark because then I was involved with this Arctic Climate Impact Assessment. And most of the things then were -- Greenland was a big player in that as well as Norway and then to a lesser extent Sweden and Finland.

KAREN BREWSTER: Okay, yeah, why don't we save that.

DAVID KLEIN: Yeah.

KAREN BREWSTER: Seems like a whole other topic.

DAVID KLEIN: Yeah.

KAREN BREWSTER: So to wrap up then Greenland, how you have reflected on that work you did there.

DAVID KLEIN: Well, one of the things is when I was younger in my career when I was working in southeast on deer on PhD work, and working as a biologist. And then at the university was still focusing heavily on big ungulates and Arctic adaptations. But it was low Arctic -- And the number of vascular plant species on the North Slope, I think, is around 3,000. Up there in north Greenland, we couldn't quite crack a 100 species. And like there was like four or five species, which are the ones that were essential for the herbivores.

KAREN BREWSTER: So the North Slope isn't considered high Arctic?

DAVID KLEIN: No, it's low Arctic because you've got the Canadian Archipelago and then the North Coast is what 70⁰ north, about that.

KAREN BREWSTER: Of the North Slope? I don't remember what it is.

DAVID KLEIN: 72, I think it is.

KAREN BREWSTER: I was going to stay 72 or 73.

DAVID KLEIN: And so we were up to 83⁰ in north Greenland, so this is the northernmost land area. And you can get almost that far in Canada but not quite as far as in --

KAREN BREWSTER: Well, just from listening to you talk about all the work you did there, it sounds, as you say, you were fascinated with it and you really enjoyed Greenland and Iceland.

DAVID KLEIN: Fascinated for a lot of reasons, but one is just like the St. Matthew Island. It's a remote place that's hard to get to, so there's a lot to be learned. Plus I became more and more interested -- I became more broader, and it was the same true here. I mean I used to be pretty focused on caribou and deer in southeast, and then I moved up here, well, there was -- caribou was the main focus. And people call me a caribou biologist and I didn't really feel like I was a caribou biologist. And plus I realized people were calling me an ecologist and I said, "Well, I'd like to be considered an ecologist, but I didn't consider myself an ecologist because I didn't think -- didn't understand all the interactions that are going on." In other words, ecology is so complex, yet I was trained in ecology as an undergraduate and I understood the term. And then the problem now is, and this doesn't have to be recorded. It can be.

KAREN BREWSTER: Go ahead. The problem now is?

DAVID KLEIN: Is that young people are -- have new methodologies that are -- we didn't have, that are all important, like DNA. And you can answer so many questions with DNA, like fish migration and caribou relationships between different herds. How much exchange is there, and over how many years is there to account for them to be slightly different? Everything, every animal is different genetically but you can do so much with DNA. You can determine how much interbreeding there had been with reindeer and things like that or between herds. And then you've got this satellite collars and things that are so small now they're putting them on little tiny migratory birds that fly nonstop from Alaska to Australia. And they can plot the route because it's satellite.

KAREN BREWSTER: Well, I would say you're an ecologist based on the way you --

DAVID KLEIN: Well I consider myself an ecologist now, but what I'm saying is most people aren't -- don't pay much attention to ecology. That's the problem with habitat. I mean, it's an important part of ecosystems, especially for the herbivores, but also for everything else that's dependent upon the herbivores. And you have to factor in all these other things that you don't -- like insects, and insects here as defoliators can be really important. And so what about the red squirrel, you know. Well, as an ecologist, you got to think, well, their populations fluctuate in relationship to seed production. If humans aren't feeding them sunflower seeds in their feeder, they have to -- and they want white spruce. In starvation situation, they'll eat black spruce but it takes them so long and the seeds are so small, they're top quality, but the amount of energy and nutrients you get with the amount of work you put in, it's a losing battle. It may prevent starvation, but all winter long, it's not going to work. And then we had the spruce budworm that attack the flowering part of the buds of the spruce, white spruce, so they couldn't produce any seeds. And white spruce is the survival for the flying squirrels through the winter. So they couldn't cache, so what did they do? Well, they could go and excavate and find cones in their middens that they had missed. Well, that works for one or two years, but you can't have a lot of squirrels doing this. And then you fight to find cache that is defended by another male, and maybe you can beat him up and get it but chances are good you can't. And then we don't know enough about the female red squirrels with young. Chances are they can stay and use the same cache that the male was using. But normally in the wintertime, there's only one squirrel per cache. What happens to the young? Well, the dispersal into areas where there weren't enough squirrels and there's still food. Well, after the population is low and this coming up, well, that will work but there's all these things we don't know.

KAREN BREWSTER: Well, it just shows how complicated the ecosystems are and --

DAVID KLEIN: Exactly.

KAREN BREWSTER: -- and how being an ecologist is -- requires very broad thinking and looking at all the variables.

DAVID KLEIN: It's sort of like, well when this Molly [Rettig] was interviewing me. She's pretty knowledgeable biologically, but she isn't trained as a biologist. But I was trying to explain complexity of a system and I hadn't mentioned ecology, and she said, "Oh, that's ecology." I said, "Yeah, that's right." But most people don't understand that.

KAREN BREWSTER: Yeah. Well, and I, you know, there are all these variables and so as a non-scientist, it's hard to imagine how can you ever figure out what's going on because there's always some other variable that you have to go investigate.

DAVID KLEIN: Yeah, we talked a bit about modeling, too.

KAREN BREWSTER: Yeah. And you'll never get the answers. It feels like.

DAVID KLEIN: Right.

KAREN BREWSTER: But you guys -- you keep plugging away at trying to figure out the answers.

DAVID KLEIN: Well, we haven't discussed modeling very much.

KAREN BREWSTER: No, we'll talk about that another -- that's another part of the difference in methodology.

DAVID KLEIN: Yeah, right.

KAREN BREWSTER: And how that's changed.

DAVID KLEIN: Because we should talk about that because I've been sort of a real critic of modeling. In biological modeling of systems, complex systems. But on the other hand, I -- Well, we'll save it for the next time.

KAREN BREWSTER: Yeah, let's save it for the next time. Okay. Say goodnight, Gracie.